City Council
Regular Meeting
AGENDA

(to be held both at the physical and virtual locations below)

Civic Center Council Chamber ♦ 300 Seminary Avenue ♦ Ukiah, CA 95482

To participate or view the virtual meeting, go to the following link: https://us06web.zoom.us/j/89884146226

Or you can call in using your telephone only:

- **Call (toll free) 1-888-788-0099**
- **Enter the Access Code: 898 8414 6226**
- **To Raise Hand enter *9**
- **To Speak after being recognized: enter *6 to unmute yourself**

Alternatively, you may view the meeting (without participating) by clicking on the name of the meeting at www.cityofukiah.com/meetings.

November 19, 2025 - 5:15 PM

1. ROLL CALL

2. PLEDGE OF ALLEGIANCE

3. AB 2449 NOTIFICATIONS AND CONSIDERATIONS

4. PROCLAMATIONS/INTRODUCTIONS/PRESENTATIONS

4.a. Proclamation of the Ukiah City Council Recognizing November as Native American Heritage Month in the City of Ukiah.
Recommended Action: The Ukiah City Council will issue a proclamation recognizing November as Native American Heritage Month in the City of Ukiah.
Attachments:
1. Native American Heritage Month Proclamation

4.b. Report on the Dia de los Muertos Event.
Recommended Action: Receive report on the Dia de los Muertos Event.
Attachments: None

5. PETITIONS AND COMMUNICATIONS

6. APPROVAL OF MINUTES

6.a. Approval of the Minutes for the November 5, 2025, Regular Meeting.

Recommended Action: Approve the minutes for the November 5, 2025, Regular Meeting.

Attachments:
1. 2025-11-05 Draft Minutes

7. RIGHT TO APPEAL DECISION

Persons who are dissatisfied with a decision of the City Council may have the right to a review of that decision by a court. The City has adopted Section 1094.6 of the California Code of Civil Procedure, which generally limits to ninety days (90) the time within which the decision of the City Boards and Agencies may be judicially challenged.

8. CONSENT CALENDAR

The following items listed are considered routine and will be enacted by a single motion and roll call vote by the City Council. Items may be removed from the Consent Calendar upon request of a Councilmember or a citizen in which event the item will be considered at the completion of all other items on the agenda. The motion by the City Council on the Consent Calendar will approve and make findings in accordance with Administrative Staff and/or Planning Commission recommendations.

8.a. Adoption of an Ordinance Amending the Ukiah City Code by Adding Article 11.5 to Division 9, Chapter 2, to Establish and Regulate the Open Space (O-S) Zoning District.

Recommended Action: Adopt an Ordinance amending the Ukiah City Code by adding Article 11.5 to Division 9, Chapter 2, to establish and regulate the Open Space (O-S) Zoning District.

Attachments:
1. Open Spaces Proposed Ordinance
2. PC Resolution No. 2025-05 - Signed
3. Draft Findings of Consistency - CEQA Statutory Exemption

8.b. Adoption of an Ordinance Prezoning 1 Carousel Lane (APN 167-280-15) to the Public Facilities (PF) Zoning District for Future Use by the City of Ukiah as its Municipal Corporation Yard Following Annexation into the City's Jurisdiction.

Recommended Action: Adopt an Ordinance prezoning 1 Carousel Lane (APN 167-280-15) to the Public Facilities (PF) Zoning District for future use by the City of Ukiah as its municipal Corporation Yard following annexation into the City's jurisdiction.

Attachments:
1. Planning Commission Resolution #25-04 (Signed)
2. Prezoning Ordinance
3. City Council Resolution #25-54 (Signed)
4. Draft CEQA NOE - 1 Carousel Lane Annexation
5. Maps - 1 Carousel Lane Annexation_10.27.jd3 (1)

8.c. Approval of Contract Amendment with Ryan Jackson to Increase the Scope of Work by an Additional $40,000 to Revise the Total Not-to-Exceed Amount From $40,000 to $80,000, and Approve Corresponding Budget Amendment.

Recommended Action: Approve a contract amendment with Ryan Jackson to increase the scope of work by an additional $40,000 to revise the total not-to-exceed amount from $40,000 to $80,000, and approve corresponding budget amendment.

Attachments:
1. Attachment 1 - Ryan Jackson - IT Support Services 2526-095 - Agreement
2. COU No 2526-095-A1

8.d. Approval of Budget Amendment in the Amount of $318,074.37 and Approval of the Notice of Completion for the Recycled Water Project Phase 4 Specification 23-01, and Final Payment of 5% Retention of Ghilotti Construction Co., Inc.

Recommended Action: Approve a budget amendment in the amount of $318,074.37 and approve the Notice of Completion for the Recycled Water Project Phase 4 Specification 23-01, and final payment of 5% retention of Ghilotti Construction Co., Inc.

Attachments:
1. Awarding ASR
2. Recycled Water Project Phase 4 Vol 1 Tech Specs

3. Recycled Water Project Phase 4 Vol 2 Tech Specs
4. Recycled Water Project Phase 4 Vol 3 Tech Specs
5. Notice-of-Completion
6. Certificate of Substantial Completion

8.e. Approval of Purchase of Multiple Fleet Vehicles and Equipment from the Willow County Water District in the Amount of $219,670 Plus Tax, and Approval of Corresponding Budget Amendment.

Recommended Action: Approve purchase of multiple fleet vehicles and equipment from the Willow County Water District in the amount of $219,670 plus tax, and approval of corresponding budget amendment.

Attachments:
1. 2024-02-21 Agenda Item 13a
2. Term Sheet, Willow Vehicles and Equipment, 11-13-2025
3. Exhibit A, Willow Vehicles and Equipment

8.f. Adoption of Resolution Authorizing the City of Ukiah to Submit a Regional Payment Program Application on Behalf of Itself as Lead Participant and All Non-Lead Participants for All City/County Payment Programs with CalRecycle.

Recommended Action: Adopt resolution authorizing the City of Ukiah to submit a Regional Payment Program Application on behalf of itself as lead participant and all non-lead participants for all City/County payment programs with CalRecycle.

Attachments:
1. Proposed Resolution

9. AUDIENCE COMMENTS ON NON-AGENDA ITEMS

The City Council welcomes input from the audience. If there is a matter of business on the agenda that you are interested in, you may address the Council when this matter is considered. If you wish to speak on a matter that is not on this agenda that is within the subject matter jurisdiction of the City Council, you may do so at this time. In order for everyone to be heard, please limit your comments to three (3) minutes per person and not more than ten (10) minutes per subject. The Brown Act regulations do not allow action to be taken on audience comments in which the subject is not listed on the agenda.

10. COUNCIL REPORTS

11. CITY MANAGER/CITY CLERK REPORTS

12. PUBLIC HEARINGS (5:30 PM)

12.a. Review and Consider Introduction by Title Only of an Ordinance Adding Chapter 9 to Division 2 of Ukiah City Code to Regulate Sidewalk Vending on Public Property and in the Public Right-of-Way.

Recommended Action: Review and provide input on the Ordinance adding a new Chapter 9 to Division 2 of the Ukiah City Code to regulate sidewalk vending on public property and within the public right-of-way. Introduce and possibly adopt the Ordinance at a future date not yet certain.

Attachments:
1. Sidewalk Vending Ordinance
2. Senate Bill 946, Safe Sidewalk Vending Act

13. UNFINISHED BUSINESS

13.a. Status Report from Owner of the Palace Hotel.

Recommended Action: Receive report.

Attachments: None

14. NEW BUSINESS

14.a. Receive Presentation on 2025 Ukiah Valley Fire Authority Fuels Crew Accomplishments and Authorize the City Manager to Negotiate and Execute a Memorandum of Understanding Between the City of Ukiah and the Mendocino County Fire Safe Council for the Use of the Ukiah Valley Fire Authority Fuels Crew.

Recommended Action: Receive Presentation on 2025 Ukiah Valley Fire Authority Fuels Crew Accomplishments and authorize the City Manager to negotiate and execute Memorandum of Understanding between the City of Ukiah and the Mendocino County Fire Safe Council for the use of the Ukiah Valley Fire Authority Fuels Crew.

Attachments:

1. Draft UVFA-MCFSC MOU
2. UVFA Fuels Crew Accomplishments

14.b. Receive Updates on City Council Committee and Ad Hoc Assignments, and, if Necessary, Consider Modifications to Assignments and/or the Creation/Elimination of Ad Hoc(s); Including the Possible Disbandment of the Zoning Reform Ad Hoc, and the Creation of an Airport Infill Policy Ad Hoc.

Recommended Action: Receive report(s). The Council will consider modifications to committee and ad hoc assignments along with the creation/elimination ad hoc(s); including the disbandment of the Zoning Reform Ad Hoc, and the creation and appointment of an Airport Infill Policy Ad Hoc.

Attachments:

1. 2025 City Council Special Assignments and Ad Hocs

15. CLOSED SESSION - CLOSED SESSION MAY BE HELD AT ANY TIME DURING THE MEETING

15.a. **Conference with Legal Counsel – Anticipated Litigation**
(Government Code Section 54956.9(d)(4))
Initiation of litigation (2 cases)

15.b. **Conference with Legal Counsel – Existing Litigation**
(Government Code Section 54956.9(d)(1))
Name of case: Nui Rising Moon Trust v. City of Ukiah, et al.; Case No. 3:25-cv-08320

15.c. **Conference with Legal Counsel – Existing Litigation**
(Government Code Section 54956.9(d)(1))
Name of case: Vichy Springs Resort v. City of Ukiah, Et Al; Case No. SCUK-CVPT-2018-70200

15.d. **Conference with Legal Counsel – Existing Litigation**
(Government Code Section 54956.9(d)(1))
Name of case: Vichy Springs Resort, Inc v. City of Ukiah, et al.; Case No. 24-cv-07106-JSC

15.e. **Conference with Real Property Negotiators**
(Cal. Gov't Code Section 54956.8)
Property: APN Nos: 170-030-05; 170-030-03; 170-010-05; 170-020-07; 170-020-11; 170-040-03; 170-020-08
Negotiator: Sage Sangiacomo, City Manager
Negotiating Parties: Project Ovis LLC
Under Negotiation: Price & Terms of Payment

15.f. **Conference with Labor Negotiator (54957.6)**
Agency Designated Representative: Sage Sangiacomo, City Manager
Employee Organizations: All bargaining units
Unrepresented Employee: Police Chief

16. ADJOURNMENT

Please be advised that the City needs to be notified 72 hours in advance of a meeting if any specific accommodations or interpreter services are needed in order for you to attend. The City complies with ADA requirements and will attempt to reasonably accommodate individuals with disabilities upon request. Materials related to an item on this Agenda submitted to the City Council after distribution of the agenda packet are available for public inspection at the front counter at the Ukiah Civic Center, 300 Seminary Avenue, Ukiah, CA 95482, during normal business hours, Monday through Friday, 8:00 am to 5:00 pm. Any handouts or presentation materials from the public must be submitted to the clerk 48 hours in advance of the meeting; for handouts, please include 10 copies.

I hereby certify under penalty of perjury under the laws of the State of California that the foregoing agenda was posted on the bulletin board at the main entrance of the City of Ukiah City Hall, located at 300 Seminary Avenue, Ukiah, California, not less than 72 hours prior to the meeting set forth on this agenda.

Araceli Sandoval, Deputy City Clerk
11/14/25

Agenda Item No: 4.a.

MEETING DATE/TIME: 11/19/2025

ITEM NO: 2025-1172

City of Ukiah

AGENDA SUMMARY REPORT

SUBJECT: Proclamation of the Ukiah City Council Recognizing November as Native American Heritage Month in the City of Ukiah.

DEPARTMENT: City Manager / Admin

PREPARED BY: Maria Ceja, Administrative Analyst

PRESENTER: Douglas Crane, Mayor

ATTACHMENTS:

1. Native American Heritage Month Proclamation

Summary: The Ukiah City Council will issue a proclamation recognizing the month of November as Native American Heritage Month in the City of Ukiah. This proclamation honors the cultural heritage, history, and contributions of Native Americans throughout Mendocino County and across the United States.

Background: Since 1990, Presidents have observed Native American Heritage Month throughout the United States. These proclamations serve to honor the rich traditions, history, and contributions of Native American communities nationwide. Mendocino County is home to twelve federally recognized (and two non-federally recognized) Tribes, whose citizens contribute significantly to the cultural, social, and economic vitality of the region.

Discussion: The City of Ukiah is committed to fostering meaningful relationships with Tribal governments to provide essential services for all who live, work and visit our community. Through this proclamation (Attachment 1) the City Council reaffirms its respect for our Native American community and encourages all residents to recognize and celebrate the achievements and ongoing contributions of Native Americans during the month of November.

Recommended Action: The Ukiah City Council will issue a proclamation recognizing November as Native American Heritage Month in the City of Ukiah.

BUDGET AMENDMENT REQUIRED:

CURRENT BUDGET AMOUNT:

PROPOSED BUDGET AMOUNT:

FINANCING SOURCE:

REVENUE: Yes / No GRANT: Yes / No

PREVIOUS CONTRACT/PURCHASE ORDER NO.:

COORDINATED WITH:

STRATEGIC PLAN (SP):**SP 5C** - Create, sustain, and advance a diverse and inclusive workplace and workforce that reflects, values, and celebrates the diverse community we serve.

CLIMATE INITIATIVES (CI):

GENERAL PLAN ELEMENTS (GP):

Approved: Sage Sangiacomo, City Manager

PROCLAMATION

City of Ukiah

Recognizing

November as "Native American Heritage Month" in the City of Ukiah

Whereas, the month of November was first proclaimed as *Native American Indian Heritage Month* in 1990, by President George H. W. Bush and subsequent presidents have continued the observance annually throughout the United States often using the title *Native American Heritage Month* to honor the rich cultural heritage, history and contributions of Native Americans; and

Whereas, Mendocino County is home to twelve federally recognized Tribes and two non-federally recognized Tribes, whose citizens contribute to the cultural, social, and economic vitality of our region; which is the ancestral land of the Pomo, Yuki, Concow, Nomlaki, Pit River, Sinkyone, Wailacki, and Cahto peoples; and

Whereas, Native American communities in Mendocino County have restored their tribal governments and continue to thrive through self-determination and sovereignty; and

Whereas, Native Americans have made lasting contributions in fields such as environmental stewardship, governance, education, military service, and the arts, enriching both local communities and the nation as a whole; and

Whereas, Native Americans have served in the U.S. Armed Forces at one of the highest rates of any group, demonstrating their enduring commitment to protecting the freedoms of this, and their own Nations; and

Whereas, the City of Ukiah is committed to working cooperatively with Tribal governments to ensure essential services for all who live, work, and visit our community and encourages all residents to recognize and celebrate the contributions of Native Americans, both locally and nationally, in the month of November.

Now, therefore it be resolved, the City Council of the City of Ukiah hereby proclaims November as:

Native American Heritage Month in the City of Ukiah

Signed and sealed, this 19th day of November in the Year Two Thousand and Twenty-Five.

_____

Douglas F. Crane, Mayor

Agenda Item No: 4.b.

MEETING DATE/TIME: 11/19/2025

ITEM NO: 2025-1297

City of Ukiah

AGENDA SUMMARY REPORT

SUBJECT: Report on the Dia de los Muertos Event.

DEPARTMENT: City Manager / Admin

PREPARED BY: Maria Ceja, Administrative Analyst, Marianne Aranda, Senior Recreation Coordinator

PRESENTER: Marianne Aranda, Senior Recreation Coordinator and Maria C. Ceja, Administrative Analyst

ATTACHMENTS:

1. Dia De Los Muertos Presentation

Summary: The Community Services Department, in collaboration with the City Manager's Office, will provide an overview of the 2025 Día de los Muertos community event, which took place on Sunday, November 2, 2025, in downtown Ukiah. The celebration drew more than 1,500 attendees and featured live performances, traditional altars, local vendors, food, art, and cultural displays honoring the memory of loved ones. The event was a collaborative effort between City staff, community volunteers, local organizations, sponsors, and was widely recognized as a success in both community engagement and cultural enrichment.

Background: Día de los Muertos (Day of the Dead), is a Mexican tradition that honors and celebrates the lives of departed loved ones through art, music, food, and remembrance. The City of Ukiah, in partnership with community organizations and local sponsors, has hosted this annual event as part of its ongoing commitment to cultural inclusivity and community connection.

The City of Ukiah began by placing a community altar in front of City Hall in 2021. Then, in 2024, City staff and community volunteers provided a larger community event. The 2025 event continued this tradition with strong participation from local residents, businesses, and regional performers. Highlights included performances by Ballet Folklórico de Mendocino, Los Cautivos, and students from SPACE (School of Performing Arts and Cultural Education); a community Catrina contest; an altar exhibition organized by local families and groups; and food and artisan vendors representing Ukiah's diverse community.

Discussion: The 2025 Día de los Muertos celebration demonstrated the power of community partnership in producing inclusive and meaningful cultural programming. The event attracted over 1,500 attendees and involved more than 40 volunteers, numerous local organizations, and sponsorship support from public agencies and private businesses.

City staff from the City Manager's Office, Community Services Department, and Parks collaborated with volunteers including Azucena Huerta, Ignacio Ayala, Jackie and Juan Orozco, Visit Ukiah staff, and many others to plan, set up, and coordinate the event. Community partners such as Ukiah Vecinos en Acción, Mendocino College, and Blue Zones Project Mendocino County played key roles in ensuring the event's success.

The event featured live music and dance, local food vendors, children's activities, traditional altars (ofrendas), and an artful display of classic cars. Local media coverage and social media engagement helped draw significant attendance and positive community feedback.

The City extends appreciation to all volunteers, sponsors, performers, and City departments who contributed

to making the 2025 Día de los Muertos celebration a vibrant, family-friendly event that strengthens community ties and celebrates cultural heritage.

Recommended Action: Receive report on the Dia de los Muertos Event.

BUDGET AMENDMENT REQUIRED: n/a

CURRENT BUDGET AMOUNT: n/a

PROPOSED BUDGET AMOUNT: n/a

FINANCING SOURCE: n/a

REVENUE: Yes / No GRANT: Yes / No

PREVIOUS CONTRACT/PURCHASE ORDER NO.:

COORDINATED WITH: Community Services Department and DEI Committee

STRATEGIC PLAN (SP):**SP 5C** - Create, sustain, and advance a diverse and inclusive workplace and workforce that reflects, values, and celebrates the diverse community we serve.

CLIMATE INITIATIVES (CI):

GENERAL PLAN ELEMENTS (GP):

Approved: 
Sage Sangiacomo, City Manager

Día De Los Muertos

Sunday, November 2
11 am - 4 pm
Alex Thomas Plaza



UKIAH

c o m m i t t e e



City Staff: Marianne Aranda & Maria Ceja

Juan Orozco (Councilman & Ukiah Vecinos en Acción)

Jackie Orozco (Al Punto & Ukiah Vecinos en Acción)

Azucena Huerta (Blue Zones Project & Ukiah Vecinos en Acción)

Ignacio Ayala (SPACE & Ukiah Vecinos en Acción)

Day of Help:

Community Volunteers

Ukiah High School Club Latino

event overview



Live Performances & Music
Vendors (Information & Merchandise)
Food Vendors
Community Altar
Low Rider Cars
Catrin Contest
Arts & Crafts

community altar

Día De Los Muertos
Sunday, November 2
11 am - 4 pm
Alex Thomas Plaza
UKIAH



s u g a r s k u l l s

Día De Los Muertos
Sunday, November 2
11 am - 4 pm
Alex Thomas Plaza
UKIAH







event Schedule

Programa DEL EVENTO

12:00 PM

Los Diablos Oaxaqueños del Valle

12:45 PM

SPACE

1:40 PM

Ballet Folklorico de Mendocino

2:00 PM

Grupo Los Cautivos

3:30 PM

Catrina Contest

Concurso de Catrinas







Catrin & CATRINA Contest

Concurso Catrin y CATRINA



Celebrate the cultural
significance of "La catrina"
the TRADIONAL figure from
Dia de los muertos
by expressing your creativity

Celebra la importancia cultural
de "La Catrina", la figura
tradicional del Día de los
Muertos expresando
tu creatividad

arrive by 2:30 PM
contest on stage at 3:30 PM

Llegar a las 2:30 pm
Concurso en el escenario
a las 3:30 pM

CASH PRIZE FOR WINNER
PREMIO EN EFECTIVO PARA EL GANADOR





low rider vehicles

Día De Los Muertos
Sunday, November 2
11 am - 4 pm
Alex Thomas Plaza
UKIAH





f o o d v e n d o r s

Día De Los Muertos
Sunday, November 2
11 am - 4 pm
Alex Thomas Plaza
UKIAH







v e n d o r s

Día De Los Muertos
Sunday, November 2
11 am - 4 pm
Alex Thomas Plaza
UKIAH

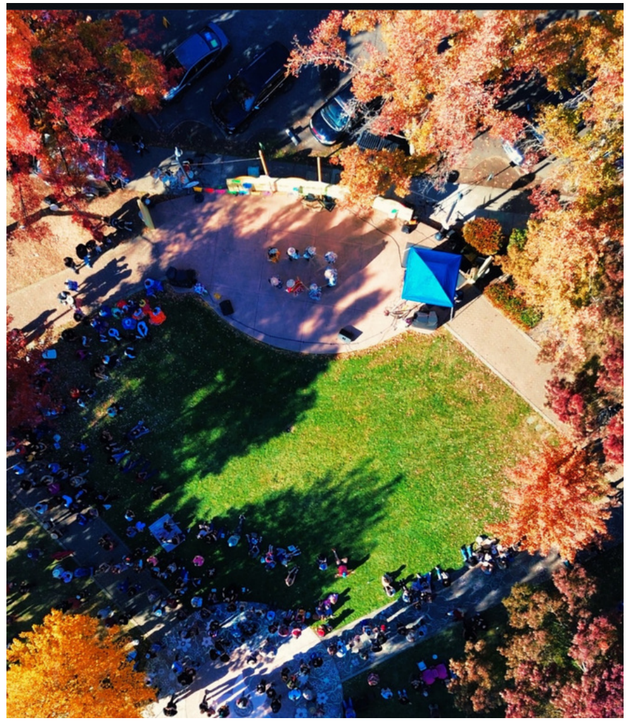




1500+ Attendance

Día De Los Muertos
Sunday, November 2
11 am - 4 pm
Alex Thomas Plaza
UKIAH







CITY OF UKIAH
CITY COUNCIL MINUTES
Regular Meeting
CIVIC CENTER COUNCIL CHAMBERS
300 Seminary Avenue, Ukiah, CA 95482
Virtual Meeting Link: *https://us06web.zoom.us/j/83674216619*

November 5, 2025
5:15 p.m.

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1. ROLL CALL

Ukiah City Council met at a Regular Meeting on November 5, 2025, having been legally noticed on October 31, 2025. The meeting was held in person and virtually at the following link: *https://us06web.zoom.us/j/83674216619.* Mayor Crane called the meeting to order at 5:17 p.m. Roll was taken with the following **Councilmembers Present:** Mari Rodin, Heather Criss, Juan V. Orozco, Susan Sher, and Douglas, F. Crane. **Staff Present:** Sage Sangiacomo, City Manager; David Rapport, City Attorney; and Araceli Sandoval, Deputy City Clerk.

MAYOR CRANE PRESIDING.

2. PLEDGE OF ALLEGIANCE

The Pledge of Allegiance was led by Mayor Crane.

3. AB 2449 NOTIFICATIONS AND CONSIDERATIONS

4. PROCLAMATIONS/INTRODUCTIONS/PRESENTATIONS

5. PETITIONS AND COMMUNICATIONS

Deputy City Clerk, Araceli Sandoval, stated that no communications had been received.

6. APPROVAL OF MINUTES

a. Approval of the Minutes for the October 15, 2025, Regular Meeting.

Motion/Second: Sher/Criss to approve Minutes of October 15, 2025, a regular meeting, as submitted. Motion **carried** by the following roll call votes: AYES: Rodin, Criss, Orozco, Sher, and Crane. NOES: None. ABSENT: None. ABSTAIN: None.

7. RIGHT TO APPEAL DECISION

8. CONSENT CALENDAR

a. Report of Disbursements for the Month of September 2025 – *Finance.*

b. Award Contract *(2526-145)* to DC Electric Inc in the Amount of $44,322.60 for Routine Traffic Signal Maintenance and Approval of Budget Amendment in the Amount of $4,322.60 – *Public Works.*

c. Approval of Purchase of Caterpillar Dozer, Mack Truck and Cozad Equipment Trailer from the Hopland Fire Protection District in the Amount of $138,000 – *Public Works.*

DRAFT

d. Approval of Contract Amendment *(2324-082-A1)* to JM Integration for On-call Maintenance and Troubleshooting at the Wastewater Treatment Plant in the Amount of $73,187.90 – *Water Resources.*

e. Approval of Contract Amendment *(2223-157-A2)* with The KPA Group for Consulting Services Related to Phase 2 Design Services at 501* South State Street in the Amount of $96,555 Including $14,310 for Additional Services During the Extended Bidding Process and $82,245 for Construction Management Support During the Construction Phase – *Finance.*

f. Approval of Contract Amendment *(2223-118-A1)* with Cintas for Uniform and Janitorial Rental Services – *Finance.*

** An administrative correction was made to the title for Agenda Item 8e to reflect the correct location.*

Motion/Second: Rodin/Criss to approve Consent Calendar Items 8a-8f, as submitted. Motion **carried** by the following roll call votes: AYES: Rodin, Criss, Orozco, Sher, and Crane. NOES: None. ABSENT: None. ABSTAIN: None.

9. AUDIENCE COMMENTS ON NON-AGENDA ITEMS

Public Comment: Kylle St. Pierre – September 17, 2025, Council Minutes; Jacqueline Williams – Ukiah Food Bank; and Fred Conklin – NUI Rising Moon Trust.

10. COUNCIL REPORTS

Presenters: Vice Mayor Sher and Councilmembers Criss, Orozco, and Rodin.

11. CITY MANAGER/CITY CLERK REPORTS

Presenters: Sage Sangiacomo, City Manager; and

- **Construction Update** – Tim Eriksen, Public Works Director / City Engineer.

12. PUBLIC HEARINGS (5:30 PM)

a. Introduction by Title Only of an Ordinance to Modify the Ukiah City Code by adding Article 11.5 to Division 9, Chapter 2, to Establish and Regulate the Open Space (O-S) Zoning District.

Presenters: Jesse Davis, Chief Planning Manager and Blake Adams, Chief Resiliency Officer.

A presentation was received.

PUBLIC HEARING OPENED AT 5:56 P.M.

Public Comment: Kylle St. Pierre.

PUBLIC HEARING CLOSED AT 6:00 P.M.

Motion/Second: Criss/Rodin to introduce an ordinance by title only. Motion **carried** by the following roll call votes: AYES: Rodin, Criss, Orozco, Sher, and Crane. NOES: None. ABSENT: None. ABSTAIN: None.

Deputy City Clerk, Araceli Sandoval, read the following ordinance title into the record:

ORDINANCE OF THE CITY COUNCIL OF THE CITY OF UKIAH ADDING A NEW ARTICLE 11.5 TO DIVISION 9, CHAPTER 2 TO UKAH CITY CODE TO ESTABLISH AND REGULATE THE OPENSPACE (O-S) ZONING DISTRICT.

DRAFT

Motion/Second: Rodin/Sher to introduce an Ordinance amending the Ukiah City Code to add Article 11.5 to Division 9, Chapter 2, establishing and regulating the Open Space (O-S) Zoning District. Motion **carried** by the following roll call votes: AYES: Rodin, Criss, Orozco, Sher, and Crane. NOES: None. ABSENT: None. ABSTAIN: None.

b. Introduction by Title Only of an Ordinance Prezoning 1 Carousel Lane (APN 167-280-15) to Public Facilities (PF) Zoning District and Adoption of a Resolution of Application to Mendocino Local Agency Formation Commission to Submit the "City of Ukiah - Corporation Yard Annexation" Application.

Presenter: Jesse Davis, Chief Planning Manager.

PUBLIC HEARING OPENED AT 6:15 P.M.

No public comment was received.

PUBLIC HEARING CLOSED AT 6:16 P.M.

Motion/Second: Criss/Sher to introduce an ordinance by title only. Motion **carried** by the following roll call votes: AYES: Rodin, Criss, Orozco, Sher, and Crane. NOES: None. ABSENT: None. ABSTAIN: None.

Deputy City Clerk, Araceli Sandoval, read the following ordinance title into the record:

ORDINANCE OF THE CITY COUNCIL OF THE CITY OF UKIAH PREZONING 1 CAROUSEL LANE (APN 167-280-15) TO PUBLIC FACILITIES (PF) WITH A GENERAL PLAN DESIGNATION OF PUBLIC (P) IN ANTICIPATION OF THE "CITY OF UKIAH – CORPORATION YARD ANNEXATION"

Motion/Second: Rodin/Orozco to introduce an Ordinance prezoning 1 Carousel Lane (APN 167-280-15) to Public Facilities (PF) Zoning District and adopt a Resolution *(2025-54)* of Application to Mendocino LAFCo to submit the 'City of Ukiah - Corporation Yard Annexation' application. Motion **carried** by the following roll call votes: AYES: Rodin, Criss, Orozco, Sher, and Crane. NOES: None. ABSENT: None. ABSTAIN: None.

13. UNFINISHED BUSINESS

a. Approval of Disbursement of up to $300,000 in Opioid Settlement Funds for the Expansion of the Ford Street Project; Authorization for the City Manager to Negotiate and Execute Agreement for Said Distribution with the Ford Street Project; and Approval of Corresponding Budget Amendment.

Presenters: Shannon Riley, Deputy City Manager and Jacqueline Williams, Ford Street Project Executive Director.

A video was received.

No public comment was received.

Motion/Second: Criss/Sher to approve the disbursement of up to $300,000 in opioid settlement funds for the expansion of the Ford Street Project; authorize the City Manager to negotiate and execute agreement *(2526-146)* for said distribution with the Ford Street Project; and approve the corresponding budget amendment. Motion **carried** by the following roll call votes: AYES: Rodin, Criss, Orozco, Sher, and Crane. NOES: None. ABSENT: None. ABSTAIN: None.

DRAFT

b. Adoption of Resolution Affirming that the Proclamation of a Local Emergency Due to Conditions Caused by Atmospheric Rivers Causing Damage to Public Infrastructure Remains in Effect.

Presenter: Traci Boyl, Senior Management Analyst.

No public comment was received.

Motion/Second: Crane/Criss to adopt a resolution *(2025-55)* affirming that the declaration of a local emergency remains in effect. Motion **carried** by the following roll call votes: AYES: Rodin, Criss, Orozco, Sher, and Crane. NOES: None. ABSENT: None. ABSTAIN: None.

14. NEW BUSINESS

a. Receive and File Fourth Quarter Financial Report (Preliminary Unaudited Year-End Results).

Presenter: Dan Buffalo, Finance Director.

A presentation was received.

No public comment was received.

Report was received.

b. Adoption of a Resolution Approving Successor Memoranda of Understanding Between the City of Ukiah and Operating Engineers, Local 3 — Water Utilities and Mechanics Unit, and Administrative and Maintenance Unit (if ratified), Effective September 19, 2025, through September 18, 2028, and Corresponding Salary Schedule(s); and Authorize the City Manager to Execute the Agreement(s) and Amend the Budget Accordingly.

Presenter: Sheri Mannion, Risk Manager /Human Resources Director.

No public comment was received.

Motion/Second: Criss/Sher to adopt a Resolution *(2025-56)* approving the successor Memoranda of Understanding between the City of Ukiah and Operating Engineers Local 3 — Water Utilities and Mechanics Unit *(2526-147)*, Effective September 19, 2025, through September 18, 2028, and Corresponding Salary Schedule; and Authorize the City Manager to Execute the Agreement and Amend the Budget Accordingly. Motion **carried** by the following roll call votes: AYES: Rodin, Criss, Orozco, Sher, and Crane. NOES: None. ABSENT: None. ABSTAIN: None.

c. Receive Updates on City Council Committee and Ad Hoc Assignments and, if Necessary, Consider Modifications to Assignments and/or the Creation/Elimination of Ad hoc(s).

No reports were received.

15. CLOSED SESSION

a. Conference with Legal Counsel – Anticipated Litigation
(Government Code Section 54956.9(d)(4))
Initiation of litigation (2 cases)

b. Conference with Legal Counsel – Existing Litigation
(Government Code Section 54956.9(d)(1))
Name of case: Nui Rising Moon Trust v. City of Ukiah, et al.; Case No. 3:25-cv-08320

DRAFT

c. Conference with Legal Counsel – Existing Litigation
(Government Code Section 54956.9(d)(1))
Name of case: Vichy Springs Resort v. City of Ukiah, Et Al; Case No. SCUK-CVPT-2018-70200

d. Conference with Legal Counsel – Existing Litigation
(Government Code Section 54956.9(d)(1))
Name of case: Vichy Springs Resort, Inc v. City of Ukiah, et al.; Case No. 24-cv-07106-JSC

e. Conference with Real Property Negotiators
(Cal. Gov't Code Section 54956.8)
Property: APN Nos: 170-030-05; 170-030-03; 170-010-05; 170-020-07; 170-020-11; 170-040-03; 170-020-08
Negotiator: Sage Sangiacomo, City Manager
Negotiating Parties: Project Ovis LLC
Under Negotiation: Price & Terms of Payment

f. Conference with Labor Negotiator (54957.6)
Agency Designated Representative: Sage Sangiacomo, City Manager
Employee Organizations: All bargaining units
Unrepresented Employee: Police Chief

16. ADJOURNMENT

There being no further business, the meeting adjourned at 7:55 p.m.

_____
Araceli Sandoval, Deputy City Clerk

DRAFT

Agenda Item No: 8.a.

MEETING DATE/TIME: 11/19/2025

ITEM NO: 2025-1269

City of Ukiah

AGENDA SUMMARY REPORT

SUBJECT: Adoption of an Ordinance Amending the Ukiah City Code by Adding Article 11.5 to Division 9, Chapter 2, to Establish and Regulate the Open Space (O-S) Zoning District.

DEPARTMENT: Community Development

PREPARED BY: Jesse Davis, Chief Planning Manager

PRESENTER: Jesse Davis, Chief Planning Manager

ATTACHMENTS:

1. Open Spaces Proposed Ordinance
2. PC Resolution No. 2025-05 - Signed
3. Draft Findings of Consistency - CEQA Statutory Exemption

Summary: Council will consider adoption of an Ordinance amending Ukiah City Code by adding Article 11.5 to Division 9, Chapter 2, to establish and regulate the Open Space (O-S) Zoning District.

Background: On December 7, 2022, the Ukiah City Council adopted the Ukiah 2040 General Plan, which includes a clear directive to enhance open space preservation through coordinated planning and regulatory tools. The various Elements of the General Plan emphasize alignment with Mendocino County's land use policies, focusing on the protection of agricultural lands, watershed areas, scenic resources, and wildlife habitat. A key implementation priority identified in the General Plan is the creation of a dedicated Open Space (O-S) Zoning District. This district would formalize the purpose, standards, and protections for lands designated as open space and serve as a compatible implementation tool for the Public (P), Recreational (REC), Agriculture (AG), and the Open Space (OS) land use designations in the 2040 General Plan. The City's Safety Element and Public Facilities Element also emphasize the need for such a zoning district, particularly to protect the community against hazards while providing opportunities for recreation, education, and community access to the City's open spaces.

At its January 8, 2025, regular meeting, the Planning Commission initiated workshop discussion on establishing an O-S zoning district to establish an Open Space Ordinance (Attachment 1). The conversation focused on clarifying the intent of the existing General Plan open space designation, particularly in areas such as the Western Hills, which were recently annexed into the City. Key topics discussed included the role of open space zoning in supporting habitat preservation, wildfire resilience, recreational access, and long-term watershed protection. The Commission also discussed the need to distinguish Ukiah's zoning standards from Mendocino County's, particularly by discouraging incompatible uses such as mining and major utility infrastructure, both of which are currently allowed under the County's open space district per Chapter 20.104 of Mendocino County Code. The Commission emphasized the importance of public access, trail connectivity, and maintaining the natural character of sensitive areas.

Following this initial workshop, Staff reconvened with the Planning Commission at the Commission's meeting on May 28, 2025, with a draft of the proposed O-S Zoning District ordinance for discussion. The Commission reviewed preliminary zoning language, including draft definitions, permitted uses, development standards, and administrative roles. A focal point of this workshop was the identification of publicly owned lands potentially suitable for the proposed O-S designation. Areas discussed included the Western Hills, Eastern Hills, Riverside Park, Gibson Creek headwaters, and portions of Low Gap Park. During the second workshop,

Commissioners offered feedback on the following topics: setbacks and development allowances such as for residential units; clarification of permitted agricultural activities; and cross-departmental responsibilities for managing open space areas (e.g., Community Development, Public Works, and Community Services). The Planning Commission voiced support for the proposed open space zoning district as a key implementation tool for the General Plan and as a proactive approach to preserve Ukiah's open space resources. While these publicly opened parcels were identified, they were intended only as conceptual examples to illustrate the types of properties that might be suitable for rezoning or partial rezoning.

Staff subsequently refined the ordinance. As recommended and requested by the Planning Commission, Staff removed previously allowed residential uses (Caretaker/Ranger Station), aligned agricultural terminology and definitions with existing regulations, and clarified allowable uses that would require a separate plan review and approval (e.g., conservation, fuel management, and habitat restoration plans).

In addition to advancing local planning goals, the proposed O-S Zoning District directly supports broader state-level general plan mandates and conservation initiatives. Specifically, the ordinance aligns with the intent of California Government Code Sections 65302 and 65560–65570, which require cities to implement the Open Space and Conservation Elements of their General Plans through concrete regulatory measures. By establishing a dedicated zoning classification for open space, the City establishes a framework for identifying, conserving, and managing open-space lands consistent with evolving State priorities such as climate adaptation, natural resource protection, sustainable land use, and equitable public access.

The ordinance also supports the goals of California's 30x30 Initiative, which seeks to conserve 30 percent of the State's lands and coastal waters by 2030. The O-S Zoning District contributes to this effort by ensuring durable protection of identified lands, restricting incompatible uses, and promoting ecological conservation, including the preservation of wildlife habitat, water resources, and wildlife corridors. The zoning framework also helps ensure these goals are maintained over time through enforceable standards, aligning Ukiah's local efforts with the State's long-term conservation strategy.

On October 22, 2025, the Planning Commission held a public hearing to review and consider the draft Open Space (O-S) Zoning District ordinance. Following Staff's presentation and public comment, the Commission voted to approve a resolution (Attachment 2) recommending City Council adoption of the ordinance, with only minor grammatical edits and clarifying revisions. The Commission recommended modifying language to require, rather than merely encourage, the use of native and drought-tolerant plant species in parking lots serving trailheads. While generally supportive, the Commission inquired about the application of the O-S district to private lands; Staff clarified that application of the O-S district on private parcels was not anticipated except through conservation easements or voluntary participation by landowners.

At the conclusion of the public hearing at their regular meeting on November 5, 2025, the Council unanimously (5-0) approved the introduction of the Ordinance (Attachment 1).

Discussion: The draft Open Space (O-S) Zoning District represents a key implementation step of the Ukiah 2040 General Plan. The proposed ordinance establishes a dedicated zoning district to preserve and manage lands identified for open space use, consistent with the City's long-term vision for natural resource protection, recreation, and hazard avoidance. The intent of the O-S District is to provide a clear regulatory framework that supports conservation and compatible public access, while ensuring the long-term protection of the City's most valuable environmental and scenic resources.

A central focus in the development of the O-S District was the creation of open space–specific definitions that reflect the City's policy direction and regional context. Staff based draft definitions on input from City Departments, the Ukiah 2040 General Plan, County of Mendocino Chapter 20.104 (Open Space Zoning District), the City of Walnut Creek's Open Space zoning regulations, and relevant State definitions, ensuring consistency with contemporary open space management practices. Each definition was developed to clearly describe allowable activities within open space areas while maintaining the district's conservation intent. Examples include rewilding, habitat banking, native plant propagation, environmental education centers, and non-obtrusive towers. These terms provide regulatory clarity and ensure that the City's zoning language aligns

with both state conservation policy and regional standards, reducing ambiguity in the review and implementation of future open space projects. This is particularly critical in ensuring alignment with recently adopted state laws, such as SB 1245, which requires the City to identify "Rewilding" opportunities correlated with the City's Land Use update in 2027.

The proposed ordinance also introduces a comprehensive setback framework designed to protect environmentally sensitive areas and minimize visual, slope, and stability impacts. A minimum 100-foot setback is required from creeks, wetlands, and mapped sensitive habitats for zoned parcels. Additional setback provisions apply to hillside areas to maintain slope stability and minimize grading. Of particular note, the O-S District establishes a reverse setback requirement for adjacent development. This means that new projects on properties adjoining designated open space lands must also provide transitional yards to ensure compatibility, maintain scenic character, and prevent encroachment into open space areas.

Although the O-S District identifies several uses as allowed by right, most activities will still require environmental review and approval under the California Environmental Quality Act (CEQA). Even seemingly minor improvements such as trails, signage, or restoration work may require formal CEQA determination when located near sensitive resources or habitats. This ensures that all projects are carefully evaluated and that potential environmental impacts are avoided or mitigated in accordance with State law.

To further protect resource values, the O-S District requires that most activities occur as part of an approved Conservation, Fuel Management, Habitat Conservation, or Grazing Plan. Activities such as vegetation management, slope stabilization, or trail construction must therefore demonstrate consistency with an adopted management plan to ensure that they contribute to long-term ecological resilience and land stewardship. This structure provides a coordinated approach to implementing conservation and wildfire resilience goals across open space lands, similar to how the City recently approved the Lookout Peak Trail environmental review. At this stage, Staff emphasizes that all properties proposed for the O-S zoning designation will be publicly owned lands. Public ownership ensures appropriate stewardship, equitable access, and alignment with the City’s management responsibilities. Privately owned parcels will not be rezoned to O-S until suitable long-term protection mechanisms such as conservation easements or acquisitions are in place to ensure consistent management.

The City is not rezoning any property at this time. The next step is to identify candidate areas for the O-S district as part of the upcoming Official Zoning and Land Use Map update. Any rezoning would be brought forward as one or more separate zoning map amendments, with parcel-level review, public notice, and hearings. For larger publicly owned holdings (e.g., Western Hills, Eastern Hills), the City may consider partial or split zoning where open space functions coexist with other identified or existing uses (such as public infrastructure, access/operations areas, or facility sites). Parks and recreation sites (e.g., Riverside Park) will be evaluated against current use, easements, and adopted plans to determine whether O-S is appropriate for all or only portions of a site.

The proposed O-S Zoning District also draws from Mendocino County Code Chapter 20.104 (Open Space District). While the County’s zoning code provided a valuable reference point, the City’s approach intentionally diverges in several key areas. The County’s Open Space District permits limited residential development, mineral extraction, and certain municipal or utility infrastructure, including renewable energy facilities. While these activities may be appropriate in a rural county context, they are inconsistent with the City’s policy direction for urban-adjacent open space lands. Within Ukiah, such uses would introduce impacts and intensities incompatible with the City’s conservation, recreation, and resource management objectives. Staff does not discount the potential appropriateness of those uses but identifies them as more suitable within the Public Facilities (P-F) Zoning District or similar designations that can accommodate infrastructure and energy-related projects while maintaining operational flexibility.

Pursuant to Section 15183 of the California Environmental Quality Act (CEQA), the project qualifies for a statutory exemption. The project is consistent with the development density and use characteristics established by the existing General Plan and zoning regulations for which an Environmental Impact Report

(EIR) has already been certified. Upon review and drafting Findings of Consistency (Attachment 3), no additional significant environmental effects peculiar to the project or its site have been identified.

Overall, the proposed O-S Zoning District provides the City with a clear, defensible regulatory framework to protect natural and scenic resources, implement the Ukiah 2040 General Plan, and guide the responsible use, stewardship, and access to the City's open space lands into the future.

Staff recommends Council adopt an Ordinance amending Ukiah City Code by adding Article 11.5 to Division 9, Chapter 2, to establish and regulate the Open Space (O-S) Zoning District.

Recommended Action: Adopt an Ordinance amending the Ukiah City Code by adding Article 11.5 to Division 9, Chapter 2, to establish and regulate the Open Space (O-S) Zoning District.

BUDGET AMENDMENT REQUIRED: N/A

CURRENT BUDGET AMOUNT: N/A

PROPOSED BUDGET AMOUNT: N/A

FINANCING SOURCE: N/A

REVENUE: No **GRANT:** No

PREVIOUS CONTRACT/PURCHASE ORDER NO.: N/A

COORDINATED WITH: Blake Adams, Chief Resilience Officer; Darcy Vaughn, Deputy City Attorney

STRATEGIC PLAN (SP): SP 3A- Review and Revise Land Use Planning Documents

CLIMATE INITIATIVES (CI): CI-5a- Update Zoning; CI-10a- Prevent Fires

GENERAL PLAN ELEMENTS (GP):Goal ENV-1- Preserve open space land for the commercial agricultural and productive uses, the protection and use of natural resources, the enjoyment of scenic beauty and recreation, protection of tribal resources, and the protection from natural hazards; Policy ENV-6.7, Trail Corridors; Implementation Program C- Open Space Management; Policy ENV-1.3, Renewable Energy; Policy PFS-12.1 Park Network; Policy LU-6.3 Hillside Access

Approved:
Sage Sangiacomo, City Manager

ORDINANCE NO.

ORDINANCE OF THE CITY COUNCIL OF THE CITY OF UKIAH ADDING A NEW ARTICLE 11.5 TO DIVISION 9, CHAPTER 2 TO UKAH CITY CODE TO ESTABLISH AND REGULATE THE OPEN-SPACE (O-S) ZONING DISTRICT.

The City Council of the City of Ukiah hereby ordains as follows:

SECTION ONE. FINDINGS

1. The City Council finds that establishing an Open-Space (O-S) Zoning District implements and is consistent with the Ukiah 2040 General Plan, particularly Goal ENV-1 to preserve open space lands for agricultural production, natural resource protection, recreation, scenic enjoyment, and hazard avoidance.

2. The City Council finds that the establishment of the proposed Zoning District is consistent with and effectuates the Ukiah 2040 General Plan. In particular, the proposed zoning district implements the land use designations of Agriculture (A), Open-Space (OS), Public (P), and Recreation (REC), and is aligned with Goal ENV-1, which promotes the preservation and management of open space lands for agricultural productivity, natural resource conservation, public recreation, scenic values, and hazard avoidance. The zoning district establishes a regulatory structure that supports and reinforces these General Plan objectives, ensuring that future land uses remain compatible with the City's long-term vision for sustainable land stewardship.

3. The City Council finds that the O-S Zoning District fulfills Policy ENV-6.7 and Policy LU-6.3 by identifying, preserving, and managing creek corridors, hillsides, and ridgelines for trails, wildlife habitat, and public access. When applied to real property, the district provides a regulatory mechanism to ensure open space resources are protected, managed, and maintained in alignment with the intent of the 2040 General Plan, and any City-approved conservation, fuel management, or habitat restoration plan.

4. The City Council finds that the O-S Zoning District aligns with Action Item ENV-1.2(C) of the Ukiah 2040 General Plan by establishing allowances within open space designated areas, ensuring compatibility with long-term land conservation and watershed management objectives, including those identified in the Western Hills Watershed Protection Area Management Plan (2024) and the Western Hills Fire Break Maintenance Plan (2025).

5. The City Council finds that the Planning Commission held duly public workshops at regular meetings on January 8, 2025, May 28, 2025, and duly noticed public hearing on October 22, 2025, to review the purpose, standards, and applicability of the proposed O-S Zoning District. The Commission received public comments, discussed implementation options, and recommended the draft ordinance for adoption following consideration of staff reports, meeting materials, and related management plans.

6. The City Council finds that creating the O-S Zoning District promotes the public health, safety, and welfare by preserving natural and scenic resources, protecting against environmental hazards, and providing opportunities for recreation, education, and community enjoyment of the City's open spaces.

7. The City Council finds that adoption of the O-S Zoning District aligns with the intent of California Government Code Sections 65302 and 65560–65570, which require cities to adopt measures necessary to implement the Open-Space and Conservation Elements of their General Plan. Establishing a dedicated zoning district provides an essential tool to designate, conserve, and manage open-space lands in response to evolving State requirements for resource protection, climate adaptation, equitable public access, and sustainable land use.

8. The City Council finds that the establishment of the proposed Zoning District supports and advances the goals of the State of California's 30x30 Initiative, which aims to conserve 30 percent of the state's lands and coastal waters by 2030. Specifically, the zoning designation ensures that identified lands are durably protected, supports the expansion of equitable access to nature, and promotes the long-term conservation of ecological values such as wildlife habitat, farmland, water resources, and carbon sequestration. Furthermore, the zoning district establishes appropriate management standards to preserve these values over time, consistent with the broader state conservation framework.

9. The City Council finds that the adoption of this O-S Zoning District Ordinance is a legislative action that implements and is consistent with the development expectations and policies established in the Ukiah 2040 General Plan. Accordingly, the proposed project qualifies for streamlined environmental review pursuant to the California Environmental Quality Act (CEQA). Further CEQA review of this action is limited in scope as provided by Public Resources Code Section 21083.3 and CEQA Guidelines Section 15183 (Projects Consistent with a Community Plan or Zoning), based upon the Environmental Impact Report (EIR) previously certified for the Ukiah 2040 General Plan.

SECTION TWO.

A new Article 11.5, entitled "REGULATIONS IN OPEN-SPACE (O-S) DISTRICTS" is hereby added to Division 9, Chapter 2 of the Ukiah City Code and shall read as follows:

§ 9140 PURPOSE AND INTENT

The purpose of the Open-Space (O-S) zoning district is to conserve natural resources, preserve ecological systems, protect scenic and cultural landscapes, and provide opportunities for passive recreation and public access where appropriate. This designation is intended to identify lands not suited for development or to land most valuable in an undeveloped state. Factors limiting the development of land would include such constraints as unstable soils, high fire hazard, remote location, poor access, or susceptibility to flooding. Valuable natural areas could include rare and endangered species and habitat, wildlife corridors, riparian vegetation zones, areas with creeks or water features, or designated scenic resources.

The O-S District is consistent with the Open-Space, Public, Agriculture, and Recreational Land Use Designations in the General Plan. The regulations contained in this Article shall apply in all Open-Space (O-S) Districts except for the Airport Industrial Park Planned Development – Open Space designation.

§ 9141 DEFINITIONS

For purposes of this Article, the words and phrases set out herein shall have the following meanings within the Open – Space Zoning District:

BOARDWALKS AND ELEVATED WALKWAYS: Structures that allow passage over sensitive areas such as wetlands or riparian zones, reducing ground disturbance and preserving natural hydrology and vegetation.

CAMPGROUND – OPEN-SPACE: Areas designated for overnight camping, including tent sites, fire rings, picnic tables, and restrooms, with minimal permanent infrastructure, intended for recreational use compatible with natural open space settings.

CULTURAL, HISTORICAL, OR ARCHAEOLOGICAL INTERPRETIVE FACILITIES: Facilities or installations that convey the cultural, historical, or archaeological significance of a site through signage, exhibits, or programming. Such uses shall be low-impact and compatible with preservation of the surrounding environment.

ENVIRONMENTAL EDUCATION CENTERS: Small-scale facilities dedicated to outdoor learning, interpretation, and stewardship. May include classrooms, demonstration gardens, or displays focused on ecology, conservation, and sustainable practices, provided they maintain the character of the surrounding open space.

FIREBREAK: A linear or perimeter strip of land or area where combustible vegetation and materials are removed or reduced to a noncombustible condition to slow or stop wildfire spread and support firefighting operations. Width, location, and maintenance shall comply with the applicable fire code or an approved Fuels Management, Vegetation Management/Wildfire Mitigation Plan.

GRAZING. The controlled feeding of livestock on open land for the purpose of vegetation management, fuel reduction, or habitat restoration, consistent with an approved conservation, fuel management, or habitat restoration plan.

HABITAT BANKING OR MITIGATION SITES: Lands preserved, enhanced, or restored to offset environmental impacts elsewhere, typically under a conservation easement or regulatory agreement. These areas support long-term ecological functions and comply with state or federal mitigation requirements.

INTERPRETIVE SIGNAGE AND EDUCATIONAL KIOSKS: Signs or display stations designed to inform visitors about the natural, cultural, or historical features of a place. They often include text, images, maps, or interactive elements.

NATIVE PLANT PROPAGATION; NURSERY AREAS: Designated spaces used to grow and reproduce local, native plant species, usually from seeds or cuttings to support restoration, conservation, or landscaping projects that aim to preserve the local ecosystem.

NON-OBTRUSIVE TOWER: A structure intended for wildfire detection, environmental monitoring, emergency communication, or similar public safety functions, and is designed to have minimal visual and environmental impact. These towers are typically slender, uninhabited, and constructed using neutral colors or materials that help them blend with the surrounding landscape. They avoid prominent placement on ridgelines or scenic vistas whenever possible and do not include large equipment shelters or features that would significantly alter the natural character of the site. Lighting is not permitted unless required by state or federal safety regulations

OUTDOOR EDUCATION: Organized programs that provide structured instruction and hands-on learning in outdoor or natural settings, including field studies, environmental science, ecology, outdoor skills, and natural interpretation.

PARKING LOTS (TRAILHEADS OR OPEN-SPACE ACCESS): Surface parking areas intended solely to support public access to trails, parks, or open space areas. These lots shall be minimally sized, use permeable materials where feasible, and be sited to reduce visual and environmental impacts.

PUBLIC PARKS AND RECREATION AREAS WITH LIMITED FACILITIES: Open space areas accessible to the public for passive or low-impact recreation, such as walking, wildlife viewing, or picnicking. May include benches, restrooms, or shade structures, but do not permit large-scale or intensive recreational infrastructure.

REWILDING: The restoration or protection of land and ecosystems to support native species, natural processes, and ecological functions, with minimal ongoing human management.

SLOPE STABILIZATION: Engineering, vegetative, and bioengineering measures to prevent or correct slope failure and erosion, including grading/terracing, soil reinforcement, rockery/riprap, retaining systems, slope drains, and temporary/permanent erosion control BMPs (e.g., silt fence, fiber rolls, hydro-mulch, check dams, sediment basins).

SPECIAL EVENTS OR TEMPORARY USES CONSISTENT WITH OPEN-SPACE VALUES: Short-term activities such as nature walks, educational workshops, cultural gatherings, or community celebrations that promote awareness, stewardship, or enjoyment of open space resources without significant alteration of the site.

TRAIL, BICYCLE (SHARED-USE PATH): A Public Trail or path primarily designed for bicycle travel, typically with a stabilized surface for bicycle traffic. Equestrian and pedestrian use is not allowed unless expressly posted and designed.

TRAIL, EQUESTRIAN: A Public Trail primarily designed, constructed, and maintained for horseback riding. May run parallel to, or be separated from, a Multi-Use Trail. Includes equestrian-specific features such as hitching rails, mounting blocks, manure bins, and trail width/clearance suitable for horses.

TRAIL, MULTI-USE: A Public Trail designed and signed for concurrent use by multiple non-motorized users, typically including hikers, bicyclists, and may include equestrian use where specifically posted and designed. Surfaces may be stabilized.

TRAIL, NATURE/FOOTPATH: A Public Trail intended for pedestrian travel only (hiking, walking, running), typically with a natural surface and minimal improvements to protect sensitive resources. Bicycles and equestrian use are not allowed unless expressly posted and designed.

TRAIL, PUBLIC: A publicly accessible route for travel and recreation located in parks, open space, or easements, designed for pedestrian use and, where signed or improved, may include other permitted non-motorized users.

TRAIL SPUR (ACCESS SPUR): A short Public Trail segment that provides connection from a trailhead, street, school, park, or neighborhood to a Multi-Use, Bicycle, Equestrian, or Nature/Footpath.

TRAILHEAD: A designated access point to one or more trails that may include parking, restrooms, potable water, signage/maps, staging areas (including equestrian staging), and maintenance access while safeguarding open-space from prohibited access or usage.

WATER DETENTION AND RECHARGE FACILITIES: Infrastructure designed to temporarily capture, hold, and infiltrate stormwater to reduce runoff, prevent erosion, and recharge groundwater. Includes bioswales, retention basins, and percolation ponds designed to integrate with natural systems.

WILDFIRE PUBLIC SAFETY INFRASTRUCTURE: Equipment intended to support wildfire preparedness, detection, and emergency response. This includes, but is not limited to, dedicated firefighting assets (e.g., water storage tanks, staging areas) and emergency communication infrastructure (e.g., public alert systems, emergency sirens, and related systems) necessary to ensure operational readiness during wildfire events.

§ 9142 ALLOWED USES

The following uses are allowed by right in the Open-Space (O-S) District:

Conservation and Habitat Restoration Activities, consistent with approved conservation, fuel management, or habitat restoration plans

Grazing, consistent with approved conservation, fuel management, or habitat restoration plans

Fuel Break, consistent with approved conservation, fuel management, or habitat restoration plans

Habitat Corridors and Linkages, consistent with approved conservation, fuel management, or habitat restoration plans

Interpretive signage and Educational Kiosks

Native Plant Propagation Areas

Native Tree Nurseries

Outdoor Education

Rewilding, consistent with approved conservation, fuel management, or habitat restoration plans

Row & Field Crops and Animal Raising – General Agriculture, excluding permanent structures

Slope Stabilization And Erosion Control, consistent with approved conservation, fuel management, or habitat restoration plans

Wildfire Public Safety Infrastructure

§ 9143 PERMITTED USES

The following uses require approval of an appropriate Use Permit pursuant to the provisions contained in Article 20 of this Chapter.

Campground (Open-Space)

Cultural, historical, or archaeological interpretive facilities

Environmental education centers

Habitat banking or mitigation sites

Park and recreation services

Parking lot(s) serving trailheads or open-space recreation areas

Special events or temporary uses consistent with open space purpose and intent

Trail, Bicycle (Shared-Use)

Trail, Equestrian

Trail, Multi-Use

Trail, Nature/Footpath, consistent with approved conservation, fuel management, or habitat restoration plans

Trail, Public

Trail-Spur

Trailhead

Water detention and recharge facilities

§ 9144 HEIGHT LIMITS

A. Primary structures: Maximum height of 25 feet.
B. Accessory structures: Maximum height of 15 feet or height of main building, whichever is less.
C. Improvements:
    1. Non-obtrusive towers and equipment used exclusively for wildfire detection, emergency communications, or similar public safety purposes may exceed 25 feet. Any such increase would be subject to discretionary review, and must be the minimum necessary for operational effectiveness and designed to reduce visual and environmental impact.
    2. Fences or walls: Maximum height of 7 feet, unless consistent with an approved conservation, fuel management or habitat restoration plan, or approved by Use Permit.

§ 9145 SITE AREA

There is no minimum site area for uses in the O-S District; however, development intensity must conform to open space purpose and intent.

§ 9146 SETBACKS

Yard setbacks apply to all new structures, additions, grading, and site improvements, including fences, walls, pavement, and other hardscape features, as conveyed below.

A. Environmental. A minimum 100-foot setback is required from the edge of sensitive environmental resources, including creeks and rivers (measured from the top of bank), wetlands (from the delineated wetland boundary), and mapped sensitive habitat areas.

B. Visual. To minimize visual impacts, development within or near setback areas shall be sited and designed to maintain natural sightlines and reduce visual prominence through building placement, height and massing control, material selection, and landscape screening, with particular attention to ridgelines.

C. Slope. For sloped terrain, additional setbacks from the top of slope and toe of slope are required to avoid excessive grading. Slope percentage shall be measured as average grade over a horizontal distance of at least 25 feet, based on existing (pre-project) topography.

1. On slopes 15% to less than 30%, principal structures and foundations shall be set back a minimum of 10 feet from the top of ridge and 10 feet from the toe of slope.
2. On slopes 30% or greater, new structures and grading to create building pads are prohibited unless the review authority finds that no practicable alternative exists and that a geotechnical report demonstrates stability without increasing erosion risk; where allowed, the minimum top- and toe-of-slope setbacks shall be 30 feet.

D. Yard Setbacks: Any adjacent lot that shares a side or rear lot line with land zoned O-S shall provide a transition yard measured from that line as follows for the following uses:

1. Single Family Residential: Rear 25 feet, side 12 feet;
2. Multifamily: Rear 30 feet, side 15 feet;
3. Non-Residential: Rear 35 feet, side 15 feet.

E. Exception. As part of the applicable Use Permit process, the Zoning Administrator or the Planning Commission may allow encroachments into required setbacks when no practicable alternative exists and the proposed design minimizes both physical and visual disturbance. Findings shall be supported by site- specific analysis, including (as applicable) a geotechnical report, erosion and sediment control plan, and visual analysis.

§ 9147 PARKING

A. For all trailheads and recreation areas the parking requirements shall be one space per ten (10) average daily visitors. The required number of parking spaces may be adjusted by the Community Development Director through a Determination of Appropriate Use, based on anticipated patterns of use, including but not limited to similar regional facilities; bicycle or pedestrian access requirements; equestrian facilities; educational or group programming; seasonal or event-based usage; proximity to public transit or urbanized areas.

B. Parking surfaces shall be permeable and screened with vegetation, where feasible.

C. No overnight public parking is allowed unless allowed by an issued Special Event or Use Permit.

D. Other Uses: All other uses are subject to the provisions contained in Article 17 of this Chapter.

§ 9148 ADDITIONAL REQUIREMENTS

A. Resource Protection: Grading or vegetation removal shall only be permitted with approval from the Community Development Director or Public Works Director on an emergency basis when not part of an approved conservation, fuel management or habitat restoration plan.

B. Lighting: Artificial lighting in the Open-Space District is generally discouraged. Any lighting must be minimal and dark-sky compliant according to International Dark-Sky Association's (IDA) guidelines for outdoor lighting to minimize light pollution.

C. Fencing: For Allowed uses, the use of fencing in the Open-Space Zoning District is generally discouraged. Any fencing installed must be wildlife-friendly or implemented to maintain public safety. Fences are prohibited if they would impede wildlife movement within a designated wildlife or habitat corridor, as determined by the City based on substantial evidence.

D. Parking Lot & Recreation Area Landscaping: Landscape plantings in the Open-Space District must be native and drought-tolerant species. Parking and recreation surfacing shall be permeable except where infeasible for compliance with the Americans with Disabilities Act or to serve emergency access.

E. Requirements for Special Events: Events in the Open-Space District must be consistent with the purpose of the zoning district set forth in this Article and shall not significantly degrade natural resources or impair public enjoyment of the area. All events require prior approval through a Use Permit.

§ 9149 DETERMINATION OF APPROPRIATE USE

Whenever a use is not listed in this Article as a used allowed by right or a use subject to a Use Permit in the O-S Zoning District, the Community Development Director shall determine whether the use is appropriate for the Zoning District, either as of right or subject to a Use Permit. In making this determination, the Planning Director shall find as follows:

A. That the use would not be incompatible with other existing or allowed uses in the O-S Zoning District.

B. That the use would not be detrimental to the continuing preservation of resources or access to the area in which the use would be located.

C. That the use involves a similar scale and impact to uses that are designated allowed uses in this Article.

D. That the use is consistent with the purpose and intent of the Open-Space Zoning District, including the protection of natural resources, scenic values, and the long-term preservation of open space for public or ecological benefit.

E. In the case of determining that a use not listed in this Article as an allowed or permitted use could be established with the securing of a Use Permit, the Community Development Director shall find that the proposed use is similar in nature and intensity to the uses listed as permitted uses. All determinations of the Community Development Director regarding

whether a use can be allowed or permitted in the Open- Space Zoning District shall be final unless a written appeal to the City Council, stating the reasons for the appeal, and the appeal fee, if any, established from time to time by City Council resolution, is filed with the City Clerk within ten (10) days of the date the decision was made. Appeals may be filed by an applicant or any interested party. The City Council shall conduct a duly noticed public hearing on the appeal in accordance with the applicable procedures as set forth in this Chapter. At the close of the public hearing, the City Council may affirm, reverse, revise or modify the appealed decision of the Community Development Director. All City Council decisions on appeals of the Director's actions are final for the City.

SECTION THREE.

1. Publication: Within fifteen (15) days after its adoption, this Ordinance shall be published once in a newspaper of general circulation in the City of Ukiah. In lieu of publishing the full text of the Ordinance, the City may publish a summary of the Ordinance once 5 days prior to its adoption and again within fifteen (15) days after its adoption.

2. Effective Date: The ordinance shall become effective thirty (30) days after its adoption.

3. Severability: If any section, subsection, subdivision, paragraph, sentence, clause or phrase of this Ordinance, or its application to any person or circumstance, is for any reason held to be invalid or unenforceable, such invalidity or unenforceability shall not affect the validity or enforceability of the remaining sections, subsections, subdivisions, paragraphs, sentences, clauses or phrases of this Ordinance, or its application to any other person or circumstance. The City Council of the City of Ukiah hereby declares that it would have adopted each section, subsection, subdivision, paragraph, sentence, clause or phrase hereof, irrespective of the fact that any one or more other sections, subsections, subdivisions, paragraphs, sentences, clauses or phrases hereof be declared invalid or unenforceable.

Introduced by title only on November 5, 2025, by the following roll call vote:

AYES: Councilmembers Rodin, Criss, Orozco, Sher, and Mayor Crane.
NOES: None.
ABSENT: None.
ABSTAIN: None.

Adopted on November 19, 2025, by the following roll call vote:

AYES:
NOES:
ABSENT:
ABSTAIN:

_____
Douglas F. Crane, Mayor

ATTEST:

_____
Kristine Lawler, CMC/City Clerk

RESOLUTION NUMBER PC-2025-05
CITY OF UKIAH
OCTOBER 22, 2025

RESOLUTION OF THE PLANNING COMMISSION OF THE CITY OF UKIAH RECOMMENDING CITY COUNCIL ADOPTION OF AN ORDINANCE AMENDING THE UKIAH CITY CODE TO ESTABLISH AN OPEN SPACE (O-S) ZONING DISTRICT CONSISTENT WITH THE UKIAH 2040 GENERAL PLAN

WHEREAS, on December 7, 2022, the Ukiah City Council adopted Resolution No. 2022-79 certifying the Environmental Impact Report for the Ukiah 2040 General Plan (State Clearinghouse No. 2022050556), which evaluated the environmental impacts of the General Plan, and included adoption of a Mitigation Monitoring and Reporting Program and Statement of Overriding Considerations; and

WHEREAS, the Ukiah 2040 General Plan calls for the preservation and long-term stewardship of open space lands for the purposes of agriculture, natural resource conservation, public recreation, scenic values, and hazard mitigation, particularly through the implementation of Goal ENV-1 and related policies and action items of the Ukiah 2040 General Plan; and

WHEREAS, Government Code Sections 65302 and 65560–65570 require cities to adopt measures that implement the Open Space and Conservation Elements of their General Plans, including the designation and regulation of open space lands; and

WHEREAS, the City of Ukiah has prepared a draft ordinance establishing the Open Space (O-S) zoning district to implement the Ukiah 2040 General Plan and to regulate land uses, development standards, and allowable activities within designated publicly-owned open space areas; and

WHEREAS, the proposed O-S Zoning District allows for implementation of key General Plan policies including ENV-6.7 (Public Open Space) and LU - 6.3 (Open Space Access) by identifying and preserving riparian areas, hillsides, ridgelines, and habitat corridors for conservation, recreation, and hazard mitigation; and

WHEREAS, the O-S Zoning District also implements Action Item ENV-1.2(C) by formalizing zoning standards that align with the objectives of the Western Hills Watershed Protection Area Management Plan (2024) and the Western Hills Fire Break Maintenance Plan (2025); and

WHEREAS, while the adoption of the Open Space Zoning District Ordinance does not designate any specific parcels of real property, it is intended to be applied to publicly owned lands under the jurisdiction of the City of Ukiah or other public entities, consistent with the goals and policies of the Ukiah 2040 General Plan; and

WHEREAS, the O-S Zoning District supports the goals of the State of California's 30x30 Initiative, which seeks to conserve 30% of the state's lands and waters by 2030; and

WHEREAS, the proposed Ordinance promotes the public health, safety, and welfare by protecting open space lands from incompatible development, supporting climate adaptation and water resource protection, and preserving areas for low-impact public recreation and education; and

WHEREAS, the Planning Commission held two publicly noticed workshops on January 8, 2025, and May 28, 2025, to review and discuss the intent, purpose, applicability, and draft language of the proposed Open Space (O-S) Zoning District, received public comments, and provided feedback to staff to guide ordinance development; and

WHEREAS, on October 22, 2025, the Planning Commission held a duly noticed public hearing to consider the proposed Ordinance, received public comment, reviewed staff reports and supporting documentation, and closed the public comment period; and

WHEREAS, the Ordinance has been reviewed for environmental compliance pursuant to the California Environmental Quality Act (CEQA), and is consistent with the Environmental Impact Report certified for the Ukiah 2040 General Plan, qualifying for streamlined CEQA review under CEQA Guidelines Section 15183 and Public Resources Code; and

WHEREAS, the Planning Commission finds that the Ordinance is in the public interest, consistent with the Ukiah General Plan, advances key environmental and land use goals, and provides a clear regulatory framework for the use and preservation of open space lands in the City of Ukiah.

NOW, THEREFORE, BE IT RESOLVED that the Planning Commission of the City of Ukiah, based on the staff report, environmental review, public testimony, and all written and oral materials presented at the hearing, makes the following findings and recommendations:

1. The above recitals are true and correct and are incorporated herein by reference.
2. The proposed Ordinance is consistent with the Ukiah 2040 General Plan and implements the goals, objectives, and policies of the Open Space, Land Use, and Environmental Elements, particularly Goal ENV-1 and related policies.
3. The Ordinance qualifies for streamlined CEQA review pursuant to CEQA Guidelines Section 15183 and Public Resources Code Section 21083.3 because it implements and is consistent with the policies of the adopted 2040 General Plan, and no significant effects beyond those identified in the certified General Plan EIR are anticipated.
4. The Planning Commission recommends that the City Council introduce and adopt an Ordinance adding Article 11.5 to Division 9, Chapter 2 of the Ukiah City Code, as shown in the attached Exhibit A, establishing the Open Space (O-S) zoning district.

BE IT FURTHER RESOLVED that the Planning Commission designates the City Clerk as the custodian of the documents and other materials constituting the record of proceedings upon which this resolution is based. These materials are available at the City of Ukiah Community Development Department, 300 Seminary Avenue, Ukiah, CA 95482.

I hereby certify that according to the Provisions of Government Code Section 25103 delivery of this document has been made.

PASSED AND ADOPTED at a regular meeting of the Planning Commission of the City of Ukiah on this 22nd day of October, 2025, by the following roll call vote:

AYES: Commissioners Brown, Monaña, Johnson, Hilliker, and Chair de Grassi
NOES: None
ABSENT: None
ABSTAIN: None

Jesse Davis, AICP
Chief Planning Manager

Alex De Grassi
Chair, Ukiah Planning Commission
10/22/25

ATTEST:

Kristine Lawler, CMC
City Clerk

Exhibit A: Revised Ordinance

ORDINANCE NO.

ORDINANCE OF THE CITY COUNCIL OF THE CITY OF UKIAH ADDING A NEW ARTICLE 11.5 TO DIVISION 9, CHAPTER 2 TO UKAH CITY CODE TO ESTABLISH AND REGULATE THE OPEN-SPACE (O-S) ZONING DISTRICT.

The City Council of the City of Ukiah hereby ordains as follows:

SECTION ONE. FINDINGS

1. The City Council finds that establishing an Open-Space (O-S) Zoning District implements and is consistent with the Ukiah 2040 General Plan, particularly Goal ENV-1 to preserve open space lands for agricultural production, natural resource protection, recreation, scenic enjoyment, and hazard avoidance.

2. The City Council finds that the establishment of the proposed Zoning District is consistent with and effectuates the Ukiah 2040 General Plan. In particular, the proposed zoning district implements the land use designations of Agriculture (A), Open-Space (OS), Public (P), and Recreation (REC), and is aligned with Goal ENV-1, which promotes the preservation and management of open space lands for agricultural productivity, natural resource conservation, public recreation, scenic values, and hazard avoidance. The zoning district establishes a regulatory structure that supports and reinforces these General Plan objectives, ensuring that future land uses remain compatible with the City's long-term vision for sustainable land stewardship.

3. The City Council finds that the O-S Zoning District fulfills Policy ENV-6.7 and Policy LU-6.3 by identifying, preserving, and managing creek corridors, hillsides, and ridgelines for trails, wildlife habitat, and public access. When applied to real property, the district provides a regulatory mechanism to ensure open space resources are protected, managed, and maintained in alignment with the intent of the 2040 General Plan, and any City-approved conservation, fuel management, or habitat restoration plan.

4. The City Council finds that the O-S Zoning District aligns with Action Item ENV-1.2(C) of the Ukiah 2040 General Plan by establishing allowances within open space designated areas, ensuring compatibility with long-term land conservation and watershed management objectives, including those identified in the Western Hills Watershed Protection Area Management Plan (2024) and the Western Hills Fire Break Maintenance Plan (2025).

5. The City Council finds that the Planning Commission held duly public workshops at regular meetings on January 8, 2025, May 28, 2025, and duly noticed public hearing on October 22, 2025, to review the purpose, standards, and applicability of the proposed O-S Zoning District. The Commission received public comments, discussed implementation options, and recommended the draft ordinance for adoption following consideration of staff reports, meeting materials, and related management plans.

6. The City Council finds that creating the O-S Zoning District promotes the public health, safety, and welfare by preserving natural and scenic resources, protecting against environmental hazards, and providing opportunities for recreation, education, and community enjoyment of

the City's open spaces.

7. The City Council finds that adoption of the O-S Zoning District aligns with the intent of California Government Code Sections 65302 and 65560–65570, which require cities to adopt measures necessary to implement the Open-Space and Conservation Elements of their General Plan. Establishing a dedicated zoning district provides an essential tool to designate, conserve, and manage open-space lands in response to evolving State requirements for resource protection, climate adaptation, equitable public access, and sustainable land use.

8. The City Council finds that the establishment of the proposed Zoning District supports and advances the goals of the State of California's 30x30 Initiative, which aims to conserve 30 percent of the state's lands and coastal waters by 2030. Specifically, the zoning designation ensures that identified lands are durably protected, supports the expansion of equitable access to nature, and promotes the long-term conservation of ecological values such as wildlife habitat, farmland, water resources, and carbon sequestration. Furthermore, the zoning district establishes appropriate management standards to preserve these values over time, consistent with the broader state conservation framework.

9. The City Council finds that the adoption of this O-S Zoning District Ordinance is a legislative action that implements and is consistent with the development expectations and policies established in the Ukiah 2040 General Plan. Accordingly, the proposed project qualifies for streamlined environmental review pursuant to the California Environmental Quality Act (CEQA). Further CEQA review of this action is limited in scope as provided by Public Resources Code Section 21083.3 and CEQA Guidelines Section 15183 (Projects Consistent with a Community Plan or Zoning), based upon the Environmental Impact Report (EIR) previously certified for the Ukiah 2040 General Plan.

SECTION TWO.

A new Article 11.5, entitled "REGULATIONS IN OPEN-SPACE (O-S) DISTRICTS" is hereby added to Division 9, Chapter 2 of the Ukiah City Code and shall read as follows:

§ 9140 PURPOSE AND INTENT

The purpose of the Open-Space (O-S) zoning district is to conserve natural resources, preserve ecological systems, protect scenic and cultural landscapes, and provide opportunities for passive recreation and public access where appropriate. This designation is intended to identify lands not suited for development or to land most valuable in ~~its~~ an undeveloped state. Factors limiting the development of land would include such constraints as unstable soils, high fire hazard, remote location, poor access, or susceptibility to flooding. Valuable natural areas could include rare and endangered species and habitat, wildlife corridors, riparian vegetation zones, areas with creeks or water features, or designated scenic resources.

The O-S District is consistent with the Open-Space, Public, Agriculture, and Recreational Land Use Designations in the General Plan. The regulations contained in this Article shall apply in all Open-Space (O-S) Districts except for the Airport Industrial Park Planned Development – Open Space designation.

§ 9141 DEFINITIONS

For purposes of this Article, the words and phrases set out herein shall have the following meanings within the Open – Space Zoning District:

BOARDWALKS AND ELEVATED WALKWAYS: Structures that allow passage over sensitive areas such as wetlands or riparian zones, reducing ground disturbance and preserving natural hydrology and vegetation.

CAMPGROUND – OPEN~~-~~ SPACE: Areas designated for overnight camping, including tent sites, fire rings, picnic tables, and restrooms, with minimal permanent infrastructure, intended for recreational use compatible with natural open space settings.

CULTURAL, HISTORICAL, OR ARCHAEOLOGICAL INTERPRETIVE FACILITIES: Facilities or installations that convey the cultural, historical, or archaeological significance of a site through signage, exhibits, or programming. Such uses shall be low-impact and compatible with preservation of the surrounding environment.

ENVIRONMENTAL EDUCATION CENTERS: Small-scale facilities dedicated to outdoor learning, interpretation, and stewardship. May include classrooms, demonstration gardens, or displays focused on ecology, conservation, and sustainable practices, provided they maintain the character of the surrounding open space.

FIREBREAK: A linear or perimeter strip of land or area where combustible vegetation and materials are removed or reduced to a noncombustible condition to slow or stop wildfire spread and support firefighting operations. Width, location, and maintenance shall comply with the applicable fire code or an approved Fuels Management, Vegetation Management/Wildfire Mitigation Plan.

GRAZING. The controlled feeding of livestock on open land for the purpose of vegetation management, fuel reduction, or habitat restoration, consistent with an approved conservation, fuel management, or habitat restoration plan.

HABITAT BANKING OR MITIGATION SITES: Lands preserved, enhanced, or restored to offset environmental impacts elsewhere, typically under a conservation easement or regulatory agreement. These areas support long-term ecological functions and comply with state or federal mitigation requirements.

INTERPRETIVE ~~SIGNATE~~ SIGNAGE AND EDUCATIONAL KIOSKS: Signs or display stations designed to inform visitors about the natural, cultural, or historical features of a place. They often include text, images, maps, or interactive elements.

NATIVE PLANT PROPAGATION; NURSERY AREAS: Designated spaces used to grow and reproduce local, native plant species, usually from seeds or cuttings to support restoration, conservation, or landscaping projects that aim to preserve the local ecosystem.

NON-OBTRUSIVE TOWER: A structure intended for wildfire detection, environmental monitoring, emergency communication, or similar public safety functions, and is designed to have minimal visual and environmental impact. These towers are typically slender, uninhabited, and constructed using neutral colors or materials that help them blend with the surrounding landscape. They avoid

prominent placement on ridgelines or scenic vistas whenever possible and do not include large equipment shelters or features that would significantly alter the natural character of the site. Lighting is not permitted unless required by state or federal safety regulations

OUTDOOR ~~EDUCACTION~~EDUCATION: Organized programs that provide structured instruction and hands-on learning in outdoor or natural settings, including field studies, environmental science, ecology, outdoor skills, and natural interpretation.

PARKING LOTS (TRAILHEADS OR OPEN-SPACE ACCESS): Surface parking areas intended solely to support public access to trails, parks, or open space areas. These lots shall be minimally sized, use permeable materials where feasible, and be sited to reduce visual and environmental impacts.

PUBLIC PARKS AND RECREATION AREAS WITH LIMITED FACILITIES: Open space areas accessible to the public for passive or low-impact recreation, such as walking, wildlife viewing, or picnicking. May include benches, restrooms, or shade structures, but do not permit large-scale or intensive recreational infrastructure.

REWILDING: The restoration or protection of land and ecosystems to support native species, natural processes, and ecological functions, with minimal ongoing human management.

SLOPE STABILIZATION: Engineering, vegetative, and bioengineering measures to prevent or correct slope failure and erosion, including grading/terracing, soil reinforcement, rockery/riprap, retaining systems, slope drains, and temporary/permanent erosion control BMPs (e.g., silt fence, fiber rolls, hydro-mulch, check dams, sediment basins).

SPECIAL EVENTS OR TEMPORARY USES CONSISTENT WITH OPEN-SPACE VALUES: Short-term activities such as nature walks, educational workshops, cultural gatherings, or community celebrations that promote awareness, stewardship, or enjoyment of open space resources without significant alteration of the site.

TRAIL, BICYCLE (SHARED-USE PATH): A Public Trail or path primarily designed for bicycle travel, typically with a stabilized surface for bicycle traffic. Equestrian and pedestrian use is not allowed unless expressly posted and designed.

TRAIL, EQUESTRIAN: A Public Trail primarily designed, constructed, and maintained for horseback riding. May run parallel to, or be separated from, a Multi-Use Trail. Includes equestrian-specific features such as hitching rails, mounting blocks, manure bins, and trail width/clearance suitable for horses.

TRAIL, MULTI-USE: A Public Trail designed and signed for concurrent use by multiple non-motorized users, typically including hikers, bicyclists, and may include equestrian use where specifically posted and designed. Surfaces may be stabilized.

TRAIL, NATURE/FOOTPATH: A Public Trail intended for pedestrian travel only (hiking, walking, running), typically with a natural surface and minimal improvements to protect sensitive resources. Bicycles and equestrian use are not allowed unless expressly posted and designed.

TRAIL, PUBLIC: A publicly accessible route for travel and recreation located in parks, open space, or easements, designed for pedestrian use and, where signed or improved, may include other

permitted non-motorized users.

TRAIL SPUR (ACCESS SPUR): A short Public Trail segment that provides connection from a trailhead, street, school, park, or neighborhood to a Multi-Use, Bicycle, Equestrian, or Nature/Footpath.

TRAILHEAD: A designated access point to one or more trails that may include parking, restrooms, potable water, signage/maps, staging areas (including equestrian staging), and maintenance access while safeguarding open-space from prohibited access or usage.

WATER DETENTION AND RECHARGE FACILITIES: Infrastructure designed to temporarily capture, hold, and infiltrate stormwater to reduce runoff, prevent erosion, and recharge groundwater. Includes bioswales, retention basins, and percolation ponds designed to integrate with natural systems.

WILDFIRE PUBLIC SAFETY INFRASTRUCTURE: Equipment intended to support wildfire preparedness, detection, and emergency response. This includes, but is not limited to, dedicated firefighting assets (e.g., water storage tanks, staging areas) and emergency communication infrastructure (e.g., public alert systems, emergency sirens, and related systems) necessary to ensure operational readiness during wildfire events.

§ 9142 ALLOWED USES

The following uses are allowed by right in the Open Space (O-S) District:

Conservation and Habitat Restoration Activities, consistent with approved conservation, fuel management, or habitat restoration plans

Grazing, consistent with approved conservation, fuel management, or habitat restoration plans

Fuel Break, consistent with approved conservation, fuel management, or habitat restoration plans

Habitat Corridors and Linkages, consistent with approved conservation, fuel management, or habitat restoration plans

Interpretive signage and Educational Kiosks

Native Plant Propagation Areas

Native Tree Nurseries

Outdoor Education

Rewilding, consistent with approved conservation, fuel management, or habitat restoration plans

Row & Field Crops and Animal Raising – General Agriculture, excluding permanent structures

Slope Stabilization And Erosion Control, consistent with approved conservation, fuel management, or habitat restoration plans

Wildfire Public Safety Infrastructure

§ 9143 PERMITTED USES

The following uses require approval of an appropriate ~~u~~Use P~~p~~ermit pursuant to the provisions contained in Article 20 of this Chapter.

Campground (Open-Space)

Cultural, historical, or archaeological interpretive facilities

Environmental education centers

Habitat banking or mitigation sites

Park and recreation services

Parking lot(s) serving trailheads or open-space recreation areas

Special events or temporary uses consistent with open space purpose and intent

Trail, Bicycle (Shared-Use)

Trail, Equestrian

Trail, Multi-Use

Trail, Nature/Footpath, consistent with approved conservation, fuel management, or habitat restoration plans

Trail, Public

Trail-Spur

Trailhead

Water detention and recharge facilities

§ 9144 HEIGHT LIMITS

A. Primary structures: Maximum height of 25 feet.
B. Accessory structures: Maximum height of 15 feet or height of main building, whichever is less.
C. Improvements:
    1. Non-obtrusive towers and equipment used exclusively for wildfire detection, emergency

communications, or similar public safety purposes may exceed 25 feet. Any such increase would be subject to discretionary review, and must be the minimum necessary for operational effectiveness and designed to reduce visual and environmental impact.

2. Fences or walls: Maximum height of 7 feet, unless consistent with an approved conservation, fuel management or habitat restoration plan, or approved by Use Permit.

§ 9145 SITE AREA

There is no minimum site area for uses in the O-S District; however, development intensity must conform to open space purpose and intent.

§ 9146 SETBACKS

Yard setbacks apply to all new structures, additions, grading, and site improvements, including fences, walls, pavement, and other hardscape features, as conveyed below.

A. Environmental. A minimum 100-foot setback is required from the edge of sensitive environmental resources, including creeks and rivers (measured from the top of bank), wetlands (from the delineated wetland boundary), and mapped sensitive habitat areas.

B. Visual. To minimize visual impacts, development within or near setback areas shall be sited and designed to maintain natural sightlines and reduce visual prominence through building placement, height and massing control, material selection, and landscape screening, with particular attention to ridgelines.

C. Slope. For sloped terrain, additional setbacks from the top of slope and toe of slope are required to avoid excessive grading. Slope percentage shall be measured as average grade over a horizontal distance of at least 25 feet, based on existing (pre-project) topography.

1. On slopes 15% to less than 30%, principal structures and foundations shall be set back a minimum of 10 feet from the top of ridge and 10 feet from the toe of slope.
2. On slopes 30% or greater, new structures and grading to create building pads are prohibited unless the review authority finds that no practicable alternative exists and that a geotechnical report demonstrates stability without increasing erosion risk; where allowed, the minimum top- and toe-of-slope setbacks shall be 30 feet.

D. Yard Setbacks: Any adjacent lot that shares a side or rear lot line with land zoned O-S shall provide a transition yard measured from that line as follows for the following uses:

1. Single Family Residential: Rear 25 feet, side 12 feet;
2. Multifamily: Rear 30 feet, side 15 feet;
3. Non-Residential: Rear 35 feet, side 15 feet.

E. Exception. As part of the applicable Use Permit process, the Zoning Administrator or the Planning Commission may allow encroachments into required setbacks when no practicable alternative exists and the proposed design minimizes both physical and visual disturbance. Findings shall be supported by site-specific analysis, including (as applicable) a geotechnical report, erosion and sediment control plan, and visual analysis.

§ 9147 PARKING

A. For all trailheads and recreation areas the parking requirements shall be one space per ten (10)

average daily visitors. The required number of parking spaces may be adjusted by the Community Development Director through a Determination of Appropriate Use, based on anticipated patterns of use, including but not limited to similar regional facilities; bicycle or pedestrian access requirements; equestrian facilities; educational or group programming; seasonal or event-based usage; proximity to public transit or urbanized areas.

B. Parking surfaces shall be permeable and screened with vegetation, where feasible.

C. No overnight public parking is allowed unless allowed by an issued Special Event or Use ~~permit~~Permit.

D. Other Uses: All other uses are subject to the provisions contained in Article 17 of this Chapter.

§ 9148 ADDITIONAL REQUIREMENTS

A. Resource Protection: Grading or vegetation removal shall only be permitted with approval from the Community Development Director or Public Works Director on an emergency basis when not part of an approved conservation, fuel management or habitat restoration plan.

B. Lighting: Artificial lighting in the Open~~-~~Space District is generally discouraged. Any lighting must be minimal and dark-sky compliant according to International Dark-Sky Association's (IDA) guidelines for outdoor lighting to minimize light pollution.

C. Fencing: For Allowed uses, the use of fencing in the Open~~-~~Space Zoning District is generally discouraged. Any fencing installed ~~used~~ must be wildlife-friendly or implemented to maintain public safety. Fences are prohibited if they would impede wildlife movement within a designated wildlife or habitat corridor, as determined by the City based on substantial evidence.

D. Parking Lot & Recreation Area Landscaping: Landscape plantings in the Open~~-~~Space District must be ~~either~~ native and ~~or~~ drought-tolerant species. Parking and recreation surfacing shall be permeable except where infeasible for compliance with the Americans with Disabilities Act or to serve emergency access.

E. Requirements for Special Events: Events in the Open~~-~~Space District must be consistent with the purpose of the zoning district set forth in this Article and shall not significantly degrade natural resources or impair public enjoyment of the area. All events require prior approval through a Use Permit~~use permit~~.

§ 9149 DETERMINATION OF APPROPRIATE USE

Whenever a use is not listed in this Article as a used allowed by right or a use subject to a Use Permit ~~use permit~~ in the O-S Zoning District, the Community Development Director shall determine whether the use is appropriate for the Zoning District, either as of right or subject to a Use Permit~~use permit~~. In making this determination, the Planning Director shall find as follows:

A. That the use would not be incompatible with other existing or allowed uses in the O-S Zoning District.

B. That the use would not be detrimental to the continuing preservation of resources or access to the area in which the use would be located.

C. That the use involves a similar scale and impact to uses that are designated allowed uses in this Article.

D. That the use is consistent with the purpose and intent of the Open-Space Zoning District, including the protection of natural resources, scenic values, and the long-term preservation of open space for public or ecological benefit.

E. In the case of determining that a use not listed in this Article as an allowed or permitted use could be established with the securing of a ~~use~~ Use ~~permit~~Permit, the Community Development Director shall find that the proposed use is similar in nature and intensity to the uses listed as permitted uses. All determinations of the Community Development Director regarding whether a use can be allowed or permitted in the Open- Space Zoning District shall be final unless a written appeal to the City Council, stating the reasons for the appeal, and the appeal fee, if any, established from time to time by City Council resolution, is filed with the City Clerk within ten (10) days of the date the decision was made. Appeals may be filed by an applicant or any interested party. The City Council shall conduct a duly noticed public hearing on the appeal in accordance with the applicable procedures as set forth in this Chapter. At the close of the public hearing, the City Council may affirm, reverse, revise or modify the appealed decision of the ~~Open-Space District~~Community Development Director. All City Council decisions on appeals of the Director's actions are final for the City.

SECTION THREE.

1. Publication: Within fifteen (15) days after its adoption, this Ordinance shall be published once in a newspaper of general circulation in the City of Ukiah. In lieu of publishing the full text of the Ordinance, the City may publish a summary of the Ordinance once 5 days prior to its adoption and again within fifteen (15) days after its adoption.

2. Effective Date: The ordinance shall become effective thirty (30) days after its adoption.

3. Severability: If any section, subsection, subdivision, paragraph, sentence, clause or phrase of this Ordinance, or its application to any person or circumstance, is for any reason held to be invalid or unenforceable, such invalidity or unenforceability shall not affect the validity or enforceability of the remaining sections, subsections, subdivisions, paragraphs, sentences, clauses or phrases of this Ordinance, or its application to any other person or circumstance. The City Council of the City of Ukiah hereby declares that it would have adopted each section, subsection, subdivision, paragraph, sentence, clause or phrase hereof, irrespective of the fact that any one or more other sections, subsections, subdivisions, paragraphs, sentences, clauses or phrases hereof be declared invalid or unenforceable.

Introduced by title only on , 2025, by the following roll call vote:

AYES:
NOES:
ABSENT:
ABSTAIN:

Adopted on , 2025, by the following roll call vote:

AYES:
NOES:
ABSENT:
ABSTAIN:

Douglas F. Crane, Mayor

ATTEST:

Kristine Lawler, CMC/City Clerk

City of Ukiah

COMMUNITY DEVELOPMENT DEPARTMENT

Draft Findings of Consistency:

Open Space Zoning Ordinance

CEQA Section 15183 Statutory Exemption

October 22, 2025

SCH No: XXXXXXXXXX

Prepared by:

City of Ukiah

Community Development Department

Planning Division

300 Seminary Avenue, Ukiah, CA 95482

www.cityofukiah.com/community-development/planning-services/

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I. PROJECT INFORMATION

Project Title: Ordinance of the City Council of the City of Ukiah Adding a New Article 11.5 to Division 9, Chapter 2 to Establish and Regulate the Open Space (O-S) Zoning District
Lead Agency Address and Phone Number: City of Ukiah Community Development Department 300 Seminary Avenue Ukiah, California 95482
CEQA Contact Person and Phone Number: Katherine Schaefers, Planning Manager City of Ukiah, Community Development Department (707) 463-6203 KSchaefers@cityofukiah.com
Applicant: City of Ukiah
Property Owner: City of Ukiah
Project Location: City-wide within the Open Space (O-S) Zoning District
General Plan Designation: Those designations listed as compatible with the proposed O-S Zoning District, including: Public (P), Recreational (REC), Open Space (OS), Agriculture (AG)
Zoning Designation: Open Space (O-S) - Proposed

II. INTRODUCTION

1. Purpose of the CEQA Guidelines Section 15183 Findings of Consistency

California Public Resources Code section 21083.3 and California Environmental Quality Act (CEQA) Guidelines Section 15183 provide an exemption from additional environmental review for projects that are consistent with the development density established by existing zoning, community plan or general plan policies for which an Environmental Impact Report (EIR) was certified, except as might be necessary to examine whether there are project-specific significant effects which are peculiar to the project or its site.

Section 15183 specifies that examination of environmental effects shall be limited to those effects that:

(1) Are peculiar to the project or the parcel on which the project would be located, and were not analyzed as significant effects in a prior EIR on the zoning action, general plan, or community plan, with which the project is consistent,
(2) Are potentially significant off-site impacts and cumulative impacts which were not discussed in the prior EIR prepared for the general plan, community plan or zoning action, or
(3) Are previously identified significant effects which, as a result of substantial new information which was not known at the time the EIR was certified, are determined to have a more severe adverse impact than discussed in the prior EIR.

Since the adoption of a zoning ordinance is considered a discretionary action and a "Project" under CEQA Guidelines Section 15378, the application of Section 15183 is appropriate for this legislative action. This section limits the examination of environmental effects to those effects that are peculiar to the project or its site, or which the prior EIR failed to analyze.

2. Ukiah 2040 General Plan EIR

The Ukiah 2040 General Plan and its associated EIR (SCH# 2022050556) were certified in December 2022. The General Plan designates land uses defining the type and amount of development that can occur throughout the City and proposed annexation areas through the planning horizon year of 2040 (over approximately 18 years). The EIR serves as the foundational environmental document for subsequent projects and implementing ordinances, such as the proposed Open Space Zoning District. The adoption of the O-S Ordinance is consistent with the goals and policies of the General Plan and can therefore utilize this prior environmental analysis for tiering and streamlining purposes.

III. PROJECT DESCRIPTION

1. Project Purpose

The Open Space (O-S) Zoning District Ordinance establishes a regulatory mechanism to implement the open space conservation goals of the Ukiah 2040 General Plan. The purpose of the O-S district is to conserve natural resources, preserve ecological systems, protect scenic

and cultural landscapes, and provide opportunities for passive recreation and public access where appropriate.

The ordinance addresses the following core goals and policies of the Ukiah 2040 General Plan:

- **Goal ENV-1:** To preserve open space lands for natural resource protection, recreation, scenic enjoyment, and hazard avoidance.
- **Policy ENV-6.7 and Policy LU-6.3:** By providing a regulatory mechanism to identify, preserve, and manage creek corridors, hillsides, and ridgelines for trails, wildlife habitat, and public access.
- **Action Item ENV-1.2(C):** By establishing allowances ensuring compatibility with long-term land conservation and watershed management objectives, specifically referencing the Western Hills Watershed Protection Area Management Plan (2024).
- **Government Code Compliance:** The ordinance fulfills the intent of state law (Government Code Sections 65302 and 65560–65570) requiring the City to adopt measures to implement the Open Space and Conservation Elements of the General Plan.

2. Environmental Setting and Project Location

The City of Ukiah is located in the Ukiah Valley, a region defined by a mix of urban development, agricultural lands, and undeveloped natural areas. Open space, meaning land or water areas that remain largely unimproved and support ecological, recreational, or scenic values, is an important component of the broader landscape. The Ukiah Valley includes significant areas of hillside, riparian corridors, and rural lands that contribute to the environmental and visual character of the region.

Within the city limits, the City of Ukiah owns and manages a range of park and recreation facilities totaling approximately 260 acres. These include neighborhood and community parks, as well as Low Gap Park, an 80-acre open space area owned by Mendocino County. Low Gap Park features an existing network of trails that extend into the hills west of the city and support passive recreation uses. Additional regional open space areas within the City's planning sphere include Mill Creek Park (400 acres), Lake Mendocino Recreation Area (5,110 acres), and Cow Mountain Recreation Area (60,000 acres). These regional open space areas are managed by the County of Mendocino, or Federal entities, such as the U.S. Army Corps of Engineers, or the Bureau of Land Management. The Russian River also provides recreational opportunities for Ukiah residents, with public access available at four locations within or near city limits: the City Softball Complex, Vichy Springs Road crossing, Riverside Park, and the Talmage Road crossing.

The City’s existing holdings help to preserve the valley’s natural features and ecological health. These lands include oak woodlands, hillside areas, and riparian corridors that provide important wildlife habitat and natural space for residents. While some areas are open to the public, others feature restricted access or lack formal infrastructure. Recent acquisitions such as the City-Owned Annexation (2023) and the Western Hills Annexation (2024) have expanded the City’s open space inventory and provide future opportunities for preservation and management. These

areas contribute to long-range goals for viewshed protection, wildfire risk reduction, and public recreation. While these lands currently function as open space, they are designated Public (P) in the General Plan and zoned Public Facilities (PF) in the zoning code.

With the adoption of the Ukiah 2040 General Plan, the City established a new Open Space land use designation. This designation applies to lands that are unsuitable for development due to environmental constraints such as slope instability, fire hazard, poor access, or flood risk, or that are otherwise considered most valuable in their undeveloped state. Typical areas include creek corridors, hillsides, and ridgelines. The Open Space designation is intended to ensure the long-term protection of these areas for ecological, recreational, or scenic purposes.

At present, the City's zoning code does not include a corresponding Open Space zoning district. As a result, lands designated as Open Space in the General Plan cannot be zoned in a manner consistent with the intended use. This ordinance would enable implementation of the General Plan by providing a regulatory framework for the management, use, and protection of designated open space lands. Although the ordinance applies citywide, it would initially affect a limited number of parcels owned or controlled by the City. Future rezonings to apply the O-S district to other properties would be subject to separate discretionary review and environmental evaluation, as applicable.

IV. EVALUATION OF ENVIRONMENTAL EFFECTS

The following evaluation determines whether the proposed O-S Zoning Ordinance qualifies for streamlined review pursuant to CEQA Guidelines Section 15183 by evaluating the three mandatory findings (Density, Project-Specific Effects, and Unanalyzed Impacts) required by the guidelines.

1. Density

Finding: The proposed Open Space Zoning Ordinance is consistent with the development density established by the Ukiah 2040 General Plan policies for which an EIR was certified.

Discussion: The Open Space (OS) designation in the Ukiah 2040 General Plan explicitly establishes the density and intensity as N/A (not applicable) for both Minimum/Maximum Density (dwelling units per acre) and Floor Area Ratio. The designation is intended to identify lands that are to remain undeveloped due to environmental constraints or conservation value. The O-S Zoning District is designed specifically to enforce this intent, conserving natural resources and restricting development.

The limited allowed uses in the O-S district, such as public trails, conservation and habitat restoration activities, and native plant propagation areas, are inherently low-intensity and non-residential. These uses fully conform to and support the General Plan's designated density of N/A, thereby maintaining consistency with the General Plan and meeting the requirements of CEQA Guidelines Section 15183.

2. Project-Specific Effects Peculiar to the Project or its Site

Finding: There are no project-specific environmental effects which are peculiar to the adoption of the O-S Zoning Ordinance or to its sites, and which the Ukiah 2040 EIR failed to analyze as significant effects.

Discussion: The O-S Ordinance is a regulatory measure whose primary effect is environmental preservation and protection of sensitive lands. The General Plan EIR inherently analyzed the impacts associated with the lack of development in Open Space areas and established policies (e.g., Goal ENV-1, Policy LU-6.2, Goal ENV-6) intended to minimize impacts on scenic vistas, hillsides, and riparian habitats.

The O-S Zoning Ordinance directly implements these protective goals, such as safeguarding creek corridors and managing open space resources. Since the ordinance focuses on conservation, it reinforces the environmental baselines assumed in the EIR. Any future development activities permitted by the ordinance (e.g., public trails or habitat restoration) would be site-specific projects requiring subsequent environmental documentation (such as an Initial Study or site-specific environmental review) to ensure compliance with the EIR and identify any peculiar, site-specific effects. The adoption of the ordinance itself, being a consistent and protective regulatory act, does not introduce new environmental effects peculiar to the parcels that were not already contemplated under the General Plan's land use designation.

3. Significant Impacts Not Analyzed in the Prior EIR

Finding: There are no project-specific impacts which the Ukiah 2040 EIR failed to analyze as significant effects.

Discussion: The EIR certified for the Ukiah 2040 General Plan is a program-level document that analyzed the cumulative and regional impacts of land use patterns, including policies designed to manage and protect natural resources and prevent land use conflicts. The O-S Ordinance is an implementing measure that strictly adheres to the land use assumptions of the General Plan EIR and furthers its protective policies, such as:

- **Minimizing Land Use Incompatibilities:** The ordinance reduces the potential for urban/resource conflicts by restricting development in environmentally sensitive areas, aligning with Policy LU-7.1 and Goal AG-1.
- **Preservation of Resources:** By protecting creek corridors, hillsides, and habitat (Policies ENV-6.7/LU-6.3), the ordinance reduces the possibility of significant impacts on biological resources, aesthetic resources, and water quality, which are all issues analyzed in the GP EIR.

Because the ordinance restricts development and solidifies environmental preservation, it results in impacts that are either equivalent to or less severe than those anticipated and analyzed in the certified EIR, and therefore introduces no unanalyzed significant impacts.

4. Cumulative Impacts

Finding: There are no potentially significant offsite and/or cumulative impacts that the Ukiah 2040 EIR failed to evaluate.

Discussion: The O-S Ordinance is a component of a larger City strategy aimed at achieving sustainable growth by prioritizing infill development and preserving surrounding open space and agricultural resources (Policy LU-7.1). The establishment of this zoning district contributes positively to the regional environmental and cumulative land use context by providing legal permanency to the protection of ecological systems, scenic areas, and hazard avoidance areas. The cumulative impacts of development within the City limits, coupled with resource preservation strategies, were addressed in the certified EIR. The O-S Ordinance supports the cumulative goal of long-term sustainability of the region's resources.

5. New Information

Finding: There is no substantial new information that results in more severe environmental impacts than anticipated by the Ukiah 2040 EIR.

Discussion: No substantial new information has been identified demonstrating that the proposed regulatory adoption of the O-S Zoning District would result in more severe impacts than those disclosed in the EIR. The ordinance is consistent with the established General Plan density and land use policy directives. The purpose of the O-S district is to mitigate the hazards inherent to these lands and conserve resources. This function prevents the environmental baseline conditions (which supported the EIR's findings) from being undermined by incompatible development.

V. DETERMINATION

In accordance with CEQA Guidelines Section 15183, the City Council finds that the proposed Open Space (O-S) Zoning District Ordinance qualifies for streamlined environmental review because the following conditions are met:

1. The project (adoption of the O-S Zoning Ordinance) is consistent with the development density (N/A) established by the Ukiah 2040 General Plan policies for which an EIR was certified.
2. There are no project-specific effects peculiar to the regulatory action or its general site, and which the Ukiah 2040 EIR failed to analyze as significant effects.
3. No specific parcels are being rezoned by this action, and no real property is being affected. If rezoning is proposed for any parcel in the future, a site-specific review will be conducted to evaluate the environmental impacts of applying the O-S zoning district to that property.
4. There are no project-specific impacts which the Ukiah 2040 EIR failed to analyze as significant effects.

Therefore, the City Council relies upon the EIR previously certified for the Ukiah 2040 General Plan, and further CEQA review is limited pursuant to CEQA Guidelines Section 15183 and Public Resources Code Section 21083.3.

Agenda Item No: 8.b.

MEETING DATE/TIME: 11/19/2025

ITEM NO: 2025-1270

City of Ukiah

AGENDA SUMMARY REPORT

SUBJECT: Adoption of an Ordinance Prezoning 1 Carousel Lane (APN 167-280-15) to the Public Facilities (PF) Zoning District for Future Use by the City of Ukiah as its Municipal Corporation Yard Following Annexation into the City's Jurisdiction.

DEPARTMENT: Community Development

PREPARED BY: Jesse Davis, Chief Planning Manager

PRESENTER: Jesse Davis, Chief Planning Manager

ATTACHMENTS:

1. Planning Commission Resolution #25-04 (Signed)
2. Prezoning Ordinance
3. City Council Resolution #25-54 (Signed)
4. Draft CEQA NOE - 1 Carousel Lane Annexation
5. Maps - 1 Carousel Lane Annexation_10.27.jd3 (1)

Summary: Council will consider adoption of an Ordinance prezoning 1 Carousel Lane (APN 167-280-15) to the Public Facilities (PF) Zoning District for future use by the City of Ukiah as its municipal Corporation Yard following annexation into the City's jurisdiction.

Background: On January 16, 2020, the City Council adopted the City's Annexation Policy (Resolution No. 2020-06), which directs the City to pursue, apply for, and support annexations to limit urban sprawl and to ensure efficient delivery of municipal services without undue financial burden on residents. The City's long-range framework was further advanced with adoption of the 2040 General Plan on December 7, 2022, and adoption of the 2022 Municipal Service Review and Sphere of Influence on December 19, 2022. These documents support annexation of unincorporated parcels to facilitate orderly growth and provision of municipal services.

The City has successfully implemented this policy through recent annexations. On September 11, 2023, Mendocino LAFCo approved annexation A-2021-01, which annexed 16 City-owned parcels totaling approximately 450 acres. These sites were acquired by the City for public purposes beginning with the former Ukiah Landfill in 1955. In the Western Hills of the Ukiah Valley, the City annexed 27 assessor parcels totaling approximately 791 acres, of which the majority of parcels are City-owned. That annexation supported open space preservation, public access, and limited residential development consistent with City policies.

In 2022, to fund the replacement of municipal facilities and associated city street improvements, the City issued approximately $15 million in Lease Revenue Bonds. The existing Corporation Yard is located on the east side of the Ukiah Municipal Airport. The City has outgrown the site, which also features antiquated facilities, and no longer meets the operational needs for Fleet and Plant Maintenance, Street Maintenance, Water/Wastewater Maintenance, and formerly the Electric Utility Department. Additionally, the location was increasingly incompatible with Ukiah Municipal Airport operations as the Airport seeks to attract new tenants and services, and integrate the Airport with the commercial uses located along Airport Park Boulevard.

After evaluating alternative sites for a new Corporation Yard, including new construction opportunities which initial estimates showed to be cost-prohibitive, the City identified the purchase of 1 Carousel Lane as the most

viable option for replacement of its existing Municipal Corporation Yard. In May 2025, the City acquired 1 Carousel Lane (APN 167-280-15), to serve as the new Municipal Corporation Yard, which functions as the central operations and maintenance hub for the City's Department of Public Works and related public utilities. The acquisition advances the City's plan to modernize infrastructure and improve service delivery and efficiency in coordination with regional partners, including water and sanitation providers.

Although the property at 1 Carousel Lane is located outside city limits, it lies within the Ukiah Valley Water Authority (UVWA) service area, a Joint Powers Authority that includes the City of Ukiah, Millview County Water District, Redwood Valley County Water District, Calpella County Water District, and Willow County Water District. This regional joint-powers approach is intended to improve coordination, modernize water infrastructure, and enhance long-term water reliability. The City is able to annex non-contiguous territory as a "City-owned island" under Government Code § 56742, as this property is within the City's previously adopted Sphere of Influence (2022).

Per the Phase I Environmental Site Assessment (ESA) performed by EBA Engineering (EBA), the property is described as such:

The project site contains a single commercial structure that is approximately 98,000 square feet in size and generally segregated into three units, herein described as Suites 1A, 1B, and 1C. The structure was reportedly built in three phases over several decades starting in 1969. The structure consists of a steel framed building with steel siding and roof and there is no wall separating Suites A and 1B. A concrete slab on grade floor extends throughout the structure. Most of the structure is open warehouse…Areas of the subject property not covered with the site buildings consist primarily of asphalt surfaces used for employee and customer parking and [Distribution Center] shipping and receiving trucks. A fenced gravel parking area is present on the eastern side of the subject property that is used for parking trucks by the [Distribution Center].

As required by the applicable Government Code provisions, the parcel is under 300 acres, lies in the same county as the City, is owned by the City, and is to be used for municipal purposes, i.e. as the Corporation Yard. Because the site meets all statutory criteria, the Mendocino Local Agency Formation Commission (LAFCo) may approve annexation notwithstanding non-contiguity; Staff also acknowledges the limitations in Government Code § 56742(c) regarding subsequent non-contiguous annexations of property not owned or used by the City.

Following the Planning Commission's approval of the draft Resolution supporting the prezoning of the parcel to Public Facilities at its October 8, 2025, meeting (Attachment 1), Staff prepared the approved materials for City Council consideration, including the Prezoning Ordinance (Attachment 2) and Resolution of Application (Attachment 3), as well as an updated CEQA Notice of Exemption (Attachment 4). Included in the Resolution of Application is the City's required Plan for Service, in accordance with California Government Code § 56653.

At the conclusion of the public hearing at their regular meeting on November 5, 2025, the Council unanimously (5-0) approved the introduction of the Ordinance (Attachment 2), and adopted the resolution of application (Attachment 3) to submit a formal request to Mendocino LAFCo for annexation proceedings.

Discussion: This request is a City-initiated prezoning to assign a City zoning classification to land that is outside City limits, with the classification becoming effective on the date of annexation. California Government Code § 65859 authorizes a city to prezone unincorporated territory by ordinance after public notice and hearing. The Planning Commission holds a hearing and makes a recommendation, and the City Council then adopts the prezoning ordinance. Government Code § 56742 directs LAFCo to consider the adopted prezoning when acting on an annexation.

Prezoning does not annex the property, does not authorize new development, and does not grant entitlements. It sets the zoning that will automatically apply to the property once LAFCo records the Certificate of Completion and recognizes the annexation. For 1 Carousel Lane, the City will prezone the parcel to Public Facilities (PF) and apply the General Plan Public (P) designation for consistency. Included in Attachment 5 are the official prezoning and land use designation maps, along with their associated regulations. Processing of

the application is conducted under Government Code §§ 56742 and 65859 and the procedures and district standards in the Ukiah City Code, particularly Section 9267.

Site Description:The subject property is in unincorporated Mendocino County, north of the City of Ukiah limits, in an area with a mix of commercial, residential, and industrial uses. It consists of one (1) industrially developed parcel of about 7.9 acres with access from Carousel Lane, a private road. As indicated in the maps within Attachment 5, the site was originally developed in the late 1970s. Topography is generally flat, with an average elevation of about 628 feet above mean sea level. The property is bordered by York Creek to the north, the Russian River to the east, North State Street to the west, and Carousel Lane and adjacent commercial uses to the south.The site address is 1 Carousel Lane, Ukiah, California, APN 167-280-15. The parcel is developed with an approximately 98,000-square foot warehouse configured as three suites. Suites 1A and 1B are planned for City use as the Municipal Corporation Yard, including fleet and equipment maintenance, parts and materials storage, water and wastewater maintenance shops, staging, and administrative support. Suite 1C is utilized as a commercial warehouse-distribution center that conducts indoor package handling with truck loading and unloading via Carousel Lane. Operations are predominantly indoors with typical receiving and shipping and limited outdoor staging. No heavy manufacturing or high nuisance processes are present or proposed.

The subject property is indicated to have been developed as a commercial property with construction of the initial phase of the site building by Carousel Carpet Mill in 1969 which operated at the site until 2010. The building subsequently underwent two expansions in 1981 and 1989 and has been occupied by several commercial tenants to the present day. While initially developed with a septic system, the site is now connected to the Ukiah Valley Sanitation District (UVSD).

Surrounding Land Use and Zoning: The surrounding area is primarily light industrial and commercial, but features a variety of nearby residential uses as well. Common activities nearby include warehousing and logistics, wholesale and distribution, contractor supply and small contractor yards, equipment service and rental, and small fabrication or repair shops typical of the County Limited Industrial (I1) district. Industrial traffic primarily uses North State Street, which provides efficient access to U.S. 101. Buildings are generally single story with paved yards and designated loading areas. Outdoor storage, where it occurs in proximity, is limited and typically tied to distribution or contractor operations.

Staff Analysis: Prezoning assigns a City zoning classification to unincorporated land, and City standards will automatically apply if and when annexation occurs. For this site, the Public Facilities (PF) zoning district is paired with the General Plan Public (P) designation to match its municipal function.

A Municipal Corporation Yard is a public facility use that fits the Public (P) designation in the 2040 General Plan. The PF district implements that designation by allowing corporation yards and related maintenance, storage, and administrative activities. The existing warehouse layout and circulation are suitable for these functions. The FedEx operation in Suite 1C may continue within or alongside the PF district, subject to PF regulations and any applicable conditional use or nonconforming provisions. This prezoning and the anticipated annexation do not add floor area, authorize new uses, or change occupancy from current conditions as it pertains to Suite 1C and related operations. Any private commercial activity operating within Suite 1C shall be required to comply with all applicable City regulations and established business standards.

Improvements to the parcel will be limited to essential facility adjustments, including life-safety and ADA upgrades, compliance with materials storage requirements, security and lighting enhancements, and interior build-outs necessary to accommodate municipal operations. These modifications do not represent a substantive intensification or alteration of land use but rather ensure the facility’s safe and effective operation as a public facility.

Although open space and agricultural lands occur in the general vicinity of the subject parcel, physical buffers such as North State Street, U.S. 101, York Creek and the Russian River corridor separate the site from potential agricultural operations. The nearest designated agricultural lands are located approximately 1,400

feet west of the project site, across U.S. 101, and are currently under a Type 1 Williamson Act contract. The subject parcel itself is not subject to Williamson Act restrictions.

CEQA: Staff has reviewed the project and determined that it is exempt from CEQA under Guidelines § 15319, Class 19(a). The parcel is approximately 7.87 acres and is already developed with about 98,000 square feet of commercial and industrial floor area, including City municipal corporation yard functions and space leased to private tenants. The site is already served by public utilities, and no extension or expansion of service capacity is proposed. The prezoning is consistent with the City's General Plan and authorized pursuant to Government Code §§ 56742 and 65859 to ensure that City zoning applies upon annexation. Because the action is procedural and does not trigger physical changes, no environmental impacts will result, and the project qualifies for the Class 19(a) exemption.

Staff recommends Council adopt the Ordinance prezoning 1 Carousel Lane (APN 167-280-15) to the Public Facilities (PF) Zoning District for future use by the City of Ukiah as its municipal Corporation Yard following annexation into the City's jurisdiction.

Recommended Action: Adopt an Ordinance prezoning 1 Carousel Lane (APN 167-280-15) to the Public Facilities (PF) Zoning District for future use by the City of Ukiah as its municipal Corporation Yard following annexation into the City's jurisdiction.

BUDGET AMENDMENT REQUIRED: N/A

CURRENT BUDGET AMOUNT: N/A

PROPOSED BUDGET AMOUNT: $7,000

FINANCING SOURCE: 20012200.52304

REVENUE: No **GRANT:** No

PREVIOUS CONTRACT/PURCHASE ORDER NO.:

COORDINATED WITH: Darcy Vaughn, Assistant City Attorney; Maya Simerson, Project and Grant Administrator

STRATEGIC PLAN (SP): N/A

CLIMATE INITIATIVES (CI):CI-5b – Protect against sprawl through completion of annexations

GENERAL PLAN ELEMENTS (GP): PFS-1 (Water); PFS - 2 (Service Delivery); PFS -7 (Infrastructure)

Approved: 
Sage Sangiacomo, City Manager

RESOLUTION NO. 2025-04

RESOLUTION OF THE PLANNING COMMISSION OF THE CITY OF UKIAH RECOMMENDING THAT THE CITY COUNCIL PREZONE 1 CAROUSEL LANE (APN 167-280-15) TO PUBLIC FACILITIES (PF) WITH A GENERAL PLAN PUBLIC (P) DESIGNATION FOR USE AS A MUNICIPAL COPRORATION YARD

WHEREAS, on January 16, 2020, the Ukiah City Council adopted an Annexation Policy (Resolution No. 2020-06) directing the City to pursue, apply for, and support annexations to avoid the negative consequences of continued urban sprawl and to ensure the efficient provision of municipal services without placing an undue financial burden on the City or its residents; and

WHEREAS, on December 7, 2022, the City Council adopted the 2040 General Plan and certified the associated Program Environmental Impact Report, and on December 19, 2022, the City's Municipal Service Review and Sphere of Influence were adopted, which together support orderly annexation of unincorporated parcels to provide logical boundaries and efficient service delivery; and

WHEREAS, on September 11, 2023, at a regular meeting, the Mendocino Local Agency Formation Commission approved the City of Ukiah's annexation request identified as LAFCo File No. A-2021-01 for City-owned parcels in unincorporated Mendocino County; and

WHEREAS, on November 4, 2024, the Mendocino Local Agency Formation Commission voted unanimously to approve the City of Ukiah annexation of 27 assessor parcels totaling approximately 791 acres, of which about 732 acres are City-owned, and a Sphere of Influence amendment for one parcel, APN 003-190-11, in the Western Hills of the Ukiah Valley for open space preservation, public access, and limited residential development; and

WHEREAS, California Government Code Sections 65859 and 56742 and Ukiah Municipal Code Section 9267 authorize the City to prezone unincorporated territory adjoining the City so that the City's zoning will apply automatically if and when annexation is approved and completed; and

WHEREAS, the subject property located at 1 Carousel Lane, Ukiah, California, identified as Assessor's Parcel Number 167-280-15, consists of one developed parcel of approximately 7.87 acres improved with an industrial/commercial building of about 98,000 square feet configured as three suites, with Suites 1A and 1B planned for City Municipal Corporation Yard functions and Suite 1C occupied by a warehouse distribution use; and

WHEREAS, on May 7, 2025, the City Council approved the purchase of 1 Carousel Lane (APN 167-280-15); the sale closed on June 30, 2025, and the City took title to the property; and

WHEREAS, the City acquired 1 Carousel Lane to serve as the Municipal Corporation Yard, the central operations and maintenance hub for the City's Public Works Department and utilities; and

WHEREAS, the site is already served by public utilities, and no expansion of service capacity is proposed as part of this action; and

WHEREAS, the City proposes to prezone the subject property to the Public Facilities (PF) zoning district and to apply the General Plan Public (P) land use designation pursuant to Ukiah Municipal Code Chapter 2, Zoning, Article 15, so that City land use policies and regulations will apply upon annexation; and

WHEREAS, the Mendocino Local Agency Formation Commission is the independent agency with jurisdiction to review and act on proposed annexations pursuant to the Cortese-Knox-Hertzberg Local Government Reorganization Act, and the City intends to advance an annexation proposal for the subject property to Mendocino LAFCo following City Council action on prezoning; and

WHEREAS, on June 19, 2024, the City Council adopted Resolution No. 2024-32 approving the Mendocino County Master Tax Sharing Agreement among the County and the cities, which allows separate agreements for particular annexations, and for this City-owned municipal facility the City anticipates coordinating a separate tax-sharing agreement with the County that will not alter rights or obligations of non-party agencies; and

WHEREAS, the City, acting as Lead Agency under the California Environmental Quality Act, has determined that the prezoning and related annexation of the subject property are categorically exempt from environmental review pursuant to CEQA Guidelines Section 15319, Class 19(a), because the property is already developed with existing facilities and the action does not authorize new construction, change in occupancy, or intensification of use; and

WHEREAS, on October 8, 2025, the Planning Commission held a duly noticed public hearing on the proposed prezoning, considered the staff report and all public testimony, and closed the public hearing.

NOW, THEREFORE, BE IT RESOLVED by the Planning Commission of the City of Ukiah as follows:

Section 1. CEQA. The Planning Commission finds that the prezoning is exempt from CEQA under Guidelines Section 15319, Class 19(a) for annexations of existing facilities and lots for exempt facilities. The Commission recommends that the City Council adopt this finding and direct filing of a Notice of Exemption.

Section 2. Recommendation on Prezoning. The Planning Commission recommends that the City Council adopt an ordinance prezoning 1 Carousel Lane (APN 167-280-15) to Public Facilities (PF) and applying the General Plan Public (P) land use designation, to take effect upon annexation in accordance with Government Code Section 65859.

Section 3. LAFCo Transmittal. The Planning Commission recommends that the City Council direct staff to transmit the adopted prezoning to Mendocino LAFCo pursuant to Government Code Section 56742 and to advance annexation processing for the subject property, including coordination with the County on a separate tax-sharing agreement as appropriate.

Section 4. Findings. Based on the entire record, the Planning Commission finds and determines that:

A. The prezoning is consistent with Government Code Section 65859 and Ukiah Municipal Code Section 9267. Processed per UMC §9267 and Gov. Code §§65859, 56742. Public notice for both hearings was published and mailed to owners within 300 feet using the current County roll;

the Planning Commission held a duly noticed hearing and made a recommendation, and the City Council will hold its duly noticed hearing. The prezoning ordinance will take effect upon annexation per UMC §9267(C).

B. The prezoning is consistent with the City's 2040 General Plan and implements the Public (P) designation through the PF district, which accommodates Municipal Corporation Yard functions and related public facility uses. The action aligns zoning with the site's existing use and ownership and does not depend on annexation to validate current operations.

C. The prezoning will not be detrimental to the public interest, health, safety, convenience, or welfare. It aligns zoning with existing municipal ownership and operations and does not authorize new development or intensify use.

D. The action is exempt from CEQA pursuant to Guidelines Section 15319, Class 19(a), because the site is fully developed and no physical changes or expansion of service capacity are proposed.

PASSED AND ADOPTED at a regular meeting of the Planning Commission of the City of Ukiah on this 8th day of October, 2025, by the following roll call vote:

AYES: Commissioners Brown, Montano, Johnson, Hilliker, and Chair de Grassi
NOES: None
ABSENT: None
ABSTAIN: None

Alex De Grassi, Chair
City of Ukiah Planning Commission 10-8-2025

ATTEST:

Kristine Lawler, CMC
City Clerk

ORDINANCE NO. ___

ORDINANCE OF THE CITY COUNCIL OF THE CITY OF UKIAH PREZONING 1 CAROUSEL LANE (APN 167-280-15) TO PUBLIC FACILITIES (PF) WITH A GENERAL PLAN DESIGNATION OF PUBLIC (P) IN ANTICIPATION OF THE "CITY OF UKIAH – CORPORATION YARD ANNEXATION"

The City Council of the City of Ukiah hereby ordains as follows:

SECTION ONE – FINDINGS

1. On December 7, 2022, the City Council adopted the Ukiah 2040 General Plan and certified the related Program Environmental Impact Report (SCH # 2022050556). On December 19, 2022, the Council adopted the Municipal Service Review and Sphere of Influence Update.

2. On June 19, 2024, the City Council adopted Resolution No. 2024-32, approving participation in the Mendocino County Master Tax Sharing Agreement (MTSA). The MTSA does not preclude one or more of the Parties from entering separate agreements regarding particular Annexations; provided, however, that nothing in any separate agreement shall affect the rights and obligations of cities not party to that separate agreement.

3. California Government Code §§ 65859 and 56742, and Ukiah City Code § 9267, authorize the City to prezone unincorporated territory so that City zoning will apply upon annexation.

4. The subject property at 1 Carousel Lane, Ukiah (APN 167-280-15), comprises approximately 7.87 acres and is developed with a 98,000-square-foot industrial/commercial building configured as three suites. Suites 1A and 1B are intended for Corporation Yard functions, while Suite 1C is currently occupied by an existing warehouse/distribution tenant.

5. On May 7, 2025, the City Council approved purchase of the subject property, with the sale closing on June 30, 2025.

6. The City proposes to prezone the property to Public Facilities (PF) and assign the Public (P) General Plan land use designation. The Planning Commission held a duly noticed public hearing on October 8, 2025, considered staff reports and public testimony, and adopted Planning Commission Resolution No. 2025-04 recommending adoption of this Ordinance.

SECTION TWO – PURPOSE AND INTENT.

The property at 1 Carousel Lane (APN 167-280-15), as depicted in Exhibit A, is prezoned to Public Facilities (PF) and assigned the Public (P) General Plan designation. This prezoning shall become operative only upon annexation, in accordance with Government Code § 65859 and Ukiah City Code § 9267. The purpose of this Ordinance is to prezone the subject parcel for municipal use, ensuring that the proposed zoning designation is consistent with the City's General Plan and the property's intended municipal use as a Corporation Yard.

SECTION THREE - CEQA FINDINGS

The City Council, acting as the Lead Agency under the California Environmental Quality Act ("CEQA") (Pub. Res. Code § 21000 et seq.; 14 Cal. Code Regs. § 15000 et seq.), hereby finds and determines, based on the whole of the administrative record, that the prezoning is categorically exempt from CEQA pursuant to CEQA Guidelines § 15319(a) (Class 19: Annexations of Existing Facilities and Lots for Exempt Facilities). The subject property is fully developed, and the action entails no new development. A Notice of Exemption has been prepared in accordance with CEQA Guidelines § 15062 and is attached hereto as Exhibit B.

SECTION FOUR. PUBLICATION AND EFFECTIVE DATE

Publication. Within thirty (30) days after its adoption, the City Clerk shall cause this Ordinance to be published in accordance with Government Code § 36933.

Effective and Operative Dates. This Ordinance shall take effect thirty (30) days after its adoption but shall become operative only upon the date that the Mendocino LAFCo Executive Officer issues a Certificate of Completion for the "City of Ukiah – Corporation Yard Annexation."

INTRODUCED by title only at a regular meeting of the City Council of the City of Ukiah on November 5, 2025, by the following roll call vote:

AYES: Councilmembers Rodin, Criss, Orozco, Sher, and Mayor Crane.
NOES: None.
ABSENT: None.
ABSTAIN: None.

PASSED AND ADOPTED at a regular meeting of the City Council of the City of Ukiah on , 2025, by the following roll call vote:

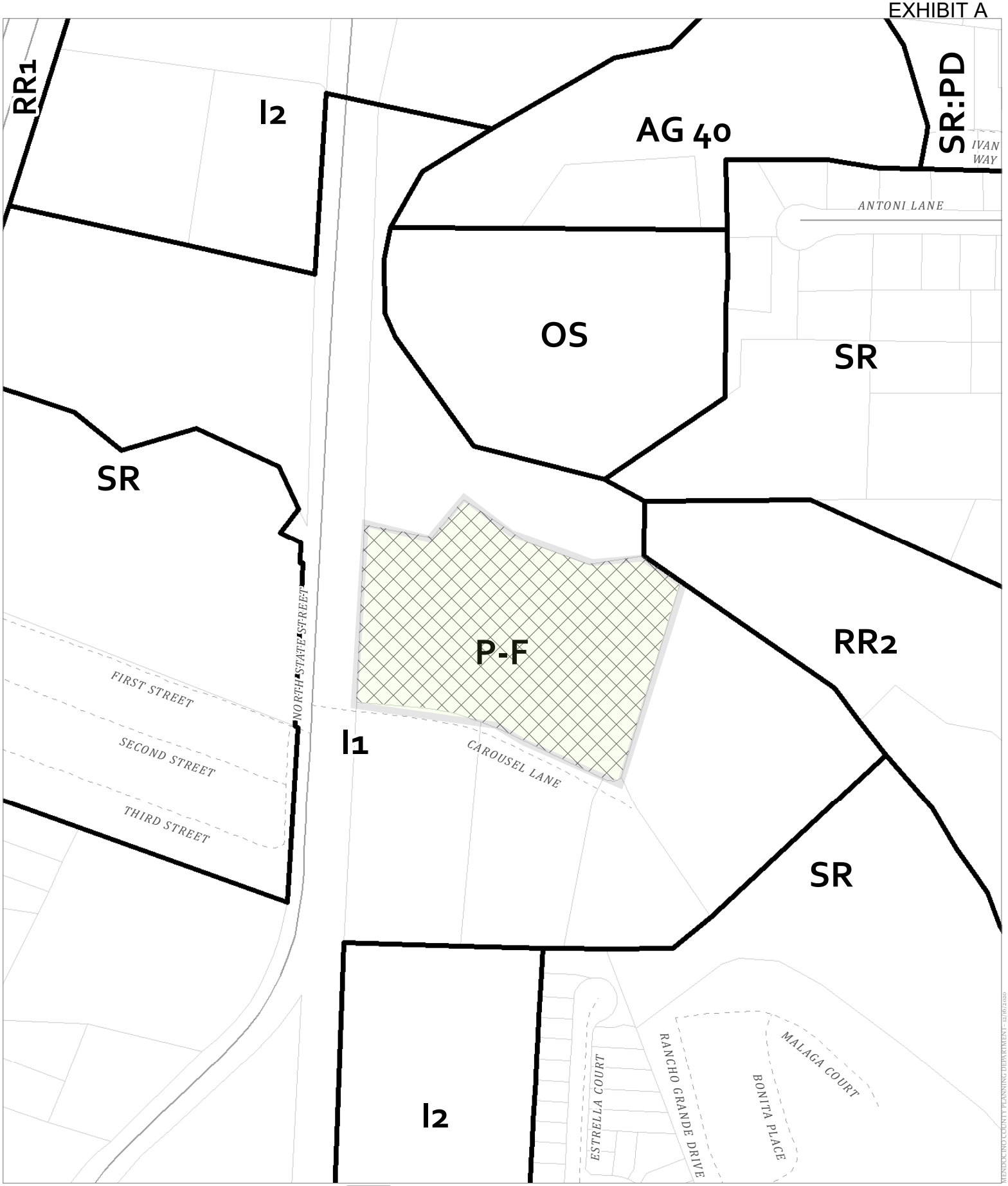
AYES:
NOES:
ABSENT:
ABSTAIN:

_____
Douglas F. Crane, Mayor

ATTEST:

_____
Kristine Lawler, CMC/City Clerk

Exhibit A – Proposed Prezone & Land Use Designation Exhibits
Exhibit B - Notice of Exemption (CEQA Guidelines §15319(a))



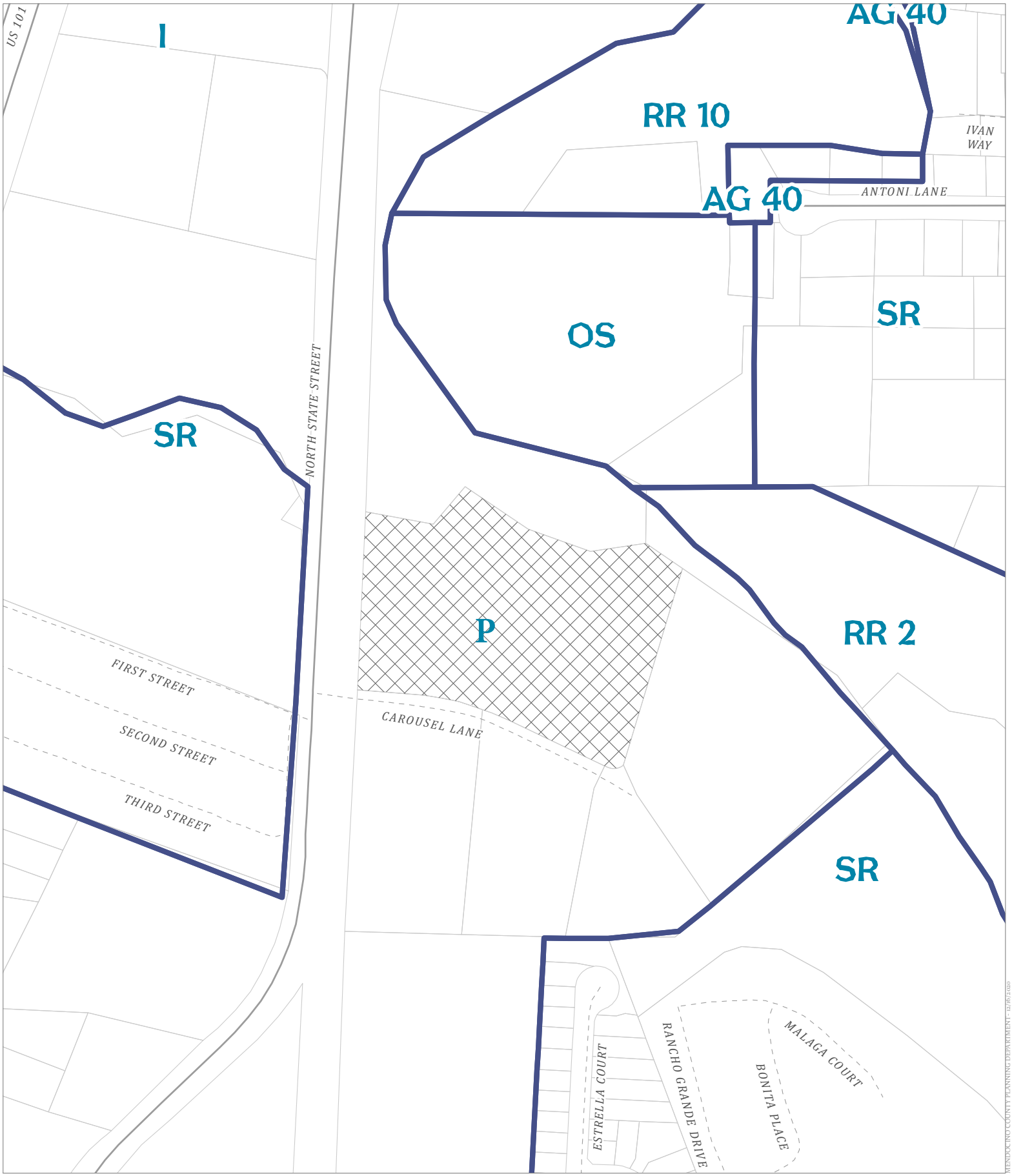
CASE: File No. 25-001107
OWNER: City of Ukiah
APN: 167-280-15
APLCT: City of Ukiah
AGENT: N/A
ADDRESS: 1 Carousel Lane, Ukiah

County Zoning Districts
Public Roads
City Prezone Designation

0 150 300 Feet
0 0.025 0.05 Miles
1:3,600

PREZONE DISPLAY MAP

MENDOCINO COUNTY PLANNING DEPARTMENT - 02/06/2020



CASE: File No. 25-001107
OWNER: City of Ukiah
APN: 167-280-15
APLCT: City of Ukiah
AGENT: N/A
ADDRESS: 1 Carousel Lane, Ukiah

General Plan Classes - County

Public Roads

City Land Use Designation - Proposed

0 150 300 Feet
0 0.025 0.05 Miles
1:3,600

MENDOCINO COUNTY PLANNING DEPARTMENT - 02/06/2026

PROPOSED GENERAL PLAN CLASSIFICATIONS

City of Ukiah
COMMUNITY DEVELOPMENT DEPARTMENT

NOTICE OF CEQA EXEMPTION

TO: X **Office of Planning and Research**
1400 Tenth Street, Room 121
Sacramento, CA 95814

X **County Clerk**
500 Low Gap Road
Ukiah, CA, 95482

FROM: **City of Ukiah**
300 Seminary Avenue
Ukiah, CA 95482

PROJECT TITLE: 'City of Ukiah - Public Facility (PF) Prezone – Municipal Corporation Yard'

PROJECT SITE: 1 Carousel Lane, Ukiah, CA; APN 167-280-15

PUBLIC AGENCY City of Ukiah, City Council

DATE OF APPROVAL: PENDING

NAME OF PROJECT APPLICANT: City of Ukiah, Community Development Department

DRAFT

TO: X **Office of Planning and Research**
1400 Tenth Street, Room 121
Sacramento, CA 95814

X **Mendocino County Clerk- Recorder**
501 Low Gap Road, STE 1020
Ukiah, CA 95482

FROM: **City of Ukiah**
300 Seminary Avenue
Ukiah, CA 95482

CEQA EXEMPTION STATUS:

- ☐ **Ministerial**
- ☐ **Declared Emergency**
- X **Categorical Exemption:** Article 19, Class 1, Section 15319, Class 19(a) - Annexation of Existing Facilities.
- ☐ **Statutory Exemption Section**

PROJECT DESCRIPTION: Pursuant to California Government Code Sections 56742 and 65859, and Ukiah Municipal Code Section 9267, the City of Ukiah (Applicant and Property Owner) proposes to prezone one unincorporated parcel (Assessor's Parcel Number 167-280-15), addressed as 1 Carousel Lane, to the Public Facilities (PF) zoning district in accordance with Ukiah Municipal Code Chapter 2, Zoning, Article 15 (Public Facilities District). The parcel would also receive a Public (P) land use designation consistent with the City's 2040 General Plan. The prezoning action is a procedural step intended to facilitate the future annexation of the subject property into the City of Ukiah. The property currently lies within the unincorporated area of Mendocino County.

REASONS WHY PROJECT IS EXEMPT: The City of Ukiah, acting as Lead Agency under the California Environmental Quality Act (CEQA), has determined that the project is categorically exempt from environmental review pursuant to CEQA Guidelines Section 15319, Class 19(a) – Annexations of Existing Facilities and Lots for

Exempt Facilities. The exemption applies because the subject property, a 7.87±-acre parcel, is fully developed with approximately 98,000 square feet of existing commercial and industrial floor area, including the City's municipal corporation yard and space leased to private tenants. The proposed prezoning and annexation do not authorize any new construction, change in occupancy, or intensification of land use beyond existing conditions. The site is already served by public utilities, and no extension or expansion of service capacity is proposed as part of this action. The prezoning is consistent with the City's General Plan and is being pursued in accordance with Government Code Sections 56742 and 65859 to ensure that City land use policies and zoning regulations apply upon annexation. This action is procedural in nature and anticipatory of potential future changes, none of which are authorized or triggered by the current proposal. As no physical alterations or environmental impacts will result, the project clearly qualifies for exemption under Class 19(a).

Lead Agency Contact Person:	Jesse Davis, Chief Planning Manager
Phone Number:	(707) 463-6207
Email:	jdavis@cityofukiah.com

This is to certify that the Notice of Exemption, along with all supporting documentation and project-related materials, is available for public review at the City of Ukiah Community Development Department, Planning Division, located at 300 Seminary Avenue, Ukiah, CA 95482.

	TBD	Chief Planning Manager
Signature (Public Agency)	(Date)	(Title)

RESOLUTION NO. 2025-54

RESOLUTION OF APPLICATION BY THE UKIAH CITY COUNCIL TO INITIATE ANNEXATION OF CITY-OWNED PROPERTY AT 1 CAROUSEL LANE (APN 167-280-15) FOR USE AS A MUNICIPAL CORPORATION YARD

WHEREAS, the City of Ukiah ("City") desires to initiate proceedings pursuant to Part 3 of the Cortese-Knox-Hertzberg Local Government Reorganization Act of 2000 (Government Code §56000 et seq.) for a change of organization consisting of the annexation of one (1) parcel located at 1 Carousel Lane (Assessor's Parcel Number 167-280-15) to the City of Ukiah; and

WHEREAS, on October 15, 2025, a Notice of Intention to adopt this Resolution of Application was mailed to each affected agency as required by Government Code § 56654; and

WHEREAS, the proposed "City of Ukiah – Corporation Yard Annexation" is located in unincorporated Mendocino County, approximately 2.3 miles north of the Ukiah city limits, in an area with a mix of commercial and industrial uses; and

WHEREAS, the subject territory consists of one (1) industrially developed parcel totaling approximately 7.9 acres with access from Carousel Lane, a private road; more particularly described and depicted in Exhibit "A" (Draft Legal Description and Boundary Map) attached hereto and incorporated herein by reference; and

WHEREAS, the subject territory contains zero registered voters and is therefore uninhabited pursuant to Government Code § 56046; and

WHEREAS, there is unanimous consent among affected landowners for the proposed annexation, including an existing deed restriction by which the former owner of the parcel, in 1988, consented to future annexation and agreed to petition for annexation to the City upon the City's request; and

WHEREAS, on May 7, 2025, the City Council approved purchase of the subject property, with the sale closing on June 30, 2025; and

WHEREAS, the City has prezoned the subject property to the Public Facilities (PF) zoning district and has applied the Public (P) General Plan land use designation pursuant to Ukiah Municipal Code Chapter 2 (Zoning), Article 15, so that City land use policies and regulations will apply upon annexation, consistent with Government Code § 56375(a)(7). Prezoning shall be adopted by ordinance prior to LAFCo consideration of this application; and

WHEREAS, the purpose of the City of Ukiah – Corporation Yard Annexation is to bring the newly-acquired municipal corporation yard property into City jurisdiction to allow for efficient provision of municipal services, improve opportunities for grant funding, ensure consistency with the City's risk management policies, and facilitate the relocation of City public works, utilities, and fleet operations from the existing facility at the Ukiah Municipal Airport; and

WHEREAS, this proposal is consistent with the City of Ukiah Sphere of Influence, as last adopted by the Mendocino Local Agency Formation Commission on August 3, 2023; and

WHEREAS, the City Council requests that the proposed annexation be subject to the following terms and conditions:

1. Upon the effective date of annexation, the annexed territory shall be subject to all City of Ukiah ordinances, resolutions, policies, fees, and regulations then in effect.

2. All existing easements and public utility rights, including electricity and sewer, shall remain in full force and effect.

WHEREAS, a Plan for Services meeting the requirements of Government Code §56653 is attached as Exhibit "B," demonstrating the City's ability to provide all necessary municipal services to the subject territory. The site is already served by utilities, and no extension or expansion of service capacity is proposed beyond typical service connections, new metering, with regard to utilities for an existing facility; and

WHEREAS, anticipated construction and maintenance work is limited to interior improvements subject to standard building permits that do not expand building area, occupancy, or utility capacity and therefore do not trigger construction-related environmental effects beyond typical, short-duration interior work or site improvements and maintenance; and

WHEREAS, the City Council finds the proposed annexation is exempt from the California Environmental Quality Act (CEQA) pursuant to Section 15319(a) (Class 19 – Annexation of Existing Facilities and Lots for Exempt Facilities) of the CEQA Guidelines, as the proposal involves annexation of an existing developed property for continued use as a municipal facility without expansion or intensification of use. A draft Notice of Exemption is attached as Exhibit "C"; and

WHEREAS, on June 19, 2024, the City Council adopted Resolution No. 2024-32, approving participation in the Mendocino County Master Tax Sharing Agreement (MTSA). The MTSA does not preclude one or more of the associated cities from entering separate agreements regarding particular Annexations; provided, however, that nothing in any separate agreement shall affect the rights and obligations of Cities not party to that separate agreement; and

WHEREAS, the City Council considered all oral and written testimony provided by interested agencies and members of the public prior to and during the noticed public hearing held on November 5, 2025, for adoption of this Resolution of Application; and

WHEREAS, because the territory is uninhabited and the sole affected landowner has consented to the annexation, the City requests that LAFCo order the annexation without an election and waive protest proceedings to the fullest extent authorized by Government Code §§ 56662 and 56663.

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Ukiah that this Resolution of Application is hereby adopted and approved. The Mendocino Local Agency Formation Commission is requested to take proceedings for the City of Ukiah – Corporation Yard Annexation in accordance with the Cortese-Knox-Hertzberg Local Government Reorganization Act of 2000 and the terms and conditions stated herein.

BE IT FURTHER RESOLVED, the City Manager, or designee, on behalf of the City of Ukiah, is authorized and directed to file this Resolution of Application, together with all necessary maps, legal descriptions, environmental documentation, tax exchange documentation, and supporting materials, with Mendocino LAFCo, and to take all further actions necessary to effectuate the filing and processing of this annexation request.

PASSED AND ADOPTED at a regular meeting of the City Council of the City of Ukiah on this 5th day of November, 2025, by the following roll call vote:

AYES: Councilmembers Rodin, Criss, Orozco, Sher, and Mayor Crane.
NOES: None.
ABSENT: None.
ABSTAIN: None.

Douglas F. Crane, Mayor

ATTEST:

Araceli Sandoval, Deputy City Clerk

EXHIBIT "A"
Legal Description
The City of Ukiah Annexation of City Owned Property
(LAFCo File No. _____)

All that real property situated in the unincorporated area of Mendocino County, State of California, described as follows:

AREA A:

Being a portion of Lot 140 of Healey's Survey and Map of Yokayo Rancho and being the lands of the City of Ukiah described in that certain Grant Deed recorded in Instrument Number 2025-05366, Mendocino County Records, more particularly described as follows:

COMMENCING at the National Geodetic Survey station, being a 3-1/4" Aluminum Disk marked CA DOT / 101 MEN 25.13; thence North 04°59'34" West, 14917.74 feet to the southwest corner of the said City of Ukiah property and the **POINT OF BEGINNING**; thence along the boundary of said City of Ukiah property the following twelve (12) courses:

1. North 04°05'30" East, 425.00 feet;
2. South 79°09'00" East, 179.56 feet;
3. North 44°19'00" East, 120.04 feet;
4. South 55°34'00" East, 182.98 feet;
5. South 68°36'20" East, 167.42 feet;
6. North 84°44'40" East, 144.51 feet;
7. South 53°15'30" East, 105.00 feet;
8. South 21°48'43" West, 489.43 feet;
9. From a tangent that bears South 66°29'06" West, along a curve to the right with a radius of 50.00 feet, a central angle of 50°12'30" and an arc length of 43.81 feet;
10. North 63°18'24" West, 239.08 feet;
11. Along a curve to the left with a radius of 730.00 feet, a central angle of 22°36'06" and an arc length of 287.94 feet;
12. North 85°54'30" West, 112.00 feet to the **POINT OF BEGINNING.**

Area = 7.90 acres

AP 167-280-15

The basis of bearings for this description is based on NAD83, California Coordinate System (CCS83), Zone 2 (2010.00 epoch date) using the two found National Geodetic Survey monuments designated "101 MEN 25.13" and "HPGN D CA 01 CG" said bearing South 05°01'58" East, shown on Exhibit "A", attached hereto and made a part hereof.

The purpose of this description is for annexation purposes and to compy with the State Board of Equalization's "Written Legal (geodetic) Description Requirements". This description is to be used to establish geodetic position only and is not intended to establish property ownership.

_____ _____
Ron W. Franz L.S. 7173 Dated

City of Ukiah
COMMUNITY DEVELOPMENT DEPARTMENT

PLAN FOR SERVICES
CITY OF UKIAH - CORPORATION YARD ANNEXATION

Project Name: City of Ukiah – Corporation Yard Annexation
Applicant(s): City of Ukiah
Site Address | APN: 1 Carousel Lane, Ukiah, CA 95482 | APN 167-280-15
Acreage: ±7.9 acres
Existing Facility: 98,000-square-foot industrial warehouse
Proposed Use: Municipal Corporation Yard for the City of Ukiah and Ukiah Valley Water Authority to support infrastructure maintenance and operations.

PURPOSE AND SUMMARY OF SERVICES - BACKGROUND

This Plan for Services is submitted in accordance with California Government Code §56653, which requires a local agency proposing annexation to describe how municipal services will be provided to the affected area.

In accordance with California law:

1. When a local agency submits a resolution of application for a change of organization, it must also provide a plan for delivering services to the affected territory. LAFCO must review this plan and evaluate the City's ability to maintain existing service levels.
2. The plan must include the following elements, as well as any additional information required by the commission or executive officer:
    - A list and description of services to be provided to the area.
    - The expected level and scope of those services.
    - A timeline for when services can be feasibly provided.
    - Any upgrades or improvements to infrastructure or facilities required by the City.
    - A summary of how the services will be financed.

EXISTING SITE

Per the Phase I Environmental Site Assessment (ESA) performed by EBA Engineering (EBA) for 1 Carousel Lane, Ukiah, CA 95482 | APN 167-280-15, the property is described as such:

> *The project site contains a single commercial structure that is approximately 98,000 square feet in size and generally segregated into three units, herein described as Suites 1A, 1B, and 1C. The structure was reportedly built in three phases over several decades starting in 1969. The structure consists of a steel framed building with steel siding and roof and there is no wall separating Suites A*

and 1B. A concrete slab on grade floor extends throughout the structure. Most of the structure is open warehouse…Areas of the subject property not covered with the site buildings consist primarily of asphalt surfaces used for employee and customer parking and [Distribution Center] shipping and receiving trucks. A fenced gravel parking area is present on the eastern side of the subject property that is used for parking trucks by the [Distribution Center].

EXISTING AND PROPOSED SERVICE PROVIDERS (1 CAROUSEL LANE)

The City of Ukiah provides the following overview of existing and proposed service providers, should annexation be approved:

Service	Existing Provider	Service Provider - Post Annexation	Comments
General Government (Planning, Building, Business Licensing, and Code Enforcement)	Mendocino County	City of Ukiah	Planning, Building, Business Licensing, and Code Enforcement services for the subject parcel shall be provided by the City of Ukiah. Given the site's operation as a Public Facility, City involvement is anticipated to be limited to: (1) Issuance of business licenses for occupants utilizing existing commercial warehouse or yard areas; and (2) Review and permitting of tenant/municipal improvements, as required by applicable building, fire, and municipal codes.
General Government (Environmental Health (Land Use), Public	Mendocino County	Mendocino County	Countywide functions, particularly Environmental Health (Land Use), Public Health, Air Quality, and Certified Unified Program Agency (CUPA), remain under County

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Service	Existing Provider	Service Provider - Post Annexation	Comments
Health, and Air Quality)			jurisdiction and are unaffected by this action.
Law Enforcement	Mendocino County Sheriff	Ukiah Police Department	The Ukiah Police Department ("UPD") shall assume primary law-enforcement jurisdiction for the subject territory. Existing mutual-aid agreements with surrounding agencies shall remain in full force and effect. Based on current information, no material increase in service-call volume is anticipated.
Fire Protection / Emergency Medical	Ukiah Valley Fire Authority (UVFA)	No change	Emergency medical services (EMS) and fire protection shall continue pursuant to existing dispatch, automatic-aid, and mutual-aid protocols. No new stations, apparatus, or personnel are required, and no changes to response districts or standards of coverage are anticipated. The property is already serviced by the UVFA.
Water	Millview County Water District / Ukiah Valley Water Authority	No change	The subject property is served by existing water connections operated by the Ukiah Valley Water Authority ("UVWA") per the Millview County Water District. No new main extensions, service laterals, or capacity upgrades are required to accommodate this action. Service is expected to continue without interruption.

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Service	Existing Provider	Service Provider - Post Annexation	Comments
Wastewater	Ukiah Valley Sanitation District	No change	Service will remain with the Ukiah Valley Sanitation District (UVSD); no change in provider or service-area boundaries. Existing sewer connections, conveyance and treatment capacity are sufficient; no new laterals, main extensions, or upsizing are required. No additional capacity reservations. Similar to previous City-owned annexation proposals, detachment from the UVSD is not necessary or requested.
Stormwater	County of Mendocino (Municipal Separate Storm Sewer System)	City of Ukiah (Municipal Separate Storm Sewer System)	Compliance with City stormwater management requirements continues. No new impervious area proposed, and the City will apply its existing MS4 regulations.
Solid Waste	C&S Waste Solutions (County Franchise – Redwood Waste Solutions)	No change	Collection, recycling, and disposal services shall continue to be provided by C&S Waste Solutions under the County's existing franchise (Redwood Waste Solutions). No change in provider, service levels, routes, or service-area boundaries is required. Regulated materials and recyclables shall be managed in accordance with existing permits, local agreement, and all applicable state and local regulations.
Transportation / Streets	Private (Carousel Lane)	No change	Primary site access remains via Carousel Lane, which is a 60' private road and public utility

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Service	Existing Provider	Service Provider - Post Annexation	Comments
			easement for which the City maintains partial responsibility for maintenance and repair. No new roads, signalization, parking or easements required for use as a corporation yard.
Parks / Library / Recreation	County / City	Not applicable	No new employment generation or proposed residential uses. Facility transfer of existing employees assigned to the existing Corporation Yard. No new public service demand generated.
Public Utilities (Electric & Gas / Telecom)	PG&E / AT&T & Comcast	No change	Electric and gas service shall continue to be provided by Pacific Gas and Electric Company (PG&E), and telecommunications service by AT&T and Comcast. No change in providers, service-area boundaries, or facilities is proposed. Franchise utilities will continue service under existing agreements, easements, and rights-of-way. No new connections, relocations, or capacity upgrades are anticipated at this time. Given the site's operation as a corporation yard, no material increase in service demand is expected, as the operational intensity is generally consistent with that of existing businesses in the area.

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TIMELINE AND EXISTING SERVICES

On a limited basis, the City of Ukiah intends to begin using the property immediately upon annexation for municipal staging, vehicle parking, equipment storage, and other routine City and UVWA functions. Initial improvements are minimal and will focus primarily on accessibility upgrades, metering, and interior improvements necessary to support safe and compliant operations. These activities are not expected to alter existing site conditions, disrupt adjacent land uses, or require major construction. Limited development of the facility can occur simultaneously with ongoing operations, allowing the City to establish an interim operational presence while completing facility upgrades within existing building and operational yard footprints.

SERVICE STANDARDS AND OPERATIONS

- Hours and Staffing: Standard municipal hours (6:30 a.m. – 6 p.m.). No substantial increase in permanent staffing is anticipated given past uses of the property and staff already based at the existing Corporation Yard. There will be no public facing component to the facility.
- Facility Operations: Routine City and UVWA operations, repair, equipment storage, and maintenance activities.
- Security: Existing industrial security measures in place. Hazardous materials storage and handling remain permitted and compliant with all City, County, and State regulations.
- Maintenance: Facility and yard upkeep funded through departmental operating budgets and internal service funds.

INFRASTRUCTURE & SITE STATUS

The subject property appears to have been undeveloped open grasslands as late as 1941. This is evidenced by an aerial photograph from that year. The subject property is indicated to have been developed as a commercial property with construction of the initial phase of the site building by Carousel Carpet Mill in 1969 which operated at the site until 2010. The building subsequently underwent two expansions in 1981 and 1989 and has been occupied by several commercial tenants to the present day. While initially developed with a septic system, the site is now connected to the UVSD.

The site is currently occupied by an agricultural sales and service company, which the City will replace, and a shipping distribution center, which will remain under City jurisdiction. The property's use is well documented through County permits, with no major gaps in the record.

FISCAL EFFECTS & IMPACTS

Operating costs for the Corporation Yard and Water Authority activities will be funded through existing City budgets, departmental funds, and the UVWA, consistent with the City's adopted cost allocation plan as part of the JPA. Operating costs will also be offset

by the closure of the existing Corporation Yard facility at 1320 Airport Rd. and transfer of services to 1 Carousel Lane. Further considerations are detailed below:

Land Acquisition, Capital and Tenant/Municipal Improvements: Financed through a combination of City bond proceeds, Capital Improvement Program (CIP) funds, and competitive grants, the property was acquired by the City of Ukiah for $7.6 million. The City has allocated up to $3 million for municipal improvements to City the Corporation Yard as part of the bond proceeds.

- Taxes and Assessments:
    - The property is City-owned and therefore exempt from ad valorem property tax. Commercial or joint-use operations remain subject to possessory interest tax that will be addressed as a separate tax share agreement with the County of Mendocino.
    - On June 19, 2024, the City Council adopted Resolution No. 2024-32, approving participation in the Mendocino County Master Tax Sharing Agreement (MTSA). The MTSA does not preclude one or more of the associated cities from entering separate agreements regarding particular Annexations; provided, however, that nothing in any separate agreement shall affect the rights and obligations of those Parties not party to that separate agreement.
    - Given the municipal function of this parcel and the limited number of parcels identified for this annexation, the City will request a separate tax share agreement to more appropriately evaluate the site-specific considerations of this request, and the applicability of the previously adopted MTSA to a single parcel.
- Permits and Fees: Building and encroachment permits will be processed internally; related costs are budgeted within the project. Existing permits and records will be transferred to the City of Ukiah and integrated into the City's permit system.
- Utility Rates: Water and sewer services funded by user fees per Proposition 218 cover the cost associated with operation and maintenance of the facility. If necessary, future rate changes will follow statutory noticing and hearing procedures.
- No new municipal taxes or special assessments are proposed as part of this annexation to cover the cost of acquisition, relocation or upgrades to the facility.

LAND USE CONSISTENCY

The City intends to prezone the property to Public Facilities (PF) with a Public (P) General Plan land use designation to take effect upon annexation pursuant to Government Code

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§65859. The project site consists of a large commercial building of approximately 98,000 square feet, divided into three main suites. As described by the Phase 1 Evaluation, the structure functions primarily as a warehouse facility with supporting office and utility spaces. The western portions are used for office operations, employee amenities, package storage, and limited light industrial activity such as packaging and distribution. The eastern portion operates as a distribution hub, where goods are transferred directly between transport vehicles with minimal long-term storage. The surrounding development along Carousel Lane appears to follow a similar industrial and commercial pattern, characterized by storage, distribution, and light manufacturing uses.

The existing site operations and surrounding development are compatible with a municipal corporation yard, both in function and intensity of use, as they share similar industrial and logistical characteristics and are unlikely to create land use conflicts.

Current (County of Mendocino):

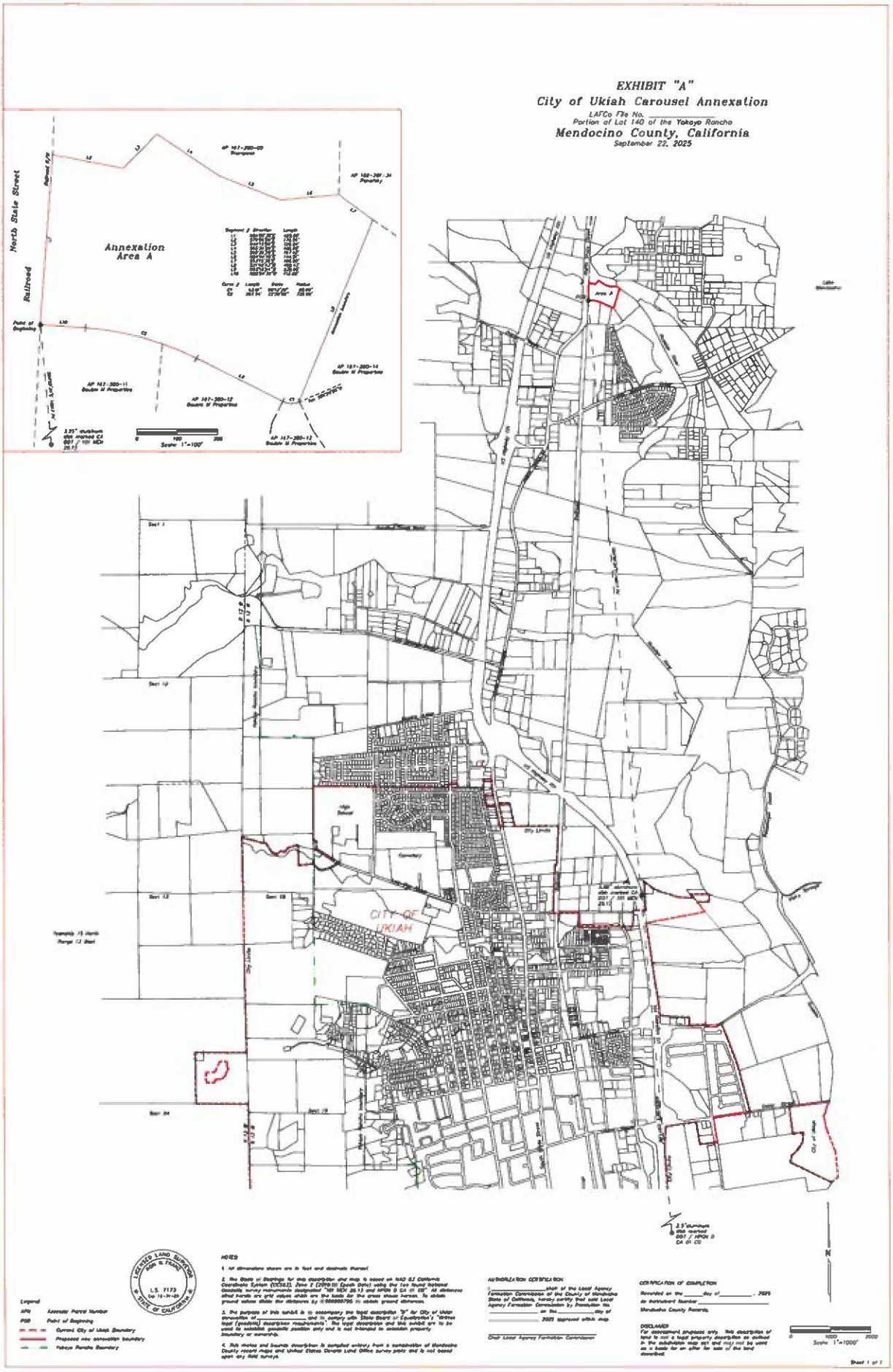
- Zoning: Limited Industrial (I-1) (Mendocino County Code Ch. 20.09
- Existing Limited Industrial Land Uses: "Wholesaling, Storage and Distribution—Light"; "Agricultural Sales and Services"" Minor Impact Utilities"

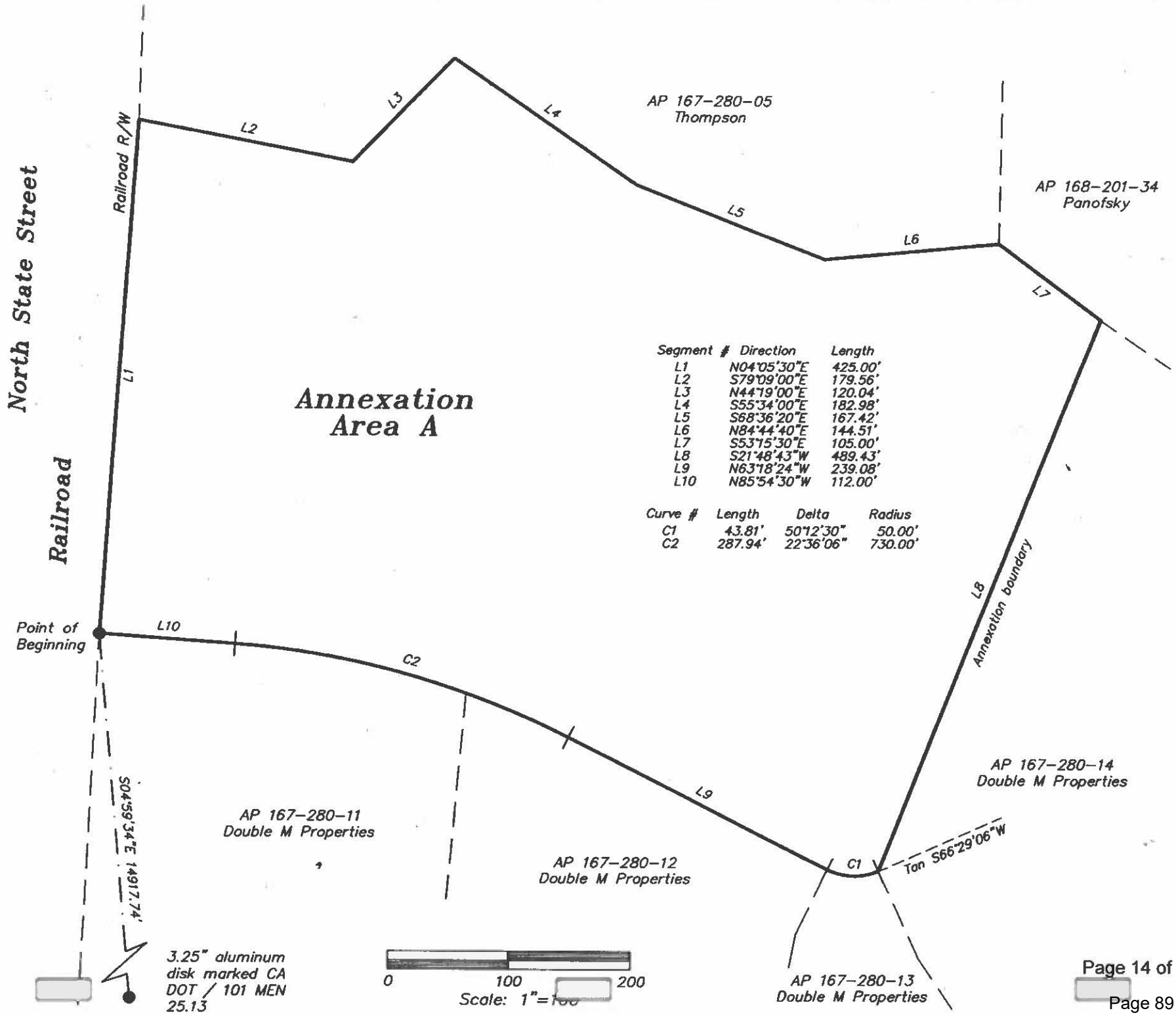
Proposed (City of Ukiah):

- Zoning: Public Facilities (PF) (Ukiah Municipal Code, Ch. 2, Art. 15)
- General Plan: Public (P) (Ukiah 2040 General Plan)
- Proposed Public Facility Land Uses: "Corporation yards"; "Quasi-public land uses""; "Light manufacturing and industrial uses"

CONCLUSION

While the proposed annexation of 1 Carousel Lane would create an incorporated island, it represents a logical and cost-effective location for extending the City of Ukiah's municipal service responsibilities within the Ukiah Valley, particularly regarding water and wastewater service delivery through the Ukiah Valley Water Authority (UVWA) and on behalf of the Ukiah Valley Sanitation District. The property will serve as a municipal corporation yard and water authority facility within an existing industrial warehouse complex surrounded by compatible uses, requiring only limited improvements that can be completed concurrently with ongoing operations. All essential municipal and utility services are already available to the site, and no new infrastructure extensions, staffing increases, or public-facing functions are anticipated. The annexation is consistent with the City's General Plan, prezoning actions, and adopted Capital Improvement Program identifying the relocation of the Corporation Yard to a new facility, and it will improve operational efficiency by consolidating municipal and water maintenance activities within a modernized, centrally located facility.


EXHIBIT "A"
City of Ukiah Carousel Annexation
LAFCo File No. ____
Portion of Lot 140 of the Yokaya Rancho
Mendocino County, California
September 22, 2025
North State Street
Railroad
Annexation Area A
Point of Beginning
Scale: 1"=100'
Area A
CITY OF UKIAH
City Limits
Scale: 1"=1000'
N
Legend
APN Assessor Parcel Number
POB Point of Beginning
Current City of Ukiah Boundary
Proposed new annexation boundary
Yokaya Rancho Boundary
NOTES
AUTHORIZATION CERTIFICATION
CERTIFICATION OF COMPLETION
DISCLAIMER
Sheet 1 of 1



Segment #	Direction	Length
L1	N04°05'30"E	425.00'
L2	S79°09'00"E	179.56'
L3	N44°19'00"E	120.04'
L4	S55°34'00"E	182.98'
L5	S68°36'20"E	167.42'
L6	N84°44'40"E	144.51'
L7	S53°15'30"E	105.00'
L8	S21°48'43"W	489.43'
L9	N63°18'24"W	239.08'
L10	N85°54'30"W	112.00'

Curve #	Length	Delta	Radius
C1	43.81'	50°12'30"	50.00'
C2	287.94'	22°36'06"	730.00'

City of Ukiah
COMMUNITY DEVELOPMENT DEPARTMENT

NOTICE OF CEQA EXEMPTION

TO: X **Office of Planning and Research**
1400 Tenth Street, Room 121
Sacramento, CA 95814

X **County Clerk**
500 Low Gap Road
Ukiah, CA, 95482

FROM: **City of Ukiah**
300 Seminary Avenue
Ukiah, CA 95482

PROJECT TITLE: 'City of Ukiah - Public Facility (PF) Prezone – Municipal Corporation Yard'

PROJECT SITE: 1 Carousel Lane, Ukiah, CA; APN 167-280-15

PUBLIC AGENCY City of Ukiah, City Council

DATE OF APPROVAL: PENDING

NAME OF PROJECT APPLICANT: City of Ukiah, Community Development Department

DRAFT

TO: X **Office of Planning and Research**
1400 Tenth Street, Room 121
Sacramento, CA 95814

X **Mendocino County Clerk- Recorder**
501 Low Gap Road, STE 1020
Ukiah, CA 95482

FROM: **City of Ukiah**
300 Seminary Avenue
Ukiah, CA 95482

CEQA EXEMPTION STATUS:

- ☐ **Ministerial**
- ☐ **Declared Emergency**
- X **Categorical Exemption:** Article 19, Class 1, Section 15319, Class 19(a) - Annexation of Existing Facilities.
- ☐ **Statutory Exemption Section**

PROJECT DESCRIPTION: Pursuant to California Government Code Sections 56742 and 65859, and Ukiah Municipal Code Section 9267, the City of Ukiah (Applicant and Property Owner) proposes to prezone one unincorporated parcel (Assessor's Parcel Number 167-280-15), addressed as 1 Carousel Lane, to the Public Facilities (PF) zoning district in accordance with Ukiah Municipal Code Chapter 2, Zoning, Article 15 (Public Facilities District). The parcel would also receive a Public (P) land use designation consistent with the City's 2040 General Plan. The prezoning action is a procedural step intended to facilitate the future annexation of the subject property into the City of Ukiah. The property currently lies within the unincorporated area of Mendocino County.

REASONS WHY PROJECT IS EXEMPT: The City of Ukiah, acting as Lead Agency under the California Environmental Quality Act (CEQA), has determined that the project is categorically exempt from environmental review pursuant to CEQA Guidelines Section 15319, Class 19(a) – Annexations of Existing Facilities and Lots for

Exempt Facilities. The exemption applies because the subject property, a 7.87±-acre parcel, is fully developed with approximately 98,000 square feet of existing commercial and industrial floor area, including the City's municipal corporation yard and space leased to private tenants. The proposed prezoning and annexation do not authorize any new construction, change in occupancy, or intensification of land use beyond existing conditions. The site is already served by public utilities, and no extension or expansion of service capacity is proposed as part of this action. The prezoning is consistent with the City's General Plan and is being pursued in accordance with Government Code Sections 56742 and 65859 to ensure that City land use policies and zoning regulations apply upon annexation. This action is procedural in nature and anticipatory of potential future changes, none of which are authorized or triggered by the current proposal. As no physical alterations or environmental impacts will result, the project clearly qualifies for exemption under Class 19(a).

Lead Agency Contact Person:	Jesse Davis, Chief Planning Manager
Phone Number:	(707) 463-6207
Email:	jdavis@cityofukiah.com

This is to certify that the Notice of Exemption, along with all supporting documentation and project-related materials, is available for public review at the City of Ukiah Community Development Department, Planning Division, located at 300 Seminary Avenue, Ukiah, CA 95482.

	TBD	Chief Planning Manager
Signature (Public Agency)	(Date)	(Title)

City of Ukiah
COMMUNITY DEVELOPMENT DEPARTMENT

NOTICE OF CEQA EXEMPTION

TO: X **Office of Planning and Research**
1400 Tenth Street, Room 121
Sacramento, CA 95814

X **County Clerk**
500 Low Gap Road
Ukiah, CA, 95482

FROM: **City of Ukiah**
300 Seminary Avenue
Ukiah, CA 95482

PROJECT TITLE: 'City of Ukiah - Public Facility (PF) Prezone – Municipal Corporation Yard'

PROJECT SITE: 1 Carousel Lane, Ukiah, CA; APN 167-280-15

PUBLIC AGENCY City of Ukiah, City Council

DATE OF APPROVAL: PENDING

NAME OF PROJECT APPLICANT: City of Ukiah, Community Development Department

DRAFT

TO: X **Office of Planning and Research**
1400 Tenth Street, Room 121
Sacramento, CA 95814

X **Mendocino County Clerk- Recorder**
501 Low Gap Road, STE 1020
Ukiah, CA 95482

FROM: **City of Ukiah**
300 Seminary Avenue
Ukiah, CA 95482

CEQA EXEMPTION STATUS:

- ☐ **Ministerial**
- ☐ **Declared Emergency**
- X **Categorical Exemption:** Article 19, Class 1, Section 15319, Class 19(a) - Annexation of Existing Facilities.
- ☐ **Statutory Exemption Section**

PROJECT DESCRIPTION: Pursuant to California Government Code Sections 56742 and 65859, and Ukiah Municipal Code Section 9267, the City of Ukiah (Applicant and Property Owner) proposes to prezone one unincorporated parcel (Assessor's Parcel Number 167-280-15), addressed as 1 Carousel Lane, to the Public Facilities (PF) zoning district in accordance with Ukiah Municipal Code Chapter 2, Zoning, Article 15 (Public Facilities District). The parcel would also receive a Public (P) land use designation consistent with the City's 2040 General Plan. The prezoning action is a procedural step intended to facilitate the future annexation of the subject property into the City of Ukiah. The property currently lies within the unincorporated area of Mendocino County.

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Lead Agency Contact Person: Jesse Davis, Chief Planning Manager
Phone Number: (707) 463-6207
Email: jdavis@cityofukiah.com

This is to certify that the Notice of Exemption, along with all supporting documentation and project-related materials, is available for public review at the City of Ukiah Community Development Department, Planning Division, located at 300 Seminary Avenue, Ukiah, CA 95482.

	TBD	Chief Planning Manager
Signature (Public Agency)	(Date)	(Title)

167-28

154-020
154-037

N
1"= 200'

Fr. Lot 140, Yokayo Rancho

Parcel Map C2 D29 P48

Bk 169

Bk 168 20

26

2
8.6 A±

N16°44'14"W 778.94'

N17°55'E 420.14'

275.0'

660'

S17°55'W 203.0'

227+00.0

225+00.0

85.22' 87.86'

N73°35'40"W 306.03'

℄ YORK CREEK

N32°35'40"W 142.22'

S75°11'30"W 191.35'

N65°39'W 218.05'

N26°56'W 154.03'

104

4000

WEST BRANCH

5

1
4.63 A±

S16°46'14"W 500.10'

N20°E

LOT 140

N50°50'36"W 210.72'

S37°12'19"W 105.94'

34.73'

101
26535-61

700.0'

321.02'

N18°44'07"E 293.54'

3
11.86 A±

C2 D4 P45
C2 D4 P50

N69°35'31"W 1059.17'

N18°18'42"E 52.58'

4
11.42 A±

154-020 154-037

12-8-89
3-21-91

S02°54'35"W 2083.79

198.96'

3900

NORTH STATE STREET

3999

N.W.P.R.R.

3800

3901

466.57'

N69°35'31"W 1164.60'

NOTE: This map was prepared for assessment purposes only. No liability is assumed for the data delineated hereon.

Bk 169

S79°09'09"E 179.56

N44°19'E 120.04

S55°24'E 182.98'

S63°36'20"E 167.42'

N84°44'40"E 144.51

C2 D16 P61

15
7.9 A±

1028.02'

112'

196.32'

398.99'

91.63'

239.08'

489.43'

43.8'

60.0'

75.0'

154-020
154-037

RUSSIAN RIVER

S53°15'30"E 455.07'

560.07'

S33°02'E 200.66'

152.19'

702.19'

582.19'

S60°48'54"W

550.8'

120.00'

"AR"

Pcl.4
14
6.49 A±

C2 D5 P2

C2 D29 P48

Pcl.1
11
4.04 A±

Pcl.2
12
3.19 A±

Pcl.3
13
2.05 A±

N04°05'30"E 603.02'

564.01'

378.89'

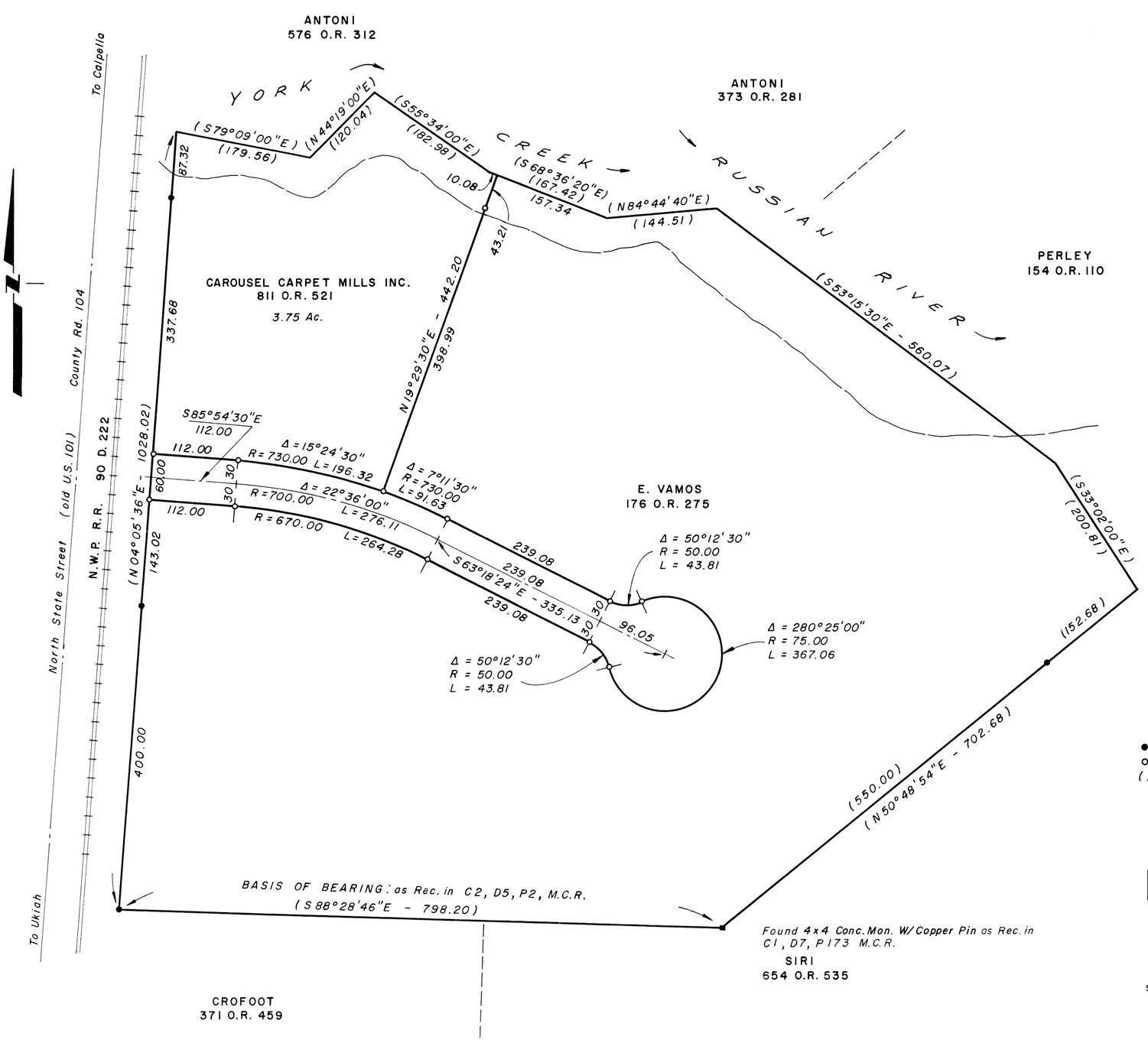
334.63'

290.00'
N88°28'46"W

250.00'

798.20' 258.20'

Assessor's Map
County of Mendocino, Calif.
March 1967



SURVEYOR'S CERTIFICATE

REGISTERED PROFESSIONAL ENGINEER · EDWARD F. CARPENTER · No. 10430 · CIVIL ENGINEER · STATE OF CALIFORNIA

This Map correctly represents a Survey made under my direction in conformance with the requirements of the Land Surveyor's Act at the request of Ukiah Development Corporation.

Edward F. Carpenter
EDWARD F. CARPENTER / R.C.E. 10430

COUNTY SURVEYOR'S CERTIFICATE

This Map has been examined for conformance with the requirements of the Land Surveyor's Act.
This 26th day of APRIL, 1970

C. F. Campbell
C. F. CAMPBELL · R.C.E. 16017

COUNTY RECORDER'S CERTIFICATE

Filed this 30th day of April, 1971, ~~1970~~ at 9:16 O'clock A M. in Map Case 2 Drawer 16 Page 61 at the request of Edward F Carpenter by: Dept of Public Works

Viola Richardson
VIOLA RICHARDSON

A. Dunn
BY DEPUTY

FEE: $5.00

LEGEND

- ● *Found 1/2" I.P. Tagged L.S. 3089*
- o *Set 1/2" I.P. Tagged R.C.E. 10430*
- ( ) *Record Data as shown on 2-5-2*

RECORD OF SURVEY

FOR

UKIAH DEVELOPMENT CORPORATION

BEING A PORTION OF LOT 140 YOKAYO RANCHO

SCALE: 1" = 100' OCTOBER, 1970

MENDOCINO COUNTY, CALIFORNIA

THIS MAP CONFORMS TO THE REQUIREMENTS OF SEC. 11535 (C)(3) BUSINESS & PROFESSIONS CODE, APPROVED BY PLANNING COMMISSION ON OCT. 16, 1970.

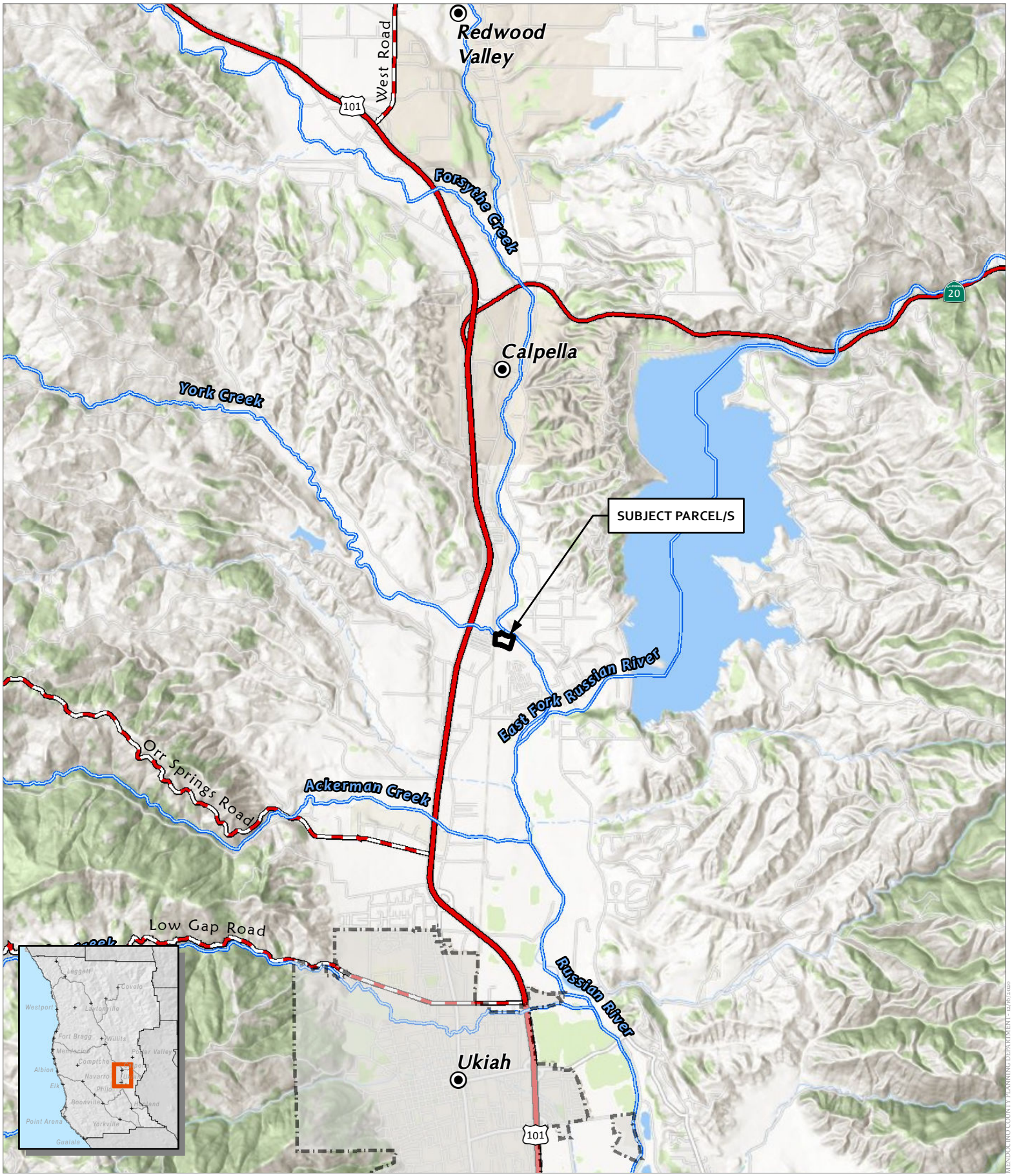
EDWARD F. CARPENTER · *Consulting Civil Engineer*
1188 NORTH STATE ST. UKIAH, CALIFORNIA

JOB NO. 109 - 70

SHEET 1 OF 1 SHEETS

CASE	2
DRAWER	16
PAGE	61

5125



CASE: File No. 25-001107
OWNER: City of Ukiah
APN: 167-280-15
APLCT: City of Ukiah
AGENT: N/A
ADDRESS: 1 Carousel Lane, Ukiah

Major Towns & Places
City Limits
Highways
Major Roads

0 2,550 5,100 Feet
0 0.5 1 Miles
1:63,360

LOCATION MAP

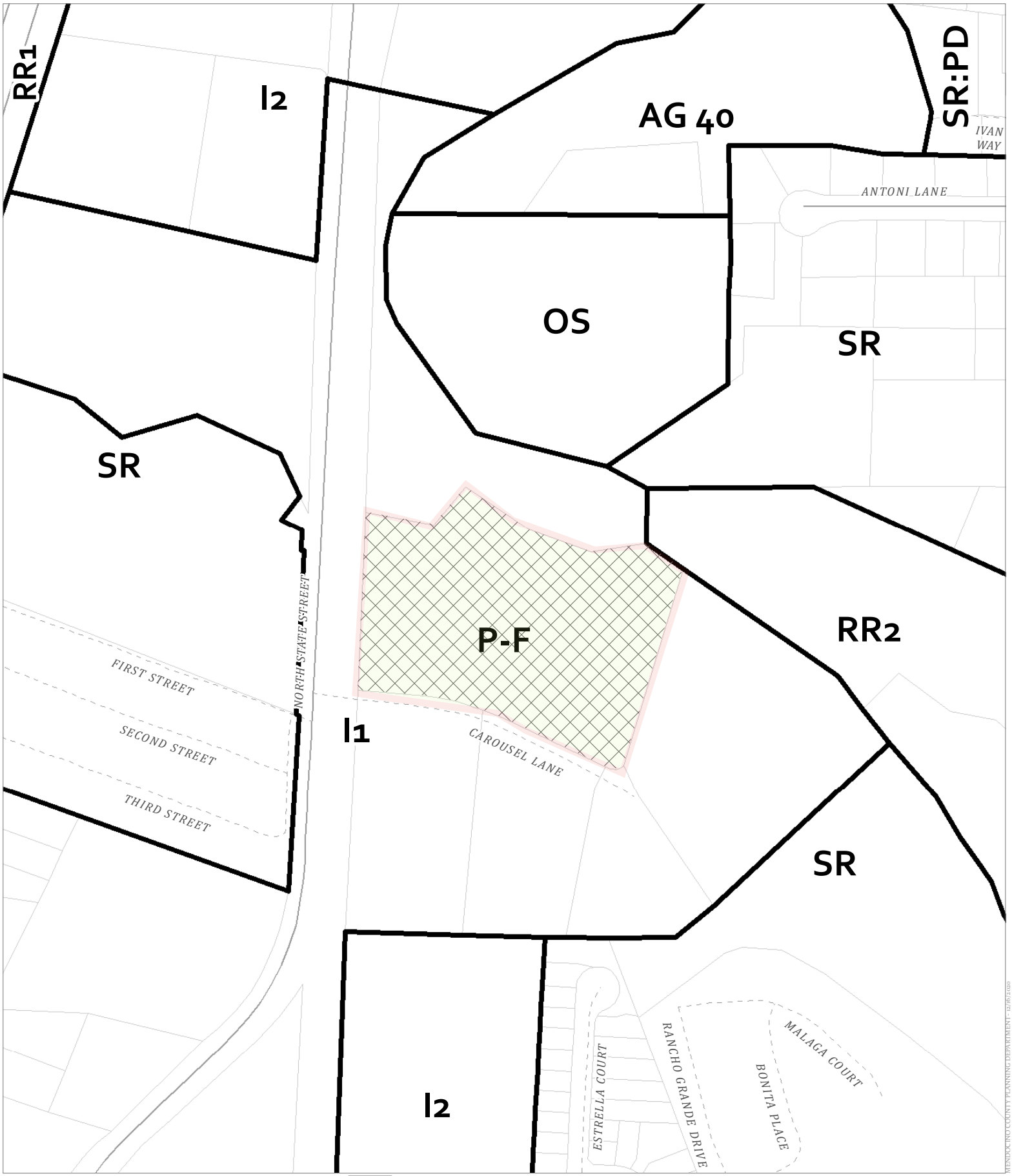


CASE: File No. 25-001107
OWNER: City of Ukiah
APN: 167-280-15
APLCT: City of Ukiah
AGENT: N/A
ADDRESS: 1 Carousel Lane, Ukiah

Named Rivers
Public Roads

0 75 150 Feet
0 0.0125 0.025 Miles
1:1,800

AERIAL IMAGERY



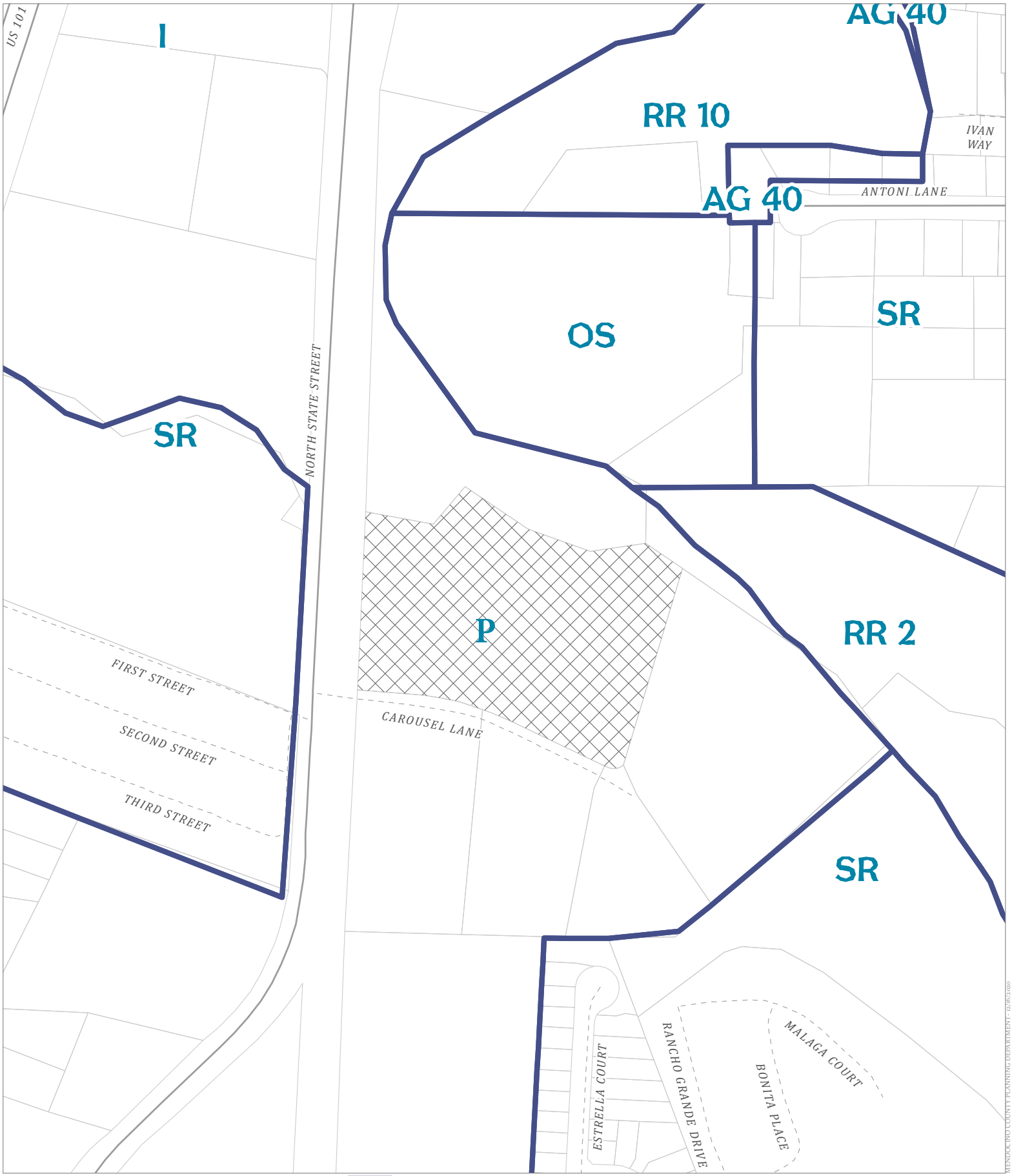
CASE: File No. 25-001107
OWNER: City of Ukiah
APN: 167-280-15
APLCT: City of Ukiah
AGENT: N/A
ADDRESS: 1 Carousel Lane, Ukiah

County Zoning Districts
Public Roads
City Prezone Designation

0 150 300 Feet
0 0.025 0.05 Miles
1:3,600

PREZONE DISPLAY MAP

MENDOCINO COUNTY PLANNING DEPARTMENT - 02/06/2026



CASE: File No. 25-001107
OWNER: City of Ukiah
APN: 167-280-15
APLCT: City of Ukiah
AGENT: N/A
ADDRESS: 1 Carousel Lane, Ukiah

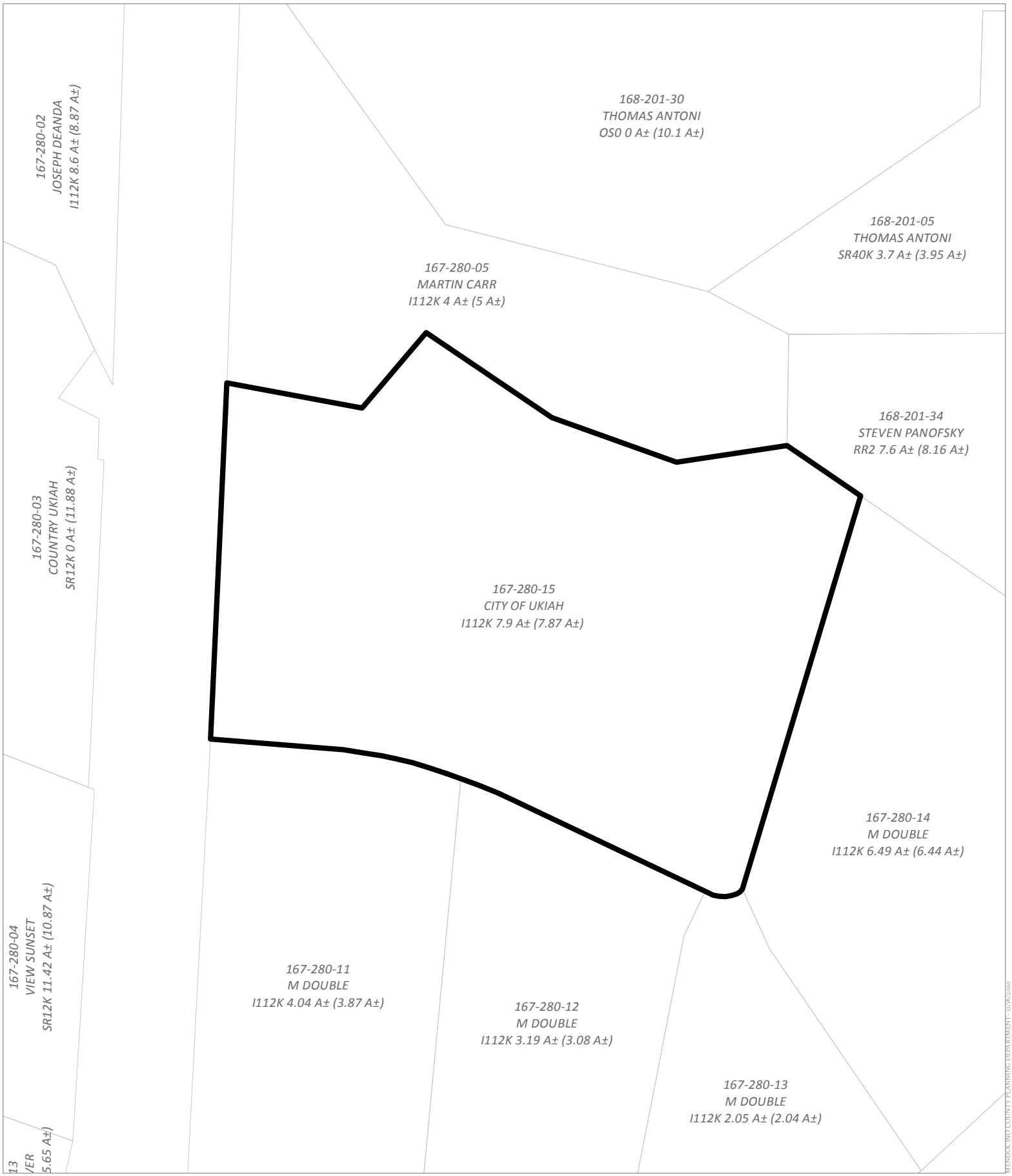
General Plan Classes

Public Roads

0 150 300 Feet
0 0.025 0.05 Miles
1:3,600

PROPOSED GENERAL PLAN CLASSIFICATIONS

MENDOCINO COUNTY PLANNING DEPARTMENT - 02/06/2026

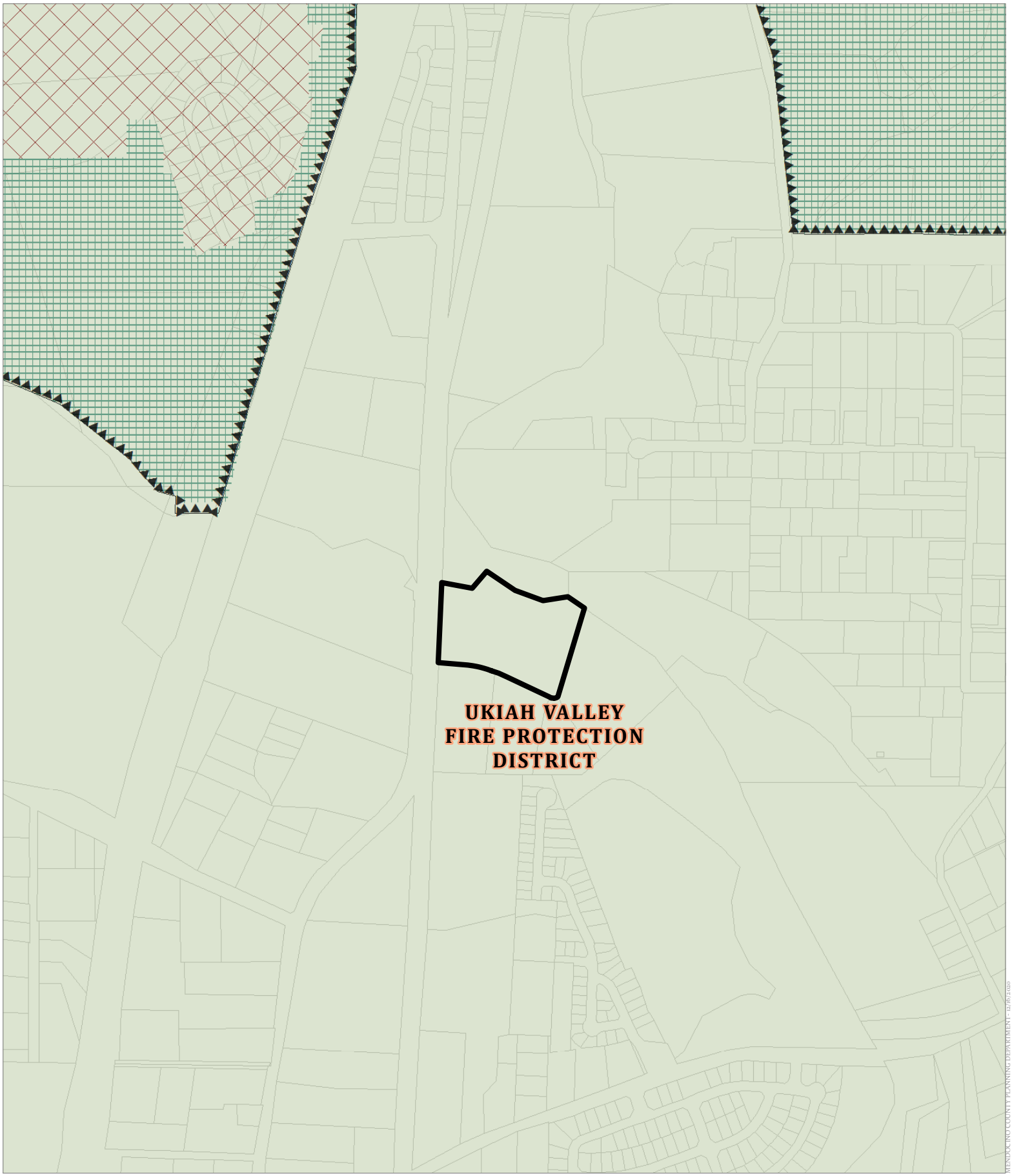


CASE: File No. 25-001107
OWNER: City of Ukiah
APN: 167-280-15
APLCT: City of Ukiah
AGENT: N/A
ADDRESS: 1 Carousel Lane, Ukiah

0 75 150 Feet
0 0.0125 0.025 Miles
1:1,800

ADJACENT PARCELS

MENDOCINO COUNTY PLANNING DEPARTMENT - 02/06/2026



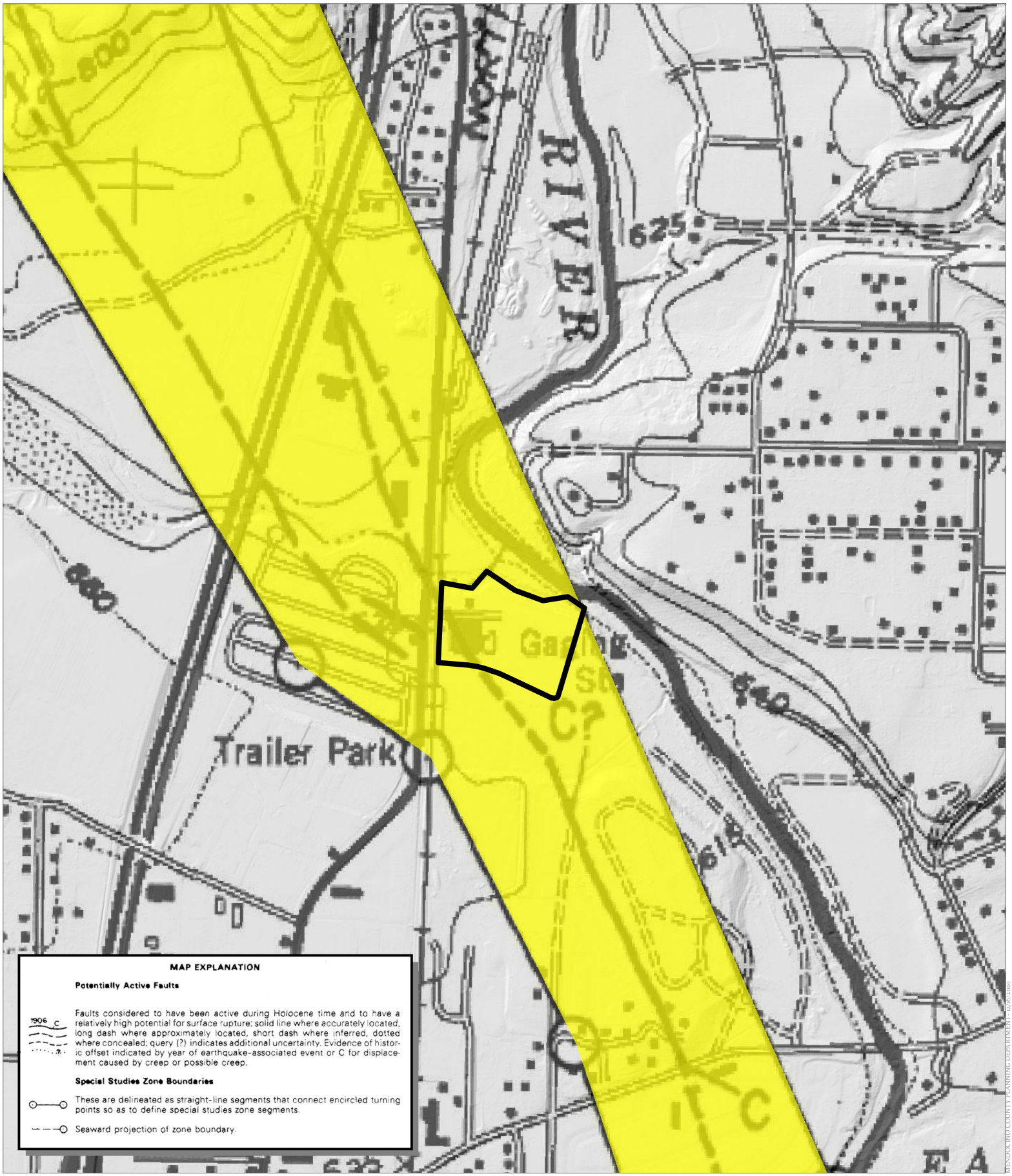
CASE: DR 2020-0001
OWNER: AE Carousel LP
APN: 167-280-15
APLCT: Vital Garden Supply
AGENT: Kent Borowick
ADDRESS: 1 Carousel Lane, Ukiah

High Fire Hazard
Moderate Fire Hazard
County Fire Districts
LRA

0 335 670 Feet
0 0.05 0.1 Miles
1:8,000

FIRE RESPONSIBILITY AREAS
LOCAL RESPONSIBILITY AREA

MENDOCINO COUNTY PLANNING DEPARTMENT - 02/06/2020

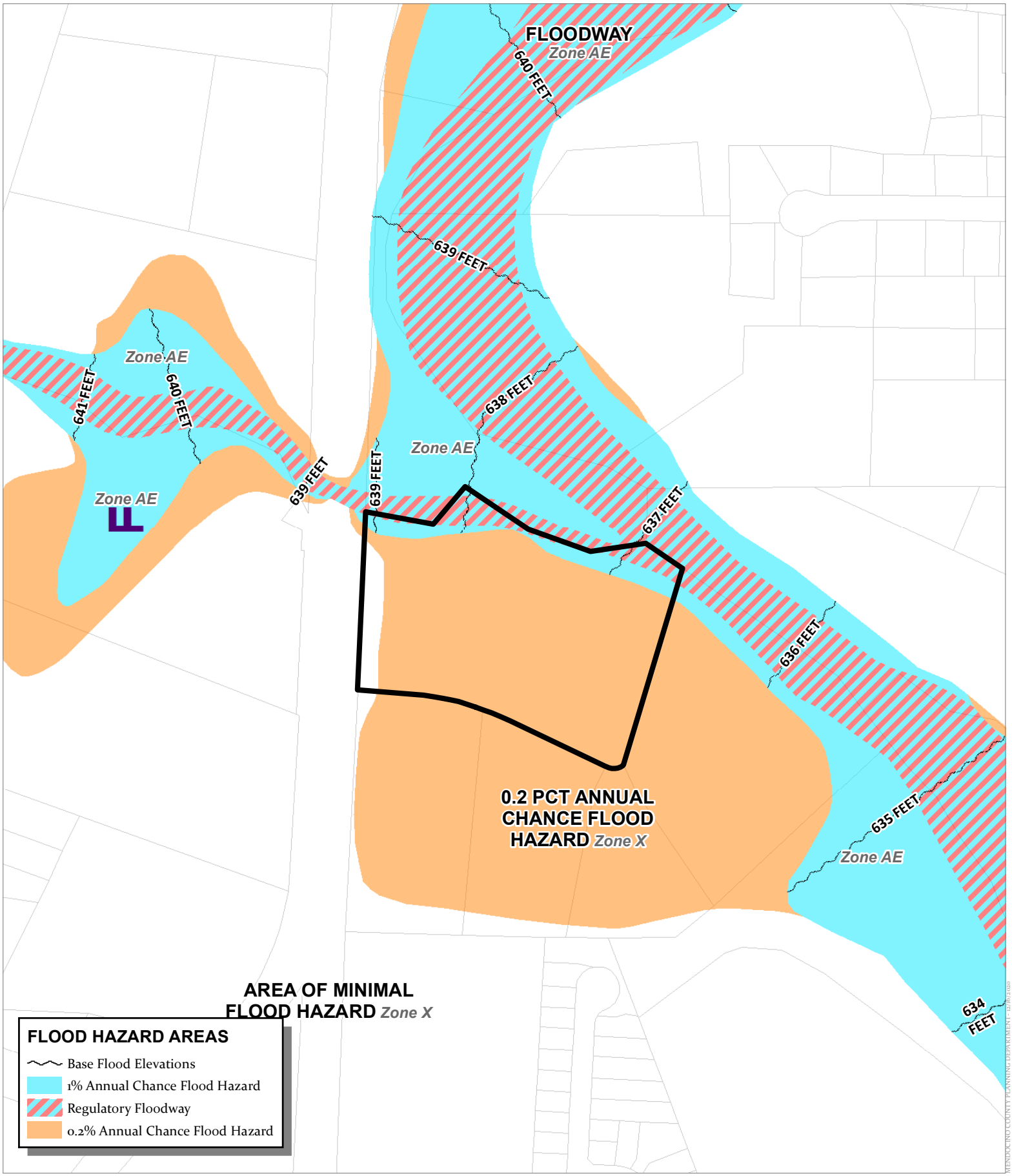


CASE: File No. 25-001107
OWNER: City of Ukiah
APN: 167-280-15
APLCT: City of Ukiah
AGENT: N/A
ADDRESS: 1 Carousel Lane, Ukiah

Maacama Fault Zone

0 335 670 Feet
0 0.05 0.1 Miles
1:8,000

EARTHQUAKE FAULT ZONES



CASE: File No. 25-001107
OWNER: City of Ukiah
APN: 167-280-15
APLCT: City of Ukiah
AGENT: N/A
ADDRESS: 1 Carousel Lane, Ukiah

SPECIAL FLOOD HAZARD AREAS

167-28

154-020
154-037

N
1"= 200'

Fr. Lot 140, Yokayo Rancho

Parcel Map C2 D29 P48

Bk 169

Bk 168 20

(26)

(1) 4.63 A±

(2) 8.6 A±

(3) 11.86 A±

(4) 11.42 A±

(5)

(11) Pcl.1 4.04 A±

(12) Pcl.2 3.19 A±

(13) Pcl.3 2.05 A±

(14) Pcl.4 6.49 A±

(15) 7.9 A±

LOT 140

N20°E 660'

S16°46'14"W 500.10'

N50°50'36"W 210.72'

S37°12'19"W 105.94'

34.73'

275.0'

S17°55'W 203.0'

227+00.0

225+00.0

220+00.0

85.22' 87.86'

700.0'

321.02'

N18°44'07"E 293.54'

N18°18'42"E 52.58'

N16°44'14"W 778.94'

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℄ YORK CREEK

N32°35'40"W 142.22'

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104

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S33°02'E 200.66'

+152.19'

702.19'

582.19'

S60°48'54"W 550.8'

334.63'

75.0'

60.0'

43.8'

43.21'

157.34'

105'

C2 D16 P61

C2 D5 P2

C2 D29 P48

N69°35'31"W 1059.17'

S02°54'35"W 2083.79

198.96'

N69°35'31"W 1164.60'

466.57'

N04°05'30"E 603.02'

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798.20' 258.20'

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"AR"

1028.02'

112'

196.32'

398.99'

91.63'

239.08'

489.43'

3999

3900

3800

3901

N.W.P.R.R.

NORTH STATE STREET

RUSSIAN RIVER

WEST BRANCH

101

26535-61

154-020 154-037

12-8-89
3-21-91

NOTE: This map was prepared for assessment purposes only. No liability is assumed for the data delineated hereon.

Assessor's Map
County of Mendocino, Calif.
March 1967

Carousel Lane Property

1 Carousel Lane

Ukiah, CA 95482

Inquiry Number: 7951457.8

April 09, 2025

The EDR Aerial Photo Decade Package

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

EDR Aerial Photo Decade Package

04/09/25

Site Name:

Carousel Lane Property
1 Carousel Lane
Ukiah, CA 95482
EDR Inquiry # 7951457.8

Client Name:

EBA Engineering
825 Sonoma Avenue
Santa Rosa, CA 95404
Contact: Kevin Coker

Environmental Data Resources, Inc. (EDR) Aerial Photo Decade Package is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's professional researchers provide digitally reproduced historical aerial photographs, and when available, provide one photo per decade.

Search Results:

Year	Scale	Details	Source
2020	1"=500'	Flight Year: 2020	USDA/NAIP
2016	1"=500'	Flight Year: 2016	USDA/NAIP
2012	1"=500'	Flight Year: 2012	USDA/NAIP
2009	1"=500'	Flight Year: 2009	USDA/NAIP
2006	1"=500'	Flight Year: 2006	USDA/NAIP
1993	1"=500'	Acquisition Date: July 11, 1993	USGS/DOQQ
1983	1"=500'	Flight Date: September 09, 1983	USDA
1976	1"=500'	Flight Date: July 22, 1976	USGS
1963	1"=500'	Flight Date: August 04, 1963	USGS
1952	1"=500'	Flight Date: July 15, 1952	USDA
1941	1"=500'	Flight Date: October 09, 1941	USDA

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INQUIRY #: 7951457.8
YEAR: 2020
= 500'
N
EDR


INQUIRY #: 7951457.8
YEAR: 2016
= 500'
N
EDR


INQUIRY #: 7951457.8
YEAR: 2012
= 500'
N
EDR


INQUIRY #: 7951457.8
YEAR: 2009
= 500'
N
EDR


INQUIRY #: 7951457.8
YEAR: 2006
= 500'
N
EDR



INQUIRY #: 7951457.8

YEAR: 1993

= 500'

N

EDR



INQUIRY #: 7951457.8

YEAR: 1983

= 500'

N

EDR



INQUIRY #: 7951457.8

YEAR: 1976

= 500'

N

EDR



INQUIRY #: 7951457.8

YEAR: 1963

= 500'

N

EDR



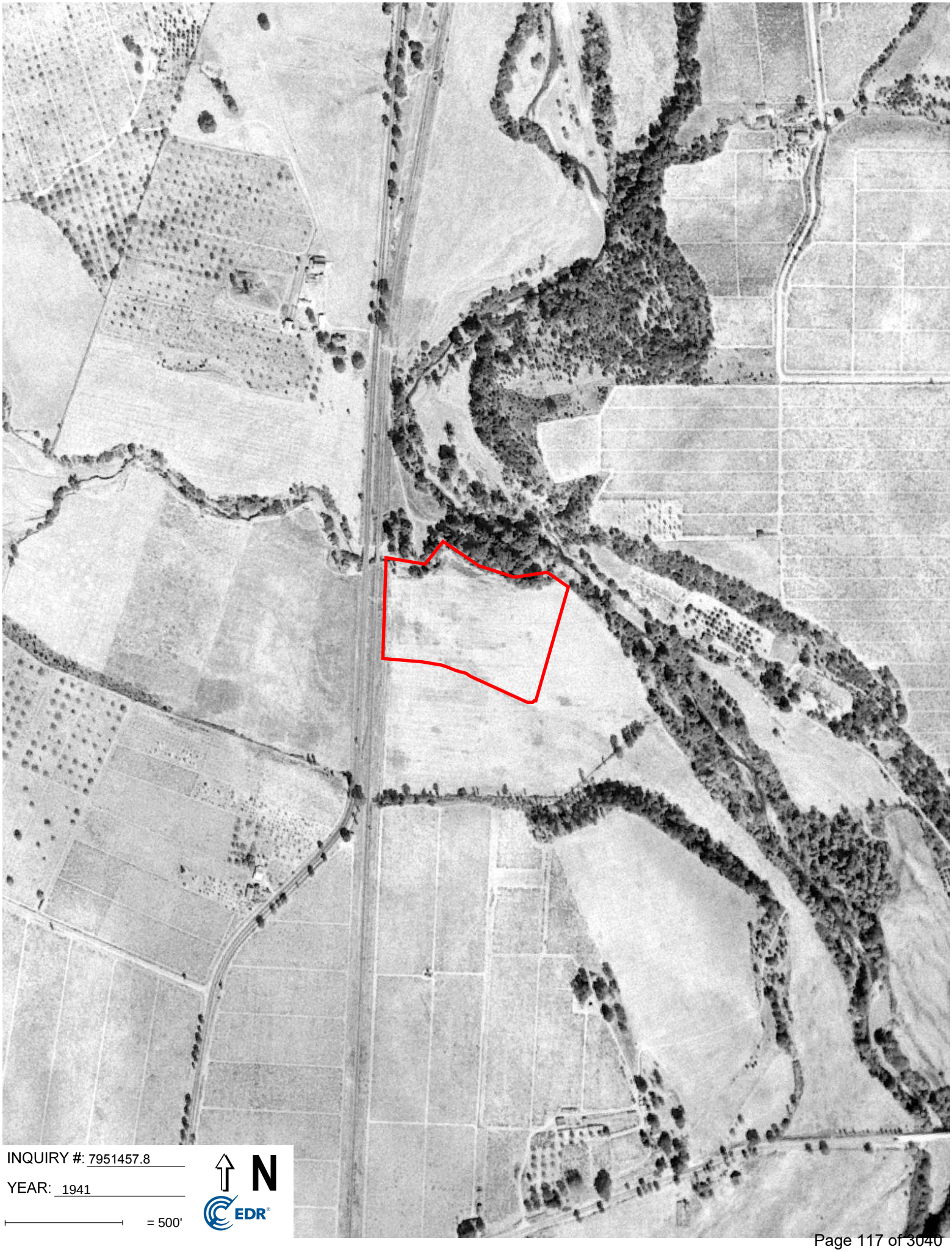
INQUIRY #: 7951457.8

YEAR: 1952

= 500'

N

EDR



INQUIRY #: 7951457.8

YEAR: 1941

= 500'

N

EDR

Carousel Lane Property

1 Carousel Lane

Ukiah, CA 95482

Inquiry Number: 7951457.4

April 08, 2025

EDR Historical Topo Map Report

with QuadMatch™

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

EDR Historical Topo Map Report

04/08/25

Site Name:

Carousel Lane Property
1 Carousel Lane
Ukiah, CA 95482
EDR Inquiry # 7951457.4

Client Name:

EBA Engineering
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Santa Rosa, CA 95404
Contact: Kevin Coker

EDR Topographic Map Library has been searched by EDR and maps covering the target property location as provided by EBA Engineering were identified for the years listed below. EDR's Historical Topo Map Report is designed to assist professionals in evaluating potential liability on a target property resulting from past activities. EDRs Historical Topo Map Report includes a search of a collection of public and private color historical topographic maps, dating back to the late 1800s.

Search Results:

P.O.# 25-3730

Project: Carousel Lane Property

Coordinates:

Latitude:	39.201723 39° 12' 6" North
Longitude:	-123.20218 -123° 12' 8" West
UTM Zone:	Zone 10 North
UTM X Meters:	482542.69
UTM Y Meters:	4339181.86
Elevation:	628.33' above sea level

Maps Provided:

2022
2018
2015
2012
1975
1958
1947

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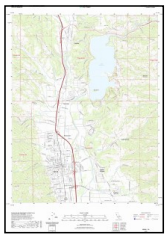
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Topo Sheet Key

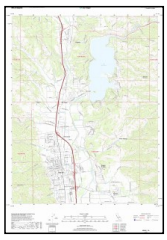
This EDR Topo Map Report is based upon the following USGS topographic map sheets.

2022 Source Sheets



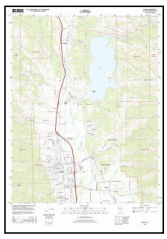
Ukiah
2022
7.5-minute, 24000

2018 Source Sheets



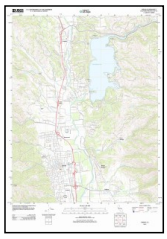
Ukiah
2018
7.5-minute, 24000

2015 Source Sheets



Ukiah
2015
7.5-minute, 24000

2012 Source Sheets

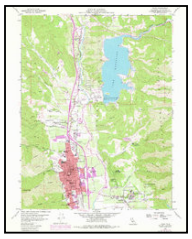


Ukiah
2012
7.5-minute, 24000

Topo Sheet Key

This EDR Topo Map Report is based upon the following USGS topographic map sheets.

1975 Source Sheets



Ukiah
1975
7.5-minute, 24000
Aerial Photo Revised 1975

1958 Source Sheets



Ukiah
1958
7.5-minute, 24000
Aerial Photo Revised 1957

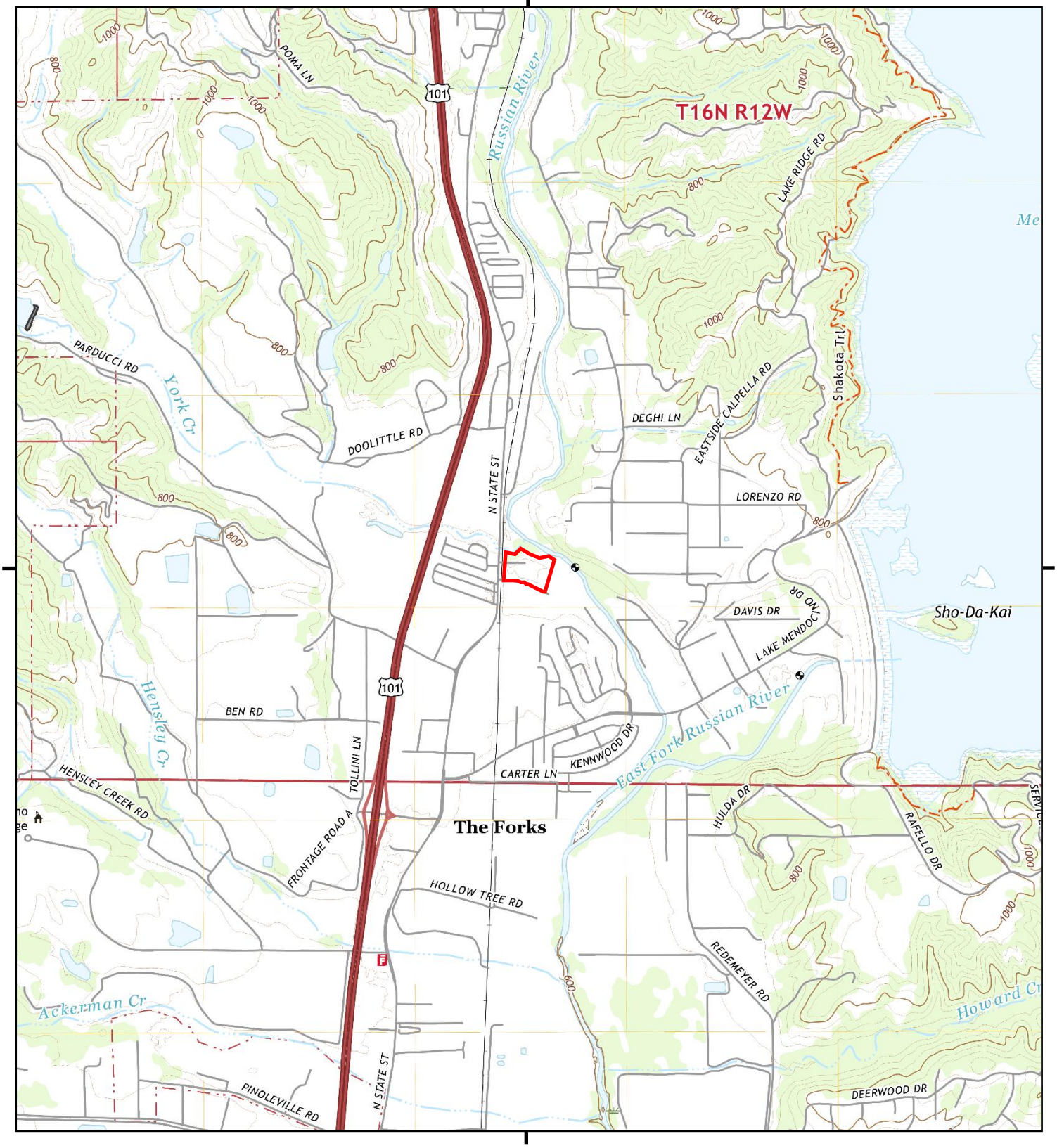
1947 Source Sheets



UKIAH
1947
15-minute, 50000

Historical Topo Map

2022



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

TP, Ukiah, 2022, 7.5-minute

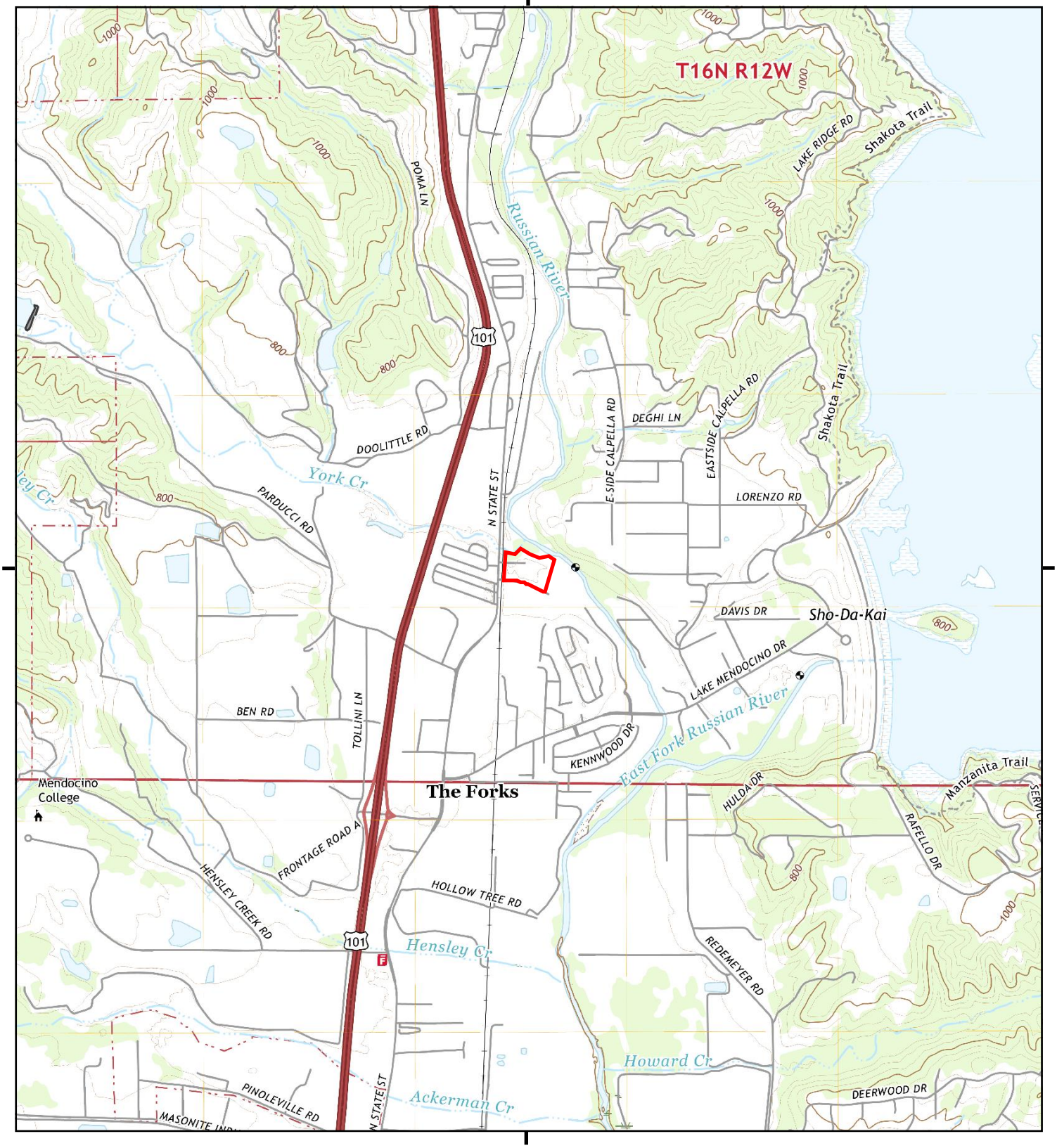
SITE NAME: Carousel Lane Property
ADDRESS: 1 Carousel Lane
Ukiah, CA 95482
CLIENT: EBA Engineering

N

7951457 - 4 0808-5

Historical Topo Map

2018



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

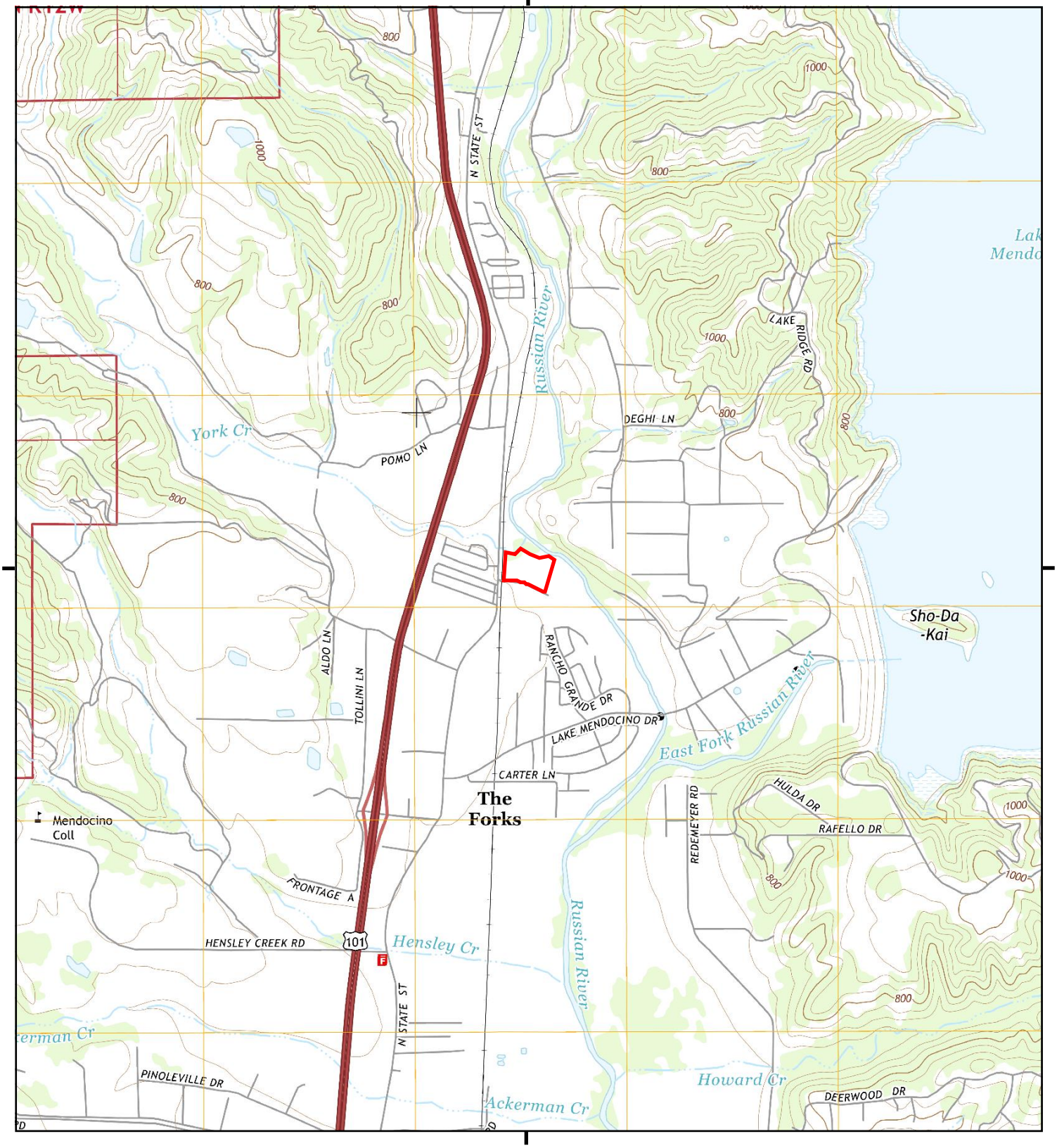
TP, Ukiah, 2018, 7.5-minute

SITE NAME: Carousel Lane Property
ADDRESS: 1 Carousel Lane
Ukiah, CA 95482
CLIENT: EBA Engineering

N

Historical Topo Map

2015



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

TP, Ukiah, 2015, 7.5-minute

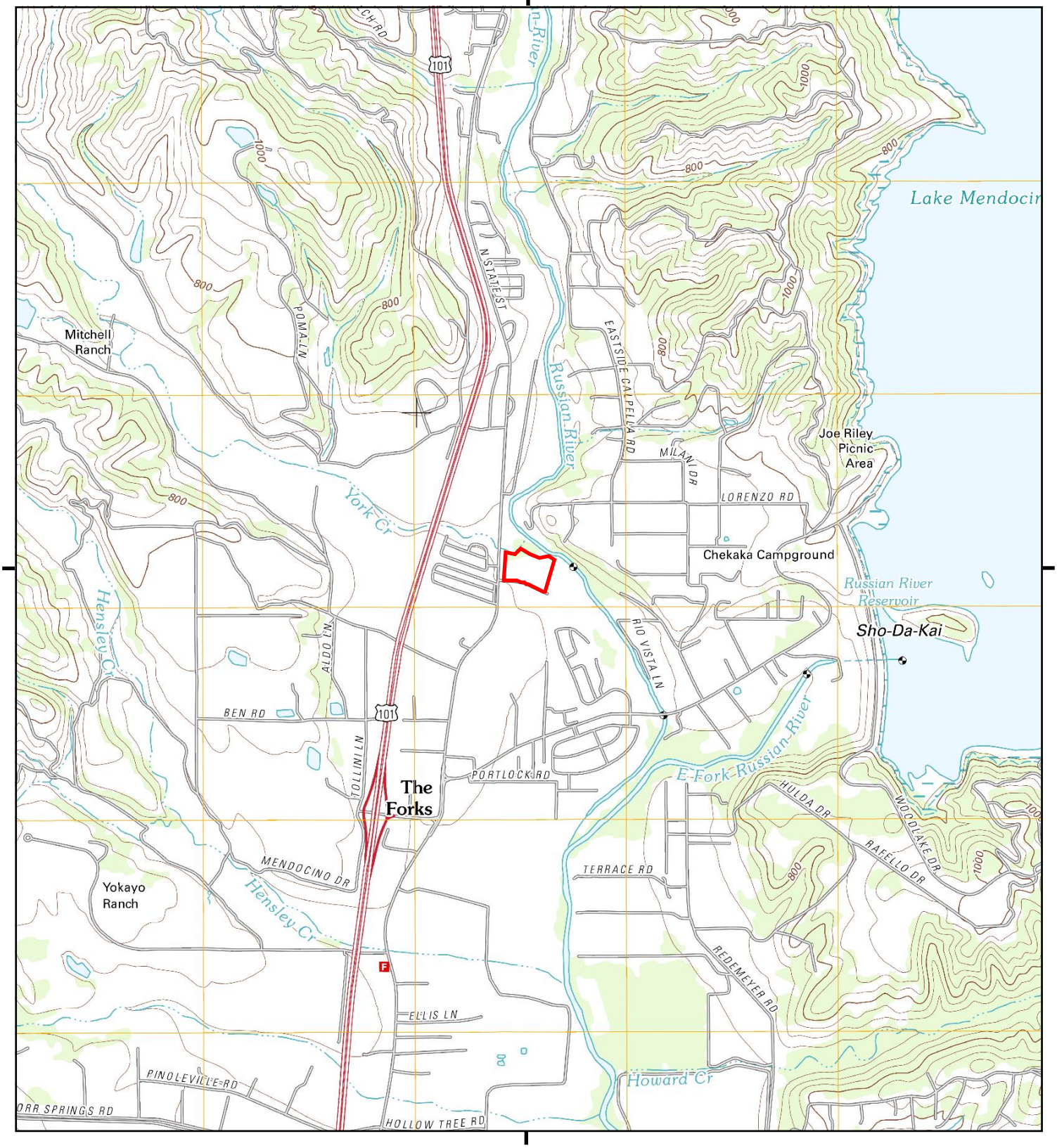
SITE NAME: Carousel Lane Property
ADDRESS: 1 Carousel Lane
Ukiah, CA 95482
CLIENT: EBA Engineering

N

7951457 - 4 0808.7

Historical Topo Map

2012



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

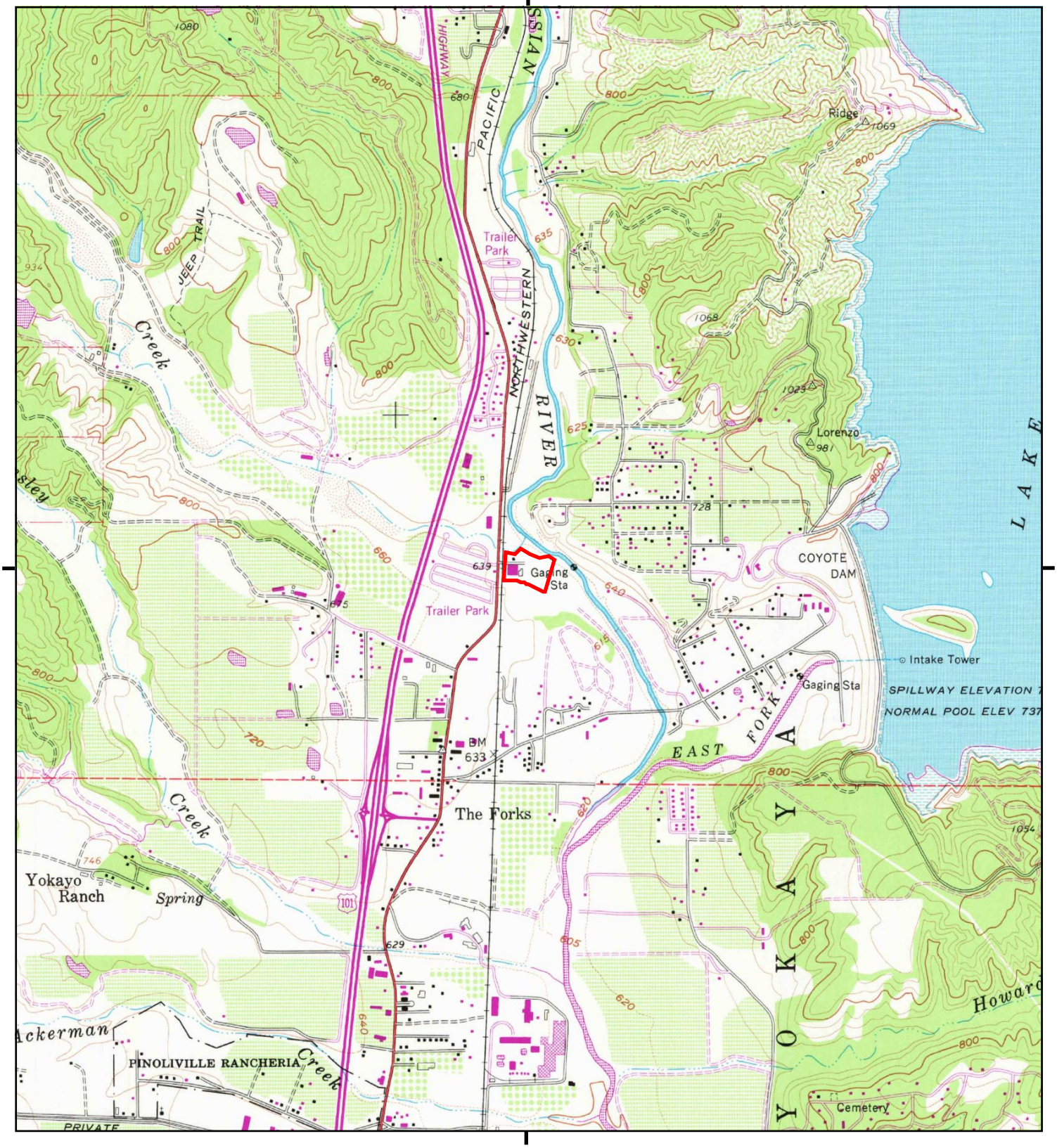
TP, Ukiah, 2012, 7.5-minute

SITE NAME: Carousel Lane Property
ADDRESS: 1 Carousel Lane
Ukiah, CA 95482
CLIENT: EBA Engineering

N

Historical Topo Map

1975



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

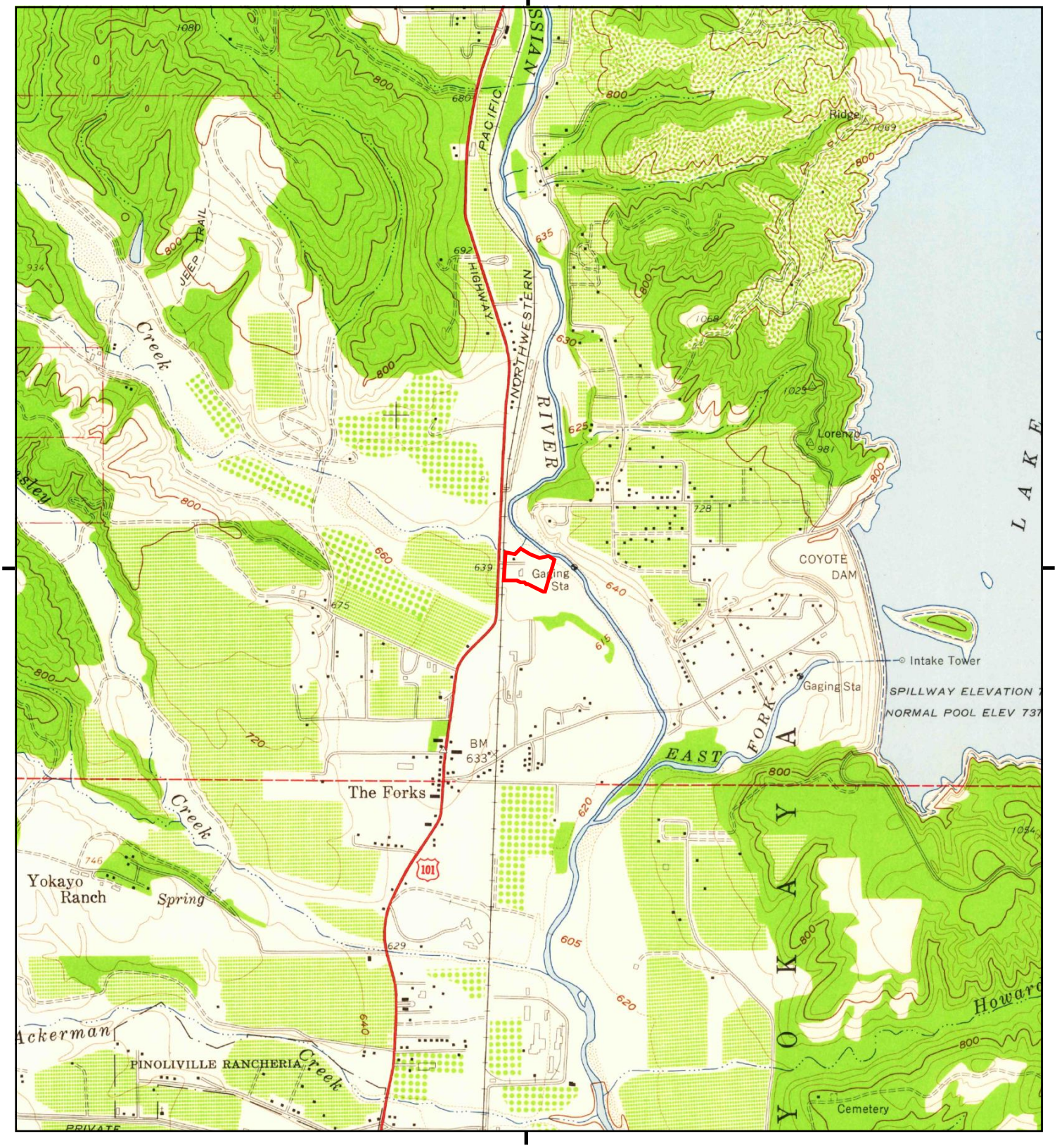
TP, Ukiah, 1975, 7.5-minute

SITE NAME: Carousel Lane Property
ADDRESS: 1 Carousel Lane
Ukiah, CA 95482
CLIENT: EBA Engineering

N

Historical Topo Map

1958



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

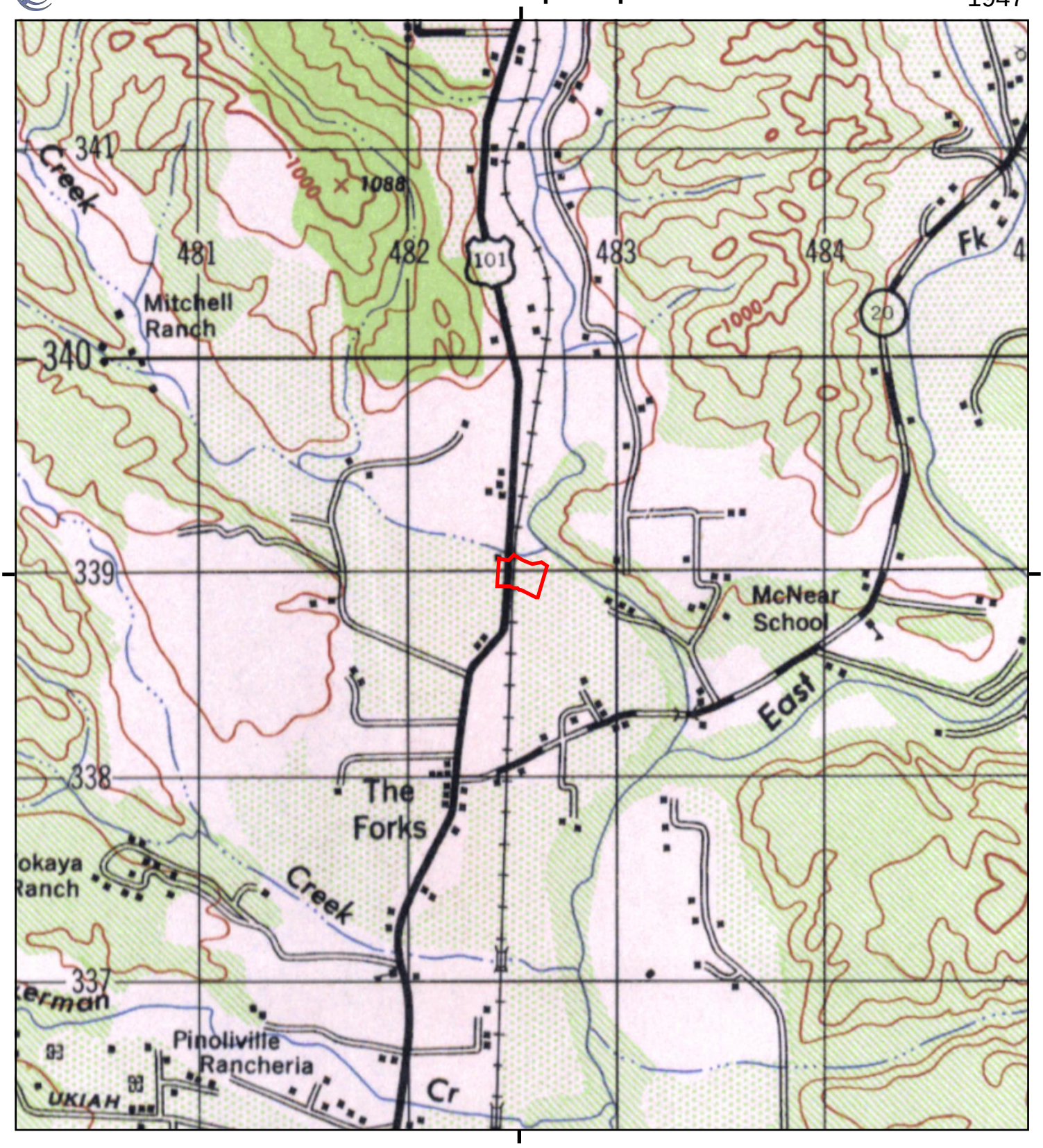
TP, Ukiah, 1958, 7.5-minute

SITE NAME: Carousel Lane Property
ADDRESS: 1 Carousel Lane
Ukiah, CA 95482
CLIENT: EBA Engineering

N

Historical Topo Map

1947



This report includes information from the following map sheet(s).

0 Miles 0.25 0.5 1 1.5

NW N NE
W E
SW S SE

TP, UKIAH, 1947, 15-minute

SITE NAME: Carousel Lane Property
ADDRESS: 1 Carousel Lane
Ukiah, CA 95482
CLIENT: EBA Engineering

N

Agenda Item No: 8.c.

MEETING DATE/TIME: 11/19/2025

ITEM NO: 2025-1282

City of Ukiah

AGENDA SUMMARY REPORT

SUBJECT: Approval of Contract Amendment with Ryan Jackson to Increase the Scope of Work by an Additional $40,000 to Revise the Total Not-to-Exceed Amount From $40,000 to $80,000, and Approve Corresponding Budget Amendment.

DEPARTMENT: Information Services **PREPARED BY:** Scott Shaver, I.T. Manager

PRESENTER: Consent Calendar

ATTACHMENTS:

1. Attachment 1 - Ryan Jackson - IT Support Services 2526-095 - Agreement
2. COU No 2526-095-A1

Summary: Council will consider approving a contract amendment with Ryan Jackson to increase the scope of work by an additional $40,000, revising the total not-to-exceed amount from $40,000 to $80,000, and approving a corresponding budget amendment.

Background: The City has procured Information Technology consulting services with Ryan Jackson in a previously executed agreement (Attachment 1). This agreement was executed on July 1, 2025, to provide a scope of specialized Information Technology services not to exceed $40,000.

Discussion: This proposed amendment (Attachment 2) revises the Agreement for Professional services dated July 1, 2025, between the City of Ukiah and Ryan Jackson for professional services relating to IT Support. This adds additional scope of work and increases the not-to-exceed amount by $40,000. This change updates the total not-to-exceed amount from $40,000 to $80,000. The purpose of this engagement is continued support of current projects and addresses immediate cybersecurity compliance and operational needs within the Ukiah Police Department (UPD) network infrastructure. This work will focus on the implementation, monitoring, and remediation of cybersecurity vulnerabilities and threats to meet Department of Justice (DOJ), California Law Enforcement Telecommunications System (CLETS), and Criminal Justice Information Services (CJIS) compliance requirements.

A corresponding budget amendment is requested to fund this additional work, paid out of additional use of reserves in the IT fund and the reduction in budget for the network rebuild capital project.

Staff requests Council approve a contract amendment with Ryan Jackson to increase the scope of work by an additional $40,000, revising the total not-to-exceed amount from $40,000 to $80,000, and approve a corresponding budget amendment.

Recommended Action: Approve a contract amendment with Ryan Jackson to increase the scope of work by an additional $40,000 to revise the total not-to-exceed amount from $40,000 to $80,000, and approve corresponding budget amendment.

BUDGET AMENDMENT REQUIRED: Yes

CURRENT BUDGET AMOUNT: 20913930.52100: $0; 20913940.52100: $0; 20913950.52100: $0; 20913940.80100.18493: $260,963

PROPOSED BUDGET AMOUNT: 20913930.52100: $8,000; 20913940.52100: $16,000; 20913950.52100: $16,000; 20913940.80100.18493: $245,963

FINANCING SOURCE: IT fund reserves

REVENUE: No GRANT: No

PREVIOUS CONTRACT/PURCHASE ORDER NO.:COU No 2526-095

COORDINATED WITH:

STRATEGIC PLAN (SP):

CLIMATE INITIATIVES (CI):

GENERAL PLAN ELEMENTS (GP):

Approved: Sage Sangiacomo, City Manager

AGREEMENT FOR PROFESSIONAL CONSULTING SERVICES

This Agreement, made and entered into this 1st day of July, 2025 (“Effective Date”), by and between CITY OF UKIAH, CALIFORNIA, hereinafter referred to as "City" and Ryan Jackson, a sole proprietor organized and in good standing under the laws of the state of California, hereinafter referred to as "Consultant".

RECITALS

This Agreement is predicated on the following facts:

a. City requires consulting services related to IT Support Services.

b. Consultant represents that it has the qualifications, skills, experience and properly licensed to provide these services, and is willing to provide them according to the terms of this Agreement.

c. City and Consultant agree upon the Scope-of-Work and Work Schedule attached hereto as Attachment "A", describing contract provisions for the project and setting forth the completion dates for the various services to be provided pursuant to this Agreement.

TERMS OF AGREEMENT

1.0 DESCRIPTION OF PROJECT

1.1 The Project is described in detail in the attached Scope-of-Work (Attachment "A").

2.0 SCOPE OF SERVICES

2.1 As set forth in Attachment "A".

2.2. Additional Services. Additional services, if any, shall only proceed upon written agreement between City and Consultant. The written Agreement shall be in the form of an Amendment to this Agreement.

3.0 CONDUCT OF WORK

3.1 Time of Completion. Consultant shall commence performance of services as required by the Scope-of-Work upon receipt of a Notice to Proceed from City and shall complete such services by 6/30/26. Consultant shall complete the work to the City's reasonable satisfaction, even if contract disputes arise or Consultant contends it is entitled to further compensation.

4.0 COMPENSATION FOR SERVICES

4.1 Basis for Compensation. For the performance of the professional services of this Agreement, Consultant shall be compensated on a time and expense basis not to

exceed a guaranteed maximum dollar amount of $40,000. Labor charges shall be based upon hourly billing rates for the various classifications of personnel employed by Consultant to perform the Scope of Work as set forth in the attached Attachment A, which shall include all indirect costs and expenses of every kind or nature, except direct expenses. The direct expenses and the fees to be charged for same shall be as set forth in Attachment A. Consultant shall complete the Scope of Work for the not-to-exceed guaranteed maximum, even if actual time and expenses exceed that amount.

4.2 Changes. Should changes in compensation be required because of changes to the Scope-of-Work of this Agreement, the parties shall agree in writing to any changes in compensation. "Changes to the Scope-of-Work" means different activities than those described in Attachment "A" and not additional time to complete those activities than the parties anticipated on the date they entered this Agreement.

4.3 Sub-contractor Payment. The use of sub-consultants or other services to perform a portion of the work of this Agreement shall be approved by City prior to commencement of work. The cost of sub-consultants shall be included within guaranteed not-to-exceed amount set forth in Section 4.1.

4.4 Terms of Payment. Payment to Consultant for services rendered in accordance with this contract shall be based upon submission of monthly invoices for the work satisfactorily performed prior to the date of the invoice less any amount already paid to Consultant, which amounts shall be due and payable thirty (30) days after receipt by City. The invoices shall provide a description of each item of work performed, the time expended to perform each task, the fees charged for that task, and the direct expenses incurred and billed for. Invoices shall be accompanied by documentation sufficient to enable City to determine progress made and to support the expenses claimed.

5.0 ASSURANCES OF CONSULTANT

5.1 Independent Contractor. Consultant is an independent contractor and is solely responsible for its acts or omissions. Consultant (including its agents, servants, and employees) is not the City's agent, employee, or representative for any purpose.

It is the express intention of the parties hereto that Consultant is an independent contractor and not an employee, joint venturer, or partner of City for any purpose whatsoever. City shall have no right to, and shall not control the manner or prescribe the method of accomplishing those services contracted to and performed by Consultant under this Agreement, and the general public and all governmental agencies regulating such activity shall be so informed.

Those provisions of this Agreement that reserve ultimate authority in City have been inserted solely to achieve compliance with federal and state laws, rules, regulations, and interpretations thereof. No such provisions and no other provisions of this Agreement shall be interpreted or construed as creating or establishing the relationship of employer and employee between Consultant and City.

Consultant shall pay all estimated and actual federal and state income and self-employment taxes that are due the state and federal government and shall furnish and pay worker's compensation insurance, unemployment insurance and any other benefits required by law for himself and his employees, if any. Consultant agrees to indemnify and hold City and its officers, agents and employees harmless from and against any claims or demands by federal, state or local government agencies for any such taxes or

benefits due but not paid by Consultant, including the legal costs associated with defending against any audit, claim, demand or law suit.Consultant warrants and represents that it is a properly licensed professional or professional organization with a substantial investment in its business and that it maintains its own offices and staff which it will use in performing under this Agreement.

5.2 Conflict of Interest. Consultant understands that its professional responsibility is solely to City. Consultant has no interest and will not acquire any direct or indirect interest that would conflict with its performance of the Agreement. Consultant shall not in the performance of this Agreement employ a person having such an interest. If the City Manager determines that the Consultant has a disclosure obligation under the City's local conflict of interest code, the Consultant shall file the required disclosure form with the City Clerk within 10 days of being notified of the City Manager's determination.

6.0 INDEMNIFICATION

6.1 Insurance Liability. Without limiting Consultant's obligations arising under Paragraph 6.2 Consultant shall not begin work under this Agreement until it procures and maintains for the full period of time allowed by law, surviving the termination of this Agreement insurance against claims for injuries to persons or damages to property, which may arise from or in connection with its performance under this Agreement.

A. Minimum Scope of Insurance

Coverage shall be at least as broad as:

1. Insurance Services Office ("ISO) Commercial General Liability Coverage Form No. CG 20 10 10 01 and Commercial General Liability Coverage – Completed Operations Form No. CG 20 37 10 01.

2. ISO Form No. CA 0001 (Ed. 1/87) covering Automobile Liability, Code 1 "any auto" or Code 8, 9 if no owned autos and endorsement CA 0025.

3. Worker's Compensation Insurance as required by the Labor Code of the State of California and Employers Liability Insurance.

4. Errors and Omissions liability insurance appropriate to the consultant's profession. Architects' and engineers' coverage is to be endorsed to include contractual liability.

B. Minimum Limits of Insurance

Consultant shall maintain limits no less than:

1. General Liability: $1,000,000 combined single limit per occurrence for bodily injury, personal injury and property damage including operations, products and completed operations. If Commercial General Liability Insurance or other form with a general aggregate limit is used, the general aggregate limit shall apply separately to the work performed under this Agreement, or the aggregate limit shall be twice the prescribed per occurrence limit.

2. Automobile Liability: $1,000,000 combined single limit per accident for

bodily injury and property damage.

3. Worker's Compensation and Employers Liability: Worker's compensation limits as required by the Labor Code of the State of California and Employers Liability limits of $1,000,000 per accident.

4. Errors and Omissions liability: $1,000,000 per occurrence.

C. Deductibles and Self-Insured Retentions

Any deductibles or self-insured retentions must be declared to and approved by the City. At the option of the City, either the insurer shall reduce or eliminate such deductibles or self-insured retentions as respects to the City, its officers, officials, employees and volunteers; or the Consultant shall procure a bond guaranteeing payment of losses and related investigations, claim administration and defense expenses.

D. Other Insurance Provisions

The policies are to contain, or be endorsed to contain, the following provisions:

1. General Liability and Automobile Liability Coverages

a. The City, it officers, officials, employees and volunteers are to be covered as additional insureds as respects; liability arising out of activities performed by or on behalf of the Consultant, products and completed operations of the Consultant, premises owned, occupied or used by the Consultant, or automobiles owned, hired or borrowed by the Consultant for the full period of time allowed by law, surviving the termination of this Agreement. The coverage shall contain no special limitations on the scope-of-protection afforded to the City, its officers, officials, employees or volunteers.

b. The Consultant's insurance coverage shall be primary insurance as respects to the City, its officers, officials, employees and volunteers. Any insurance or self-insurance maintained by the City, its officers, officials, employees or volunteers shall be in excess of the Consultant's insurance and shall not contribute with it.

c. Any failure to comply with reporting provisions of the policies shall not affect coverage provided to the City, its officers, officials, employees or volunteers.

d. The Consultant's insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respect to the limits of the insurer's liability.

2. Worker's Compensation and Employers Liability Coverage

The insurer shall agree to waive all rights of subrogation against the City, its officers, officials, employees and volunteers for losses arising from Consultant's performance of the work, pursuant to this Agreement.

~~3. Professional Liability Coverage~~

~~If written on a claims-made basis, the retroactivity date shall be the effective date of this Agreement. The policy period shall extend one (1) year from the date of final approved invoice.~~

~~4. All Coverages~~

~~Each Insurance policy required by this clause shall be endorsed to state that coverage shall not be suspended, voided, canceled by either party, reduced in coverage or in limits except after thirty (30) days prior written notice by certified mail, return receipt requested, has been given to the City.~~

~~E. Acceptability of Insurers~~

~~Insurance is to be placed with admitted California insurers with an A.M. Best's rating of no less than A- for financial strength, AA for long-term credit rating and AMB-1 for short-term credit rating.~~

~~F. Verification of Coverage~~

~~Consultant shall furnish the City with Certificates of Insurance and with original Endorsements effecting coverage required by this Agreement. The Certificates and Endorsements for each insurance policy are to be signed by a person authorized by that insurer to bind coverage on its behalf. The Certificates and Endorsements are to be on forms provided or approved by the City. Where by statute, the City's Workers' Compensation - related forms cannot be used, equivalent forms approved by the Insurance Commissioner are to be substituted. All Certificates and Endorsements are to be received and approved by the City before Consultant begins the work of this Agreement. The City reserves the right to require complete, certified copies of all required insurance policies, at any time. If Consultant fails to provide the coverages required herein, the City shall have the right, but not the obligation, to purchase any or all of them. In that event, the cost of insurance becomes part of the compensation due the contractor after notice to Consultant that City has paid the premium.~~

~~G. Subcontractors~~

~~Consultant shall include all subcontractors or sub-consultants as insured under its policies or shall furnish separate certificates and endorsements for each sub-contractor or sub-consultant. All coverage for sub-contractors or sub-consultants shall be subject to all insurance requirements set forth in this Paragraph 6.1.~~

6.2 Indemnification. Consultant shall hold harmless, defend and indemnify City its officers, officials, employees and volunteers from and against all claims, damages, losses and expenses including attorney fees which actually or allegedly arise out of the performance of the work described herein, caused in whole or in part by any negligent act or omission of the consultant, any subcontractor, anyone directly or indirectly employed by any of them or anyone for whose acts any of them may be liable, except where caused by the active negligence, sole negligence, or willful misconduct of City its officers, officials, employees and volunteers.

References in this paragraph to City or Consultant, include their officers, employees, agents, and subcontractors.

7.0 CONTRACT PROVISIONS

7.1 Ownership of Work. All documents furnished to Consultant by City and all documents or reports and supportive data prepared by Consultant under this Agreement are owned and become the property of the City upon their creation and shall be given to City immediately upon demand and at the completion of Consultant's services at no additional cost to City. Deliverables are identified in the Scope-of-Work, Attachment "A". All documents produced by Consultant shall be furnished to City in digital format and hardcopy. Consultant shall produce the digital format, using software and media approved by City.

7.2 Governing Law. Consultant shall comply with the laws and regulations of the United States, the State of California, and all local governments having jurisdiction over this Agreement. The interpretation and enforcement of this Agreement shall be governed by California law and any action arising under or in connection with this Agreement must be filed in a Court of competent jurisdiction in Mendocino County.

7.3 Entire Agreement. This Agreement plus its Attachment(s) and executed Amendments set forth the entire understanding between the parties.

7.4 Severability. If any term of this Agreement is held invalid by a court of competent jurisdiction, the remainder of this Agreement shall remain in effect.

7.5 Modification. No modification of this Agreement is valid unless made with the agreement of both parties in writing.

7.6 Assignment. Consultant's services are considered unique and personal. Consultant shall not assign, transfer, or sub-contract its interest or obligation under all or any portion of this Agreement without City's prior written consent.

7.7 Waiver. No waiver of a breach of any covenant, term, or condition of this Agreement shall be a waiver of any other or subsequent breach of the same or any other covenant, term or condition or a waiver of the covenant, term or condition itself.

7.8 Termination. This Agreement may only be terminated by either party: 1) for breach of the Agreement; 2) because funds are no longer available to pay Consultant for services provided under this Agreement; or 3) City has abandoned and does not wish to complete the project for which Consultant was retained. A party shall notify the other party of any alleged breach of the Agreement and of the action required to cure the breach. If the breaching party fails to cure the breach within the time specified in the notice, the contract shall be terminated as of that time. If terminated for lack of funds or abandonment of the project, the contract shall terminate on the date notice of termination is given to Consultant. City shall pay the Consultant only for services performed and expenses incurred as of the effective termination date. In such event, as a condition to payment, Consultant shall provide to City all finished or unfinished documents, data, studies, surveys, drawings, maps, models, photographs and reports prepared by the Consultant under this Agreement. Consultant shall be entitled to receive just and equitable compensation for any work satisfactorily completed hereunder, subject to off-set for any direct or consequential damages City may incur as

a result of Consultant's breach of contract.

7.9 Execution of Agreement. This Agreement may be executed in duplicate originals, each bearing the original signature of the parties. Alternatively, this Agreement may be executed and delivered by facsimile or other electronic transmission, and in more than one counterpart, each of which shall be deemed an original, and all of which together shall constitute one and the same instrument. When executed using either alternative, the executed agreement shall be deemed an original admissible as evidence in any administrative or judicial proceeding to prove the terms and content of this Agreement.

8.0 NOTICES

Any notice given under this Agreement shall be in writing and deemed given when personally delivered or deposited in the mail (certified or registered) addressed to the parties as follows:

CITY OF UKIAH
DEPT. OF FINANCE
300 SEMINARY AVENUE
UKIAH, CALIFORNIA 95482-5400

RYAN JACKSON
268 POMO DR
UKIAH CA 95482

9.0 SIGNATURES

IN WITNESS WHEREOF, the parties have executed this Agreement the Effective Date:

CONSULTANT

BY: _____ 08/06/2025
Date

PRINT NAME: Ryan Jackson

571-75-7915
IRS IDN Number

CITY OF UKIAH

BY: _____ 08/12/2025
Date

CITY MANAGER

ATTEST

Kristine Lawler
Kristine Lawler (Aug 13, 2025 07:46:23 PDT) 08/13/2025
Date

CITY CLERK

Statement of Work (SOW)
Network Redesign for the City of Ukiah
Consultant: Ryan Jackson

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1. Introduction

This Statement of Work (SOW) outlines the network redesign and infrastructure improvement project for the City of Ukiah. The work will be conducted by Ryan Jackson in a consulting capacity. The City IT department will be responsible for acquiring all necessary equipment. This document details the scope, objectives, deliverables, and responsibilities associated with this engagement.

2. Objectives

The primary objectives of this project are:

- Enhance security by routing all network traffic through the Palo Alto 880 Firewall.
- Modernize network infrastructure by replacing end-of-life equipment.
- Improve network segmentation and redundancy for reliability and security.
- Implement industry best practices where feasible.
- Standardize network configurations for consistency and ease of management.
- Upgrade wireless infrastructure with the vendor of choice.

3. Scope of Work

3.1 Critical Tasks

3.1.1 Network Flow Modification

- Transition from a Distribution/Core network design to a modified architecture.
- Ensure all network traffic is routed through the Palo Alto 880 Firewall to utilize features such as:
    - Antivirus
    - Monitoring
    - Wildfire threat intelligence
    - Intrusion Detection/Prevention Systems (IDS/IPS)

3.1.2 AT&T Connection Reconfiguration

- Reconfigure AT&T connection to flow directly into the Palo Alto 880 Firewall instead of the Main Distribution Frame (MDF) access-level switch.
- Ensure proper routing from the firewall to the Distribution Switch in the Server Room.

3.1.3 Switch Replacement

- Replace 12-15 end-of-life switches. (Potentially all switches pending board approval)
- Replace Distribution Stack with 9300-series switches already in stock.
- Move access-level connections off the Distribution Stack onto a dedicated access-level switch in the Server Room.

3.1.4 Standardization of Switch Configuration

- Implement industry best practices for switch configurations, including:
    - 802.1x authentication for VLAN assignment (requires new RADIUS server).
    - Port security to prevent cyber threats such as DHCP/DNS poisoning.
    - VLAN segmentation considerations while maintaining deployment feasibility.

3.1.5 Wireless Infrastructure Upgrade

- Assist with deployment of a new wireless infrastructure as per the vendor selected by the City.

3.1.6 Logical Segmentation for Police Department and City Networks

- Ensure complete logical separation between Police Department and City Networks using Palo Alto 880 Firewall, other than where absolutely needed for connectivity or functionality.

3.1.7 Firewall Replacement

- Replace Cisco firewalls with currently supported models.
- Upgrade Department of Justice Firewall and firewalls at North/South Fire Stations (End of Life 2026).

3.2 High Priority Tasks

3.2.1 Server Rack Rewiring and Cleanup

- Remove deprecated equipment.
- Re-cable main server rack as needed.

3.2.2 MDF Rack Removal & Fiber Network Integration

The MDF removal should only be accomplished after the new fiber project is complete to ensure a seamless transition and prevent disruption. Relocating the MDF to the Server Room will provide centralized network management, improved security, and easier maintenance for IT personnel, reducing operational complexity and improving overall network efficiency.

Once the fiber network deployment is complete:

- Remove the existing MDF rack.
- Reroute all MDF connections to the Vault Room, designated as the new MDF location.
- The MDF removal should only be accomplished after the new fiber project is complete to ensure a seamless transition and prevent disruption.
- Justification: Relocating the MDF to the Server Room will provide centralized network management, improved security, and easier maintenance for IT personnel, reducing operational complexity and improving overall network efficiency.
- Post-fiber network deployment, remove the existing MDF rack.
- Reroute all MDF connections to the Vault Room, designated as the new MDF location.

3.2.3 Network Re-Route for Police Department and SW-HR

- Re-route existing Police Department network connections to the Server Room.
- Re-route SW-HR (Finance Department switch) connections to the Server Room.

Legacy Equipment to be Removed as Part of MDF Rack Removal

- T1 Router
- AT&T Spoke Network Router
- Mitel equipment

3.2.3 Redundancy and Failover Configuration

- Implement redundancy in network routes to ensure continued city network operation.
- Establish failover configurations for off-site tunneling.

3.3 Medium Priority Tasks

3.3.1 VLAN and IP Scheme Standardization

- Standardize VLAN definitions across all sites.
- Adopt the IP scheme format: **10.[Site].[VLAN].[Node]**
    - Example: VLAN 4 for users, VLAN 7 for printers, VLAN 10 for servers, etc.
    - The second octet denotes the site, the third octet represents VLAN/purpose, and the fourth octet identifies the specific node.

3.3.2 Network Cabinet Organization

- Clean up network cabinets for better cable management.
- If necessary, relocate racks (e.g., SW-HR) for improved organization. If required, the City will be responsible for relocating the rack, while the consultant will assist with network reconfiguration and reconnections.

3.3.3 Migration to Starlink for Select Sites

- Transition sites currently using T1/AT&T spoke networks to Starlink where applicable. This may include configuration of switches, routers, firewalls, and tunnels as needed to ensure proper network functionality and connectivity.

3.4 Other Tasks per Request of the City of Ukiah IT

- The consultant may perform additional IT-related tasks as requested by the City of Ukiah IT Department. These tasks will be scoped and approved prior to commencement and may include, but are not limited to, infrastructure changes, troubleshooting, configuration updates, and support beyond the predefined items in this scope.

4. Deliverables

1. **Network Architecture Report** – Document outlining the updated network topology and flow.
2. **Firewall Configuration Report** – Configuration details and security enhancements implemented on the Palo Alto 880.
3. **Switch Replacement & Standardization Report** – List of replaced switches and standardized configurations applied.
4. **Wireless Infrastructure Deployment Report** – Details on the new wireless system.
5. **Network Segmentation Report** – Evidence of logical separation for Police Department and City Networks.
6. **Redundancy & Failover Plan** – Outline of redundancy and failover configurations.
7. **Updated VLAN/IP Scheme Documentation** – Finalized VLAN and IP addressing plan.
8. **Post-Implementation Report** – Summary of work completed, outstanding issues, and recommendations for future improvements.

5. Timeline & Milestones

Disclaimer: The timelines and milestones outlined in this document are subject to change based on the availability of the consultant, the City of Ukiah, and any procurement lead times required for equipment or vendor support.

Milestone	Task	Estimated Completion
Phase 1	Network flow modification, AT&T reconfiguration, Firewall routing	4-6 weeks
Phase 2	Switch replacements, VLAN standardization, Police Department segmentation	6-8 weeks
Phase 3	Wireless infrastructure, MDF migration, redundancy configurations	8-12 weeks
Phase 4	Network cabinet organization, Starlink migration, final documentation	12-16 weeks

6. Responsibilities

Consultant (Ryan Jackson):

- Provide expertise, design, and configuration for the network redesign.
- Implement all technical changes as outlined in the scope of work.
- Document all modifications and provide necessary training to City IT staff.

City of Ukiah IT Department:

- Procure all required hardware and software.
- Assist with implementation and testing as needed.
- Provide access and necessary credentials for configuration changes.
- Maintain and manage network post-implementation.

7. Assumptions & Constraints

- The execution of work outlined in this document is contingent upon the availability of funding from the City of Ukiah. Work will proceed based on priority until either completion, suspension pending additional funding, or termination by either party with advance notice.
- All hardware procurement will be handled by the City of Ukiah.
- Network downtime will be scheduled to minimize operational impact.
- Some tasks are dependent on the deployment of the high-speed fiber network.
- City IT staff availability may impact scheduling.
- Standard IT Services Rate: $125/hour.
- Emergency High-Priority Support Rate (when explicitly requested by the City): $175/hour.

COU No. 2526-095-A1

CITY OF UKIAH

AMENDMENT NO. 1
TO
PROFESSIONAL SERVICES CONTRACT 2526-095
BETWEEN
RYAN JACKSON
and THE CITY OF UKIAH

This Amendment No. 1, entered on November __, 2025 revises the Agreement for Professional services dated July 1st, 2025 between the City of Ukiah and Ryan Jackson, for professional services relating to IT Support.

This Amendment No. 1 adds additional Scope of Work per Exhibit 1 and adds an additional not-to-exceed amount of $40,000. This revises the total, not-to-exceed amount to $80,000.

Except as expressly amended by this Amendment, all other terms remain unchanged and in full force and effect.

IN WITNESS WHEREOF, THE PARTIES HAVE EXECUTED THIS AMENDMENT ON THE EFFECTIVE DATE:

RYAN JACKSON

BY: _____ DATE: _____

PRINT NAME: _____

CITY OF UKIAH

BY: _____ DATE: _____
SAGE SANGIACOMO, CITY MANAGER

ATTEST

BY: _____ DATE: _____
KRISTINE LAWLER, CITY CLERK

DRAFT

Amendment to Statement of Work (SOW)

Cybersecurity Implementation and Compliance Support for the Ukiah Police Department

Consultant: Ryan Jackson

1. Introduction

This Amendment supplements the existing Statement of Work between the City of Ukiah and Ryan Jackson. The purpose of this engagement is to address immediate cybersecurity compliance and operational needs within the Ukiah Police Department (UPD) network infrastructure. This work will focus on the implementation, monitoring, and remediation of cybersecurity vulnerabilities and threats to meet Department of Justice (DOJ), California Law Enforcement Telecommunications System (CLETS), and Criminal Justice Information Services (CJIS) compliance requirements.

2. Objectives

- Implement cybersecurity tools, systems, and configurations necessary to strengthen the UPD network security posture.
- Establish continuous vulnerability and threat monitoring for the UPD network and associated systems.
- Audit access and activity logs related to critical systems, including RIMS, CJIS, DOJ, and CLETS environments.
- Identify and remediate vulnerabilities, threats, or non-compliance issues as they arise through systematic patching and risk mitigation processes.
- Engage with third-party contractors and vendors as needed to support, coordinate, and lead cybersecurity initiatives on behalf of the Ukiah Police Department.
- Facilitate transition planning and knowledge transfer once internal staffing or permanent cybersecurity personnel are appointed.

3. Scope of Work

3.1 Critical Tasks

1. 3.1.1 Cybersecurity Tool Implementation

Implement and configure cybersecurity monitoring and management tools, including but not limited to vulnerability scanners, endpoint protection, and network monitoring solutions. Ensure all deployed systems align with DOJ, CLETS, and CJIS technical standards.

2. 3.1.2 Vulnerability and Threat Monitoring

Establish ongoing threat detection and vulnerability scanning procedures for the UPD network. This includes proactive monitoring for zero-day vulnerabilities, CVE alerts, and other indicators of compromise across critical systems.

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3. 3.1.3 Log Auditing and Access Review

Conduct recurring audits of security and access logs related to systems containing protected criminal justice information (RIMS, CJIS, DOJ, CLETS). Ensure that all logging, alerting, and review procedures meet federal and state standards for access control and data protection.

4. 3.1.4 Vulnerability Remediation and Patch Management

Collaborate with the City IT Department and external vendors to apply patches, configuration changes, or mitigation measures to remediate vulnerabilities identified through assessment or monitoring processes. Document all remediation efforts for compliance verification.

5. 3.1.5 Contractor Coordination and Cybersecurity Leadership

Engage with vendors, managed service providers, and consultants to lead or assist in the implementation of cybersecurity initiatives affecting the UPD network. Ensure that all external engagements align with compliance frameworks and organizational objectives.

4. Deliverables

- Cybersecurity Implementation Report – detailing the tools, configurations, and integrations deployed.
- Vulnerability Assessment & Monitoring Report – outlining active scans, findings, and prioritized risk items.
- Log Audit Summary Report – documenting access reviews and anomalies identified in protected system logs.
- Remediation and Patch Summary – showing vulnerabilities resolved and actions pending.
- Transition Plan and Documentation – to ensure effective handoff and training of internal personnel once staffing becomes available.

5. Responsibilities

6. Consultant (Ryan Jackson):

- Perform cybersecurity tool deployment, configuration, and validation.
- Conduct monitoring, log auditing, and remediation oversight.
- Document and report all findings, actions, and recommendations.
- Provide consultation and leadership to City and UPD IT staff and contractors.
- Facilitate training and knowledge transfer to internal staff upon transition.

7. City of Ukiah / Ukiah Police Department:

- Provide access to systems, staff, and data as necessary for audit and monitoring functions.
- Procure or license required cybersecurity tools and platforms.
- Coordinate with consultant and external vendors for scheduling and system access.

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6. Timeline & Milestones

The duration of this engagement is dependent upon internal staffing and the remediation of identified vulnerabilities. Initial tool implementation and monitoring setup are expected within 4–6 weeks, followed by a continued monitoring and remediation phase extending until proper hand-off is completed.

7. Disclaimer

This engagement serves as a temporary remediation and compliance support measure to ensure the Ukiah Police Department maintains DOJ, CLETS, and CJIS security standards. Ryan Jackson has accepted delegated cybersecurity responsibilities for this purpose. These duties are intended to address immediate compliance needs and operational risks. Ongoing consultation, training, and documentation will be provided.

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Agenda Item No: 8.d.

MEETING DATE/TIME: 11/19/2025

ITEM NO: 2025-1288

City of Ukiah

AGENDA SUMMARY REPORT

SUBJECT: Approval of Budget Amendment in the Amount of $318,074.37 and Approval of the Notice of Completion for the Recycled Water Project Phase 4 Specification 23-01, and Final Payment of 5% Retention of Ghilotti Construction Co., Inc.

DEPARTMENT: Water Resources **PREPARED BY:** Seth Strader, Administrative Analyst

PRESENTER: Sean White, Water Resources Director

ATTACHMENTS:

1. Awarding ASR
2. Recycled Water Project Phase 4 Vol 1 Tech Specs
3. Recycled Water Project Phase 4 Vol 2 Tech Specs
4. Recycled Water Project Phase 4 Vol 3 Tech Specs
5. Notice-of-Completion
6. Certificate of Substantial Completion

Summary: Council will consider approving a budget amendment in the amount of $318,074.37 and approving the Notice of Completion for the Recycled Water Project Phase 4, Specification 23-01, and the payment of the 5% retention to Ghilotti Construction Co., Inc.

Background: Phase 4 of the Recycled Water expands the ability for the City to produce recycled water and extend the delivery of it to further green areas like Pomolita Middle School, Frank Zeek Elementary, Ukiah High, Todd Grove Park, Vinewood Park, the Cemetery, and more. This will reduce the demand for potable water for non-drinking use. The City of Ukiah was awarded $53,770,000.00 in grant funds for the construction of Phase 4 of the Recycled Water Project.

On June 21, 2023, Ghilotti Construction Co., Inc. was awarded the contract for construction (Attachment 1) in the amount of $45,942,805.00 for the construction of the Recycled Water Project Phase 4, Specification 23-01.

Discussion:

The original awarded contract amount of $45,942,805 was fully encumbered; however, the additional 10% contingency, though included in the FY 23/24 budget (when this contract was awarded), was not encumbered. As a result, that portion of the approved appropriation did not roll forward into the future fiscal years.

At this time, $1,094,581.76 remains available on the contract, while the final invoice totals $1,412,656.13. A budget amendment of $318,074.37 is therefore requested to ensure sufficient appropriation. This adjustment increases the contract to $49,850,369.51, which remains within both the total original awarded grant amount and the original contract amount inclusive of the 10% contingency ($50,537,086).

The contracted work was completed by the contractor in conformance with the approved plans and specification on November 14, 2025; See Attachments 2-4. The 5% retention payment will be made to the contractor after 35 days from the date the Notice of Completion (Attachment 5) is recorded with the County Recorder. See Attachment 6 for the Certificate of Substantial Completion from Carollo Engineers, the project manager and engineer for the Recycled Water Project Phase 4.

Staff recommends that Council approve the requested budget amendment of $318,074.37, which will be fully reimbursed by grant funds already awarded by the State Water Resource Control Board. Staff also requests that Council approve the Notice of Completion, approve final payment of 5% retention to Ghilotti Construction Co., Inc. and direct the City Clerk to record the Notice of Completion with the County Recorder.

Recommended Action: Approve a budget amendment in the amount of $318,074.37 and approve the Notice of Completion for the Recycled Water Project Phase 4 Specification 23-01, and final payment of 5% retention of Ghilotti Construction Co., Inc.

BUDGET AMENDMENT REQUIRED: YES

CURRENT BUDGET AMOUNT: 83027330.80230.18052: $1,094,581.76

PROPOSED BUDGET AMOUNT:83027330.80230.18052: $1,412,656.13

FINANCING SOURCE: California State Water Resources Control Board Water Recycling Funding Program Construction Grant

REVENUE: No GRANT: Yes

PREVIOUS CONTRACT/PURCHASE ORDER NO.: Contract 2223220

COORDINATED WITH: Jason Benson, Senior Engineer and Sean White, Director of Water Resources

STRATEGIC PLAN (SP): **SP 2A** - Continue the development and maintenance of a comprehensive Capital Improvement Plan that considers the climate impacts of those improvements.

CLIMATE INITIATIVES (CI):**CI-7a** – Expand sustainable water practices.

GENERAL PLAN ELEMENTS (GP):GP-A4 - Public Facilities, Services, and Infrastructure Element GP-A5 - Environment and Sustainability Element

Approved: Sage Sangiacomo, City Manager

City of Ukiah

MEMORANDUM

Date: 6/21/23

To: Ukiah City Council

Cc: Andrew Stricklin, Associate Engineer; Jason Benson, Senior Civil Engineer; Tim Eriksen, Director of Public Works; Sean White, Director of Water Resources

From: Seth Strader, Public Works Analyst; Mary Horger, Financial Services Manager

Subject: Item 13.b. – Bid Results for Specification 23-01 Recycled Water Project – Phase 4

This memo is to inform the City Council members of the results of the bid opening for Specification 23-01, Recycled Water Project – Phase 4.

Two bids were received. Argonaut Constructors submitted a bid in the amount of $49,417,050. Ghilotti Construction submitted a bid in the amount of $45,942,805 and are the apparent lowest responsive and responsible bidder. Please refer to Attachment 1 for a copy of the bid tabulation, and Attachment 2 for a copy of Ghilotti' s bid.

Therefore, staff is recommending awarding the bid for the Recycled Water Project – Phase 4, Specification 23-01 to Ghilotti Construction in the amount of $45,942,805, and approve a budget amendment for the bid amount, as well as a 10% contingency. Although grant funded, there is a possibility that the City may be liable for cost overruns.

Recommended Action:
Award bid for the Recycled Water Project – Phase 4, Specification 23-01 to Ghilotti Construction in the amount of $45,942,805 and approve corresponding budget amendment in the amount of $50,537,086.

Bid Tabulation

Spec 23-01 RECYCLED WATER PROJECT - PHASE 4

Bid Opening: 2:00 p.m., June 20, 2023

ITEM #	ITEM DESCRIPTION	QTY	UOM	Ghilotti Construction Co. Inc.		Argonaut Constructors	
				UNIT PRICE	TOTAL	UNIT PRICE	TOTAL
1	Mobilization	1	LS	$ 4,500,000	$ 4,500,000.00	$ 2,200,000.00	$ 2,200,000.00
2	Traffic Control	1	LS	$ 188,000	$ 188,000.00	$ 870,000.00	$ 870,000.00
3	Temporary Facilities and Controls (per Section 01500)	1	LS	$ 110,000	$ 110,000.00	$ 275,000.00	$ 275,000.00
4	Temporary Excavation Support - WWTP	1	LS	$ 125,000	$ 125,000.00	$ 260,000.00	$ 260,000.00
5	Dewatering - WWTP	1	LS	$ 82,000	$ 82,000.00	$ 225,000.00	$ 225,000.00
6	Dechlorination Structure (Area 60)	1	LS	$ 240,000	$ 240,000.00	$ 250,000.00	$ 250,000.00
7	Buried Sludge Piping	1	LS	$ 55,000	$ 55,000.00	$ 37,000.00	$ 37,000.00
8a	Scope of Supply provided by WesTech	1	LS	$ 3,118,000	$ 3,118,000.00	$ 4,500,000.00	$ 4,500,000.00
8b1	Tank Coating (per Specification Section 09960)	10000	SF	$ 41	$ 410,000.00	$ 42.00	$ 420,000.00
8b2	Type II Corrosion Remediation (per drawing 85S01)	200	SF	$ 280	$ 56,000.00	$ 250.00	$ 50,000.00
8b3	Type III Corrosion Remediation (per drawing 85S01)	200	SF	$ 555	$ 111,000.00	$ 250.00	$ 50,000.00
8c	Rotary-Lobe Blowers (per Specification Section 11376A)	1	LS	$ 350,000	$ 350,000.00	$ 675,000.00	$ 675,000.00
8d	Coagulant Feed Pump (per Specification Section 11242)	1	LS	$ 90,000	$ 90,000.00	$ 333,000.00	$ 333,000.00
8e	Rapid Mix Pump (per Specification Section 11312O)	1	LS	$ 100,000	$ 100,000.00	$ 87,000.00	$ 87,000.00
8f	All other Work associated with Area 85	1	LS	$ 145,000	$ 145,000.00	$ 250,000.00	$ 250,000.00
9	Backwash Pump Station (Area 87)	1	LS	$ 310,000	$ 310,000.00	$ 340,000.00	$ 340,000.00
10	Carousel Pump Station (Area 89)	1	LS	$ 808,000	$ 808,000.00	$ 340,000.00	$ 340,000.00
11	PAU Pump Station (Area 91)	1	LS	$ 525,000	$ 525,000.00	$ 525,000.00	$ 525,000.00
12a	PAU Excavation	40000	CY	$ 130	$ 5,200,000.00	$ 180.00	$ 7,200,000.00
12b	PAU Embankment	1	LS	$ 987,000	$ 987,000.00	$ 352,000.00	$ 352,000.00
13	PAU Concrete Liner and Inlets	1	LS	$ 4,180,000	$ 4,180,000.00	$ 4,100,000.00	$ 4,100,000.00
14	Yard Piping - WWTP	1	LS	$ 405,000	$ 405,000.00	$ 480,000.00	$ 480,000.00
15a	12 kV Work	1	LS	$ 90,000	$ 90,000.00	$ 90,000.00	$ 90,000.00
15b	Electrical Ductbanks	1	LS	$ 1,265,000	$ 1,265,000.00	$ 1,350,000.00	$ 1,350,000.00
15b.1	All other Electrical Work	1	LS	$ 948,000	$ 948,000.00	$ 550,000.00	$ 550,000.00
16	Instrumentation & Controls Work - WWTP	1	LS	$ 700,000	$ 700,000.00	$ 725,000.00	$ 725,000.00
17	Startup and Commissioning (per Specification Section 01756) - WWTP	1	LS	$ 270,000	$ 270,000.00	$ 118,000.00	$ 118,000.00
18	All other Work - WWTP	1	LS	$ 88,000	$ 88,000.00	$ 1,410,000.00	$ 1,410,000.00
19	Temporary Excavation Support - WTP	1	LS	$ 68,000	$ 68,000.00	$ 357,000.00	$ 357,000.00
20	Dewatering - WTP	1	LS	$ 25,000	$ 25,000.00	$ 115,000.00	$ 115,000.00
21	Recycled Water Storage Tank (per Specification Section 13207)	1	LS	$ 4,850,000	$ 4,850,000.00	$ 5,600,000.00	$ 5,600,000.00
22	Recycled Water Pump Station	1	LS	$ 1,988,000	$ 1,988,000.00	$ 1,425,000.00	$ 1,425,000.00
23	WTP Excavations and Embankments	1	LS	$ 800,000	$ 800,000.00	$ 875,000.00	$ 875,000.00

24	WTP Yard Piping	1	LS	$ 394,000	$ 394,000.00	$ 670,000.00	$ 670,000.00
25	21" Sewer Replacement	1	LS	$ 260,000	$ 260,000.00	$ 325,000.00	$ 325,000.00
26	Concrete Manholes	3	EA	$ 18,500	$ 55,500.00	$ 30,000.00	$ 90,000.00
27	Electrical Work - WTP	1	LS	$ 1,440,000	$ 1,440,000.00	$ 1,250,000.00	$ 1,250,000.00
27a	Recycled Water Pump Station Electrical Building	1	LS	$ 480,000	$ 480,000.00	$ 600,000.00	$ 600,000.00
27b	Other Miscellaneous Electrical Work - WTP	1	LS	$ 28,000	$ 28,000.00	$ 35,000.00	$ 35,000.00
28	Instrumentation and Controls Work - WTP	1	LS	$ 700,000	$ 700,000.00	$ 715,000.00	$ 715,000.00
29	Startup and Commissioning (per Specification Section 01756) - WTP	1	LS	$ 10,000	$ 10,000.00	$ 90,000.00	$ 90,000.00
30	All other Work - WTP	1	LS	$ 128,000	$ 128,000.00	$ 500,000.00	$ 500,000.00
31	Temporary Excavation Support - Distribution System	1	LS	$ 180,000	$ 180,000.00	$ 110,000.00	$ 110,000.00
32	Dewatering - Distribution System	1	LS	$ 22,000	$ 22,000.00	$ 25,000.00	$ 25,000.00
33	18-inch diameter PVC pipeline in trench	3781	LF	$ 625	$ 2,363,125.00	$ 515.00	$ 1,947,215.00
34	16-inch diameter PVC pipeline in trench	20	LF	$ 625	$ 12,500.00	$ 750.00	$ 15,000.00
35	12-inch diameter PVC pipeline in trench	3857	LF	$ 325	$ 1,253,525.00	$ 205.00	$ 790,685.00
36	10-inch diameter PVC pipeline in trench	3145	LF	$ 325	$ 1,022,125.00	$ 235.00	$ 739,075.00
37	8-inch diameter PVC pipeline in trench	827	LF	$ 250	$ 206,750.00	$ 185.00	$ 152,995.00
38	6-inch diameter PVC pipeline in trench	2718	LF	$ 250	$ 679,500.00	$ 170.00	$ 462,060.00
39	4-inch diameter PVC pipeline in trench	206	LF	$ 250	$ 51,500.00	$ 170.00	$ 35,020.00
40	12-inch diameter ductile iron pipeline	150	LF	$ 1,400	$ 210,000.00	$ 1,300.00	$ 195,000.00
41a	Microtunnel Crossing (including pressure pipe and casing)	1	LS	$ 450,000	$ 450,000.00	$ 480,000.00	$ 480,000.00
41b	Railroad Crossing (including pressure pipe and casing)	1	LS	$ 250,000	$ 250,000.00	$ 325,000.00	$ 325,000.00
42	Pipeline Blow-off Assemblies	12	EA	$ 20,000	$ 240,000.00	$ 17,000.00	$ 204,000.00
43	Pipeline Combination Air Valves	20	EA	$ 25,000	$ 500,000.00	$ 16,500.00	$ 330,000.00
44	Pipeline Butterfly Valves	6	EA	$ 14,000	$ 84,000.00	$ 16,000.00	$ 96,000.00
45	Pipeline Gate Valve	10	EA	$ 6,000	$ 60,000.00	$ 5,000.00	$ 50,000.00
46	Meters and Service Lines	13	EA	$ 40,000	$ 520,000.00	$ 38,000.00	$ 494,000.00
47	Pedestrian Bridge	1	LS	$ 800,000	$ 800,000.00	$ 360,000.00	$ 360,000.00
48	Startup and Commissioning (per Specification Section 01756) - Distribution System	1	LS	$ 44,480	$ 44,480.00	$ 12,000.00	$ 12,000.00
49	All other Work - Distribution System	1	LS	$ 262,000	$ 262,000.00	$ 1,840,000.00	$ 1,840,000.00
50	Demobilization	1	LS	$ 48,800	$ 48,800.00	$ 45,000.00	$ 45,000.00
				GRAND TOTAL	**$ 45,942,805**		**$ 49,417,050**

Alternate Price for Line 12a of Base Bid as Per Addendum 5

12a	PAU Excavation to onsite location as per Addendum 5.	40000	CY	$ 65.00	$ 2,600,000.00	$ 49.00	$ 1,960,000.00

CITY OF UKIAH
MENDOCINO COUNTY, CALIFORNIA

PROPOSAL

FOR
RECYCLED WATER PROJECT – PHASE 4

Specification No. 23-01

The undersigned, as bidder,
declares that he or she has examined thoroughly all of the contract documents herein contained, that this proposal is made without collusion with any other person, firm or corporation and that all laws and ordinances relating to the interest of public officers in this contract have been complied with in every respect.

AND he or she proposes and agrees, if this proposal is accepted,

1) that he or she will contract with the City of Ukiah, Mendocino County, California, in the form of the copy of the agreement herein contained

   a) to provide all necessary machinery, tools, apparatus and other means of construction;

   b) to furnish all materials;

   c) to provide all superintendence, overhead expenses and all labor and expenses of whatever nature necessary to complete the job in conformity with the specifications and drawings and other contract provisions herein or reasonably implied hereby or as necessary to complete the work in the manner and within the time named herein and according to the requirements and to the reasonable satisfaction of the City Engineer;

   d) to pay all charges of freight transportation and hauling;

2) that he or she indemnifies the City against any loss or damage arising from any act of the undersigned as Contractor; and

3) that he or she will accept as full payment therefor the following sums:

The Bidder certifies the following:

1) This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.
2) Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.
3) Bidder has not solicited or induced any individual or entity to refrain from bidding.
4) Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract as defined below:
   a) Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process.
   b) Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.
   c) Collusive practice means a scheme or arrangement between 2 or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels.
   d) Coercive practice means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

This Bid will remain subject to acceptance for [60] days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

In accordance with California Public Contract Code Section 2200 et seq., ("Iran Contracting Act of 2010"), Bidder certifies that Bidder is not identified on the list created by the California Department of General Services (DGS) in accordance with California Public Contract Code Section 2203(b) as a Person engaging in investment activities in Iran.

BIDDING SCHEDULE

In the case of any discrepancy between the unit price and the total set forth for the item, the unit price shall prevail; provided, however, that if the amount set forth as a unit price is ambiguous, unintelligible or uncertain for any reason, or is omitted, or in the case of lump sum items, is not the same amount as the entry in the "Total" column, then the amount set forth in the "Total" column for the item shall prevail in accordance with the following:

1. As to lump sum items, the amount set forth in the "Total" column shall be the unit price;
2. As to unit basis items, the amount set forth in the "Total" column shall be divided by the estimated quantity for the item and the price thus obtained shall be the unit price.

The Total Base Bid shall be the sum of the items in the "Total" column. In case of discrepancy between the sum of the items in the "Total" column and the amount entered as Total Base Bid, the sum of the "Total" column items shall prevail. The bid comparison will be based on the sum of the items in the "total" column for each bidder.

The Unit prices for the various Construction Items below include all costs associated with the General Conditions, Special Provisions, Requirements of the Construction Contract, and represent the total, complete, in-place cost for each specific Construction Item in accordance with the Construction Documents, including all elements, work components, accessories, and connections, shown in applicable details or required to yield a complete, sound and functional component or system appropriate for its intended function, whether or not such is specifically described or listed in any description of measurement or payment. The total amount of the Construction items below shall represent the total and complete cost of the fully functional Project. All work not specifically listed below be required to complete the work of the various construction items and the cost of such shall be considered as included throughout the various unit prices indicated.

Lowest bid will be based on the lowest Base Bid.

NAME OF BIDDER: Ghilotti Construction Company, Inc.
SPEC #: **23-01**
PROJECT NAME: **RECYCLED WATER PROJECT – PHASE 4**

ITEM #	DESCRIPTION	UOM		QTY	UNIT PRICE	TOTAL
1	Mobilization	LS		1	4500000	4500 000
2	Traffic Control	LS		1	188000	188000
3	Temporary Facilities and Controls (per Section 01500)	LS		1	110000	110000
4	Temporary Excavation Support - WWTP	LS		1	125000	125000
5	Dewatering - WWTP	LS		1	82000	82000
6	Dechlorination Structure (Area 60)	LS		1	240000	240000
7	Buried Sludge Piping	LS		1	55000	55000
8	Packaged Water Treatment System Rehabilitation (per Specification Section 11802) (Area 85)					
8a	Scope of Supply provided by WesTech	LS		1	3118000	3118000
8b.1	Tank Coating (per Specification Section 09960)	SF		10,000	41	410000
8b.2	Type II Corrosion Remediation (per drawing 85S01)	SF		200	280	56000
8b.3	Type III Corrosion Remediation (per drawing 85S01)	SF		200	555	111000
8c	Rotary-Lobe Blowers (per Specification Section 11376A)	LS		1	350000	350000
8d	Coagulant Feed Pump (per Specification Section 11242)	LS		1	90000	90000
8e	Rapid Mix Pump (per Specification Section 11312O)	LS		1	100000	100000
8f	All other Work associated with Area 85	LS		1	145000	145000
9	Backwash Pump Station (Area 87)	LS		1	310000	310000
10	Carousel Pump Station (Area 89)	LS		1	808000	808000
11	PAU Pump Station (Area 91)	LS		1	525000	525000
12a	PAU Excavation	CY		40,000	130	5200 000
12b	PAU Embankment	LS		1	987000	987000
13	PAU Concrete Liner and Inlets	LS		1	4186000	4180000
14	Yard Piping - WWTP	LS		1	905000	405000
15	Electrical Work - WWTP					
15a	12 kV Work	LS		1	90000	90000

15b	Electrical Ductbanks	LS		1	1265000	1265000
15b	All other Electrical Work	LS		1	948000	948000
16	Instrumentation & Controls Work - WWTP	LS		1	700000	700000
17	Startup and Commissioning (per Specification Section 01756) - WWTP	LS		1	270000	270000
18	All other Work - WWTP	LS		1	88000	88000
19	Temporary Excavation Support - WTP	LS		1	68000	68000
20	Dewatering - WTP	LS		1	25000	25000
21	Recycled Water Storage Tank (per Specification Section 13207)	LS		1	4850000	4850000
22	Recycled Water Pump Station	LS		1	1988000	1988000
23	WTP Excavations and Embankments	LS		1	800000	800000
24	WTP Yard Piping	LS		1	394000	394000
25	21" Sewer Replacement	LS		1	260000	260000
26	Concrete Manholes	EA		3	18500	55500
27	Electrical Work - WTP	LS		1	1440000	1440000
27a	Recycled Water Pump Station Electrical Building	LS		1	480000	480000
27b	Other Miscellaneous Electrical Work - WTP	LS		1	28000	28000
28	Instrumentation and Controls Work - WTP	LS		1	700000	700000
29	Startup and Commissioning (per Specification Section 01756) - WTP	LS		1	10000	10000
30	All other Work - WTP	LS		1	128000	128000
31	Temporary Excavation Support - Distribution System	LS		1	180000	180000
32	Dewatering - Distribution System	LS		1	22000	22000
33	18-inch diameter PVC pipeline in trench	LF		3781	625	~~2633125~~ 2363125
34	16-inch diameter PVC pipeline in trench	LF		20	625	12500
35	12-inch diameter PVC pipeline in trench	LF		3857	325	1253525
36	10-inch diameter PVC pipeline in trench	LF		3145	325	1022125
37	8-inch diameter PVC pipeline in trench	LF		827	250	206750
38	6-inch diameter PVC pipeline in trench	LF		2718	250	679500

39	4-inch diameter PVC pipeline in trench	LF		206	250	51500
40	12-inch diameter ductile iron pipeline	LF		150	1400	210000
41a	Microtunnel Crossing (including pressure pipe and casing)	LS		1	450000	450000
41b	Railroad Crossing (including pressure pipe and casing)	LS		1	250000	250000
42	Pipeline Blow-off Assemblies	EA		12	20000	240000
43	Pipeline Combination Air Valves	EA		20	25000	506000
44	Pipeline Butterfly Valves	EA		6	14000	84000
45	Pipeline Gate Valve	EA		10	6000	60000
46	Meters and Service Lines	EA		13	40000	520000
47	Pedestrian Bridge	LS		1	800000	800000
48	Startup and Commissioning (per Specification Section 01756) - Distribution System	LS		1	44480	44480
49	All other Work - Distribution System	LS		1	262000	262000
50	Demobilization	LS		1	48800	48800
TOTAL BASE BID ==>>			$ 45942805			

ALTERNATE PRICE FOR LINE 12a OF BASE BID AS PER ADDENDUM 5

ITEM #	DESCRIPTION	UOM	QTY	UNIT PRICE	TOTAL
1	PAU Excavation to onsite location as per Addendum 5.	CY	40,000	65	2 600 000

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We, the undersigned, acknowledge that the City Council has reserved the right to reject any or all bids and to determine which proposal is, in its opinion, the lowest responsive bid from a responsible bidder and that which it deems in the best interest of the City to accept. We, the undersigned, further agree, if this proposal shall be accepted, to sign the agreement and to furnish the required bonds with satisfactory surety, or sureties, within fifteen (15) calendar days after written notice that the contract is ready for signature; and, if the undersigned shall fail to contract, as aforesaid, it shall be understood that he or she has abandoned the contract and that, therefore, this proposal shall be null and void and the proposal guaranty accompanying this proposal, or the amount of said guaranty, shall be forfeited to and become the property of the City. Otherwise, the proposal guaranty accompanying this proposal shall be returned to the undersigned.

Witness our hands this day of 20th Day of June, 20 23

Licensed in accordance with an act providing for the registration of California Contractors License No. 644515, expiration date 5/31/24.

THE CONTRACTOR'S LICENSE NUMBER AND EXPIRATION DATE STATED HEREIN ARE MADE UNDER PENALTY OF PERJURY.

Department of Industrial Relations Public Works Contractor Registration Number: 1000003044

Signature of bidder or bidders, with business name, address, phone number and fax number:

Thomas Smith, Vice President of Estimating

Ghilotti Construction Company, Inc., 246 Ghilotti Ave., Santa Rosa, CA 95407

Ph: 707-585-1221/ Fx: 707-585-1601

Notice: In the case of a corporation, give below the addresses of the principal office thereof and names and addresses of the President, Secretary, Treasurer.

Ghilotti Construction Company, Inc.

246 Ghilotti Ave., Santa Rosa, CA 95407

Brian Ongaro - President/Secretary I. Terence Huie - CFO/Treasurer

FAIR EMPLOYMENT PRACTICES CERTIFICATION

TO: City of Ukiah

The undersigned, in submitting a bid for performing the following work by Contract, hereby certifies that he or she has or will meet the standards of affirmative compliance with the Fair Employment Practices requirements of the Special Provisions contained herein.

RECYCLED WATER PROJECT – PHASE 4

(Signature of Bidder) Thomas Smith, Vice President of Estimating

Business Mailing Address:

Ghilotti Construction Company, Inc.

246 Ghilotti Avenue

Santa Rosa, CA 95407

Business Location:

Same as above

(The bidder shall execute the certification of this page prior to submitting his or her proposal.)

WORKER'S COMPENSATION CERTIFICATE

I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for Worker's Compensation or undertake self-insurance in accordance with the provisions of that code and I will comply with such provisions before commencing the performance of the work of this contract.

Witness my hand this 20th day of June, 2023

Signature of Bidder, with Business Address:

Thomas Smith, Vice President of Estimating

Ghilotti Construction Company, Inc.

246 Ghilotti Avenue, Santa Rosa, CA 95407

CERTIFICATION OF NONDISCRIMINATION IN EMPLOYMENT

The bidder represents that he or she has/has not, participated in a previous contract or subcontract subject to either the equal opportunity clause herein or the clause contained in Section 301 of Executive Order 10925; that he or she has/has not, filed all required compliance reports; and that representations indicating submission of required compliance prior to subcontract awards.

Signature and address of Bidder:

Date 6/20/23

Thomas Smith, Vice President of Estimating

Ghilotti Construction Company, Inc.

246 Ghilotti Avenue, Santa Rosa, CA 95407

(This certification shall be executed by the bidder in accordance with Section 60-1.6 of the Regulations of the President's Committee on Equal Employment Opportunity for implementing Executive Orders 10925 and 11114.)

LIST OF PROPOSED SUBCONTRACTORS

In compliance with the provisions of Sections 4100-4108 of the California Public Contract Code and any amendments thereof, each bidder shall set forth (a) the name and location of the place of business of each subcontractor who will perform work or labor or render service in or about the construction site or a subcontractor licensed by the State of California who, under subcontract to the prime contractor, specially fabricates and installs a portion of the work or improvement according to detailed drawings contained in the plans and specifications in an amount in excess of one-half of 1 percent of the total bid and (b) the California Contractor License Number for each subcontractor, and (c) the portion of the work to be done by each subcontractor. (See General Conditions Section 1-09.) Include with the name of each sub-contractor their Department of Industrial Relations Public Works Contractor Registration Number.

SUBCONTRACTOR NAME	SUBCONTRACTOR LICENSE NUMBER	SUBCONTRACTOR DIR REGISTRATION NUMBER	SUBCONTRACTOR BUSINESS ADDRESS	DESCRIPTION OF WORK
Full Bore Inc.	1061459	PW-LR-1000561508	P.O. Box 1771 Clovis, CA 93613	Microtunnel Crossing - Bore & Jack (Partial), Railroad Crossing - Bore & Jack (Partial)

BP-01

LIST OF PROPOSED SUBCONTRACTORS

In compliance with the provisions of Sections 4100-4108 of the California Public Contract Code and any amendments thereof, each bidder shall set forth (a) the name and location of the place of business of each subcontractor who will perform work or labor or render service in or about the construction site or a subcontractor licensed by the State of California who, under subcontract to the prime contractor, specially fabricates and installs a portion of the work or improvement according to detailed drawings contained in the plans and specifications in an amount in excess of one-half of 1 percent of the total bid and (b) the California Contractor License Number for each subcontractor, and (c) the portion of the work to be done by each subcontractor.(See General Conditions Section 1-09.) Include with the name of each sub-contractor their Department of Industrial Relations Public Works Contractor Registration Number.

SUBCONTRACTOR NAME	SUBCONTRACTOR LICENSE NUMBER	SUBCONTRACTOR DIR REGISTRATION NUMBER	SUBCONTRACTOR BUSINESS ADDRESS	DESCRIPTION OF WORK
Bear State Construction	795997	PW-LR-1000874145	P.O. Box 1333 Sebastopol, CA 95473	Electrical Building

BP-02

LIST OF PROPOSED SUBCONTRACTORS

In compliance with the provisions of Sections 4100-4108 of the California Public Contract Code and any amendments thereof, each bidder shall set forth (a) the name and location of the place of business of each subcontractor who will perform work or labor or render service in or about the construction site or a subcontractor licensed by the State of California who, under subcontract to the prime contractor, specially fabricates and installs a portion of the work or improvement according to detailed drawings contained in the plans and specifications in an amount in excess of one-half of 1 percent of the total bid and (b) the California Contractor License Number for each subcontractor, and (c) the portion of the work to be done by each subcontractor.(See General Conditions Section 1-09.) Include with the name of each sub-contractor their Department of Industrial Relations Public Works Contractor Registration Number.

SUBCONTRACTOR NAME	SUBCONTRACTOR LICENSE NUMBER	SUBCONTRACTOR DIR REGISTRATION NUMBER	SUBCONTRACTOR BUSINESS ADDRESS	DESCRIPTION OF WORK
Mike Brown Electric Co.	306767	1000000469	561-A Mercantile Dr. Cotati, CA 94931	Electrical

BP-04

LIST OF PROPOSED SUBCONTRACTORS

In compliance with the provisions of Sections 4100-4108 of the California Public Contract Code and any amendments thereof, each bidder shall set forth (a) the name and location of the place of business of each subcontractor who will perform work or labor or render service in or about the construction site or a subcontractor licensed by the State of California who, under subcontract to the prime contractor, specially fabricates and installs a portion of the work or improvement according to detailed drawings contained in the plans and specifications in an amount in excess of one-half of 1 percent of the total bid and (b) the California Contractor License Number for each subcontractor, and (c) the portion of the work to be done by each subcontractor.(See General Conditions Section 1-09.) Include with the name of each sub-contractor their Department of Industrial Relations Public Works Contractor Registration Number.

SUBCONTRACTOR NAME	SUBCONTRACTOR LICENSE NUMBER	SUBCONTRACTOR DIR REGISTRATION NUMBER	SUBCONTRACTOR BUSINESS ADDRESS	DESCRIPTION OF WORK
Terra Con Constructors Inc.	562511	1000002920	P.O. Box 276 Healdsburg, CA 95448	Mechanical

BP-05

LIST OF PROPOSED SUBCONTRACTORS

In compliance with the provisions of Sections 4100-4108 of the California Public Contract Code and any amendments thereof, each bidder shall set forth (a) the name and location of the place of business of each subcontractor who will perform work or labor or render service in or about the construction site or a subcontractor licensed by the State of California who, under subcontract to the prime contractor, specially fabricates and installs a portion of the work or improvement according to detailed drawings contained in the plans and specifications in an amount in excess of one-half of 1 percent of the total bid and (b) the California Contractor License Number for each subcontractor, and (c) the portion of the work to be done by each subcontractor.(See General Conditions Section 1-09.) Include with the name of each sub-contractor their Department of Industrial Relations Public Works Contractor Registration Number.

SUBCONTRACTOR NAME	SUBCONTRACTOR LICENSE NUMBER	SUBCONTRACTOR DIR REGISTRATION NUMBER	SUBCONTRACTOR BUSINESS ADDRESS	DESCRIPTION OF WORK
Techno Coatings Inc.	296517	1000005841	785 E. Debra Ln Anaheim, CA 92805	Painting & Coating

LIST OF PROPOSED SUBCONTRACTORS

In compliance with the provisions of Sections 4100-4108 of the California Public Contract Code and any amendments thereof, each bidder shall set forth (a) the name and location of the place of business of each subcontractor who will perform work or labor or render service in or about the construction site or a subcontractor licensed by the State of California who, under subcontract to the prime contractor, specially fabricates and installs a portion of the work or improvement according to detailed drawings contained in the plans and specifications in an amount in excess of one-half of 1 percent of the total bid and (b) the California Contractor License Number for each subcontractor, and (c) the portion of the work to be done by each subcontractor.(See General Conditions Section 1-09.) Include with the name of each sub-contractor their Department of Industrial Relations Public Works Contractor Registration Number.

SUBCONTRACTOR NAME	SUBCONTRACTOR LICENSE NUMBER	SUBCONTRACTOR DIR REGISTRATION NUMBER	SUBCONTRACTOR BUSINESS ADDRESS	DESCRIPTION OF WORK
Sonoma Reinforcing Inc.	823619	1000013275	10001 Old Redwood Hwy Windsor, CA 95492	Furnish & Install Rebar

LIST OF PROPOSED SUBCONTRACTORS

In compliance with the provisions of Sections 4100-4108 of the California Public Contract Code and any amendments thereof, each bidder shall set forth (a) the name and location of the place of business of each subcontractor who will perform work or labor or render service in or about the construction site or a subcontractor licensed by the State of California who, under subcontract to the prime contractor, specially fabricates and installs a portion of the work or improvement according to detailed drawings contained in the plans and specifications in an amount in excess of one-half of 1 percent of the total bid and (b) the California Contractor License Number for each subcontractor, and (c) the portion of the work to be done by each subcontractor.(See General Conditions Section 1-09.) Include with the name of each sub-contractor their Department of Industrial Relations Public Works Contractor Registration Number.

SUBCONTRACTOR NAME	SUBCONTRACTOR LICENSE NUMBER	SUBCONTRACTOR DIR REGISTRATION NUMBER	SUBCONTRACTOR BUSINESS ADDRESS	DESCRIPTION OF WORK
D.N. Tanks Inc.	979914	1000005732	351 Cypress Lane El Cajon, CA 92020	Recycled Water Storage Tank

BUILT
FOR THE FUTURE

June 20, 2023

Seth Strader
City of Ukiah
300 Seminary Avenue
Ukiah CA 95482

Subject: Recycled Water Project – Phase 4
DN Tanks Qualifications Statement Package

Dear Mr. Strader:

Per Section 13270 Subsections 1.03.E, 1.04 and 1.05, amended by Addendum #3, DN Tanks is providing the following information as our Qualifications Statement Package.

In the near term, our contact person for this project is Tyler Bernhard. After award of project, a Project Manager will be assigned to carry the project to successful completion.

Tyler Bernhard
N. CA Regional Manager
351 Cypress Lane
El Cajon, CA 92020
(916) 426-5838

Following is DN Tanks' company information and project references per Section 1.05.A.2.

DN Tanks looks forward to working with the City of Ukiah on Recycled Water Project – Phase 4.

Sincerely,

Antonio Hernandez, Jr.
Regional Estimator
DN Tanks, LLC.

Who We Are

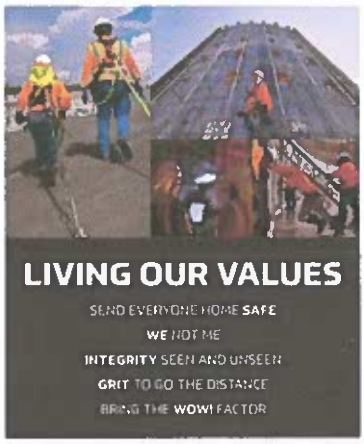
DN Tanks, LLC specializes in the design and construction of AWWA D110 prestressed concrete tanks used for potable water, wastewater, chilled water and other liquids. With over 90 years of experience, and over 3,000 tanks ranging in capacity from 40,000 gallons to 42 million gallons, DN Tanks offers expanded construction capacity, unmatched technical expertise and proficiency in multiple types of proven tank designs to provide customized storage solutions. Our tanks are designed to meet varying project requirements while delivering our clients the lowest future cost of ownership and best long-term value.

Mission Statement

Our mission is to provide the highest quality liquid storage design and construction services at the best long-term value with an unrivaled customer experience.

Core Values

DN Tanks provides exception quality throughout the life of the project bidding, construction, and operation by staying true to our core values. Caring, communication, innovation and ingenuity, passion, professional excellence, safety, and teamwork are always at the forefront of our approach to all situations. DN Tanks strives to use these Core Values as a litmus test for each action we take and interaction we have. At DN Tanks we feel that a positive client experience starts with every Team Member operating in alignment with our Core Values every day.



Financial Statement

DN Tanks has been with the same bonding company, Eastern Insurance, for over 30 years. During this time the professionalism and relationships of our firms has been well established. If DN Tanks, LLC were awarded this contract which requires performance and/or payment bonds, Eastern Insurance would provide the required surety bonds as requested. As is customary, the execution of final bonds on any particular project is subject to normal underwriting review of the contract terms and conditions by the DN Tanks team as well as our bonding company.



BUILT FOR THE FUTURE

351 Cypress Lane
El Cajon CA 92020

Statement of Experience

DN Tanks Projects (partial list)

Project Information:
Tracy, CA, USA
Ground Storage
1 - 2.67 MG (114.00 FT ID x 35.25 FT SWD x 42.50 FT WH)

Year Built: 2023
Project Name: Tracy Hills Phase 2A Zone 5/6 Tanks Project

Owner:
Lennar Homes of California, LLC
2603 Camino Ramon, Suite 525
San Ramon, CA, USA 94583
Contact: Emmons, Lea

Engineer:
Coleman Engineering
1223 Pleasant Grove, Suite 100
Roseville, CA, USA 95678
Contact: Tom, Cody
(916) 791-1188

Project Information:
Ceres, CA, USA
Ground Storage
1 - 3.00 MG (127.00 FT ID x 30.33 FT SWD x 35.00 FT WH)

Year Built: 2022
Project Name: River Bluff Reservoir & Pump Station Project

Owner:
City of Ceres
2220 Magnolia Street
Ceres, CA, USA 95307
Contact: Royal, Samir
(209) 538-5732

Engineer:
Black Water Consulting Engineers, Inc.
605 Standiford Avenue
Modesto, CA, USA 95350
Contact: Black, Jeff
(209) 322-1817

Project Information:
Hughson, CA, USA
Clearwell
1 - 5.30 MG (187.00 FT ID x 26.00 FT SWD)

Year Built: 2021
Project Name: SRWA Regional Surface Water Supply Project

Owner:
Stanislaus Regional Water Authority (SRWA)
156 S. Broadway
Turlock, CA, USA 95380
Contact: Reynolds, Garner
(209) 668-5540

Engineer:
Jacobs
6312 S. Fiddlers Green Cir
Greenwood Village, CO, USA 80111
Contact: Brustad, Karl
(720) 286-2000

Proprietary and confidential information, intended solely for the use of the authorized recipient.

BUILT FOR THE FUTURE

351 Cypress Lane
El Cajon CA 92020

Statement of Experience

DN Tanks Projects (partial list)

Project Information:
Bakersfield, CA, USA
Ground Storage
1 - 1.06 MG (95.00 FT ID x 20.53 FT SWD x 22.83 FT WH)

Year Built: 2020
Project Name: East Niles Pump Station Concrete Water Storage Tank Project

Owner:
East Niles Community Services Dist.
1417 Vale Street
Bakersfield, CA, USA 93306
Contact: Ruiz, Timothy
(661) 871-2011

Engineer:
MKN & Associates, Inc.
1800 21st Street, Suite C
Bakersfield, CA, USA 93301
Contact: Nord, Joshua
(661) 873-4262

Project Information:
Oakland, CA, USA
Ground Storage
1 - 1.00 MG (92.00 FT ID x 23.13 FT SWD x 28.38 FT WH)

Year Built: 2019
Project Name: Carisbrook

Owner:
East Bay MUD (Main)
375 11th Street
Oakland, CA, USA 94607-4240
Contact: Hartlaub, Michael
(866) 403-2683

Engineer:
Engineering by Owner

Project Information:
Tulare, CA, USA
Ground Storage
1 - 2.00 MG (100.00 FT ID x 35.00 FT SWD x 37.00 FT WH)

Year Built: 2018
Project Name: Tulare Water Storage Tanks Improvement Project

Owner:
City of Tulare
411 East Kern Avenue
Tulare, CA, USA 93274
Contact: Carlini, Joseph
(559) 685-2300

Engineer:
Carollo Engineers
1401 Fulton Street, Suite 802
Fresno, CA, USA 93721
Contact: Cleveland, Chris
(559) 436-6616

Proprietary and confidential information, intended solely for the use of the authorized recipient.

Statement of Experience

DN Tanks Projects (partial list)

Project Information:
San Mateo, CA, USA
Ground Storage
1 - 3.86 MG (157.92 FT ID x 27.00 FT SWD x 35.00 FT WH)

Year Built: 2017
Project Name: Station 27 Beresford Tank

Owner:
California Water Service Company
1720 North First Street
San Jose, CA, USA 95112-4508
Contact: Lieu, Susan
(408) 367-8200

Engineer:
Engineering By Owner

Project Information:
Hillsborough, CA, USA
Ground Storage
1 - 0.58 MG (69.00 FT ID x 20.83 FT SWD x 23.83 FT WH)

Year Built: 2016
Project Name: Vista Tank Reconstruction Project

Owner:
Town of Hillsborough
1600 Floribunda Avenue
Hillsborough, CA, USA 94010
Contact: Willis, Paul
(650) 375-7400

Engineer:
CSG Consultants, Inc.
550 Pilgrim Drive
Foster City, CA, USA 94404
Contact: Kong, Lynette
(650) 522-2500

Project Information:
San Bruno, CA, USA
Ground Storage
1 - 2.00 MG (110.00 FT ID x 30.00 FT SWD x 39.25 FT WH)

Year Built: 2015
Project Name: Tank No. 3 (Glenview) Replacement Project

Owner:
City of San Bruno (Dept. of Public Services)
567 El Camino Real
San Bruno, CA, USA 94066-4247
Contact: Anderson, Will
(650) 877-8865

Engineer:
West Yost Associates (Davis)
2020 Research Park Drive
Davis, CA, USA 95616-2687
Contact: Wanlass, Jeffrey
(530) 756-5905

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BUILT FOR THE FUTURE

351 Cypress Lane
El Cajon CA 92020

Statement of Experience

DN Tanks Projects (partial list)

Project Information:
Woodland, CA, USA
Ground Storage
1 - 3.00 MG (130.00 FT ID x 31.60 FT SWD x 33.00 FT WH)

Year Built: 2014
Project Name: First New Ground Level Tank, CIP #08-33

Owner:
City of Woodland (main)
655 N. Pioneer Ave
Woodland, CA, USA 95776
Contact: Busch, Tim
(530) 661-5850

Engineer:
West Yost Associates (Davis)
2020 Research Park Drive
Davis, CA, USA 95616-2687
Contact: Wanlass, Jeffrey
(530) 756-5905

Project Information:
Covina, CA, USA
Ground Storage
1 - 3.00 MG (140.00 FT ID x 25.00 FT SWD x 28.00 FT WH)

Year Built: 2013
Project Name: 3.0 MG Charter Oak Reservoir

Owner:
City of Covina - Public Works City Yard
534 North Barranca Avenue
Covina, CA, USA 91723
Contact: Dospital, Dean
(626) 384-5234

Engineer:
Civiltec Engineering, Inc.
118 West Lime Avenue
Monrovia, CA, USA 91016
Contact: Kerger, Terry
(626) 357-0588

Project Information:
Fresno, CA, USA
Clearwell
1 - 3.00 MG (128.00 FT ID x 32.00 FT SWD x 33.00 FT WH)

Year Built: 2012
Project Name: T-3 Water Storage and Treatment Facility

Owner:
City of Fresno (Department of Public Utilities)
2600 Fresno Street
Fresno, CA, USA 93721
Contact: Tolbert, Mike
(559) 621-1496

Engineer:
AECOM
1360 East Spruce Avenue
Fresno, CA, USA 93720
Contact: Reitz, Mark
(559) 448-8222

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BUILT FOR THE FUTURE

351 Cypress Lane
El Cajon CA 92020

Statement of Experience

DN Tanks Projects (partial list)

Project Information:
Lafayette, CA, USA
Ground Storage
1 - 2.70 MG (133.00 FT ID x 28.00 FT SWD x 31.00 FT WH)

Year Built: 2011
Project Name: 2.7 MG Highland Reservoir

Owner:
East Bay MUD (Main)
375 11th Street
Oakland, CA, USA 94607-4240
Contact: Franceschi, Paul
(866) 403-2683

Engineer:
Engineering by Owner

Project Information:
Richmond, CA, USA
Ground Storage
1 - 1.00 MG (76.50 FT ID x 29.10 FT SWD x 32.50 FT WH)

Year Built: 2011
Project Name: 1.0 MG Schapiro Reservoir Replacement

Owner:
East Bay MUD (Main)
375 11th Street
Oakland, CA, USA 94607-4240
Contact: Franceschi, Paul
(866) 403-2683

Engineer:
Engineering by Owner

Project Information:
Hilo, HI, USA
Ground Storage
1 - 2.00 MG (137.00 FT ID x 20.00 FT SWD x 21.00 FT WH)

Year Built: 2010
Project Name: 2.0 MG Piihonua Reservoir #2

Owner:
Dept. of Water Supply, County of Hawaii (main)
345 Kekuanaoa Street, Suite 20
Hilo, HI, USA 96720-4388
Contact: Inaba, Kurt
(808) 961-8070

Engineer:
Tom Nance Water Resource Engineering
560 N. Nimitz Hwy, Ste. 213
Honolulu, HI, USA 96817
Contact: Fukumitsu, Gregory
(808) 537-1141

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BUILT FOR THE FUTURE

351 Cypress Lane
El Cajon CA 92020

Statement of Experience

DN Tanks Projects (partial list)

Project Information:
San Ramon, CA, USA
Reuse
1 - 1.80 MG (90.00 FT ID x 39.00 FT SWD x 42.50 FT WH)

Year Built: 2009
Project Name: 1.8 MG R3000 Recycled Water Reservoir

Owner:
East Bay MUD (Main)
375 11th Street
Oakland, CA, USA 94607-4240
Contact: Franceschi, Paul
(866) 403-2683

Engineer:
Engineering by Owner

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351 Cypress Lane
El Cajon CA 92020

Statement of Experience

DN Tanks Potable Water Projects (partial list)

Project Information:
San Mateo, CA, USA
Ground Storage
1 - 3.86 MG (157.92 FT ID x 27.00 FT SWD x 35.00 FT WH)

Year Built: 2017
Project Name: Station 27 Beresford Tank

Owner:
California Water Service Company
1720 North First Street
San Jose, CA, USA 95112-4508
Contact: Lieu, Susan
(408) 367-8200

Engineer:
Engineering By Owner

Project Information:
Berkeley, CA, USA
Ground Storage
1 - 3.50 MG (141.00 FT ID x 33.00 FT SWD x 38.00 FT WH)

Year Built: 2016
Project Name: Summit Reservoir Replacement

Owner:
East Bay MUD (Main)
375 11th Street
Oakland, CA, USA 94607-4240
Contact: Franceschi, Paul
(866) 403-2683

Engineer:
Engineering by Owner

Project Information:
Hillsborough, CA, USA
Ground Storage
1 - 0.58 MG (69.00 FT ID x 20.83 FT SWD x 23.83 FT WH)

Year Built: 2016
Project Name: Vista Tank Reconstruction Project

Owner:
Town of Hillsborough
1600 Floribunda Avenue
Hillsborough, CA, USA 94010
Contact: Willis, Paul
(650) 375-7400

Engineer:
CSG Consultants, Inc.
550 Pilgrim Drive
Foster City, CA, USA 94404
Contact: Kong, Lynette
(650) 522-2500

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351 Cypress Lane
El Cajon CA 92020

Statement of Experience

DN Tanks Potable Water Projects (partial list)

Project Information:
Fresno, CA, USA
Ground Storage
1 - 3.00 MG (126.00 FT ID x 34.00 FT SWD x 37.00 FT WH)

Year Built: 2015
Project Name: Construct T-4 3 MG Water Tank and Booster Pump Station

Owner:
City of Fresno
1910 E. University Avenue
Fresno, CA, USA 93703-2988
Contact: Buche, Brock
(559) 621-7770

Engineer:
QK
601 Pollasky Avenue, Suite 301
Clovis, CA, USA 93612
Contact: Wathen, Ronald
(559) 449-2400

Project Information:
San Bruno, CA, USA
Ground Storage
1 - 2.00 MG (110.00 FT ID x 30.00 FT SWD x 39.25 FT WH)

Year Built: 2015
Project Name: Tank No. 3 (Glenview) Replacement Project

Owner:
City of San Bruno (Dept. of Public Services)
567 El Camino Real
San Bruno, CA, USA 94066-4247
Contact: Anderson, Will
(650) 877-8865

Engineer:
West Yost Associates (Davis)
2020 Research Park Drive
Davis, CA, USA 95616-2687
Contact: Wanlass, Jeffrey
(530) 756-5905

Project Information:
Rancho Cucamonga, CA, USA
Ground Storage
1 - 6.00 MG (161.50 FT ID x 40.00 FT SWD x 44.50 FT WH)

Year Built: 2014
Project Name: 6.0 MG Lloyd Michael WTP Reservoir

Owner:
Cucamonga Valley Water District
10440 Ashford Street
Rancho Cucamonga, CA, USA 91730-3057
Contact: Hills, Robert
(909) 987-2591

Engineer:
Black & Veatch
5 Peters Canyon Road
Irvine, CA, USA 92606
Contact: Lazenby, Andrew
(949) 753-0500

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BUILT
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351 Cypress Lane
El Cajon CA 92020

Statement of Experience

DN Tanks Potable Water Projects (partial list)

Project Information:
Woodland, CA, USA
Ground Storage
1 - 3.00 MG (130.00 FT ID x 31.60 FT SWD x 33.00 FT WH)

Year Built: 2014
Project Name: First New Ground Level Tank, CIP #08-33

Owner:
City of Woodland (main)
655 N. Pioneer Ave
Woodland, CA, USA 95776
Contact: Busch, Tim
(530) 661-5850

Engineer:
West Yost Associates (Davis)
2020 Research Park Drive
Davis, CA, USA 95616-2687
Contact: Wanlass, Jeffrey
(530) 756-5905

Project Information:
Covina, CA, USA
Ground Storage
1 - 3.00 MG (140.00 FT ID x 25.00 FT SWD x 28.00 FT WH)

Year Built: 2013
Project Name: 3.0 MG Charter Oak Reservoir

Owner:
City of Covina - Public Works City Yard
534 North Barranca Avenue
Covina, CA, USA 91723
Contact: Dospital, Dean
(626) 384-5234

Engineer:
Civiltec Engineering, Inc.
118 West Lime Avenue
Monrovia, CA, USA 91016
Contact: Kerger, Terry
(626) 357-0588

Project Information:
Vandenberg AFB, CA, USA
Ground Storage
2 - 4.00 MG (170.00 FT ID x 24.00 FT SWD x 28.75 FT WH)

Year Built: 2012
Project Name: 2 X 4.0 MG Tanks

Owner:
US Army - Los Angeles District, Corps of
1318 New Mexico Avenue
Vandenberg AFB, CA, USA 93437
Contact: Wynn, Valencia
(805) 201-6156

Engineer:
Penfield & Smith
Suite A, 210 East Enos Drive
Santa Maria, CA, USA 93454
Contact: Daniels, Brianna
(805) 925-2345

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351 Cypress Lane
El Cajon CA 92020

Statement of Experience

DN Tanks Potable Water Projects (partial list)

Project Information:
Lafayette, CA, USA
Ground Storage
1 - 2.70 MG (133.00 FT ID x 28.00 FT SWD x 31.00 FT WH)

Year Built: 2011
Project Name: 2.7 MG Highland Reservoir

Owner:
East Bay MUD (Main)
375 11th Street
Oakland, CA, USA 94607-4240
Contact: Franceschi, Paul
(866) 403-2683

Engineer:
Engineering by Owner

Project Information:
Richmond, CA, USA
Ground Storage
1 - 1.00 MG (76.50 FT ID x 29.10 FT SWD x 32.50 FT WH)

Year Built: 2011
Project Name: 1.0 MG Schapiro Reservoir Replacement

Owner:
East Bay MUD (Main)
375 11th Street
Oakland, CA, USA 94607-4240
Contact: Franceschi, Paul
(866) 403-2683

Engineer:
Engineering by Owner

Project Information:
Worland, WY, USA
Ground Storage
1 - 0.25 MG (50.00 FT ID x 17.50 FT SWD x 18.50 FT WH)

Year Built: 2011
Project Name: 0.25 MG Big Horn Tank

Owner:
Big Horn Regional Joint Powers Board
1100 N 10th St
Worland, WY, USA 82401
Contact: Joyce, John
(307) 272-4860

Engineer:
Engineering Associates
902 13th Street
Cody, WY, USA 82414
Contact: Schatz, Cody
(307) 587-4911

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351 Cypress Lane
El Cajon CA 92020

Statement of Experience

DN Tanks Potable Water Projects (partial list)

Project Information:
Hilo, HI, USA
Ground Storage
1 - 2.00 MG (137.00 FT ID x 20.00 FT SWD x 21.00 FT WH)

Year Built: 2010
Project Name: 2.0 MG Piihonua Reservoir #2

Owner:
Dept. of Water Supply, County of Hawaii (main)
345 Kekuanaoa Street, Suite 20
Hilo, HI, USA 96720-4388
Contact: Inaba, Kurt
(808) 961-8070

Engineer:
Tom Nance Water Resource Engineering
560 N. Nimitz Hwy, Ste. 213
Honolulu, HI, USA 96817
Contact: Fukumitsu, Gregory
(808) 537-1141

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351 Cypress Lane
El Cajon CA 92020

Statement of Experience

DN Tanks Projects - Dome Roof (partial list)

Project Information:
Tracy, CA, USA
Ground Storage
1 - 2.67 MG (114.00 FT ID x 35.25 FT SWD x 42.50 FT WH)

Year Built: 2023
Project Name: Tracy Hills Phase 2A Zone 5/6 Tanks Project

Owner:
Lennar Homes of California, LLC
2603 Camino Ramon, Suite 525
San Ramon, CA, USA 94583
Contact: Emmons, Lea

Engineer:
Coleman Engineering
1223 Pleasant Grove, Suite 100
Roseville, CA, USA 95678
Contact: Tom, Cody
(916) 791-1188

Project Information:
Palo Alto , CA, USA
Ground Storage
1 - 1.50 MG (80.00 FT ID x 40.00 FT SWD x 48.00 FT WH)

Year Built: 2022
Project Name: Corte Madera Reservoir Replacement Project (CIP WS-09000)

Owner:
City of Palo Alto
250 Hamilton Avenue
Palo Alto, CA, USA 94301
Contact: Antonio, Romel
(650) 329-2460

Engineer:
SRT Consultants
90 New Montgomery St., Suite 905
San Francisco, CA, USA 94105
Contact: Monahan, Tim
(415) 776-5800

Project Information:
Turlock, CA, USA
Ground Storage
1 - 2.38 MG (125.00 FT ID x 25.75 FT SWD x 30.75 FT WH)

Year Built: 2022
Project Name: Surface Water Distribution System Improvements

Owner:
City of Turlock (Municipal Services)
156 S. Broadway, Suite 270
Turlock, CA, USA 95380-5454
Contact: Cooke, Michael
(209) 668-5590

Engineer:
Carollo Engineers - Headquarters
2795 Mitchell Drive
Walnut Creek, CA, USA 94598
Contact: Peterson, Justin
(925) 932-1710

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351 Cypress Lane
El Cajon CA 92020

Statement of Experience

DN Tanks Projects - Dome Roof (partial list)

Project Information:
Hughson, CA, USA
Clearwell
1 - 5.30 MG (187.00 FT ID x 26.00 FT SWD)

Year Built: 2021
Project Name: SRWA Regional Surface Water Supply Project

Owner:
Stanislaus Regional Water Authority (SRWA)
156 S. Broadway
Turlock, CA, USA 95380
Contact: Reynolds, Garner
(209) 668-5540

Engineer:
Jacobs
6312 S. Fiddlers Green Cir
Greenwood Village, CO, USA 80111
Contact: Brustad, Karl
(720) 286-2000

Project Information:
Tracy, CA, USA
Ground Storage
1 - 3.75 MG (137.00 FT ID x 35.00 FT SWD x 41.83 FT WH)

Year Built: 2020
Project Name: Tracy Hills Phase 1A/1B at Grade Water Tank and Pump Station - Zone 3

Owner:
City of Tracy
333 Civic Center Drive
Tracy, CA, USA 95376
Contact: Emmons, Lea
(209) 831-6000

Engineer:
Ruggeri-Jensen-Azar
4960 Chabot Drive
Pleasanton, CA, USA 94588
Contact: Radoycis, Rich
(925) 227-9100

Project Information:
Brentwood, CA, USA
Reuse
1 - 3.00 MG (166.50 FT ID x 19.71 FT SWD x 24.00 FT WH)

Year Built: 2019
Project Name: Non-Potable Storage Facility, CIP Project No. 592-59198

Owner:
City of Brentwood
150 City Parkway
Brentwood, CA, USA 94513
Contact: McKinney, Phil
(925) 516-5420

Engineer:
Coleman Engineering
1223 Pleasant Grove, Suite 100
Roseville, CA, USA 95678
Contact: Coleman, Chad
(916) 791-1188

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351 Cypress Lane
El Cajon CA 92020

Statement of Experience

DN Tanks Projects - Dome Roof (partial list)

Project Information:
San Bruno, CA, USA
Ground Storage
1 - 2.00 MG (110.00 FT ID x 30.00 FT SWD x 39.25 FT WH)

Year Built: 2015
Project Name: Tank No. 3 (Glenview) Replacement Project

Owner:
City of San Bruno (Dept. of Public Services)
567 El Camino Real
San Bruno, CA, USA 94066-4247
Contact: Anderson, Will
(650) 877-8865

Engineer:
West Yost Associates (Davis)
2020 Research Park Drive
Davis, CA, USA 95616-2687
Contact: Wanlass, Jeffrey
(530) 756-5905

Project Information:
Woodland, CA, USA
Clearwell
2 - 2.88 MG (136.00 FT ID x 28.00 FT SWD x 30.25 FT WH)

Year Built: 2015
Project Name: Davis Woodland Water Supply Project

Owner:
City of Woodland (main)
655 N. Pioneer Ave
Woodland, CA, USA 95776
Contact: Busch, Tim
(530) 661-5850

Engineer:
West Yost Associates
2020 Research Park Drive
Davis, CA, USA 95618
Contact: Wanlass, Jeffrey
(530) 756-5905

Project Information:
Woodland, CA, USA
Ground Storage
1 - 3.00 MG (130.00 FT ID x 31.60 FT SWD x 33.00 FT WH)

Year Built: 2014
Project Name: First New Ground Level Tank, CIP #08-33

Owner:
City of Woodland (main)
655 N. Pioneer Ave
Woodland, CA, USA 95776
Contact: Busch, Tim
(530) 661-5850

Engineer:
West Yost Associates (Davis)
2020 Research Park Drive
Davis, CA, USA 95616-2687
Contact: Wanlass, Jeffrey
(530) 756-5905

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FOR THE FUTURE

351 Cypress Lane
El Cajon CA 92020

Statement of Experience

DN Tanks Projects - Dome Roof (partial list)

Project Information:
Indio, CA, USA
Aerobic Digester
1 - 1.50 MG (85.00 FT ID x 30.00 FT SWD x 36.50 FT WH)

Year Built: 2013
Project Name: 1.5 MG Digester

Owner:
Valley Sanitary District
45-500 Van Buren Street
Indio, CA, USA 92201
Contact: Buchwald, Ronald
(760) 347-2356

Engineer:
Lee & Ro, Inc.
1199 South Fullerton Road
City of Industry, CA, USA 91748-1232
Contact: Ro, Charles
(626) 912-3391

Project Information:
Riverside, CA, USA
Aerobic Digester
2 - 2.00 MG (90.00 FT ID x 38.00 FT SWD x 42.00 FT WH)

Year Built: 2013
Project Name: 2 x 2.0 MG Digesters

Owner:
City of Riverside (Main Office)
3750 University Avenue
Riverside, CA, USA 92501
Contact: Farley, John
(951) 782-5672

Engineer:
Simon Wong Engineering
1412 Van Ness Avenue
San Francisco, CA, USA 94109
Contact: Ng, Eric
(415) 441-3240

Project Information:
Vandenberg AFB, CA, USA
Ground Storage
2 - 4.00 MG (170.00 FT ID x 24.00 FT SWD x 28.75 FT WH)

Year Built: 2012
Project Name: 2 X 4.0 MG Tanks

Owner:
US Army - Los Angeles District, Corps of
1318 New Mexico Avenue
Vandenberg AFB, CA, USA 93437
Contact: Wynn, Valencia
(805) 201-6156

Engineer:
Penfield & Smith
Suite A, 210 East Enos Drive
Santa Maria, CA, USA 93454
Contact: Daniels, Brianna
(805) 925-2345

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BUILT FOR THE FUTURE

351 Cypress Lane
El Cajon CA 92020

Statement of Experience

Danelly Justiniano, Design Engineer

Project Information:
Cathedral City, CA, USA
Ground Storage
1 - 2.74 MG (141.50 FT ID x 24.00 FT SWD x 37.00 FT WH)

Year Built: 2023
Project Name: Rio Vista Reservoir (Developer)

Owner:
Coachella Valley Water District (Palm Desert
75525 Hovley Lane East
Palm Desert, CA, USA 92211
Contact: Ruiz, Dan
(760) 398-2651

Engineer:
Krieger & Stewart
3602 University Avenue
Riverside, CA, USA 92501-3331
Contact: Watson, Pat
(951) 684-6900

Project Information:
Bakersfield, CA, USA
Anaerobic Digester
1 - 0.51 MG (55.00 FT ID x 27.00 FT SWD x 30.00 FT WH)

Year Built: 2022
Project Name: Kern Sanitation Authority Digester System Expansion, Contract No. 20091, Project No. 9144-KSA-17/18-22

Owner:
Kern Sanitation Authority
2700 "M" Street, Suite 400
Bakersfield, CA, USA 93301
Contact: Perez, Kyle

Engineer:
AECOM
5001 East Commercenter Drive
Bakersfield, CA, USA 93309-1655
Contact: Ojeda, Yeimy
(661) 283-2323

Project Information:
Ceres, CA, USA
Ground Storage
1 - 3.00 MG (127.00 FT ID x 30.33 FT SWD x 35.00 FT WH)

Year Built: 2022
Project Name: River Bluff Reservoir & Pump Station Project

Owner:
City of Ceres
2220 Magnolia Street
Ceres, CA, USA 95307
Contact: Royal, Samir
(209) 538-5732

Engineer:
Black Water Consulting Engineers, Inc.
605 Standiford Avenue
Modesto, CA, USA 95350
Contact: Black, Jeff
(209) 322-1817

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351 Cypress Lane
El Cajon CA 92020

Statement of Experience

Danelly Justiniano, Design Engineer

Project Information:
Kensington, CA, USA
Ground Storage
2 - 3.50 MG (173.50 FT ID x 22.50 FT SWD x 25.63 FT WH)

Year Built: 2022
Project Name: San Pablo Clearwell & Rate Control Station Replacement

Owner:
East Bay MUD (Main)
375 11th Street
Oakland, CA, USA 94607-4240
Contact: Franceschi, Paul
(866) 403-2683

Engineer:
Engineering by Owner

Project Information:
Palo Alto , CA, USA
Ground Storage
1 - 1.50 MG (80.00 FT ID x 40.00 FT SWD x 48.00 FT WH)

Year Built: 2022
Project Name: Corte Madera Reservoir Replacement Project (CIP WS-09000)

Owner:
City of Palo Alto
250 Hamilton Avenue
Palo Alto, CA, USA 94301
Contact: Antonio, Romel
(650) 329-2460

Engineer:
SRT Consultants
90 New Montgomery St., Suite 905
San Francisco, CA, USA 94105
Contact: Monahan, Tim
(415) 776-5800

Project Information:
Thousand Palms, CA, USA
Ground Storage
1 - 10.00 MG (234.83 FT ID x 32.00 FT SWD x 41.00 FT WH)

Year Built: 2022
Project Name: 10.0 MG Reservoir 4605-2 Construction (Sky Mountain Pressure Zone)

Owner:
Coachella Valley Water District
51501 Tyler Street
Coachella, CA, USA 92236
Contact: Fogg, Brian
(760) 398-2651

Engineer:
Krieger & Stewart
3602 University Avenue
Riverside, CA, USA 92501-3331
Contact: Watson, Pat
(951) 684-6900

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351 Cypress Lane
El Cajon CA 92020

Statement of Experience

Danelly Justiniano, Design Engineer

Project Information:
Turlock, CA, USA
Ground Storage
1 - 2.38 MG (125.00 FT ID x 25.75 FT SWD x 30.75 FT WH)

Year Built: 2022
Project Name: Surface Water Distribution System Improvements

Owner:
City of Turlock (Municipal Services)
156 S. Broadway, Suite 270
Turlock, CA, USA 95380-5454
Contact: Cooke, Michael
(209) 668-5590

Engineer:
Carollo Engineers - Headquarters
2795 Mitchell Drive
Walnut Creek, CA, USA 94598
Contact: Peterson, Justin
(925) 932-1710

Project Information:
Valley Center, CA, USA
Ground Storage
1 - 2.13 MG (80.00 FT ID x 54.00 FT SWD x 59.00 FT WH)

Year Built: 2022
Project Name: Hauck Mesa Storage Reservoir - Specification 639

Owner:
San Diego County Water Authority (main)
4677 Overland Avenue
San Diego, CA, USA 92123-1233
Contact: Whitaker, Kirk
(858) 522-6800

Engineer:
Lee & Ro, Inc.
10640 Scripps Ranch Blvd.
San Diego, CA, USA 92131
Contact:
(858) 558-4411

Project Information:
Danville, CA, USA
Ground Storage
1 - 0.60 MG (60.50 FT ID x 30.00 FT SWD x 34.25 FT WH)

Year Built: 2021
Project Name: Acorn No. 1, Derby, Scenic, and Scenic East Reservoirs Rehabilitation - Specification 2153

Owner:
East Bay MUD (Main)
375 11th Street
Oakland, CA, USA 94607-4240
Contact: Franceschi, Paul
(866) 403-2683

Engineer:
East Bay MUD (Main)
375 11th Street
Oakland, CA, USA 94607-4240
Contact: Franceschi, Paul
(866) 403-2683

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351 Cypress Lane
El Cajon CA 92020

Statement of Experience

Danelly Justiniano, Design Engineer

Project Information:
Hughson, CA, USA
Clearwell
1 - 5.30 MG (187.00 FT ID x 26.00 FT SWD)

Year Built: 2021
Project Name: SRWA Regional Surface Water Supply Project

Owner:
Stanislaus Regional Water Authority (SRWA)
156 S. Broadway
Turlock, CA, USA 95380
Contact: Reynolds, Garner
(209) 668-5540

Engineer:
Jacobs
6312 S. Fiddlers Green Cir
Greenwood Village, CO, USA 80111
Contact: Brustad, Karl
(720) 286-2000

Project Information:
Huntington Beach , CA, USA
EQ
1 - 2.50 MG (124.00 FT ID x 30.00 FT SWD x 34.50 FT WH)

Year Built: 2021
Project Name: Groundwater Replenishment System, Final Expansion Project, Contract No. GWRS-2019-1

Owner:
Orange County Water District
18700 Ward Street
Fountain Valley, CA, USA 92708
Contact: Scott-Roberts, Sandy
(714) 378-3200

Engineer:
Black & Veatch
5 Peters Canyon Road
Irvine, CA, USA 92606
Contact: ten Bosch, Rich
(949) 753-0500

Project Information:
Huntington Beach , CA, USA
EQ
1 - 3.50 MG (146.00 FT ID x 30.00 FT SWD x 34.50 FT WH)

Year Built: 2021
Project Name: Groundwater Replenishment System, Final Expansion Project, Contract No. GWRS-2019-1

Owner:
Orange County Water District
18700 Ward Street
Fountain Valley, CA, USA 92708
Contact: Scott-Roberts, Sandy
(714) 378-3200

Engineer:
Black & Veatch
5 Peters Canyon Road
Irvine, CA, USA 92606
Contact: ten Bosch, Rich
(949) 753-0500

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BUILT FOR THE FUTURE

351 Cypress Lane
El Cajon CA 92020

Statement of Experience

Ron Toth, Tank Superintendent

Project Information:
Kensington, CA, USA
Ground Storage
2 - 3.50 MG (173.50 FT ID x 22.50 FT SWD x 25.63 FT WH)

Year Built: 2022
Project Name: San Pablo Clearwell & Rate Control Station Replacement

Owner:
East Bay MUD (Main)
375 11th Street
Oakland, CA, USA 94607-4240
Contact: Franceschi, Paul
(866) 403-2683

Engineer:
Engineering by Owner

Project Information:
San Jose, CA, USA
Ground Storage
2 - 5.75 MG (205.00 FT ID x 22.00 FT SWD x 26.50 FT WH)

Year Built: 2021
Project Name: Columbine Station Improvements Project

Owner:
San Jose Water Company
1221 A South Bascom Avenue
San Jose, CA, USA 95128
Contact: Nugteren, Erik
(408) 279-7886

Engineer:
Water Works Engineers
1730 S. El Camino Real, Suite 280
San Mateo, CA, USA 94402
Contact: Bertsch, Cindy
(650) 539-3420

Project Information:
Brentwood, CA, USA
Reuse
1 - 3.00 MG (166.50 FT ID x 19.71 FT SWD x 24.00 FT WH)

Year Built: 2019
Project Name: Non-Potable Storage Facility, CIP Project No. 592-59198

Owner:
City of Brentwood
150 City Parkway
Brentwood, CA, USA 94513
Contact: McKinney, Phil
(925) 516-5420

Engineer:
Coleman Engineering
1223 Pleasant Grove, Suite 100
Roseville, CA, USA 95678
Contact: Coleman, Chad
(916) 791-1188

Proprietary and confidential information; intended solely for the use of the authorized recipient.

BUILT
FOR THE FUTURE

351 Cypress Lane
El Cajon CA 92020

Statement of Experience

Ron Toth, Tank Superintendent

Project Information:
Berkeley, CA, USA
Ground Storage
1 - 3.50 MG (141.00 FT ID x 33.00 FT SWD x 38.00 FT WH)

Year Built: 2016
Project Name: Summit Reservoir Replacement

Owner:
East Bay MUD (Main)
375 11th Street
Oakland, CA, USA 94607-4240
Contact: Franceschi, Paul
(866) 403-2683

Engineer:
Engineering by Owner

Project Information:
Woodland, CA, USA
Clearwell
2 - 2.88 MG (136.00 FT ID x 28.00 FT SWD x 30.25 FT WH)

Year Built: 2015
Project Name: Davis Woodland Water Supply Project

Owner:
City of Woodland (main)
655 N. Pioneer Ave
Woodland, CA, USA 95776
Contact: Busch, Tim
(530) 661-5850

Engineer:
West Yost Associates
2020 Research Park Drive
Davis, CA, USA 95618
Contact: Wanlass, Jeffrey
(530) 756-5905

Project Information:
Rancho Cucamonga, CA, USA
Ground Storage
1 - 6.00 MG (161.50 FT ID x 40.00 FT SWD x 44.50 FT WH)

Year Built: 2014
Project Name: 6.0 MG Lloyd Michael WTP Reservoir

Owner:
Cucamonga Valley Water District
10440 Ashford Street
Rancho Cucamonga, CA, USA 91730-3057
Contact: Hills, Robert
(909) 987-2591

Engineer:
Black & Veatch
5 Peters Canyon Road
Irvine, CA, USA 92606
Contact: Lazenby, Andrew
(949) 753-0500

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BUILT FOR THE FUTURE

351 Cypress Lane
El Cajon CA 92020

Statement of Experience

Arcenio Meza, Prestressing Superintendent

Project Information:
Cathedral City, CA, USA
Ground Storage
1 - 2.74 MG (141.50 FT ID x 24.00 FT SWD x 37.00 FT WH)

Year Built: 2023
Project Name: Rio Vista Reservoir (Developer)

Owner:
Coachella Valley Water District (Palm Desert
75525 Hovley Lane East
Palm Desert, CA, USA 92211
Contact: Ruiz, Dan
(760) 398-2651

Engineer:
Krieger & Stewart
3602 University Avenue
Riverside, CA, USA 92501-3331
Contact: Watson, Pat
(951) 684-6900

Project Information:
Palo Alto , CA, USA
Ground Storage
1 - 1.50 MG (80.00 FT ID x 40.00 FT SWD x 48.00 FT WH)

Year Built: 2022
Project Name: Corte Madera Reservoir Replacement Project (CIP WS-09000)

Owner:
City of Palo Alto
250 Hamilton Avenue
Palo Alto, CA, USA 94301
Contact: Antonio, Romel
(650) 329-2460

Engineer:
SRT Consultants
90 New Montgomery St., Suite 905
San Francisco, CA, USA 94105
Contact: Monahan, Tim
(415) 776-5800

Project Information:
Turlock, CA, USA
Ground Storage
1 - 2.38 MG (125.00 FT ID x 25.75 FT SWD x 30.75 FT WH)

Year Built: 2022
Project Name: Surface Water Distribution System Improvements

Owner:
City of Turlock (Municipal Services)
156 S. Broadway, Suite 270
Turlock, CA, USA 95380-5454
Contact: Cooke, Michael
(209) 668-5590

Engineer:
Carollo Engineers - Headquarters
2795 Mitchell Drive
Walnut Creek, CA, USA 94598
Contact: Peterson, Justin
(925) 932-1710

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BUILT
FOR THE FUTURE

351 Cypress Lane
El Cajon CA 92020

Statement of Experience

Arcenio Meza, Prestressing Superintendent

Project Information:
San Jose, CA, USA
Ground Storage
2 - 5.75 MG (205.00 FT ID x 22.00 FT SWD x 26.50 FT WH)

Year Built: 2021
Project Name: Columbine Station Improvements Project

Owner:
San Jose Water Company
1221 A South Bascom Avenue
San Jose, CA, USA 95128
Contact: Nugteren, Erik
(408) 279-7886

Engineer:
Water Works Engineers
1730 S. El Camino Real, Suite 280
San Mateo, CA, USA 94402
Contact: Bertsch, Cindy
(650) 539-3420

Project Information:
Tracy, CA, USA
Ground Storage
1 - 3.75 MG (137.00 FT ID x 35.00 FT SWD x 41.83 FT WH)

Year Built: 2020
Project Name: Tracy Hills Phase 1A/1B at Grade Water Tank and Pump Station - Zone 3

Owner:
City of Tracy
333 Civic Center Drive
Tracy, CA, USA 95376
Contact: Emmons, Lea
(209) 831-6000

Engineer:
Ruggeri-Jensen-Azar
4960 Chabot Drive
Pleasanton, CA, USA 94588
Contact: Radoycis, Rich
(925) 227-9100

Project Information:
Santa Paula, CA, USA
Ground Storage
1 - 3.00 MG (137.00 FT ID x 28.00 FT SWD x 36.00 FT WH)

Year Built: 2018
Project Name: East Area No. 1 Reservoir

Owner:
City of Santa Paula
970 Ventura Street
Santa Paula, CA, USA 93060
Contact: Gaitan, Raul
(805) 525-4478

Engineer:
Jensen Design & Survey, Inc.
1672 Donlon Street
Ventura, CA, USA 93003
Contact: Talmadge, Robert
(800) 676-1916

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BUILT
FOR THE FUTURE

351 Cypress Lane
El Cajon CA 92020

Statement of Experience

Arcenio Meza, Prestressing Superintendent

Project Information:
Santa Cruz, CA, USA
Ground Storage
1 - 6.00 MG (220.00 FT ID x 21.67 FT SWD x 24.67 FT WH)

Year Built: 2015
Project Name: Bay Replacement Reservoir, Phase 3

Owner:
City of Santa Cruz (Center Street)
809 Center Street
Santa Cruz, CA, USA 95060-3864
Contact: McKinney, Terry
(831) 420-5200

Engineer:
Consolidated CM
Ste. 1520, 180 Grand Avenue
Oakland, CA, USA 94612
Contact: Scoble, Matt
(510) 208-1720

Project Information:
Grass Valley, CA, USA
Ground Storage
1 - 4.60 MG (211.00 FT ID x 18.20 FT SWD x 19.00 FT WH)

Year Built: 2013
Project Name: Banner-Taylor Tank Replacement Design & Build Project - 4.6MG

Owner:
Nevada Irrigation District (main)
1036 West Main Street
Grass Valley, CA, USA 95945
Contact: Roderick, Doug
(530) 273-3346

Engineer:
Bennett Engineering Services
1082 Sunrise Avenue
Roseville, CA, USA 95661-5468
Contact: Rubio, Leo
(916) 783-4100

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BUILT FOR THE FUTURE

351 Cypress Lane
El Cajon CA 92020

Statement of Experience

Bryan Loera, Prestressing / Shotcrete Foreman

Project Information:
Millbrae, CA, USA
Ground Storage
1 - 1.57 MG (99.00 FT ID x 28.00 FT SWD x 38.00 FT WH)

Year Built: 2023
Project Name: Skyline Water Tank Replacement Project

Owner:
City of Millbrae (Public Works Dept.)
621 Magnolia Avenue
Millbrae, CA, USA 94030
Contact: Kao, Jane
(650) 259-2339

Engineer:
Water Works Engineers
1730 S. El Camino Real, Suite 280
San Mateo, CA, USA 94402
Contact: Bertsch, Cindy
(650) 539-3420

Project Information:
Palo Alto , CA, USA
Ground Storage
1 - 1.50 MG (80.00 FT ID x 40.00 FT SWD x 48.00 FT WH)

Year Built: 2022
Project Name: Corte Madera Reservoir Replacement Project (CIP WS-09000)

Owner:
City of Palo Alto
250 Hamilton Avenue
Palo Alto, CA, USA 94301
Contact: Antonio, Romel
(650) 329-2460

Engineer:
SRT Consultants
90 New Montgomery St., Suite 905
San Francisco, CA, USA 94105
Contact: Monahan, Tim
(415) 776-5800

Project Information:
Roseville, CA, USA
Ground Storage
2 - 6.00 MG (170.00 FT ID x 36.75 FT SWD x 40.00 FT WH)

Year Built: 2022
Project Name: West Side Tanks and Pump Station Project

Owner:
City of Roseville (main office)
2005 Hilltop Circle
Roseville, CA, USA 95747-9704
Contact: Hanson, George
(916) 774-5714

Engineer:
Water Works Engineers
2260 Douglas Blvd., Suite 105
Roseville, CA, USA 95661
Contact: Beck, Mason
(916) 780-2888

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BUILT FOR THE FUTURE

351 Cypress Lane
El Cajon CA 92020

Statement of Experience

Bryan Loera, Prestressing / Shotcrete Foreman

Project Information:
Kennewick, WA, USA
Ground Storage
1 - 6.00 MG (188.00 FT ID x 30.00 FT SWD x 31.50 FT WH)

Year Built: 2021
Project Name: 18th and Kellogg Reservoir Replacement, Contract P1810-19

Owner:
City of Kennewick
210 West 6th Avenue
Kennewick, WA, USA 99336
Contact: Lustig, Jeremy
(509) 585-4278

Engineer:
HDR, Inc.
2805 Saint Andrews Loop, Suite A
Pasco, WA, USA 99301-6121
Contact: Simmons, Erik
(509) 546-2040

Project Information:
San Jose, CA, USA
Ground Storage
2 - 5.75 MG (205.00 FT ID x 22.00 FT SWD x 26.50 FT WH)

Year Built: 2021
Project Name: Columbine Station Improvements Project

Owner:
San Jose Water Company
1221 A South Bascom Avenue
San Jose, CA, USA 95128
Contact: Nugteren, Erik
(408) 279-7886

Engineer:
Water Works Engineers
1730 S. El Camino Real, Suite 280
San Mateo, CA, USA 94402
Contact: Bertsch, Cindy
(650) 539-3420

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AMERICAN CONCRETE INSTITUTE

This is to certify that

BRYAN LOERA

has demonstrated knowledge and ability by successfully completing the ACI Certification requirements and is hereby recognized as an

ACI Shotcrete Nozzleman, Wet Mix Process, Vertical Only

Certified Date: 07/22/2022 **Expires: 07/21/2027**

Examiner of Record: Oscar C Duckworth

ACI Managing Director of Certification

The Authenticity of this certification can be verified at www. ACICertification .org/verify

ACI Certification Results Report

Report Print Date:8/19/22

ACI Shotcrete Nozzleman: Wet Mix Process

Testing Session Information:

Session: **223525** Exam Date: **07/22/2022** Exam Location: **EL CAJON, CA**
ACI Sponsoring Group: **American Shotcrete Association**
Examiner of Record: **Oscar C Duckworth**

Examinee Information

BRYAN LOERA
1584 W Mesa Dr
Rialto, CA 92376-3888

Certification ID
02191985

Status Information

Certification Status: ***CERTIFIED*** **ACI Shotcrete Nozzleman, Wet Mix Process, Vertical Only**
Certification Issue Date 07/22/2022 Thru 07/21/2027

ACI Comments:

Congratulations! You are now Certified. This is an accomplishment you can be very proud of and we will be happy to confirm this credential to anyone upon request. Enclosed is your wallet card and certificate attesting this accomplishment. In addition, a directory of all ACI Certified individuals can be found at www.ACICertification.org.
Note: If you wish to upgrade your certification to include the Overhead Position, you must pass the Overhead Position Performance Examination.

Overall Results

Overall Written Examination	**PASS**
Vertical Performance Exam	**PASS**

The Detailed Subtest Results section on next (back) page.

Detailed Subtest Results

To pass the written examination you must score 75% or higher on the written examination.

Qualification	P/F - Session	% Score
Overall Written Examination	PASS - 223525	85.00
Vertical Performance Exam	PASS - 223525	100.00

If you have any questions about this program, or other ACI activity, please feel free to contact us at (248) 848-3790.



STATEMENT OF EXPERIENCE OF BIDDER

The bidder is required to state below what work of similar magnitude or character he or she has done and to give references that will enable the City Council to judge of his or her experience, skill and business standing and his or her ability to conduct work as completely and rapidly as required under the terms of the contract.

See attached listing

GHILOTTI CONSTRUCTION COMPANY, INC.
PROJECT EXPERIENCE

JOB NUMBER	5794	Estimate # LU17317
PROJECT	RECYCLED WATER PROJECT – PHASES 1-3	Division: 10 Project Mgr: STEVE HANAK Admin: MONICA NOSSARDI
CONTRACT #	CONTRACT #1718138 SPEC 17-08	Estimator: STEVE HANAK
PROJECT DIR #	218748	Scope of Work: Construction of a recycled water system that includes a recycled water storage pond, a recycled water pump station, and a recycled water pipeline.
LOCATION	VARIOUS LOCATIONS IN UKIAH, INCLUDING RIVER STREET AND PLANT ROAD (INCORPORATED)	
OWNER	CITY OF UKIAH 300 SEMINARY AVENUE UKIAH, CA 95482 PH: 707/463-6233 FX: 707/313-3621	
CONTRACTOR	GCC	
CONSTRUCTION MANAGEMENT	CAROLLO ENGINEERS, INC. 2700 YGNACIO VALLEY RD., STE 300 WALNUT CREEK, CA 94598 PH: 925/932-1710 FX: 925/930-0208	
CONTACT	Ken Sinclair 925-260-2943 ksinclair@carollo.com	
Working Days	COMPLETE BY 11/30/18 (SUBSTANTIAL)	
Liquidated Damages	$5,000.00 / CD	
Contract Date	12/5/17	
Completion Date	11/30/19	
Contract Amount	$22,357,358.00	
G.C.C. Bond Number	070024229	

JOB NUMBER	5914	Estimate # FR19470
PROJECT	SOUTHGATE ROAD REALIGNMENT	Division: 60S Project Mgr: SAM GUTIERREZ / ROY ABDOLLAHI / JOHN PRESTON
CONTRACT #	CALTRANS EA 04-3A6414 PROJECT ID 0419000153 FED AID PROJECT BRLS-6272 (047) SFCTA CONTRACT #19/20-01	Estimator: ROD BARBER / JIM PETNIC
PROJECT DIR #	327348	Scope of Work: Demolish building, construct grading, aggregate base, hot mix asphalt (HMA) paving, concrete bike path, drainage, concrete barriers, crash cushions, bridges, mechanically stabilized embankment (MSE) retaining wall, soldier pile retaining wall, soil nail retaining wall, sign structures, signing, striping, water line, joint utility trench and electrical work, roadway excavation, planting, irrigation, erosion control, drainage, sidewalk, fencing, gates, cable barrier, concrete barrier, lighting and building work. Future work via contract change orders may include 2" gas line and tolling infrastructure.
LOCATION	04-SF-80-PM-7.8/8.0 HWY 80 ON YERBA BUENA ISLAND FROM YERBA BUENA TUNNEL TO 0.2 MILE EAST OF YERBA BUENA TUNNEL, SAN FRANCISCO (INCORPORATED)	
OWNER	SAN FRANCISCO COUNTY TRANSPORTATION AUTHORITY 1455 MARKET STREET SAN FRANCISCO, CA 94103	
CONTRACTOR	GCC	
CONSTRUCTION MANAGEMENT	THOM FRESQUEZ, P.E. PH: 510/774-5985 E-MAIL: tfresquez@mnsengineers.com	
CONTACT	LILY YU PH: 415/522-4800 E-MAIL: lily.yu@sfcta.org	
Working Days	460 WD	
Liquidated Damages	$13,500.00 / CD	
Contract Date	4/28/20	
Completion Date	TBD	
Contract Amount	$29,684,452.46	
G.C.C. Bond Number	070209710	

JOB NUMBER	5880	Estimate # SCT19133
PROJECT	#04-2640F4 – HWY 101 PETALUMA	Division: 50 Project Mgr: TIM SALLES Project Engr: CHELSYE KNIGHT / JOSHUA ZIMMERMAN Admin: BETH NAGY
CONTRACT #	#04-2640F4 FED AID #ACNH-Q101(353)N	Estimator: JIM PETNIC / ROD BARBER
PROJECT DIR #	300664	Scope of Work: HMA, CIP BRIDGES, RETAINING & SOUND WALLS & MODIFY ELECTRICAL.
LOCATION	HWY 101 FROM ROUTE 101/116 SEPARATION TO 0.4 MILE NORTH OF CORONA ROAD OVERCROSSING, PETALUMA (INCORPORATED)	
OWNER	DEPARTMENT OF TRANSPORTATION PETALUMA FIELD OFFICE 1009 CLEGG COURT, STE G PETALUMA, CA 94954	
CONTRACTOR	GCC	
CONSTRUCTION MANAGEMENT		
CONTACT	RICHARD DUNCAN, R.E. PH: 510/812-6444 E-MAIL: richard.duncan@dot.ca.gov GINA CHOI, SR. R.E. PH: 510/385-8178 E-MAIL: gina.choi@dot.ca.gov	
Working Days	660 WORKING DAYS	
Liquidated Damages	$19,200.00	
Contract Date	8/8/19	
Completion Date	TBD	
Contract Amount	$78,755,318.65	
G.C.C. Bond Number	070209654	

JOB NUMBER	5786	Estimate # LS17274
PROJECT	TRANSPORTATION IMPROVEMENTS AT REDWOOD BUSINESS PARK	Division: 10 Project Mgr: BRAD BARNES Admin: MONICA NOSSARDI
CONTRACT #	CONTRACT #1718107 SPEC #17-09	Estimator: MARK MAHBOUBI
PROJECT DIR #	211995	Scope of Work: AIRLINE TERMINAL, PAVING, SIDEWALK, PARKING LOT, SITE DEVELOPMENT.
LOCATION	AIRPORT PARK BLVD, TALMAGE ROAD, WASHINGTON ST., STATE ST., UKIAH (INCORPORATED)	
OWNER	CITY OF UKIAH 300 SEMINARY AVENUE UKIAH, CA 95482 PH: 707/463-6233 FX: 707/313-3621	
CONTRACTOR	GCC	
CONSTRUCTION MANAGEMENT		
CONTACT	MARY HORGER E-MAIL: mhorger@cityofukiah.com	
Working Days	120 WORKING DAYS	
Liquidated Damages	$500.00 / CD	
Contract Date	9/25/17	
Completion Date	8/31/19	
Contract Amount	$4,608,888.00	
G.C.C. Bond Number	070024215	

JOB NUMBER	5787	Estimate # LS17285
PROJECT	TALMAGE ROAD INTERCHANGE	Division: 10 Project Mgr: BRAD BARNES Admin: MONICA NOSSARDI
CONTRACT #	CONTRACT #1718124 SPEC #17-07	Estimator: MARK MAHBOUBI
PROJECT DIR #	213712	Scope of Work: LEAD COMPLIANCE PLAN, CONSTRUCTION AREA SIGNS/PCMS, TEMP CRASH CUSHIONS, TRAFFIC CONTROL, SWPPP, TEMP WATER POLLUTION CTRL MEASURES, SIGNS, AC PAVING, GRINDING, STRIPING, IRRIGATION, FENCING, HEADWALL, EROSION CONTROL, UNDERGROUND, MINOR CONCRETE, SIGNAL & LIGHTING, INDUCTIVE LOOP DETECTOR.
LOCATION	TALMAGE ROAD, UKIAH (INCORPORATED)	
OWNER	CITY OF UKIAH 300 SEMINARY AVENUE UKIAH, CA 95482 PH: 707/463-6233 FX: 707/313-3621	
CONTRACTOR	GCC	
CONSTRUCTION MANAGEMENT		
CONTACT	MARY HORGER E-MAIL: mhorger@cityofukiah.com	
Working Days	100 WORKING DAYS	
Liquidated Damages	$500.00 / CD	
Contract Date	9/25/17	
Completion Date	5/31/19	
Contract Amount	$1,858,888.00	
G.C.C. Bond Number	070024220	

JOB NUMBER	5792	Estimate # LS17277
PROJECT	COSTCO UKIAH	Division: 10 Project Mgr: BRAD BARNES Admin: MONICA NOSSARDI
CONTRACT #	1729-1-001	Estimator: MIKE ROSSELLI
PROJECT DIR #	N/A	Scope of Work: DEMO ASPHALT & CONCRETE, CUT-FILL ONSITE, IMPORT, FINEGRADE, BACKFILL, SEWER & WATER, CDS MEDIA FILTRATION, DROP INLETS, RSP, FIRE HYDRANTS, HDPE PIPE, AC PAVING, CL2AB, BIOSWALE, SWPPP, CURB & GUTTER, HANDICAP RAMPS, BUS STOP PADS.
LOCATION	AIRPORT PARK BLVD. UKIAH, CA 95482 (INCORPORATED)	
OWNER	COSTCO WHOLESALE 999 LAKE DRIVE ISSAQUAH, WA 98027	
CONTRACTOR	RSR CONSTRUCTION COMPANY 21360 NW AMBERWOOD DRIVE HILLSBORO, OR 97124	
CONSTRUCTION MANAGEMENT	N/A	
CONTACT	KYLE PALMER PH: 503/645-8531 E-MAIL: KPALMER@ROBCON.COM	
Working Days	TBD	
Liquidated Damages	N/A	
Contract Date	9/25/17	
Completion Date	DECEMBER 2018	
Contract Amount	$4,331,490.00	
G.C.C. Bond Number	N/A	
APN #	180-110-08-00, 180-080-57-00 THRU 59-00, 180-080-62-00 THRU 67-00	

JOB NUMBER	5909	Estimate # LR19429
PROJECT	DOWNTOWN STREETSCAPE AND ROAD DIET PROJECT	Division: 10 Project Mgr: BRAD BARNES Admin: MONICA NOSSARDI
CONTRACT #	SPECIFICATION NO. 1819-173 FED AID #RPSTPLE-5049(025) AND HSIPL-5049(026)	Estimator: MARK MAHBOUBI & STEVE HANAK
PROJECT DIR #	322415	Scope of Work: MOBILIZATION, SWPPP, STORM WATER SAMPLING & ANALYSIS, WATER POLLUTION CONTROL MEASURES, CAS / TRAFFIC CONTROL, SURVEY, STRIPING / MARKING, UTILITIES, CONCRETE, GRINDING, CLEAR & GRUB, EXCAVATION, CL II AB, HOT MIX ASPHALT (TYPE A), PAVING FABRIC, 12" RCP CL IV, DRAINAGE INLET, SHORING, MINOR CONCRETE, LANDSCAPE & IRRIGATION, DECOMPOSED GRANITE TREE WALL, ELECTRICAL.
LOCATION	ON NORTH STATE STREET FROM 250' SOUTH OF MILL STREET TO APPROX. 400' NORTH OF HENRY STREET, AND INCLUDING PORTIONS OF WEST HENRY STREET, EAST STANDLEY STREET, WEST STANDLEY STREET, EAST PERKINS STREET AND WEST PERKINS STREET, UKIAH (INCORPORATED)	
OWNER	CITY OF UKIAH 300 SEMINARY AVENUE UKIAH, CA 95482-5400	
CONTRACTOR	GCC	
CONSTRUCTION MANAGEMENT		
CONTACT	MARY HORGER PH: 707/463-6233 FX: 707/313-3621 E-MAIL: mhorger@cityofukiah.com	
Working Days	250 WORKING DAYS	
Liquidated Damages	$5,000.00 / CD	
Contract Date	2/26/20	
Completion Date	APRIL 2022	
Contract Amount	$6,448,215.95	
G.C.C. Bond Number	070209693	

JOB NUMBER	6019	Estimate # LU22098
PROJECT	Dora St. Utility Improvement Project	Division: 10 Project Mgr: Brad Barnes Admin: Monica Nossardi
CONTRACT #	Specification No. 19-01	Estimator: Brad Barnes
PROJECT DIR #	417408	Scope of Work: Sewer, Water, Grading, Paving, and Concrete.
LOCATION	130 Dora St. Ukiah, CA 95482	
OWNER	City of Ukiah 300 Seminary Ave. Ukiah, CA 95482	
CONTRACTOR		
CONSTRUCTION MANAGEMENT		
CONTACT	Andrew Stricklin P: (707) 529-7679 Email: astricklin@cityofukiah.com	
Working Days	180 WD	
Liquidated Damages		
Contract Date	April 21st 2022	
Estimated Completion Date	TBD	
Contract Amount	$4,376,766.45	
G.C.C. Bond Number	#070215960 Liberty Mutual Insurance Co.	

JOB NUMBER	5874	Estimate # AC19036
PROJECT	SOUTH BAYFRONT PEDESTRIAN BICYCLE BRIDGE	Division: 60L Project Mgr: CHRIS SMITH Admin: NAZANIN YAZDI
CONTRACT #	PROJECT NO. EPW-17-112 CIP NO. 16475006 AND 17237003	Estimator: JIM PETNIC
PROJECT DIR #	289436	Scope of Work: Construction of new bridge spanning Union Pacific Railroad main line tracks, including construction of ramps, stairs and connections from bridge to Ohlone Way, the Bay Street parking garage, and Horton Landing Park.
LOCATION	OHLONE WAY, BAY STREET PARKING GARAGE, HORTON LANDING, EMERYVILLE, CA 94603 (INCORPORATED)	
OWNER	CITY OF EMERYVILLE 1333 PARK AVENUE EMERYVILLE, CA 94608	
CONTRACTOR	GCC	
CONSTRUCTION MANAGEMENT		
CONTACT	TODD TEACHOUT, P.M. PH: 510/596-4334 E-MAIL: tteachout@emeryville.org	
Working Days	350 WORKING DAYS	
Liquidated Damages	$10,000.00 / CD	
Contract Date	5/22/19 (Notice of Award)	
Estimated Completion Date	TBD	
Contract Amount	$21,370,205.20	
G.C.C. Bond Number	070208133	

SIGNATURE(S) OF BIDDER

Accompanying this proposal is Bidder's Bond
(insert the words "cash ($)", "cashier's check" or "bidder's bond", as the case may be) in an amount equal to at least 10 percent of the bid.

The names of all persons interested in the foregoing proposal as principals are as follows:

IMPORTANT NOTICE: If bidder or other interested person is a corporation, provide the legal name of corporation and also the names of the president, secretary, treasurer and manager thereof. If a co-partnership, provide the true name of firm and also the names of all individual co-partners composing the firm. If bidder or other interested person is an individual, provide the first and last names in full.

Ghilotti Construction Company, Inc.

Brian Ongaro - President/Secretary

I. Terence Huie - CFO/Treasurer Ali Yazdi - General Manager

Licensed in accordance with an act providing for the registration of Contractors:

License No. 644515 License Expiration Date 5/31/24.

Signature(s) of Bidder:

Thoms Smith

Vice President of Estimating

NOTE: If bidder is a corporation, the legal name of the corporation shall be set forth above together with the signature of the officer or officers authorized to sign contracts on behalf of the corporation; if bidder is a co-partnership, the true name of the firm shall be set forth above together with the signature of the partner or partners authorized to sign contracts in behalf of the co-partnership; and if bidder is an individual, his or her signature shall be placed above. If a member of a partnership, a Power of Attorney must be on file with the Department prior to opening bids or submitted with the bid; otherwise, the bid will be disregarded as irregular and unauthorized.

Business address: 246 Ghilotti Avenue

Santa Rosa, CA 95407

Place of residence: San Rafael, CA - President

Dated: 6/20/23

CONSTRUCTION GHILOTTI

Since · COMPANY · 1914

100 YEARS

GHILOTTI CONSTRUCTION COMPANY, INC.

CORPORATE RESOLUTION TO EXECUTE PROPOSALS

WHEREAS, the Board of Directors (the "Board") of Ghilotti Construction Company, Inc., a California corporation (the "Corporation") deem it desirable and in the best interests of the Corporation to authorize the following Officers of the Corporation as authorized signers on the Corporation's behalf on any and all bid documents and Bidder's Bonds: Richard W. Ghilotti, Chief Executive Officer; Brian W. Ongaro, President and Secretary; Ali Yazdi, Executive Vice President of Public Works and Chief Operating Officer; Irving T. Huie, Chief Financial Officer and Treasurer; and Thomas Smith, Vice President of Estimating.

NOW, THEREFORE, BE IT RESOLVED, that the Directors hereby approve and appoint Richard W. Ghilotti, Chief Executive Officer; Brian W. Ongaro, President and Secretary; Ali Yazdi, Executive Vice President of Public Works and Chief Operating Officer; Irving T. Huie, Chief Financial Officer and Treasurer; and Thomas Smith, Vice President of Estimating for the purpose of executing in the name of the Corporation, any and all bid documents and Bidder's Bonds.

RESOLVED FURTHER, that any and all actions taken by Richard W. Ghilotti, Brian W. Ongaro, Ali Yazdi, Irving T. Huie and Thomas Smith in executing said bid documents and Bidder's Bonds be, and they hereby are, ratified and approved, and all such Proposals and bonds and documents are hereby adopted as binding obligations of the Corporation.

Secretary's Certification

The Secretary of the Corporation hereby certifies that he is the duly elected and qualified Secretary of the Corporation and certifies that the above is a true and correct record of a Board resolution that was duly adopted by the Corporation's Board of Directors at a special meeting, which was duly and regularly called and held in all respects as required by law and by the Corporation's bylaws, and which was held on July 15, 2021.

IN WITNESS WHEREOF, I have hereto set my hand as such Secretary and affixed the corporate seal of the said Corporation, this 7th day of November, 2022.

By: _____

Brian W. Ongaro, Secretary

CITY OF UKIAH
Mendocino County, California

BIDDER'S BOND

KNOW ALL MEN BY THESE PRESENTS,

That we, Ghilotti Construction Company, Inc.

_____, as PRINCIPAL and

Liberty Mutual Insurance Company

_____, as SURETY,

are held and firmly bound unto the City of Ukiah in the penal sum of 10 PERCENT OF THE TOTAL AMOUNT OF THE BID of the Principal above named, submitted by said Principal to the City of Ukiah, as the case may be, for the work described below, for the payment of which sum in lawful money of the United States, well and truly to be made, to the City Clerk to which said bid was submitted, we bind ourselves, our heirs, executors, administrators and successors jointly and severally, firmly by these presents. In no case shall the liability of the surety hereunder exceed the sum of $Ten Percent of Total Amount Bid

THE CONDITION OF THIS OBLIGATION IS SUCH,

That whereas the Principal has submitted the above-mentioned bid to the City of Ukiah, as aforesaid, for certain construction specifically described as follows, for which bids are to be opened at the Office of the City Clerk, Ukiah Civic Center, Ukiah, California, at 2:00p.m. on JUNE 20, 2023 for RECYCLED WATER PROJECT - PHASE 4.

NOW, THEREFORE, If the aforesaid Principal is awarded the contract and, within the time and manner required under the specifications, after the prescribed forms are presented to him or her for signatures, enters into a written contract, in the prescribed form, in accordance with the bid and files two bonds with the City of Ukiah, one to guarantee faithful performance and the other to guarantee payment for labor and materials, as required by law, then this obligation shall be null and void; otherwise, it shall be and remain in full force and virtue.

IN WITNESS WHEREOF, we have hereunto set our hands and seals on this 15th day of June, A.D. 20 23.

Ghilotti Construction Company, Inc. (Seal)

_____ (Seal)

_____ (Seal)

Principal Thomas Smith, VP of Estimating

Liberty Mutual Insurance Company (Seal)

Kathy Rangel (Seal)

Kathy Rangel, Attorney-In-Fact (Seal)

Surety

Address: 175 Berkeley Street, Boston, MA 02116

ACKNOWLEDGMENT

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California
County of Placer)

On June 15, 2023 before me, K. Hanley, Notary Public
(insert name and title of the officer)

personally appeared Kathy Rangel,
who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature K Hanley (Seal)

K. HANLEY
Notary Public - California
Placer County
Commission # 2384942
My Comm. Expires Nov 30, 2025

This Power of Attorney limits the acts of those named herein, and they have no authority to bind the Company except in the manner and to the extent herein stated.

Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company
West American Insurance Company

Certificate No: **8208535-977442**

POWER OF ATTORNEY

KNOWN ALL PERSONS BY THESE PRESENTS: That The Ohio Casualty Insurance Company is a corporation duly organized under the laws of the State of New Hampshire, that Liberty Mutual Insurance Company is a corporation duly organized under the laws of the State of Massachusetts, and West American Insurance Company is a corporation duly organized under the laws of the State of Indiana (herein collectively called the "Companies"), pursuant to and by authority herein set forth, does hereby name, constitute and appoint, Alexis Estrada, Curtis A. Bowden, Dona Lisa Buschmann, Edward D. Johnson, J. Buschmann, Julie A. Shiroma, K. Hanley, Kathy Rangel, Lisa Wilson, Maggie Bender-Johnson, Robert D. Laux

all of the city of Roseville state of CA each individually if there be more than one named, its true and lawful attorney-in-fact to make, execute, seal, acknowledge and deliver, for and on its behalf as surety and as its act and deed, any and all undertakings, bonds, recognizances and other surety obligations, in pursuance of these presents and shall be as binding upon the Companies as if they have been duly signed by the president and attested by the secretary of the Companies in their own proper persons.

IN WITNESS WHEREOF, this Power of Attorney has been subscribed by an authorized officer or official of the Companies and the corporate seals of the Companies have been affixed thereto this 2nd day of August, 2022.

Liberty Mutual Insurance Company
The Ohio Casualty Insurance Company
West American Insurance Company

By: _____
David M. Carey, Assistant Secretary

State of PENNSYLVANIA
County of MONTGOMERY ss

On this 2nd day of August, 2022 before me personally appeared David M. Carey, who acknowledged himself to be the Assistant Secretary of Liberty Mutual Insurance Company, The Ohio Casualty Company, and West American Insurance Company, and that he, as such, being authorized so to do, execute the foregoing instrument for the purposes therein contained by signing on behalf of the corporations by himself as a duly authorized officer.

IN WITNESS WHEREOF, I have hereunto subscribed my name and affixed my notarial seal at Plymouth Meeting, Pennsylvania, on the day and year first above written.

Commonwealth of Pennsylvania - Notary Seal
Teresa Pastella, Notary Public
Montgomery County
My commission expires March 28, 2025
Commission number 1126044
Member, Pennsylvania Association of Notaries

By: _____
Teresa Pastella, Notary Public

This Power of Attorney is made and executed pursuant to and by authority of the following By-laws and Authorizations of The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company which resolutions are now in full force and effect reading as follows:

ARTICLE IV – OFFICERS: Section 12. Power of Attorney.
Any officer or other official of the Corporation authorized for that purpose in writing by the Chairman or the President, and subject to such limitation as the Chairman or the President may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Corporation to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact, subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Corporation by their signature and execution of any such instruments and to attach thereto the seal of the Corporation. When so executed, such instruments shall be as binding as if signed by the President and attested to by the Secretary. Any power or authority granted to any representative or attorney-in-fact under the provisions of this article may be revoked at any time by the Board, the Chairman, the President or by the officer or officers granting such power or authority.

ARTICLE XIII – Execution of Contracts: Section 5. Surety Bonds and Undertakings.
Any officer of the Company authorized for that purpose in writing by the chairman or the president, and subject to such limitations as the chairman or the president may prescribe, shall appoint such attorneys-in-fact, as may be necessary to act in behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations. Such attorneys-in-fact subject to the limitations set forth in their respective powers of attorney, shall have full power to bind the Company by their signature and execution of any such instruments and to attach thereto the seal of the Company. When so executed such instruments shall be as binding as if signed by the president and attested by the secretary.

Certificate of Designation – The President of the Company, acting pursuant to the Bylaws of the Company, authorizes David M. Carey, Assistant Secretary to appoint such attorneys-in-fact as may be necessary to act on behalf of the Company to make, execute, seal, acknowledge and deliver as surety any and all undertakings, bonds, recognizances and other surety obligations.

Authorization – By unanimous consent of the Company's Board of Directors, the Company consents that facsimile or mechanically reproduced signature of any assistant secretary of the Company, wherever appearing upon a certified copy of any power of attorney issued by the Company in connection with surety bonds, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

I, Renee C. Llewellyn, the undersigned, Assistant Secretary, The Ohio Casualty Insurance Company, Liberty Mutual Insurance Company, and West American Insurance Company do hereby certify that the original power of attorney of which the foregoing is a full, true and correct copy of the Power of Attorney executed by said Companies, is in full force and effect and has not been revoked.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the seals of said Companies this 15th day of June, 2023.

By: _____
Renee C. Llewellyn, Assistant Secretary

LMS-12873 LMIC OCIC WAIC Multi Co 02/21

Not valid for mortgage, note, loan, letter of credit, currency rate, interest rate or residual value guarantees.

For bond and/or Power of Attorney (POA) verification inquiries, please call 610-832-8240 or email HOSUR@libertymutual.com.

NON-COLLUSION AFFIDAVIT

Note: Bidder shall execute the affidavit on this page prior to submitting his or her bid.

To City Council, City of Ukiah:

The undersigned in submitting a bid for performing RECYCLED WATER PROJECT – PHASE 4 by contract, being duly sworn, deposes and says:

that he or she has not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding in connection with such contract.

Ghilotti Construction Company, Inc.

Thomas Smith, Vice President of Estimating

Signature(s) of Bidder

Business Address: 246 Ghilotti Avenue

Santa Rosa, CA 95407

Place of Residence: San Rafael, CA - President

NOTARIZATION

Subscribed and sworn to before me this _____ day of _____, 20____.

See attached

Notary Public in and for the County of _____, State of California.

My Commission Expires _____, 20 ____.

CALIFORNIA JURAT WITH AFFIANT STATEMENT **GOVERNMENT CODE § 8202**

☒ See Attached Document (Notary to cross out lines 1–6 below)
☐ See Statement Below (Lines 1–6 to be completed only by document signer[s], *not* Notary)

1
2
3
4
5
6

Signature of Document Signer No. 1 *Signature of Document Signer No. 2 (if any)*

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California
County of Sonoma

Subscribed and ~~sworn to (or~~ affirmed) before me on this 19th day of June, 2023,
Date *Month* *Year*
by
(1) Thomas Smith
(and (2)),
Name(s) of Signer(s)

proved to me on the basis of satisfactory evidence to be the person(s) who appeared before me.

LAURA VAN DIEST HIDALGO
Notary Public - California
Sonoma County
Commission # 2330986
My Comm. Expires Jul 30, 2024

Signature
Signature of Notary Public

Seal
Place Notary Seal Above

OPTIONAL

Though this section is optional, completing this information can deter alteration of the document or fraudulent reattachment of this form to an unintended document.

Description of Attached Document

Title or Type of Document: _____ **Document Date:** _____

Number of Pages: _____ **Signer(s) Other Than Named Above:** _____

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ATTACHMENT A - CERTIFICATION OF COMPLIANCE WITH WATER RECYCLING FUNDING PROGRAM/STATE REVOLVING FUND CONDITIONS

CERTIFICATION OF COMPLIANCE WITH WATER RECYCLING FUNDING PROGRAM/STATE REVOLVING FUND CONDITIONS

This certification relates to the City of Ukiah's Water Recycling Project – Phase 4 Refinements Contract proposed by the Owner which expects to finance the proposed Construction Contract with assistance from the Water Recycling Funding Program (WRFP)/State Revolving Fund (SRF) loan program supported in part with funds directly made available by the State of California - Proposition 68 and Senate Bill 129. I am the undersigned prospective construction contractor or subcontractor.

I certify that I have read the SRF Program Requirements and agree to incorporate the following into the bid and/or contract:

- DEBARMENT AND SUSPENSION (EXECUTIVE ORDER 2549)
- EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 1246)
- PREVAILING WAGE STANDARDS PROVISION

I agree that I will obtain identical certifications from prospective lower-tier construction subcontractors prior to the award of any lower-tier construction subcontracts with a price exceeding $10,000. I also agree that I will retain such certifications in my files.

The Contractor certifies that neither it nor its principals is presently debarred.

(Signature of Authorized Official) 6/20/23 (Date)

Thomas Smith, Vice President of Estimating
(Name and Title of Authorized Official [Print or Type])

Ghilotti Construction Company, Inc.
(Name of Prospective Construction Contractor or Subcontractor [Print or Type])

246 Ghilotti Avenue, Santa Rosa, CA 95407 / Phone: 707-585-1221
(Address and Telephone Number of Prospective Construction Contractor or Subcontractor [Print or Type])

68-0273222
(Employer Identification Number of Prospective Construction Contractor or Subcontractor)

DOCUMENT 00436

LIST OF EQUIPMENT MANUFACTURERS

ARTICLE 1 — SELECTED MANUFACTURER/SUPPLIER

1.01 Bidder shall edit Table 1. List of Selected Equipment Manufacturers by circling the manufacturer or supplier that will furnish the respective item of equipment for the Work.

1.02 If Bidder fails to circle a manufacturer or supplier for each piece of equipment identified, the Bidder shall provide the first listed ("A") manufacturer or supplier for its Bid at no increase in the Contract amount or may be cause for rejection of the Bid.

1.03 Acceptance of a manufacturer or supplier listed by the Bidder shall not constitute a waiver of any provision of the Contract Documents.

Table 1. List of Selected Equipment Manufacturers:

Section	Equipment	Manufacturer/Supplier
11242	Liquid Chemical Diaphragm-Type Metering Pumps	(A) Prominent Fluid Controls, Inc.
11294B	Heavy-Duty Fabricated Stainless Steel Slide Gates	A. A. H. Fontaine, Series 20. B. Whipps, Inc., Series 900. C. Waterman Industries, SS-250. D. Rodney Hunt, Series A-113 or A-114. (E) Hydro Gate, Model HG-561. RW Gate, Model RW1000-S.
11312D	Vertical Turbine Short Setting Centrifugal Pumps	A. Flowserve. B. Sulzer/Johnson Pumps. C. Peerless Pump. (D) Weir/Floway. E. National Pump Co. F. Cascade Pump Company.
11312O	Horizontal ANSI Centrifugal Pumps	A. Flowserve Co. (B) ITT, Ind.
11313E	Horizontal Self-Priming Sample Centrifugal Pumps	A. Gorman Rupp Company, AMT. (B) Barnes Pumps.
11376A	Rotary-Lobe Blowers	(A) Kaeser Compressors, Com-paK Series. B. Aerzen. C. FPZ Inc.

Section	Equipment	Manufacturer/Supplier
13447	Electric Actuators	(A) Rotork Controls Inc. B. Limitorque Corp. C. Auma.
16262	Variable Frequency Drives 0.50 - 50 Horsepower	A. Eaton. B. Allen-Bradley. C. Siemens-Robicon. D. Schneider Electric. E. GE by ABB. (F) ABB.

BIDDER Ghilotti Construction Company, Inc.

Thomas Smith (Signature) Vice President of Estimating

6/20/2023

(Date)

END OF DOCUMENT

CITY OF UKIAH
UKIAH, CA

RECYCLED WATER PIPELINE PROJECT – PHASE 4

CLIENT PROJECT NO. 8860F10

TECHNICAL SPECIFICATIONS

CONFORMED DOCUMENTS

VOLUME 1 OF 3

JULY 12, 2023

CONFORMED DOCUMENTS
These Conformed Documents unify addenda issued during the bid period. If discrepancies between the Conformed Documents and the Bid Documents are found, the Bid Documents with the original addenda shall govern.
Original sealed by
Brian W. Avon,
April 7, 2023,
California C-76832.

2795 MITCHELL DRIVE • WALNUT CREEK, CALIFORNIA 94598-1601 • P. 925.932.1710

CITY OF UKIAH

RECYCLED WATER PIPELINE PROJECT - PHASE 4

DISCIPLINES RESPONSIBLE FOR SPECIFICATION SECTIONS

Original sealed by
Brian W. Avon,
April 7, 2023,
California C-76832.

CIVIL

Original sealed by
Matthew C. Kallevant,
April 7, 2023,
California C-84405.

PROCESS/MECHANICAL

Original sealed by
Jitesh Kumar Renalagotla,
April 7, 2023,
California C-86094.

STRUCTURAL

Original sealed by
Erik M. Bahneman,
April 7, 2023,
California E-E19683.

ELECTRICAL

Original sealed by
Brett A. Lee,
April 7, 2023,
California E-22911.

INSTRUMENTATION & CONTROLS

CITY OF UKIAH

RECYCLED WATER PIPELINE PROJECT – PHASE 4

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2	June 2, 2023
3	June 6, 2023
4	June 13, 2023
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CITY OF UKIAH

MENDOCINO COUNTY, CALIFORNIA

SPECIAL PROVISIONS

FOR

RECYCLED WATER PROJECT – PHASE 4

SPECIFICATION NO. 23-01

CITY OF UKIAH
DEPARTMENT OF PUBLIC WORKS
300 Seminary Avenue
Ukiah, California 95482-5400

Bids Open: ~~**Friday, _____, _____, _____June 2, 2023Wednesday June 14, 2023**~~[AD1] **June 20, 2023**[AD2]

2:00 p.m.
Office of City Clerk

CITY OF UKIAH

MENDOCINO COUNTY, CALIFORNIA

CITY COUNCIL:

MARI RODIN – MAYOR

JOSEFINA DUENAS – VICE-MAYOR

DOUGLAS CRANE – COUNCIL MEMBER

JUAN OROZCO – COUNCIL MEMBER

SUSAN SHER – COUNCIL MEMBER

SAGE SANGIACOMO – CITY MANAGER

TIM ERIKSEN – DIRECTOR OF PUBLIC WORKS / CITY ENGINEER

MARY HORGER – FINANCIAL SERVICES MANAGER

KRISTINE LAWLER – CITY CLERK

R. ALLEN CARTER – CITY TREASURER

CITY OF UKIAH
DEPARTMENT OF PUBLIC WORKS
APRIL 2023

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CITY OF UKIAH, MENDOCINO COUNTY, CALIFORNIA
NOTICE TO BIDDERS FOR RECYCLED WATER PROJECT – PHASE 4 SPECIFICATION NO. 23-01

NOTICE IS HEREBY GIVEN that sealed standard proposals for RECYCLED WATER PROJECT – PHASE 4 will be received at the Office of the City Clerk, Ukiah Civic Center, 300 Seminary Avenue, Ukiah California until 2:00 p.m. on ~~_____, Friday, June 2____,, 2023___ Wednesday June 14, 2023~~[AD1] June 20, 2023[AD2]. Bids shall be addressed to the City Clerk and shall be endorsed "RECYCLED WATER PROJECT – PHASE 4." Bids are required for the entire work described herein. No fax bids will be accepted. As soon thereafter as possible, the bids will be publicly opened and read in the Council Chambers at 300 Seminary Avenue, Ukiah. The bid opening will also be visible via live streaming at http://www.cityofukiah.com/meetings/.

Plans and Special Provisions may be inspected and/or copies obtained from the City's website at www.cityofukiah.com/purchasing. No bid will be considered unless it is made on the forms furnished by the City and is made in accordance with the details of the Special Provisions. Each bidder must be licensed as required by law. Further information regarding the work or these specifications can be obtained by calling Seth Strader, Administrative Analyst at (707) 467-5719 or by email at sstrader@cityofukiah.com.

The City Council reserves the right to reject any or all bids and to determine which proposal is, in its opinion, the lowest responsive bid by a responsible bidder and which it deems in the best interest of the City to accept. The City Council also reserves the right, but not the obligation, to waive any irregularity or failure to strictly comply with the bidding requirements, that the City determines in the reasonable exercise of its discretion does not provide the bidder with a competitive advantage over other bidders.

No contractor or subcontractor may be listed on a bid proposal for a public works unless registered with the Department of Industrial Relations ("DIR") pursuant to Labor Code section 1725.5 except as allowed. under Labor Code section 1771.1(the prime contractor shall be responsible for posting job site notices as prescribed by regulation. This project is subject to compliance monitoring and enforcement by the DIR.

Pursuant to provisions of Section 1770, including amendments thereof, of the Labor Code of the State of California, the DIR Director has ascertained the general prevailing rate of wages for straight time, overtime, Saturdays, Sundays and Holidays including employer payment for health and welfare, vacation, pension and similar purposes for the City of Ukiah. Copies of his General Prevailing Wage Determination are available on the Internet at web address: http://www.dir.ca.gov/DLSR/PWD/ The prime contractor for the work herein shall possess a current, valid State of California, Class A (General Engineering) Contractor's License. Pursuant to California Public Contract Code §22300, this contract includes provisions that allow substitutions of certain types of securities in lieu of the City withholding a portion of the partial payments due the Contractor to insure performance under this contract.

By order of the City Council, City of Ukiah, County of Mendocino, State of California.

Dated:_____ _____
Kristine Lawler, City Clerk, City of Ukiah, California

PUBLISH TWO TIMES:

INSTRUCTIONS TO BIDDERS

RECYCLED WATER PROJECT – PHASE 4 shall be performed in accordance with the Plans and Special Provisions therefor adopted, to which special reference is hereby made.

Each bidder must supply all the information required by the bid documents and Special Provisions.

Minority business enterprises will be afforded full opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color or national origin in consideration for an award of any contract entered into pursuant to this advertisement. Women will be afforded equal opportunity in all areas of employment. However, the employment of women shall not diminish the standards or requirements for the employment of minorities.

All proposals or bids shall be accompanied by a cashier's check or certified check payable to the order of the City of Ukiah amounting to 10 percent of the bid, or by a bond in said amount and signed by the bidder and a corporate surety, payable to said City. Said check shall be forfeited, or said bond shall become payable to said City in case the bidder depositing the same does not, within fifteen (15) days after written notice that the contract has been awarded to him: (a) enter into a contract with the City and (b) furnish certificates of insurance and endorsements, a bond of faithful performance and a payment bond as described in the Special Provisions.

No bidder shall withdraw his or her bid for a period of thirty (30) calendar days after the date set by the City for the opening thereof.

The Contractor and any subcontractors shall each possess a valid City of Ukiah Business License prior to the start of any work.

The Contractor shall furnish a project schedule to the Engineer prior to the start of any work and start work as scheduled.

The work is to be completed within seven hundred and seven (707) calendar days. The Contractor will pay to the City the sum of five hundred ($500.00) dollars per day for each and every calendar day's delay beyond the time prescribed.

The staff shall notify a bidder by telephone or email, if it intends to recommend the rejection of the bidder’s bid. Any bid protest must be filed with the City Clerk not more than five calendar days following the bid opening, or 2 calendar days following notice that staff is recommending the rejection of a bid. If any such timely written protest is filed, all bidders shall be provided a copy of the protest within 2 calendar days of its receipt, which may be delivered to the bidders as an email attachment. All such bidders may file with the City Manager a written objection or other response to the protest.

All objections or responses filed not more than 5 days after receipt of the written protest will be presented to the City Council at its next regular meeting occurring not less than 12 calendar days following the bid opening. The City Council will resolve the bid protest at that meeting based on the written protest, any staff recommendation and all timely written objections and responses. In accordance with the Brown Act, any person may address the City Council on this item during the meeting. The City Council action on the protest shall represent a final decision by the City on the protest.

Examination of Site, Drawings, Etc.

Each bidder shall visit the site of the proposed work and fully acquaint himself with local conditions, construction and labor required so that he or she may fully understand the facilities, difficulties and restrictions attending the execution of the work under the Contract. Bidders shall thoroughly examine and be familiar with the Plans and Special Provisions. The failure of any bidder to receive or examine any form, instrument, addendum, or other document, or to visit the site and acquaint himself with conditions there existing, shall in no way relieve the bidder from any obligation with respect to his or her proposal or to the contract. The drawings for the work show conditions as they are supposed or believed by the Engineer to exist; but, it is neither intended nor shall it be inferred that the conditions as shown thereon constitute a representation by the Engineer, the City or its officers that such conditions are actually existent, nor shall the City, the Engineer or any of their officers or

representatives be liable for any loss sustained by the Contractor as a result of a variance between the conditions shown on the drawings and the conditions actually revealed during the progress of the work or otherwise.

The bidder's attention is directed to the possible existence of obstructions and public improvements within the limits of the work or adjacent thereto, which may or may not be shown on the Drawings. Any bid shall take into consideration that conditions may exist underground or otherwise that are not known to the City or easily detected during a site inspection that could impact the time or cost of completing the project. The City expects the bids to anticipate such conditions so that it can know for budgeting and other purposes the total cost to complete the project before accepting a bid and undertaking the legal obligation to construct the project. In awarding the contract the City relies on the contractor's representation that its bid anticipates differing site conditions and the additional time or cost that such conditions may necessitate.

The bidder shall investigate to his or her satisfaction the conditions to be encountered, the character, quality and quantities of work to be performed and materials to be furnished and the requirements of the Plans, Special Provisions, Standard Specifications, Standard Plans, and Contract Documents. The submission of a proposal shall be considered conclusive evidence that the bidder has made such examination and has accepted the project workplace as a safe workplace to perform the work of the Contract.

Bidder Inquiries and Questions

Inquiries and questions must be submitted in writing via email to the following designated contact person:

Seth Strader, Administrative Analyst
Email: sstrader@cityofukiah.com

The City reserves the right to not respond to inquiries or questions submitted within 3 business days of the bid opening.

Location of the Work

All of the work to be performed is within the City of Ukiah. Project is primarily located at the following locations and as indicated on the Drawings:

- City of Ukiah Water Treatment Plant: 935 River Street, Ukiah, CA 95482
- City of Ukiah Wastewater Treatment Plant: 300 Plant Road, Ukiah, CA 95482
- Various locations within the City of Ukiah for the recycled water distribution system pipelines.

Pre-Bid Conference

A mandatory pre-bid conference will be held at the time and location indicated in the Advertisement or invitation to bid where representatives of Owner and Engineer will be present to discuss the Project.

A. Proposals will not be accepted from Bidders who do not attend the conference.
B. It is each Bidder's responsibility to sign in at the pre-bid conference to verify its participation.
    1. Bidders must sign in using the name of the organization that will be submitting a Bid.
C. An Addendum will be issued with a list of qualified Bidders that attended the pre-bid conference and who are eligible to submit a Bid for this Project.
D. Information presented at the pre-bid conference does not alter the Contract Documents.
    1. Owner will issue Addenda to make any changes to the Contract Documents that result from discussions at the pre-Bid conference.
    2. Information presented, and statements made at the pre-bid conference will not be binding or legally effective unless incorporated in an Addendum.

GENERAL CONDITIONS

SECTION 1. PROPOSAL REQUIREMENTS AND GENERAL CONDITIONS

1-01. Definitions. Whenever any word or expression defined in this section, or pronoun used in its stead, occurs in these contract documents, it shall have and is mutually understood to have the meaning given:

a. "City of Ukiah" or "City" shall mean the City of Ukiah, Mendocino County, California, acting through its City Council or any other board, body, official or officials to which or to whom the power belonging to the Council shall by virtue of any act or acts, hereafter pass or be held to appertain.

b. "Engineer" shall mean the Engineer duly and officially appointed by the City to supervise and direct the work of construction under this contract, acting personally or through agents or assistants duly authorized by him, such agents or assistants acting within the scope of the particular duties entrusted to them.

c. "Inspector" shall mean the engineering or technical inspector or inspectors duly authorized or appointed by the Engineer, limited to the particular duties entrusted to him or her or them.

d. "Contractor" shall mean the party entering into contract with the City of Ukiah for the performance of work covered by this contract and his or her authorized agents or legal representatives.

e. "Date of signing of contract" or words equivalent thereto, shall mean the date upon which this contract, with the signature of the Contractor affixed, together with the prescribed bonds, shall be or shall have been delivered to the City or its duly authorized representatives.

f. "Day" or "days", unless herein otherwise expressly defined, shall mean a calendar day or days of twenty-four hours each.

g. "The work" shall mean and include all the work specified, indicated, shown or contemplated in the contract to construct the improvement, including all alterations, amendments or extensions thereto made by contract change order or other written orders of the Engineer.

h. "Contract drawings", "drawings", "plans" shall mean and include 1) all drawings or plans which may have been prepared by or on behalf of the City, as a basis for proposals, when duly signed and made a part of this contract by incorporation or reference, 2) all drawings submitted in pursuance of the terms of this contract by the successful bidder with his or her proposal and by the Contractor to the City if and when approved by the Engineer and 3) all drawings submitted by the Engineer to the Contractor during the progress of the work as provided for herein.

i. Where "as shown", "as indicated", "as detailed" or words of similar import are used, it shall be understood that reference to the drawings accompanying these Special Provisions is made unless stated otherwise.

Where "as directed", "as permitted", "approved" or words of similar import are used, it shall be understood that the direction, requirements, permission, approval or acceptance of the Engineer is intended unless stated otherwise.

As used herein, "provide" or "install" shall be understood to mean "provide or install complete in place", that is, "furnish and install". "Shall" is mandatory; "may" is permissive.

1-02. Examination of Plans, Special Provisions and Site of Work. The bidder shall examine carefully the Proposal, Plans, Special Provisions, Contract forms and the site of the work contemplated therefor. It will be assumed that the bidder has investigated to his or her satisfaction the conditions to be encountered and the character, quality and requirements of all Plans, Special Provisions, Standard Specifications, and Standard Plans involved.

1-03. Proposal. Bids shall be made on the blank forms prepared by the City. All bids shall give the prices bid, both in writing and in figures and shall be signed by the bidder or his or her authorized representative, with his or her address. If the bid is made by an individual or partner, his or her name and the post office address of his or her business or partnership, along with his or her signature or the signature of one or more partners must be shown; if made by a corporation, the bid shall show the name of the state under the laws of which the corporation is chartered, the name of the corporation and the title of the person who signs on behalf of the corporation.

Each proposal shall be enclosed in a sealed envelope, endorsed as specified in the notice to bidders. Bidders are warned against making erasures or alterations of any kind and proposals which contain omissions, erasures, conditions, alterations, additions not called for, additional proposals or irregularities of any kind may be rejected.

1-04. Withdrawal of Bids. Any bid may be withdrawn at any time prior to the hour fixed in the notice to bidders for the openings of bids, provided that a request in writing, executed by the bidder or his or her duly authorized representative, for the withdrawal of such bid is filed with the City. The withdrawal of a bid will not prejudice the right of a bidder to file a new bid.

1-05. Public Opening of Bids. Bids will be opened and read publicly at the time and place indicated in the notice to bidders. Bidders or their agents are invited to be present.

1-06. Bid Guaranty. Each bid must be accompanied by a certified check, cashier's check or bidder's bond executed by an admitted surety insurer, payable to the order of the City of Ukiah in an amount not less than 10 percent of the bid as a guarantee that the bidder will enter into a contract, if awarded the work.

1-07. Qualification of Bidders. No contractor or subcontractor may be listed on a bid proposal for a public works project (submitted on or after March 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5 [with limited exceptions from this requirement for bid purposes only under Labor Code section 1771.1(a)]. No contractor or subcontractor may be awarded a contract for public work on a public works project (awarded on or after April 1, 2015) unless registered with the Department of Industrial Relations pursuant to Labor Code section 1725.5. The prime contractor shall be responsible for posting job site notices as prescribed by regulation. This project is subject to compliance monitoring and enforcement by the Department of Industrial Relations.

Each bidder shall be licensed under the provisions of Chapter 9, Division 3 of the Business and Professions Code and shall be skilled and regularly engaged in the general class or type of work called for under this contract. A statement setting forth this experience and business standing shall be submitted by each bidder on the form provided herewith. It is the intention of the City to award a contract only to a bidder who furnishes satisfactory evidence that he or she has the requisite experience and ability and that he or she has sufficient capital, facilities and equipment to enable him or her to prosecute the work successfully and promptly within the time and in the manner agreed.

In determining the degree of responsibility to be credited to a bidder, the City may weigh evidence that the bidder or his or her personnel charged with the responsibility in the work, has performed satisfactorily other contracts of like nature and magnitude or comparable difficulty at similar rates of progress.

1-08. Disqualification of Bidders. More than one bid from an individual business, partnership, corporation or association, under the same or different names, will not be considered. Reasonable grounds for believing that any bidder is financially interested in more than one bid for the work will cause the rejection of all bids in which he or she is so interested. If there is reason to believe that collusion exists among the bidders, none of the participants in such collusion will be considered. Bids in which the prices obviously are unbalanced may be rejected.

1-09. Identification of Subcontractors. All bids shall comply with the Subletting and Subcontracting Fair Practices Act (Public Contract Code Section 4100 and following) and shall set forth:

(a) The name and the location of the place of business of each subcontractor who will perform work or labor, or render service to the prime contractor in or about the construction of the work, or to a subcontractor licensed by the State of California who, under subcontract to the prime contractor,

specially fabricates and installs a portion of the work according to detailed drawings contained in the plans and Special Provisions, in an amount in excess of one-half of 1 percent of the prime contractor's total bid.

(b) The portion of the work which will be done by each such subcontractor. The prime contractor shall list only one subcontractor for each such portion defined by the prime contractor in his or her bid.

1-10. General Provisions of the Standard Specifications. All provisions of the General Provisions, Sections 1 through 11, of the Standard Specifications, shall be applicable to the contract except as modified by these Special Provisions. The Standard Specifications are set forth in Section 12-06 of these Special Provisions.

1-11. Addenda. If it becomes necessary to revise any part of these plans and specifications after they have been released, the City will issue an addendum containing the revision. All addenda will be posted on the City's website at www.cityofukiah.com/purchasing with the rest of the bid documents. Anyone who intends to submit a bid in response to this Request for Bid must check the website frequently for any posted addenda. Anyone submitting a bid will be deemed to have seen and agreed to be bound by the posted addenda.

SECTION 2. AWARD AND EXECUTION OF CONTRACT

2-01. Award of Contract. Award of the contract, if it be awarded, will be to the lowest responsible bidder whose bid complies with all the specified requirements. The award, if made, will be made within thirty (30) days after opening of the bids. The City reserves the right to reject any and all bids and to waive any irregularity in the proposal not pertaining to cost.

2-02. Return of Proposal Guaranties. All bid guaranties will be held until the contract has been fully executed, after which they will be returned upon request to the respective bidders whose bids they accompany.

2-03. Execution of Contract. The contract agreement shall be executed in duplicate by the successful bidder and returned, together with the contract bonds, insurance certificates and endorsements, within fifteen (15) days after written notice of the award of the contract. After execution by the City; one copy shall be filed with the City and one copy shall be returned to the Contractor. If the bidder fails or refuses to enter into the contract agreement within the required time, then the bid guaranty accompanying the bid shall be forfeited to the City.

SECTION 3. SCOPE AND INTENT OF CONTRACT

3-01. Effect of Inspection and Payments. Neither the inspection by the Engineer or an inspector, nor any order, measurement or approved modification, nor certificate or payment of money, nor acceptance of any part or whole of the work, nor any extension of time, nor any possession by the City or its agents, shall operate as a waiver of any provision of this contract or of any power reserved therein to the City, or of any right to damages thereunder; nor shall any breach of this contract be held to be a waiver of any subsequent breach. All remedies shall be construed as cumulative.

3-02. Effect of Extension of Time. The granting of any extension of time on account of delays which, in the judgement of the City, are avoidable delays shall in no way operate as a waiver on the part of the City of its rights under this contract.

3-03. Extra Work. If extra work orders are given in accordance with provisions of this contract, such work shall be considered a part hereof and shall be subject to each and all of its terms and requirements.

3-04. Assignment of Contract. The contract may be assigned or sublet in whole or in part only upon the written consent of the City acting through its authorized agents. Consent will not be given to any proposed assignment which would relieve the original contractor or its surety of their responsibilities under the contract nor will the Engineer consent to any assignment of a part of the work under the contract.

3-05. Subcontractors. The Contractor shall be as fully responsible for the acts and omissions of his or her subcontractors and of persons either directly or indirectly employed by them, as he or she is for the acts and omissions of persons directly employed by him.

The Contractor shall cause appropriate provisions to be inserted in all subcontracts relative to the work to bind subcontractors to the terms of this Contract which are applicable to the work of subcontractors.

Nothing contained in this contract shall be construed to create or shall be relied upon to create any contractual relationship between any subcontractor and the City and no action may be brought by any subcontractor against the City based on this contract.

3-06. Interpretation of Special Provisions and Drawings. The Special Provisions and the Contract Drawings are intended to be explanatory of each other. Any work indicated in the Contract Drawings and not in the Special Provisions, or vice versa, is to be executed as if indicated in both. In case of a discrepancy or conflict between the Technical Specifications and Contract Plans, the Technical Specifications shall govern. All work shown on the Contract Drawings, the dimensions of which are not figured, shall be accurately followed to the scale to which the drawings are made, but figured dimensions are in all cases to be followed, where given, though they differ from scaled measurements. Large scale drawings shall be followed in preference to small scale drawings. Should it appear that the work to be done, or any of the matters relative thereto, are not sufficiently detailed or explained in these contract documents, including the contract drawings, the Contractor shall apply to the Engineer for such further explanations as may be necessary and shall conform thereto as part of this contract, so far as may be consistent with the terms of this contract. In the event of any doubt or questions arising respecting the true meaning of the Special Provisions, reference shall be made to the Engineer and his or her decision thereon shall be final. If the Contractor believes that a clarification or interpretation justifies an increase in the contract price or contract time, the Contractor must comply with the written notice provisions of Sections 9-05 and 10-07 of these Special Provisions. Contractor's attention is directed to Section 12-06 of the Technical Specifications regarding the Standard Specifications and Standard Plans.

3-07. Addenda. If it becomes necessary to revise any part of these plans and specifications after they have been released, the City will issue an addendum containing the revision. All addenda will be posted on the City's website at www.cityofukiah.com/purchasing with the rest of the bid documents. Anyone who intends to submit a bid in response to this Request for Bid must check the website frequently for any posted addenda. Anyone submitting a bid will be deemed to have seen and agreed to be bound by the posted addenda.

3-08.

of City Officials. No city official, nor the Engineer, nor any authorized assistant of any of them, shall be personally responsible for any liability arising under this contract.

3-09. Dispute Resolution. Claims of $375,000 or less by the Contractor that arise under this Contract are subject to the mandatory dispute resolutions provisions in Public Contract Code Sections 20104-20104.6.

SECTION 4. BONDS

4-01. Faithful Performance Bond. As a part of the execution of this contract, the Contractor shall furnish a bond of a surety company or other securities providing equivalent protection such as cash, letter of credit, or certificates of deposit, acceptable to the City, conditioned upon the faithful performance of all covenants and stipulations under this contract. The amount of the bond shall be 100 percent of the total contract price, as this sum is set forth in the agreement.

4-02. Material and Labor Bond. As a part of the execution of this contract, the Contractor shall furnish a bond of a surety company or other securities providing equivalent protection such as cash, letter of credit or certificates of deposit acceptable to the City in a sum not less than 50 percent of the total contract price, as this sum is set forth in the agreement for the payment in full of all persons, companies or corporations who perform labor upon or furnish materials to be used in the work under this contract, in accordance with the provisions of Sections 3247 through 3252 inclusive of the Civil Code of the State of California and any acts amendatory thereof.

4-03. Defective Material and Workmanship Bond. As a condition precedent to the completion of this contract, the Contractor shall furnish a bond of a surety company acceptable to the City in an amount not less than 5 percent (5%) of the final contract price, to hold good for a period of one (1) year after the completion and

acceptance of the work, to protect the City against the results of defective materials, workmanship and equipment during that time. This bond shall be delivered to the City before the final payment under this contract will be made.

4-04. Notification of Surety Companies. The surety companies shall familiarize themselves with all of the conditions and provisions of this contract and they waive the right of special notification of any change or modification of this contract or of extension of time, or decreased or increased work, or of the cancellation of the contract, or of any other act or acts by the City or its authorized agents, under the terms of this contract; and failure to so notify the aforesaid surety companies of changes shall in no way relieve the surety companies of their obligation under this contract.

SECTION 5. INSURANCE REQUIREMENTS FOR CONTRACTORS (WITH CONSTRUCTION RISKS)

Contractor shall procure and maintain for the duration of the contract insurance against claims for injuries to persons or damages to property which may arise from or in connection with the performance of the work hereunder by the Contractor, his or her agents, representatives, employees or subcontractors.

5-01. Minimum Scope of Insurance

Coverage shall be at least as broad as:

1. Insurance Services Office Commercial Liability Coverage (occurrence form CG 0001).
2. Insurance Services Office form number CA 0001 (Ed. 1/87) covering Automobile Liability, code 1 (any auto).
3. Worker's Compensation insurance as required by the State of California and Employer's Liability Insurance.
4. Course of Construction insurance covering for “all risks” of loss.

5-02. Minimum Limits of Insurance

Contractor shall maintain limits no less than:

1. General Liability: $2,000,000 per occurrence for bodily injury, personal injury and property damage including operations, products and completed operations. If Commercial General Liability Insurance or other form with a general aggregate limit is used, either the general aggregate limit shall apply separately to this project/location or the general aggregate limit shall be twice the required occurrence limit.

2. Automobile Liability: $2,000,000 per accident for bodily injury and property damage.

3. Employer's Liability: $1,000,000 per accident for bodily injury and property damage.

4. Course of Construction: Completed value of the project with no co-insurance penalty provisions.

5. Contractor’s Pollution Liability Insurance: Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result of pollution conditions arising from Contractor’s operations and completed operations. This insurance shall be maintained for no less than three years after final completion.
   Contractor’s Pollution Liability:

   Each Occurrence $2,000,000

6. Contractor’s Professional Liability Insurance: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This

insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.

Contractor's Professional Liability:

Each Claim $2,000,000

5-03. Deductibles and Self-insured Retentions. Any deductibles or self-insured retentions must be declared to and approved by the City. At the option of the City, either: the insurer shall reduce or eliminate such deductibles or self-insured retentions as respects the City, its officers, officials, employees and volunteers; or the Contractor shall provide a financial guarantee satisfactory to the City guaranteeing payment of losses and related investigations, claim administration and defense expenses.

5-04. Other Insurance Provisions

The general liability and automobile liability policies are to contain, or be endorsed to contain, the following provisions:

1. The City, its officers, officials, employees and volunteers, and Design Engineer are to be covered as Additional Insured with respect to liability arising out of automobiles owned, leased, hired or borrowed by or on behalf of the contractor; and with respect to liability arising out of work or operations performed by or on behalf of the Contractor including materials, parts or equipment furnished in connection with such work or operations. General liability coverage can be provided in the form of an endorsement to the Contractor's insurance, or as a separate owner's policy.

2. The workers' compensation policy is to be endorsed with a waiver of subrogation. The insurance company, in its endorsement, agrees to waive all rights of subrogation against the City, its officers, officials, employees and volunteers for losses paid under the terms of this policy which arises from the work performed by the named insured for the City.

3. For any claims related to this project, the Contractor's insurance coverage shall be primary insurance as respects the City, its officers, officials, employees or volunteers. Any insurance or self-insurance maintained by the City, its officers, officials, employees or volunteers shall be excess of the Contractor's insurance and shall not contribute with it.

4. Each insurance policy required by this clause shall be endorsed to state that coverage shall not be canceled by either party, except after thirty (30) days' prior written notice by certified mail, return receipt requested, has been given to the City.

5. Coverage shall not extend to any indemnity coverage for the active negligence of the additional insured in any case where an agreement to indemnify the additional insured would be invalid under Subdivision (b) of Section 2782 of Civil Code.

6. Course of Construction policies shall contain the following provisions:
   a.) The City shall be named as loss payee.

7. Each policy shall contain a cross liability or severability of interest clause or endorsement.

5-05. Acceptability of Insurers

Insurance is to be placed with insurers with a current A.M. Best's rating of no less than the following:

A++ VII	A- VIII
A+ VII	B++ X

A VII B+ X

5-06. Verification of Coverage. Contractor shall furnish the City with original certificates and amendatory endorsements effecting coverage required by this clause. The endorsements shall be on forms provided by the City or on other than the City's forms, provided those endorsements or policies conform to the requirements. All certificates and endorsements are to be received within 15 days from written notice of contract award, and the work shall not commence until the certificates and endorsements have been approved by the City. The City reserves the right to require complete certified copies of all required insurance policies, including endorsements affecting the coverage required by these Special Provisions at any time.

5-07. Subcontractors. Contractor shall include all subcontractors as insureds under its policies or shall furnish separate certificates and endorsements for each subcontractor. All coverages for subcontractors shall be subject to all of the requirements stated herein.

SECTION 6. RESPONSIBILITIES AND RIGHTS OF CONTRACTOR

6-01. Legal Address of Contractor. Both the address given in the proposal and the Contractor's office in the vicinity of the work are hereby designated as places to either of which drawings, samples, notices, letters or other articles or communications to the Contractor may be mailed or delivered. The delivery at either of these places of any such thing from the City or its agents to the Contractor shall be deemed sufficient service thereof upon the Contractor and the date of such service shall be the date of such delivery. The address named in the proposal may be changed at any time by notice in writing from the Contractor to the City. Nothing herein contained shall be deemed to preclude or render inoperative the service of any drawing, sample, notice, letter or other article or communication to or upon the Contractor personally.

6-02. Office of Contractor at Site. During the performance of this contract, the Contractor shall maintain a suitable office at the site of the work which shall be the headquarters of a representative authorized to receive drawings and any such thing given to the said representatives or delivered at the Contractor's office at the site of work in his or her absence shall be deemed to have been given to the Contractor.

6-03. Attention to Work. The Contractor shall give his or her personal attention to and shall supervise the work to the end that it shall be prosecuted faithfully and when he or she is not personally present on the work, he or she shall at all reasonable times be represented by a competent superintendent or foreman who shall receive and obey all instructions or orders given under this contract and who shall have full authority to execute the same and to supply materials, tools and labor without delay and who shall be the legal representative of the Contractor. The Contractor shall be liable for the faithful observance of any instructions delivered to him or her or to his or her authorized representative.

6-04. Liability of Contractor. The Contractor shall do all of the work and furnish all labor, materials, tools and appliances, except as otherwise herein expressly stipulated, necessary or proper for performing and completing the work herein required in the manner and within the time herein specified. The mention of any specific duty or liability imposed upon the Contractor shall not be construed as a limitation or restriction of any general liability or duty imposed upon the Contractor by this contract, said reference to any specific duty or liability being made herein merely for the purpose of explanation.

The right of general supervision by the City shall not make the Contractor an agent of the City and the liability of the Contractor for all damages to persons or to public or private property, arising from the Contractor's execution of the work, shall not be lessened because of such general supervision.

Until the completion and final acceptance by the City of all the work under and implied by this contract, the work shall be under the Contractor's responsible care and charge. The Contractor shall rebuild, repair, restore and make good all injuries, damages, re-erections and repairs, occasioned or rendered necessary by causes of any nature whatsoever, excepting only acts of God and none other, to all or any portions of the work, except as otherwise stipulated.

To the fullest extent permitted by law, Contractor shall indemnify and hold harmless the City and its officers, directors, agents and employees from and against all claims, damages, losses and expenses including but not

limited to attorneys' fees, costs of suit, expert witness fees and expenses and fees and costs of any necessary private investigators arising out of or resulting from the performance of the work, provided that any such claim, damage, loss or expense (1) is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property, other than the work itself, including the loss of use resulting therefrom and (2) is caused in whole or in part by any act or omission of the Contractor, any subcontractor, or anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, regardless of whether or not it is caused in part by a party indemnified hereunder, or by the negligence or omission of a party indemnified herein.

In any and all claims against the City or any of its agents or employees by any employee of the Contractor, any subcontractor, anyone directly or indirectly employed by any of them, or anyone for whose acts any of them may be liable, the indemnification obligation shall not be limited in any way by any limitation on the amount or type of damages, compensation or benefits payable by or for the Contractor or any subcontractor under workers' or workmen's compensation acts, disability benefit acts, or other employee benefit acts. The obligation to indemnify shall extend to and include acts of the indemnified party which may be negligent or omissions which may cause negligence.

The City shall have the right to estimate the amount of such damage and to cause the City to pay the same and the amount so paid for such damage shall be deducted from the money due the Contractor under this contract; or the whole or so much of the money due or to become due the Contractor under this contract as may be considered necessary by the City, shall be retained by the City until such suits or claims for damages shall have been settled or otherwise disposed of and satisfactory evidence to that effect furnished to the City.

6-05. Protection of Persons and Property. The Contractor shall furnish such watchman, guards, fences, warning signs, walks and lights as shall be necessary and shall take all other necessary precautions to prevent damage or injury to persons or property.

All property line fences and improvements in the vicinity of the work shall be protected by the Contractor and, if they are injured or destroyed, they and any other property injured by the Contractor, his or her employees or agents, shall be restored to a condition as good as when he or she entered upon the work.

6-06. Protection of City Against Patent Claims. All fees, royalties or claims for any patented invention, article or method that may be used upon or in any manner connected with the work under this contract shall be included in the price bid for the work and the Contractor and his or her sureties shall protect and hold the City, together with all of its officers, agents, servants and employees, harmless against any and all demands made for such fees or claims brought or made on account of this contract. The Contractor shall, if requested by the Engineer, furnish acceptable proof of a proper release from all such fees or classes.

Should the Contractor, his or her agents, servants or employees, or any of them be enjoined from furnishing or using any invention, article, material or appliance supplied or required to be supplied or used under this contract, the Contractor shall promptly substitute other articles, materials or appliance, in lieu thereof, of equal efficiency, quality, finish, suitability and market value and satisfactory in all respects to the Engineer. Or, in the event that the Engineer elects, in lieu of such substitution, to have supplied and to retain and use, any such invention, article, material or appliance, as may by this contract be required to be supplied, in that event the Contractor shall pay such royalties and secure such valid licenses as may be requisite and necessary for the City, its officers, agents, servants and employees, or any of them, to use such invention, article, material or appliance without being disturbed or in any way interfered with by any proceeding in law or equity on account thereof. Should the Contractor neglect or refuse to make the substitution promptly, or to pay such royalties and secure such licenses as may be necessary, then in that event the Engineer shall have the right to make such substitution, or the City may pay such royalties and secure such licenses and charge the cost thereof against any money due to the Contractor from the City or recover the amount thereof from him or her and his or her sureties notwithstanding final payment under this contract may have been made.

6-07. Protection of Contractor's Work Property. The Contractor shall protect his or her work, supplies and materials from damage due to the nature of the work, the action of the elements, trespassers, or any cause whatsoever under his or her control, until the completion and acceptance of the work. Neither the City nor any of its agents assumes any responsibility for collecting indemnity from any person or persons causing damage to the work of the Contractor.

6-08. Regulations and Permits. The Contractor shall secure and pay for all permits, give all notices and comply with all laws, ordinances, rules and regulations bearing on the conduct of the work as drawn and specified. If the Contractor observes that the Plans and Special Provisions are at variance therewith, he or she shall promptly notify the Engineer in writing and any necessary changes shall be adjusted as provided in the contract for changes in the work. The contractor and any subcontractors shall each secure and maintain a valid City of Ukiah Business License. The City of Ukiah will issue a no fee encroachment permit to the Contractor allowing him or her to perform work within City right of way or within City property after the Contract Documents have been executed and insurance certificates and endorsements have been approved by the City.

6-09. Construction Utilities. The Contractor shall be responsible for providing for and in behalf of his or her work under this contract, all necessary utilities, such as special connection to water supply, telephones, power lines, fences, roads, watchmen, suitable storage places, etc.

6-10. Approval of Contractor's Plans. The approval by the Engineer of any drawing or any method of work proposed by the Contractor in accordance with paragraph 8-06 shall not relieve the Contractor of any of his or her responsibility for his or her errors therein and shall not be regarded as any assumption of risk or liability by the City or any officer or employee thereof and the Contractor shall have no claim under this contract on account of the failure or partial failure or inefficiency of any plan or method so approved. Such approval shall be considered to mean merely that the Engineer has no objection to the Contractor's using, upon his or her own full responsibility the plan or method approved.

6-11. Suggestions to the Contractor. Any plan or method of work suggested by the Engineer to the Contractor, but not specified or required, if adopted or followed by the Contractor in whole or in part, shall be used at the risk and responsibility of the Contractor; and the Engineer and the City shall assume no responsibility thereof.

6-12. Termination of Unsatisfactory Subcontracts. Should any subcontractor fail to perform in a satisfactory manner the work undertaken by him, such subcontract shall be terminated immediately by the Contractor upon notice from the Engineer.

6-13. Preservation of Stakes and Marks. The Contractor shall preserve carefully bench marks, reference points and stakes and in case of destruction he or she shall replace his or her stakes, reference points and bench marks and shall be responsible for any mistakes that may be caused by their unnecessary loss or disturbance. Contractor’s attention is directed to Section 7-03 of these Special Provisions.

6-14. Assistance to Engineer. At the request of the Engineer the Contractor shall provide men from his or her force and tools, stakes and other materials to assist the Engineer temporarily in making measurements and surveys and in establishing temporary or permanent reference marks. Payment for such materials and assistance will be made as provided for under the caption "Extra Work," provided, however, that the cost of setting stakes and marks carelessly lost or destroyed by the Contractor's employees will be assessed to the Contractor.

6-15. Removal of Condemned Materials and Structures. The Contractor shall remove from the site of the work, without delay, all rejected and condemned materials or structures of any kind brought to or incorporated in the work and upon his or her failure to do so, or to make satisfactory progress in so doing, within forty-eight (48) hours after the service of a written notice from the Engineer, the condemned material or work may be removed by the City and the cost of such removal shall be taken out of the money that may be due or may become due the Contractor on account of or by virtue of this contract. No such rejected or condemned material shall again be offered for use by the Contractor under this Contract.

6-16. Proof of Compliance with Contract. In order that the Engineer may determine whether the Contractor has complied with the requirements of this contract, not readily enforceable through inspection and tests of the work and materials, the Contractor shall, at any time when requested, submit to the Engineer properly authenticated documents or other satisfactory proofs as to his or her compliance with such requirements.

6-17. Errors and Omissions. If the Contractor, in the course of the work, finds any errors or omissions in plans or in the layout as given by survey points and instruction, or if he or she finds any discrepancy between the plans

and the physical conditions of the locality, he or she shall immediately inform the Engineer, in writing and the Engineer shall promptly verify the same. Any work done after such discovery, until authorized, will be done at the Contractor's risk.

6-18. Cooperation. The Contractor shall cooperate with all other contractors who may be performing work in behalf of the City and workmen who may be employed by the City on any work in the vicinity of the work to be done under this contract with the work of such contractors or workmen. he or she shall make good promptly, at his or her own expense, any injury or damage that may be sustained by other contractors or employees of the City at his or her hands.

Any difference or conflict which may arise between the Contractor and other contractors, or between the contractor and workmen of the City in regard to their work shall be adjusted and determined by the Engineer. If the work of the Contractor is delayed because of any acts or omissions of any other contractor or of the City, the Contractor shall on that account have no claim against the City other than for an extension of time.

6-19. Right of Contractor to Stop Work. Under the following conditions the Contractor shall have the right, if he or she so desires, to stop the work and terminate the contract upon ten (10) days written notice to the Engineer and recover from the City payment for all work actually performed and for all satisfactory materials actually delivered to the site of the work for permanent incorporation therein, all as may be shown by the estimate of the Engineer.

(1) If the work is stopped under an order of any court or other competent public authority for a period of time of three (3) months through no act or fault of the Contractor or of anyone employed by him.

(2) If the Engineer fails to issue the monthly certificate for payment in accordance with the terms of this contract.

(3) If the City fails to pay the Contractor within sixty (60) days after it shall have become due, as provided by the terms of this contract, any sum certified by the Engineer or awarded by the City.

All provided that if such action to terminate the contract be not instituted by the Contractor within ten (10) days after the alleged existence of such condition and if written notice of such action be not at that time delivered to the City and the Engineer, then such right shall lapse until another occasion arises according to this section.

6-20. Hiring and Dismissal of Employees. The Contractor shall employ only such foremen, mechanics and laborers as are competent and skilled in their respective lines of work and whenever the Engineer shall notify the Contractor that any person on the work is, in his or her opinion, incompetent, unfaithful, intemperate or disorderly, or refuses to carry out the provisions of this contract, or uses threatening or abusive language to any person on the work representing the City, or is otherwise unsatisfactory, such person shall be discharged im mediately from the work and shall not be re-employed upon it except with the consent of the Engineer.

6-21. Wage Rates.

1. Contractor shall pay all mechanics and laborers employed or working upon the site of the work unconditionally and without subsequent deductions or rebate on any account the full amounts due at the time of payment at wage rates not less than those contained in the applicable prevailing wage determination, regardless of any contractual relationship which may be alleged to exist between the Contractor and subcontractors and such laborers and mechanics.

2. Contractor shall comply with the California Labor Code Section 1775. In accordance with said Section 1775, Contractor shall forfeit as a penalty to the Owner, $50.00 (or the higher minimum penalty as provided in Section 1775(B)(ii) – (iii)) for each calendar day or portion thereof, for each workman paid less than the stipulated prevailing rates for such work or craft in which such workman is employed for any work done under the Contract by him or her or by any subcontractor under him or her in violation of the provisions of the Labor Code and in particular, Labor Code Sections 1770 to 1780, inclusive. In addition to said penalty and pursuant to Section 1775, the difference between such stipulated prevailing wage rates and the amount paid to each workman for each calendar day or portion thereof for which

each workman was paid less than the stipulated prevailing wage rate shall be paid to each workman by the Contractor.

3. Pursuant to the provision of Section 1770 of the Labor Code of the State of California, Owner has ascertained the general prevailing rate of wages (which rate includes employer payments for health and welfare, vacation, pension and similar purposes) applicable to the work to be done, for straight time work. The holiday wage rate listed shall be applicable to all holidays recognized in the collective bargaining agreement of the particular craft, classification or type of workmen concerned. Copies of the General Prevailing Wage Determination are available on the Internet at web address: http://www.dir.ca.gov/DLSR/PWD The Contractor shall post the wage determination at the site of work in a prominent place where it can easily be seen by the workers.

4. City will not recognize any claim for additional compensation because the Contractor has paid any rate in excess of the prevailing wage rate obtained by the Contractor. The possibility of wage increases is one of the elements to be considered by the Contractor in determining his or her bid and will not in any circumstances be considered as the basis for a claim against the City.

5. The Labor Commissioner through the Division of Labor Standards Enforcement (DLSE) may at any time require contractors and subcontractors to furnish electronic certified payroll records directly to DLSE. Commencing with contracts awarded or after April 1, 2015, all contractors and subcontractors must furnish electronic certified payroll records directly to the DLSE.

6. Travel and Subsistence Payments.

   Contractor shall make travel and subsistence payments to each workman needed to execute the work in accordance with the requirements in Section 1773.8 of the Labor Code (Chapter 880, Statutes of 1968).

7. Apprentices.

   Attention is directed to the provisions in Sections 1777.5 (Chapter 1411, Statutes of 1968) and 1777.6 of the California Labor Code concerning the employment of apprentices by the Contractor or any subcontractor under him. Contractor and any subcontractor under him or her shall comply with the requirements of said sections in the employment of apprentices.

   Information relative to apprenticeship standards, wage schedules and other requirements may be obtained from the Director of Industrial Relations, ex officio the Administrator of Apprenticeship, San Francisco, California, or from the Division of Apprenticeship Standards and its branch offices.

6-22. Cleaning Up. The Contractor shall not allow the site of the work to become littered with trash and waste material, but shall maintain the same in a neat and orderly condition throughout the construction period. The Engineer shall have the right to determine what is or is not waste material or rubbish and the place and manner of disposal.

On or before the completion of the work, the Contractor shall without charge therefore carefully clean out all pits, pipes, chambers or conduits and shall tear down and remove all temporary structures built by him or her and shall remove rubbish of all kind from any of the grounds which he or she has occupied and leave them in first class condition.

6-23. Guaranty. All work shall be guarantied for a period of one year from the date of acceptance by the City. The Contractor shall promptly make all needed repairs arising out of defective materials, workmanship and equipment.

Guarantee and Correction Period refer to the period of time following substantial completion. Acceptance by the City means formal notification of substantial completion as distinguished from acceptance for purposes of final payment.

The City is hereby authorized to make such repairs if within ten days after the mailing of a notice in writing to the Contractor or his or her agent, the Contractor shall neglect to make or undertake with due diligence the aforesaid repairs, provided, however, that in case of an emergency where, in the opinion of the City delay would cause serious loss or damage, repairs may be made without notice being sent to the Contractor and the Contractor shall pay the costs thereof.

Pursuant to the provisions of Section 4-03 of these Special Provisions, the Contractor shall furnish a Defective Material and Workmanship Bond in an amount not less than 5 percent of the final contract price, which shall be effective for a period of one (1) year after the completion and acceptance of the work.

6-24. **Contractor's General Warranty and Guarantee.** Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer is entitled to rely on Contractor's warranty and guarantee. Owner's rights under this warranty and guarantee are in addition to, and are not limited by, the one (1)-year guaranty period.

6-25. Indemnification and State Reviews. The parties agree that review or approval of the Project plans and specifications by the State Water Board is for administrative purposes only, including conformity with application and eligibility criteria, and expressly not for the purposes of design defect review or construction feasibility, and does not relieve the Recipient of its responsibility to properly plan, design, construct, operate, and maintain the Project. To the extent permitted by law, the Recipient agrees to indemnify, defend, and hold harmless the State Water Board and any trustee, and their officers, employees, and agents for the Bonds, if any (collectively, "Indemnified Persons"), against any loss or liability arising out of any claim or action brought against any Indemnified Persons form and against any and all losses, claims, damages, liabilities, or expenses, of every conceivable kind, character, and nature whatsoever arising out of, resulting from, or in any way connected with (1) the Project or the conditions, occupancy, use, possession, conduct, or management of, work done in or about, or the planning, design, acquisition, installation, or construction, of the Project or any part thereof; (2) the carrying out of any of the transactions contemplated by this Agreement or any related document; (3) any violation of any applicable law, rule or regulation, any environmental law (including, without limitation, the Federal Comprehensive Environmental Response, Compensation and Liability Act, the Resource Conservation and Recovery Act, the California Hazardous Substance Account Act, the Federal Water Pollution Control Act, the Clean Air Act, the Toxic Substances Control Act, the Occupational Safety and Health Act, the Safe Drinking Water Act, the California Hazardous Waste Control Law, and California Water Code Section 13304, and any successors to said laws), rule or regulation or the release of any toxic substance on or near the Project; or (4) any untrue statement or alleged untrue statement of any material fact or omission or alleged omission to state a material fact necessary to make the statements required to be stated therein, in light of the circumstances under which they were made, not misleading with respect to any information provided by the Recipient for use in any disclosure document utilized in connection with any of the transactions contemplated by this Agreement, except those arising from the gross negligence or willful misconduct of the Indemnified Persons. The Recipient must also provide for the defense and indemnification of the Indemnified Parties in any contractual provision extending indemnity to the Recipient in any contract let for the performance of any work under this Agreement and must cause the Indemnified Parties to be included within the scope of any provision for the indemnification and defense of the Recipient in any contract or subcontract. To the fullest extent permitted by law, the Recipient agrees to pay and discharge any judgment or award entered into or made against Indemnified Persons with respect to any such claim or action, and any settlement, compromise or other voluntary resolution. The provisions of this section survive the term of this Agreement.[AD1]

SECTION 7. RESPONSIBILITIES AND RIGHTS OF CITY

7-01. Authority of the Engineer. All work done under this contract shall be done in a workmanlike manner and shall be performed to the reasonable satisfaction of the Engineer, who shall have general supervision of all work included hereunder. To prevent disputes and litigation, the Engineer (1) shall in all cases determine the amount, quality, acceptability and fitness of the several kinds of work and materials which are to be paid for under this contract, (2) shall decide all questions relative to the true construction, meaning and intent of the Special Provisions and Drawings, (3) shall decide all questions which may arise relative to the classifications

and measurements of quantities and materials and the fulfillment of this contract and (4) shall have the power to reject or condemn all work or material which does not conform to the terms of this contract. his or her estimate and decision in all matters shall be a condition precedent to an appeal for arbitration, or the right of the Contractor to receive, demand, or claim any money or other compensation under this agreement and a condition precedent to any liability on the part of the City to the Contractor on account of this contract. Whenever the Engineer shall be unable to act, in consequence of absence or other cause, then such engineer as the Engineer or the City shall designate, shall perform any and all of the duties and be vested with any or all of the powers herein given to the Engineer.

7-02. Inspection. The City will provide engineering personnel for the inspection of the work.

The Engineer and his or her representatives shall at all times have access to the work whenever it is in preparation or progress and the Contractor shall provide proper facilities for such access and inspection.

If the Special Provisions, the Engineer's instruction, laws, ordinances, or any public authority require any work to be specially tested or approved, the Contractor shall give the Engineer timely notice of its readiness for inspection and, if the inspection is by an authority other than the Engineer, of the date fixed for such inspection. Inspections by the Engineer shall be promptly made at the source of supply where practicable. If any work shall be covered up without approval or consent of the Engineer, it must, if required by the Engineer, be uncovered for examination and properly restored at the Contractor's expense.

Re-examination of any work may be ordered by the Engineer and, if so ordered, the work must be uncovered by the Contractor. If such work is found to be in accordance with the contract documents, the City shall pay the cost of re-examination and replacement. If such work is not in accordance with the contract documents, the Contractor shall pay such cost.

Properly authorized and accredited inspectors shall be considered to be the representatives of the City limited to the duties and powers entrusted to them. It will be their duty to inspect materials and workmanship of those portions of the work to which they are assigned, either individually or collectively, under instructions of the Engineer and to report any and all deviations from the Drawings, Special Provisions and other contract provisions which may come to their notice. Any inspector may be considered to have the right to order the work entrusted to his or her supervision stopped, if in his or her opinion such action becomes necessary, until the Engineer is notified and has determined and ordered that the work may proceed in due fulfillment of all contract requirements.

7-03. Surveys. Contractor shall furnish all land surveys, establish all base lines and bench marks and make sufficient detailed surveys needed for working points, lines and elevations. The Contractor shall develop all slope stakes and batter boards. Contractor shall also develop all additional working points, lines and elevations as he or she may desire to facilitate his or her methods and sequence of construction.

7-04. Rights-of-Way. The City will provide all necessary rights-of-way and easements in or beneath which work will be performed by the Contractor under this contract.

7-05. Retention of Imperfect Work. If any portion of the work done or material furnished under this contract shall prove defective and not in accordance with the Plans and Special Provisions, and if the imperfection in the same shall not be of sufficient magnitude or importance to make the work dangerous or undesirable, the Engineer shall have the right and authority to retain such work instead of requiring the imperfect work to be removed and reconstructed, but he or she shall make such deductions therefor in the payments due or to become due the Contractor as may be just and reasonable.

7-06. Changes in the Work. The Engineer shall have the right, in writing, to order additions to, omissions from, or corrections, alterations and modifications in the line, grade, form, dimensions, plan, or kind or amount of work or materials herein contemplated, or any part thereof, either before or after the beginning of construction. However, the arithmetical sum of the cost to the City of additions and subtractions from the work under this contract shall not exceed 10 percent of original contract amount or $5,000, whichever is the greater, unless based upon a supplementary agreement to be made therefore.

The order of such additions, omissions, corrections, alterations and modifications shall be in writing and signed by the Engineer and, in order, shall then be binding upon the Contractor. The Contractor shall proceed with the work as changed and the value of such change shall be determined as provided for in section 10-07 of these Special Provisions.

Such alterations shall in no way affect, vitiate, or make void this contract or any part thereof, except that which is necessarily affected by such alterations and is clearly the evident intention of the parties to this contract.

7-07. Additional Drawings by City. The drawings made a part of this contract at the time of its execution are intended to be fairly comprehensive and to indicate in more or less detail the scope of the work. In addition to these drawings, however, the Engineer shall furnish such additional drawings from time to time during the progress of the work as are necessary to make clear or to define in greater detail the intent of the Special Provisions and the contract drawings and the Contractor shall make his or her work conform to all such drawings.

7-08. Additional and Emergency Protection. Whenever, in the opinion of the Engineer, the Contractor has not taken sufficient precautions for the safety of the public or the protection of the works to be constructed under this contract, or of adjacent structures or property which may be injured by the processes of construction on account of such neglect and whenever, in the opinion of the Engineer, an emergency shall arise and immediate action shall be considered necessary in order to protect public or private, personal or property interest, then and in that event, the Engineer, with or without notice to the Contractor may provide suitable protection to the said interests by causing such work to be done and such material to be furnished as shall provide such protection as the Engineer may consider necessary and adequate.

The cost and expense of such work and material so furnished shall be borne by the Contractor and, if the same shall not be paid on presentation of the bills therefor, then such costs shall be deducted from any amounts due or to become due the Contractor.

The performance of such emergency work under the direction of the Engineer shall in no way relieve the Contractor from any damages which may occur during or after such precaution has been taken by the Engineer.

7-09. Suspension of Work. The City may at any time suspend the work or any part thereof by giving five (5) days written notice to the Contractor. The work shall be resumed by the Contractor within ten (10) days after the date fixed in the written notice from the City to the Contractor so to do. The City shall reimburse the Contractor for expense incurred by the Contractor in connection with the work under this contract as a result of such suspension.

If the work, or any part thereof, shall be stopped by the notice in writing aforesaid and if the City does not give notice in writing to the Contractor to resume work at a date within ten (10) days of the date fixed in the written notice to suspend, then the Contractor may abandon that portion of the work so suspended and he or she will be entitled to the estimates and payments for all work done on the portions so abandoned, if any, plus 5 percent of the value of the work so abandoned, to compensate for loss of overhead, plant expense and anticipated profit.

7-10. Right of City to Terminate Contract. If the Contractor should be adjudged a bankrupt, or if he or she should make a general assignment for the benefit of his or her creditors, or if a receiver should be appointed on account of his or her insolvency, or if he or she should persistently or repeatedly refuse or should fail, except in cases for which extension of time is provided, to supply sufficient properly skilled workmen or proper materials, or if he or she should fail to make prompt payments to subcontractors or for material or labor, or persistently disregard laws, ordinances or the instructions of the Engineer, or otherwise be guilty of a substantial violation of any provision of the contract, then the City, upon the certificate of the Engineer that sufficient cause exists to justify such action, may, without prejudice to any other right or remedy and after giving the Contractor seven days written notice, terminate the employment of the Contractor and take possession of the premises and of all materials, tools and appliances and finish the work by whatever method the City may deem expedient. In such case, the Contractor shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the contract price shall exceed the expense of finishing the work, including compensation for additional managerial and administrative services, such excess shall be paid to the Contractor. If such expense shall exceed such unpaid balance, the Contractor shall pay the difference to the City. The expense incurred by the City as herein provided and the damage incurred through the Contractor's default, shall be certified by the

Engineer. In the event that a termination under this section is determined to be improper, such termination shall be deemed a constructive termination for convenience taken pursuant to section 7-12 below.

7-11. Use of Completed Portions. The City shall have the right to take possession of and use any completed or partially completed portions of the work, notwithstanding the time for completing the entire work or such portions which may not have expired; but such taking possession and using shall not be deemed an acceptance of any work not completed in accordance with the contract documents. If such prior use increases the cost of or delays the work, the Contractor shall be entitled to such extra compensation, or extension of time or both, as the Engineer may determine.

7-12. **Right of City to Terminate Contract for Convenience**. The City may terminate performance of the work called for by the contract documents in whole or, from time to time, in part, if the City determines that a termination is in the City's best interest. The Contractor shall terminate all or any part of the work upon delivery to the Contractor of a notice of termination specifying that the termination is for the convenience of the City, the extent of termination, and the effective date of such termination. After receipt of notice of termination, and except as directed by the Engineer, the Contractor shall, regardless of any delay in determining or adjusting any amounts due under this termination for convenience clause, immediately proceed with the following obligations:

1. Stop work as specified in the notice.
2. Complete any work specified in the notice of termination in a least cost/shortest time manner while still maintaining the quality called for under the contract documents.
3. Leave the property upon which the Contractor was working and upon which the facility (or facilities) forming the basis of the contract documents is situated in a safe and sanitary manner such that it does not pose any threat to the public health or safety.
4. Terminate all subcontracts to the extent that they relate to the portions of the work terminated.
5. Place no further subcontracts or orders, except as necessary to complete the continued portion of the contract.
6. Submit to the Engineer, within ten (10) calendar days from the effective date of the notice of termination, all of the usual documentation called for by the contract documents to substantiate all costs incurred by the Contractor for labor, materials and equipment through the effective date of the notice of termination. Any documentation substantiating costs incurred by the Contractor solely as a result of the City's exercise of its right to terminate this Contract pursuant to this clause, which costs the contractor is authorized under the contract documents to incur, shall: (1) be submitted to and received by the Engineer no later than 30 calendar days after the effective date of the notice of termination; (2) describe the costs incurred with particularity; and (3) be conspicuously identified as "Termination Costs occasioned by the City's Termination for Convenience."

Termination of the contract shall not relieve Surety of its obligation for any just claims arising out of or relating to the work performed. In the event that the City exercises its right to terminate this contract pursuant to this clause, the City shall pay the Contractor, upon the Contractor's submission of the documentation required by this clause and other applicable provisions of the contract documents, the following amounts:

All actual reimbursable costs incurred according to the provisions of this contract.

1. A reasonable allowance for profit on the cost of the Work performed, provided Contractor establishes to the satisfaction of the Engineer that it is reasonably probable that Contractor would have made a profit had the contract been completed and provided further, that the profit allowed shall in no event exceed fifteen (15%) percent of the costs.
2. A reasonable allowance for Contractor's administrative costs in determining the amount payable due to termination of the contract under this Article.

Notwithstanding any other provision of this Article, when immediate action is necessary to protect life and safety or to reduce significant exposure or liability, the City may immediately order Contractor to cease work on the project until such safety or liability issues are addressed to the satisfaction of the City or the contract is terminated.

SECTION 8. WORKMANSHIP, MATERIALS and EQUIPMENT

8-01. General Quality. Materials and equipment shall be new and of a quality equal to that specified or approved. Work shall be done and completed in a thorough and workmanlike manner.

8-02. Quality in Absence of Detailed Specifications. Whenever under this contract it is provided that the Contractor shall furnish materials or manufactured articles or shall do work for which no detailed specifications are set forth, the materials or manufactured articles shall be of the best grade in quality and workmanship obtainable in the market from firms of established good reputation, or, if not ordinarily carried in stock, shall conform to the usual standards for first-class materials or articles of the kind required, with due consideration of the use to which they are to be put. In general, the work performed shall be in full conformity and harmony with the intent to secure the best standard of construction and equipment of the work as a whole or in part.

8-03. Materials and Equipment Specified by Name. Whenever any material or equipment is indicated or specified by patent or proprietary name or by the name of the manufacturer, such specification shall be considered as used for the purpose of describing the material or equipment desired and shall be considered as followed by the words "or approved equal". The Contractor may offer any material or equipment which shall be equal in every respect to that specified, provided that written approval first is obtained from the Engineer.

8-04. Source of Materials. Price, fitness and quality being equal, preference shall be given by the Contractor for supplies grown, manufactured or produced in the State of California and, next, for such products partially produced in this State in accordance with Government Code Section 4332.

8-05. Storage of Materials. Materials shall be so stored to ensure the preservation of their quality and fitness for the work. They shall be so located and disposed that prompt and proper inspection thereof may be made.

8-06. Drawings, Samples and Tests. As soon as possible after execution of the contract, the Contractor shall submit to the Engineer, in quintuplicate, sufficient information including, if necessary, assembly and detail drawings to demonstrate fully that the equipment and materials to be furnished comply with the provisions and intent of these Special Provisions and Drawings. If the information thus submitted indicates the equipment or materials is acceptable, the Engineer will return one copy stamped with his or her approval; otherwise, one copy will be returned with an explanation of why the equipment or material is unsatisfactory. The Contractor shall have no claims for damages or for extension of time on account of any delay due to the revision of drawings or rejection of material. Fabrication or other work performed in advance of approval shall be done entirely at the Contractor's risk. After approval of equipment or material, the Contractor shall not deviate in any way from the design and specifications given without the written consent of the Engineer.

When requested by the Engineer, a sample or test specimens of the materials to be used or offered for use in connection with the work shall be prepared at the expense of the Contractor and furnished by him or her in such quantities and sizes as may be required for proper examination and tests, with all freight charges prepaid and with information as to their sources.

All samples shall be submitted before shipment and in ample time to permit the making of proper tests, analyses, or examination before the time at which it is desired to incorporate the material into the work. All tests of materials furnished by the Contractor shall be made by the Engineer. Samples shall be secured and tested whenever necessary to determine the quality of the material.

SECTION 9. PROSECUTION OF WORK

9-01. Equipment and Methods. The work under this contract shall be prosecuted with all materials, tools, machinery, apparatus and labor and by such methods as are necessary to the complete execution of everything described, shown, or reasonably implied. If at any time before the beginning or during the progress of the work, any part of the Contractor's plant or equipment, or any of his or her methods of execution of the work, appear to the Engineer to be unsafe, inefficient, or inadequate to insure the required quality or the rate of progress of the work, he or she may order the Contractor to increase or improve his or her facilities or methods and the Contractor shall comply promptly with such orders; but, neither compliance with such orders nor failure of the Engineer to issue such orders shall relieve the Contractor from his or her obligation to secure the degree of safety, the quality of the work and the rate of progress required of the Contractor. The Contractor alone shall be responsible for the safety, adequacy and efficiency of his or her plant, equipment and methods.

9-02. Time of Completion. The Contractor shall promptly begin the work under this contract and shall complete and make ready for full use all portions of the project made the subject of this contract within the time set forth in the agreement bound herewith.

9-03. Avoidable Delays. Avoidable delays in the prosecution or completion of the work shall include all delays which might have been avoided by the exercise of care, prudence, foresight and diligence on the part of the Contractor. The City will consider as avoidable delays within the meaning of this contract (1) delays in the prosecution of parts of the work, which may in themselves be unavoidable, but do not necessarily prevent or delay the prosecution of other parts of the work nor the completion of the whole work within the time herein specified, (2) reasonable loss of time resulting from the necessity of submitting plans to the Engineer for approval and from the making of surveys, measurements, inspections, and testing and (3) such interruptions as may occur in the prosecution of the work on account of the reasonable interference of other contractors employed by the City which do not necessarily prevent the completion of the whole work within the time herein specified.

9-04. Unavoidable Delays. Unavoidable delays in the prosecution or completion of the work under this contract shall include all delays which may result, through cause beyond the control of the Contractor and which he or she could not have provided against by the exercise of care, prudence, foresight and diligence. Orders issued by the City changing the amount of work to be done, the quantity of material to be furnished or the manner in which the work is to be prosecuted and unforeseen delays in the completion of the work of other contractors under contract with the City will be considered unavoidable delays, so far as they necessarily interfere with the Contractor's completion of the whole of the work. Delays due to normally adverse weather conditions will not be regarded as unavoidable delays. However, truly abnormal amounts of rainfall, temperatures or other weather conditions for the location of the work and time of year may be considered as unavoidable delays if those conditions necessarily cause a delay in the completion of the work.

9-05. Notice of Delays. Whenever the Contractor foresees any delay in the prosecution of the work and, in any event, immediately upon the occurrence of any delay which the contractor regards as an unavoidable delay, he or she shall notify the Engineer in writing of the probability of the occurrence of such delay and its cause, in order that the Engineer may take immediate steps to prevent, if possible, the occurrence or continuance of the delay, or, if this cannot be done, may determine whether the delay is to be considered avoidable or unavoidable, how long it continues and to what extent the prosecution and completion of the work are to be delayed thereby.

9-06. Extension of Time. Should any delays occur which the Engineer may consider unavoidable, as herein defined, the Contractor shall, pursuant to his or her application, be allowed an extension of time proportional to said delay or delays, beyond the time herein set forth, in which to complete this contract; and liquidated damages for delay shall not be charged against the Contractor by the City during an extension of time granted because of unavoidable delay or delays.

Any claim by Contractor for a time extension based on unavoidable delays shall be based on written notice delivered to the Engineer within 15 days of the occurrence of the event giving rise to the claim. Failure to file said written notice within the time specified shall constitute a waiver of said claim. Notice of the full extent of the claim and all supporting data must be delivered to the Engineer within 45 days of the occurrence unless the Engineer specifies in writing a longer period. All claims for a time extension must be approved by the Engineer and incorporated into a written change order.

9-07. Unfavorable Weather and Other Conditions. During unfavorable weather and other conditions, the Contractor shall pursue only such portions of the work as shall not be damaged thereby. No portions of the work whose satisfactory quality or efficiency will be affected by any unfavorable conditions shall be constructed while these conditions remain, unless, by special means or precautions approved by the Engineer, the Contractor shall be able to overcome them.

The Contractor shall be granted a time extension of one day for each unfavorable weather day which prevents him or her from placing concrete forms or placing and finishing concrete or asphalt concrete. Such unfavorable weather day is defined as a rain day where precipitation prevents the contractor from performing the work more than four (4) continuous hours within the authorized work period or a temperature day where the ambient temperature is below that specified for the placement of materials associated with the controlling work item for more than four (4) continuous work hours of the authorized work period.

9-08. Saturday, Sunday, Holiday and Night Work. No work shall be done between the hours of 6 p.m. and 7 a.m., nor on Saturdays, Sundays or legal holidays except such work as is necessary for the proper care and protection of work already performed, or except in cases of absolute necessity and in any case only with the permission of the Engineer.

It is understood, however, that night work may be established as a regular procedure by the Contractor if he or she first obtains the written permission of the Engineer and that such permission may be revoked at any time by the Engineer if the Contractor fails to maintain at night adequate force and equipment for reasonable prosecution and to justify inspection of the work.

9-09. Hours of Labor. Eight (8) hours of labor shall constitute a legal day's work and the Contractor or any subcontractor shall not require or permit more than eight hours of labor in a day from any person employed by him or her in the performance of the work under this contract, unless paying compensation for all hours worked in excess of eight (8) hours per day at not less than 1½ times the basic rate of pay. The Contractor shall forfeit to the City, as a penalty, the sum of twenty-five dollars ($25.00) for each workman employed in the execution of the contract by him or her or by any subcontractor, for each calendar day during which such laborer, workman, or mechanic is required or permitted to labor more than eight hours in violation of the provisions of Section 1810 to 1816, inclusive, (Article 3, Chapter 1, Part 7, Division 2) of the Labor Code of the State of California and any acts amendatory thereof.

SECTION 10. PAYMENT

10-01. Certification by Engineer. All payments under this contract shall be made upon the presentation of certificates in writing from the Engineer and shall show that the work covered by the payments has been done and the payments thereof are due in accordance with this contract.

10-02. Progress Estimates and Payment. The Engineer shall, within the first seven (7) days of each month, make an estimate of the value of the work performed in accordance with this contract during the previous calendar month.

The first estimate shall be of the value of the work satisfactorily completed in place and meeting the requirements of the contract. And every subsequent estimate, except the final estimate, shall be of the value of the work satisfactorily completed in place since the last preceding estimate was made; provided, however, that should the Contractor fail to adhere to the program of completion fixed in this contract, the Engineer shall deduct from the next and all subsequent estimates the full calculated accruing amount of the liquidated damages to the date of said estimate, until such time as the compliance with the program has been restored.

The estimate shall be signed by the Engineer and, after approval, the City shall pay or cause to be paid to the Contractor in the manner provided by law, an amount equal to 95 percent of the estimated value of the work satisfactorily performed and complete in place.

Engineer will, within 7 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer’s reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

10-03. Substitution of Securities.

1. At such times that Pubic Contract Code Section 22300 is in effect Contractor may propose the substitution of securities of at least equal market value for any moneys to be withheld to ensure performance under the Contract. Market value shall be determined as of the day prior to the date such substitution is to take place. Such substitution shall be made at the request and expense of the Contractor. The securities shall be one or more of the following types:

    (a) Bonds or interest-bearing notes or obligations of the United States, or those for which the faith and credit of the United States are pledged for the payment of principal and interest.

(b) Bonds or interest-bearing notes on obligations that are guaranteed as to principal and interest by a federal agency of the United States.

(c) Bonds of the State of California, or those for which the faith and credit of the State of California are pledged for the payment of principal and interest.

(d) Bonds or warrants, including, but not limited to, revenue warrants, of any county, city, metropolitan water district, California water district, California water storage district, irrigation district in the State of California, municipal utility district, or school district of the State of California, which are rated by Moody's or Standard and Poor as A or better.

(e) Bonds, consolidated bonds, collateral trust debentures, consolidated debentures, or other obligations issued by federal land banks or federal intermediate credit banks established under the Federal Farm Loan Act, as amended; debentures and consolidated debentures issued by the Central Bank for Cooperatives and banks for cooperatives established under the Farm Credit Act of 1933, as amended; bonds, or debentures of the Federal Home Loan Bank Board established under the Federal Home Loan Bank Act; and stock, bonds, debentures and other obligations of the Federal National Mortgage Association established under the National Housing Act as amended and bonds of any Federal Home Loan Mortgage Corporation.

(f) Commercial paper of "prime" quality as defined by a nationally recognized organization which rates such securities. Eligible paper is further limited to issuing corporations: (1) organized and operating within the United States; (2) having total assets in excess of five hundred million dollars ($500,000,000); and (3) approved by the Pooled Money Investment Board of the State of California. Purchases of eligible commercial paper may not exceed 180 days' maturity, nor represent more than 10 percent of the outstanding paper of an issuing corporation.

(g) Bills of exchange or time drafts on and accepted by a commercial bank, otherwise known as bankers acceptances, which are eligible for purchase by the Federal Reserve System.

(h) Certificates of deposits issued by a nationally or state-chartered bank or savings and loan association.

(i) The portion of bank loans and obligations guaranteed by the United States Small Business Administration or the United States Farmers Home Administration.

(j) Student loan notes insured under the Guaranteed Student Loan Program established pursuant to the Higher Education Act of 1965, as amended (20 U.S.C. 1001, et seq.) and eligible for resale to the Student Loan Marketing Association established pursuant to Section 133 of the Education Amendments of 1972, as amended (20 U.S.C. 1087-2).

(k) Obligations issued, assumed or guaranteed by International Bank for Reconstruction and Development, the Inter-American Development Bank, the Asian Development Bank, or the Government Development Bank of Puerto Rico.

(l) Bonds, debentures and notes issued by corporations organized and operating within the United States. Such securities eligible for substitution shall be within the top three ratings of a nationally recognized rating service.

2. The securities shall be deposited with City or with any commercial bank as escrow agent, who shall arrange for transfer of such securities to the Contractor upon satisfactory completion of the contract. Any interest accrued or paid on such securities shall belong to the Contractor and shall be paid upon satisfactory completion of the contract.

The market value of the securities deposited shall at all times be maintained in an amount at least equal, in the sole judgment of City, to the moneys to be withheld pursuant to the Contract Documents to ensure performance of the Contract. In order to comply with this condition, Contractor shall deposit additional securities as necessary upon request by City or the escrow agent.

3. Upon acceptance of any Proposal that includes substituting securities for amounts withheld to ensure performance, a separate escrow agreement satisfactory in form and substance to City shall be prepared and executed by City, the Contractor and the escrow agent, which may be City. The escrow agreement shall specify, among other matters, value of securities to be deposited; procedures for valuing the securities and for adding or withdrawing securities to maintain the market value of the deposited securities at least equal to the amount of moneys which would otherwise be withheld; the terms and conditions of conversion to cash in case of the default by the Contractor; and terms, conditions and procedure for termination of the escrow. City shall have no obligation to enter any such Agreement that does not provide the City with the unilateral right to convert securities to cash and to gain immediate possession of the cash.

10-04. Acceptance. The work must be accepted by vote of the City Council of the City of Ukiah when the whole shall have been completed satisfactorily. The Contractor shall notify the Engineer, in writing, of the completion of the work, whereupon the Engineer shall promptly, by personal inspection, satisfy himself as to the actual completion of the work in accordance with the terms of the contract and shall thereupon recommend acceptance by the City Council.

10-05. Final Estimate and Payment. The Engineer shall, as soon as practicable after the final acceptance of the work done under this contract, make a final estimate of the amount of work done thereunder and the value thereof.

Such final estimate shall be signed by the Engineer, and after approval, the City shall pay or cause to be paid to the Contractor, in the manner provided by law, the entire sum so found to be due hereunder, after deducting therefrom all previous payments and such other lawful amounts as the terms of this contract prescribe.

In no case will final payment be made in less than thirty-five (35) days after the filing of the notice of completion with the County Recorder.

10-06. Delay Payments. Should any payment due the Contractor or any estimate be delayed, through fault of the City beyond the time stipulated, such delay shall not constitute a breach of contract or be the basis for a claim for damages, but the City shall pay the Contractor interest on the amount of the payment at the rate of 6 percent per annum for the period of such delay. The terms for which interest will be paid shall be reckoned, in the case of any monthly or progress payment, from the twentieth day of the month next succeeding the month in which the work was performed to the date of payment of the estimate; and in the case of the final estimate, from the forty-fifth day after acceptance to the date of payment of the final estimate.

The date of payment of any estimate shall be considered the day on which the payment is offered or mailed as evidenced by the records of the Treasurer of the City. If interest shall become due on any delayed payment, the amount thereof, as determined by the City, shall be added to a succeeding payment. If the interest shall become due on the final payment, it shall be paid on a supplementary voucher to interest or any sum or sums which, by the terms of this contract, the City is authorized to reserve or retain.

10-07. Extra Work and Work Omitted. Whenever corrections, alterations, or modifications of the work under this contract ordered by the Engineer and approved by the City increase the amount of work to be done, such added work shall be known as "extra work"; and when such corrections, alterations, or modifications decrease the amount of work to be done, such subtracted work shall be known as "work omitted".

When the Contractor considers that any changes ordered involve extra work, he or she shall immediately notify the Engineer in writing and subsequently keep him or her informed as to when and where extra work is to be performed and shall make claim for compensation therefor each month not later than the first day of the month following that in which the work claimed to be extra work was performed and he or she shall submit a daily complete statement of materials and labor used and expenses incurred on account of extra work performed, showing allocation of all materials, labor and expenses.

All such claims shall state the date of the Engineer's written order and the date of approval by the City authorizing the work on account of which claim is made. Unless such notification is made in writing within the time specified and unless complete statements of materials used and expenses incurred on account of such extra work are furnished as above required, the Contractor shall not be entitled to payment on account of extra work and

Contractor shall be deemed to have waived the right to make any future claims for compensation for such extra work.

When changes decrease the amount of work to be done, they shall not constitute a claim for damages on account of anticipated profits on the work that may be omitted.

10-08. Compensation for Extra Work or Work Omitted. Whenever corrections, additions, or modifications in the work under this contract change the amount of work to be done or the amount of compensation due the Contractor, excepting increases or decreases in contract items having unit contract prices for each measurable quantity installed in place, and such changes have been ordered in writing by the Engineer and approved by the City prior to the Contractor performing the extra work, then a price may be agreed upon. Failing such an agreement in price, the Contractor shall be compensated for performing extra work pursuant to the provisions of Section 4-1.03 D,"Extra Work", and Section 9-1.03,"Force Account Payment" of the Standard Specifications.

This method of determining the price of work shall not apply to the performance of any work which is required or reasonably implied to be performed or furnished under this contract.

10-09. Compensation to the City for Extension of Time. In case the work called for under this contract is not completed within the time limit stipulated herein, the City shall have the right as provided hereinabove, to extend the time of completion thereof. If the time limit be so extended, the City shall have the right to charge to the Contractor and to deduct from the final payment for the work the actual cost to the City of engineering, inspection, superintendence and other overhead expenses which are directly chargeable to the contract and which accrue during the period of such extension, except that the cost of final unavoidable delays shall not be included in such charges.

10-10. Liquidated Damages for Delay. It is agreed by the parties to the contract that time is of the essence and that, in case all the work is not completed before or upon the expiration of the time limit as set forth, damage, other than those cost items identified in section 10-09, will be sustained by the City and that it is and will be impracticable to determine the actual amount of damage by reason of such delay; and it is therefore agreed that the Contractor will pay to the City the sum of five hundred dollars ($500.00) per day for each and every calendar day's delay beyond the time prescribed.

In compliance with the provisions of California Public Contract Code § 7102, the Contractor will be compensated for damages incurred due to delays in completing the work due solely to the fault of the City, where such delay is unreasonable under the circumstances and not contemplated by the parties. The Contractor and City agree that determining actual damages is impracticable and extremely difficult. As such, the Contractor shall be entitled to the appropriate time extension and to payment of liquidated damages in the sum of $250 per day of delay in excess of the time specified for the completion of the work. Such amount shall constitute the only payment allowed and shall necessarily include all overhead (direct or indirect), all profit, all administrative costs, all bond costs, all labor, materials, equipment and rental costs, and any other costs, expenses and fees incurred or sustained as a result of such delay. The Contractor expressly agrees to be limited solely to the liquidated damages for all such delays as defined in this subsection.

SECTION 11. MISCELLANEOUS

11-01. Notice. Whenever any provision of the contract documents requires the giving of written notice, it shall be deemed to have been validly given if delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, or if delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice. If mailed, the notice shall be deemed received on the date of delivery stated in the return receipt.

11-02. Computation of Time. When any period of time is referred to in the Contract Documents by days, it shall be computed to exclude the first and include the last day of such period. If the last day of any such period falls on a Saturday or Sunday or on a day made a legal holiday by the law of the applicable jurisdiction, such day shall be omitted from the computation.

11-03. Claims Procedure

Contractor shall timely comply with all notices and requests for changes to the contract time or contract price, as a prerequisite to filing any claim governed by this Article. The failure to timely submit a notice of delay or notice of change, or to timely request a change to the contract time or contract price, or to timely provide any other notice or request required herein shall constitute a waiver of the right to further pursue the claim under the contract or at law.

A. **Intent.** Effective January 1, 1991, Section 20104 et seq., of the California Public Contract Code prescribes a process utilizing informal conferences, non-binding judicial supervised mediation, and judicial arbitration to resolve disputes on construction claims of $375,000 or less. Effective January 1, 2017, Section 9204 of the Public Contract Code prescribes a process for negotiation and mediation to resolve disputes on construction claims. The intent of this Article is to implement Sections 20104 et seq. and Section 9204 of the California Public Contract Code. This Article shall be construed to be consistent with said statutes.

B. **Claims.** For purposes of this Article, "Claim" means a separate demand by the Contractor, for (A) a time extension, (B) payment of money or damages arising from work done by or on behalf of the Contractor pursuant to the Contract, or (C) an amount the payment of which is disputed by the District. Claims governed by this Article may not be filed unless and until the Contractor completes all procedures for giving notice of delay or change and for the requesting of a time extension or change order. Claims governed by this Article must be filed no later than the date of final payment. The claim shall be submitted in writing to the District and shall include on its first page the following in 16 point capital font: "THIS IS A CLAIM." Furthermore, the claim shall include the documents necessary to substantiate the claim. Nothing herein is intended to extend the time limit or supersede notice requirements otherwise provided by contract for the filing of claims, including all requirements pertaining to compensation or payment for extra work, disputed work, and/or changed conditions. Failure to follow such contractual requirements shall bar any claims or subsequent lawsuits for compensation or payment thereon.

C. **Supporting Documentation.** The Contractor shall submit all claims in the following format:

Summary of claim merit and price, reference Contract Document provisions pursuant to which the claim is made
List of documents relating to claim:
Specifications
Drawings
Clarifications (Requests for Information)
Schedules
Other
Chronology of events and correspondence
Analysis of claim merit
Analysis of claim cost
Time impact analysis in CPM format

If Contractor's claim is based in whole or in part on an allegation of errors or omissions in the Drawings or Specifications for the project, Contractor shall provide a summary of the percentage of the claim subject to design errors or omissions and shall obtain a certificate of merit in support of the claim of design errors and omissions.

D. City's Response. Upon receipt of a claim pursuant to this Article, City shall conduct a reasonable review of the claim and, within a period not to exceed 45 days, shall provide the Contractor a written statement identifying what portion of the claim is disputed and what portion is undisputed. Any payment due on an undisputed portion of the claim will be processed and made within 60 days after the City issues its written statement.

If the City needs approval from its governing body to provide the Contractor a written statement identifying the disputed portion and the undisputed portion of the claim, and the City's governing body does not meet within the 45 days or within the mutually agreed to extension of time following receipt of a claim sent by registered mail or certified mail, return receipt requested, the City shall have up to three days following the next

duly publicly noticed meeting of the City's governing body after the 45-day period, or extension, expires to provide the Contractor a written statement identifying the disputed portion and the undisputed portion.

Within 30 days of receipt of a claim, the City may request in writing additional documentation supporting the claim or relating to defenses or claims the District may have against the Contractor. If additional information is thereafter required, it shall be requested and provided pursuant to this subdivision, upon mutual agreement of City and the Contractor. The City's written response to the claim, as further documented, shall be submitted to the Contractor within 30 days (if the claim is less than $15,000, within 15 days) after receipt of the further documentation, or within a period of time no greater than that taken by the Contractor in producing the additional information or requested documentation, whichever is greater.

E. Meet and Confer. If the Contractor disputes the City's written response, or the City fails to respond within the time prescribed, the Contractor may so notify the City, in writing, either within 15 days of receipt of the City's response or within 15 days of the City's failure to respond within the time prescribed, respectively, and demand in writing an informal conference to meet and confer for settlement of the issues in dispute. Upon receipt of a demand, the City shall schedule a meet and confer conference within 30 days for settlement of the dispute.

F. Mediation. Within 10 business days following the conclusion of the meet and confer conference, if the claim or any portion of the claim remains in dispute, the City shall provide the Contractor a written statement identifying the portion of the claim that remains in dispute and the portion that is undisputed. Any payment due on an undisputed portion of the claim shall be processed and made within 60 days after the City issues its written statement. Any disputed portion of the claim, as identified by the Contractor in writing, shall be submitted to nonbinding mediation, with the City and the Contractor sharing the associated costs equally. The City and Contractor shall mutually agree to a mediator within 10 business days after the disputed portion of the claim has been identified in writing, unless the parties agree to select a mediator at a later time.

If the parties cannot agree upon a mediator, each party shall select a mediator and those mediators shall select a qualified neutral third party to mediate with regard to the disputed portion of the claim. Each party shall bear the fees and costs charged by its respective mediator in connection with the selection of the neutral mediator.

For purposes of this section, mediation includes any nonbinding process, including, but not limited to, neutral evaluation or a dispute review board, in which an independent third party or board assists the parties in dispute resolution through negotiation or by issuance of an evaluation. Any mediation utilized shall conform to the timeframes in this section.

Unless otherwise agreed to by the City and the Contractor in writing, the mediation conducted pursuant to this section shall excuse any further obligation under Public Contract Code Section 20104.4 to mediate after litigation has been commenced.

The mediation shall be held no earlier than the date the Contractor completes the work or the date that the Contractor last performs work, whichever is earlier. All unresolved claims shall be considered jointly in a single mediation, unless a new unrelated claim arises after mediation is completed.

G. Procedures After Mediation. If following the mediation, the claim or any portion remains in dispute, the Contractor must file a claim pursuant to Chapter 1 (commencing with Section 900) and Chapter 2 (commencing with Section 910) of Part 3 of Division 3.6 of Title 1 of the Government Code prior to initiating litigation. For purposes of those provisions, the running of the period of time within which a claim must be filed shall be tolled from the time the Contractor submits his or her written claim pursuant to subdivision (a) until the time the claim is denied, including any period of time utilized by the meet and confer conference.

H. Civil Actions. The following procedures are established for all civil actions filed to resolve claims of $375,000 or less:

Within 60 days, but no earlier than 30 days, following the filing or responsive pleadings, the court shall submit the matter to non-binding mediation unless waived by mutual stipulation of both parties or unless mediation was held prior to commencement of the action in accordance with Public Contract Code section 9204

and the terms of this Contract. The mediation process shall provide for the selection within 15 days by both parties of a disinterested third person as mediator, shall be commenced within 30 days of the submittal, and shall be concluded within 15 days from the commencement of the mediation unless a time requirement is extended upon a good cause showing to the court.

If the matter remains in dispute, the case shall be submitted to judicial arbitration pursuant to Chapter 2.5 (commencing with Section 1141.10) of Title 3 of Part 3 of the Code of Civil Procedure, notwithstanding Section 1114.11 of that code. The Civil Discovery Act of 1986 (Article 3 (commencing with Section 2016) of Chapter 3 of Title 3 of Part 4 of the Code of Civil Procedure) shall apply to any proceeding brought under this subdivision consistent with the rules pertaining to judicial arbitration. In addition to Chapter 2.5 (commencing with Section 1141.10) of Title 3 of Part 3 of the Code of Civil Procedure, (A) arbitrators shall, when possible, be experienced in construction law, and (B) any party appealing an arbitration award who does not obtain a more favorable judgment shall, in addition to payment of costs and fees under that chapter, also pay the attorney's fees on appeal of the other party.

I. Government Code Claims. In addition to any and all contract requirements pertaining to notices of and requests for compensation or payment for extra work, disputed work, construction claims and/or changed conditions, the Contractor must comply with the claim procedures set forth in Government Code Sections 900, et seq. prior to filing any lawsuit against the City. Such Government Code claims and any subsequent lawsuit based upon the Government Code claims shall be limited to those matters that remain unresolved after all procedures pertaining to extra work, disputed work, construction claims, and/or changed conditions have been followed by Contractor. If no such Government Code claim is submitted, or if the prerequisite contractual requirements are not satisfied, no action against the City may be filed. **A Government Code claim must be filed no earlier than the date the work is completed or the date the Contractor last performs work on the project, whichever occurs first. A Government Code claim shall be inclusive of all unresolved claims unless a new unrelated claim arises after the Government Code claim is submitted.**

J. Non-Waiver. The City's failure to respond to a claim from the Contractor within the time periods described in this Article or to otherwise meet the time requirements of this Article shall result in the claim being deemed rejected in its entirety.

11-04. Arbitration. Subject to exhaustion of all other applicable contractual and administrative remedies, including Public Contract Code Section 9201, any unresolved claim arising under this contract shall be subject to binding arbitration pursuant to Article 7.1 (commencing with Section 10240) of Chapter 1 of Part 2 of the California Public Contract Code.

11-05. Litigation and Forum Selection. Contractor and City stipulate and agree that any litigation relating to the enforcement or interpretation of this contract, arising out of Contractor's performance or relating in any way to the work shall be brought in Mendocino County and that venue will lie in Mendocino County.

Except as otherwise expressly provided by law, the parties waive any objections they might otherwise have to the propriety of jurisdiction or venue in the state courts in Mendocino County and agree that California law shall govern any such litigation.

The duties and obligations imposed by these General Conditions and the rights and remedies available hereunder to the parties hereto and, in particular but without limitation, the warranties, guaranties and obligations imposed upon the Contractor and all of the rights and remedies available to the City thereunder, shall be in addition to and shall not be construed in any way as a limitation of, any rights and remedies available to any or all of them which are otherwise imposed or available by law or contract, by special warranty or guaranty, or by other provisions of the contract documents and the provisions of this paragraph shall be as effective as if repeated specifically in the contract documents in connection with each particular duty, obligation, right and remedy to which they apply. All warranties and guaranties made in the contract document shall survive final payment and termination or completion of this contract. The City disclaims an express or implied warranty that the plans and specifications identify all site conditions that could affect the time or cost to complete the Work.

11-05. Waiver. The Contractor shall strictly comply with all notices and other contract requirements. Waiver by the City of any failure of the Contractor to comply with any term of the contract, including the notice provisions, shall not be deemed a waiver of a subsequent breach.

TECHNICAL SPECIFICATIONS

SECTION 12. GENERAL INFORMATION

12-01. Location and Scope of Work. All of the work to be performed is within the City of Ukiah and consists of construction of Recycled Water Project Phase 4 - Specification No. 23-01, including: construction of new and rehabilitation of existing facilities related to the City of Ukiah's recycled water production, storage, and distribution; repair and reconstruction of existing improvements affected by the Work; and incidentals for complete and usable facilities. General locations of the work:

1. City of Ukiah Water Treatment Plant: 935 River Street, Ukiah, CA 95482.
2. City of Ukiah Wastewater Treatment Plant: 300 Plant Road, Ukiah, CA 95482.
3. Various locations within the City of Ukiah for the recycled water distribution system pipelines.

The Contractor should familiarize himself with the local conditions of the project sites. Failure to do so will in no way relieve him of the responsibility for performing any of the work or operations required as a part of this contract. Further information regarding the work or these specifications can be obtained from Seth Strader at (707) 463-6233.

12-02. Arrangement of Technical Specifications. The Technical Specifications are arranged in sections covering the various phases of work as follows:

Section No.	Title
12	General Information
13	Construction Details
14	Exclusions from General Conditions
15	Amendments to General Conditions

12-03. Arrangement of Plans. General locations and linear quantities of the work are shown in Appendix "A". A map will be provided to the successful bidder showing the exact locations of the work to be done.

12-04. Business Licenses. The Contractor and any subcontractors shall each secure and maintain a valid City of Ukiah Business License prior to the start of any portion of the work.

12-05. Permits. The Contractor shall provide, procure, and pay for all permits required to complete this work.

12-06. Standard Specifications and Standard Plans. The Standard Specifications and Standard Plans of the California State Department of Transportation, 2018, are hereby made a part of these Special Provisions and are hereinafter referred to as "California Standard Specifications" and "California Standard Plans."

Whenever in the California Standard Specifications and the California Standard Plans the following terms are used, they shall be understood to mean and refer to the following:

Department of Transportation - The City Council.

Director of Public Works - The City of Ukiah Director of Public Works.

Engineer - The Engineer, designated by the City Council, acting either directly or through properly authorized agents, such agents acting within the scope of the particular duties entrusted to them.

Laboratory - The designated laboratory authorized by the City of Ukiah to test materials and work involved in the contract.

State - The City of Ukiah

Other terms appearing in the California Standard Specifications and the California Standard Plans shall have the intent and meaning specified in Section I, Definition of Terms of the California Standard Specifications.

In case of discrepancy between the contract documents, the order of precedence from the highest to lowest is as follows:

1. (City) Special Provisions
2. (City) Project Plans
3. City Standard Plans and Details
4. California Standard Plans
5. California Standard Specifications

12-07. Temporary Facilities. All temporary facilities are the responsibility of the Contractor. The removal of said facilities shall be the responsibility of the Contractor. The Contractor shall be responsible for any and all damages to existing facilities which are a result of the work.

12-08. Public Convenience and Safety. The Contractor shall conduct operations so as to cause the least possible obstruction and inconvenience to public traffic. The Contractor shall, at his or her expense, furnish such flag persons and furnish, erect, construct and maintain such fences, barriers, lights, signs, detours, pedestrian walkways, driveway ramps and bridging as may be necessary to give adequate warning to the public that work is in progress and that dangerous conditions exist, to provide access to abutting properties and to permit the flow of pedestrian and vehicular traffic to safely and expeditiously pass the work.

12-09. Maintaining Traffic. Attention is directed to Section 7-1.08, "Public Convenience," 7-1.09, "Public Safety," 7-1.092, "Lane Closure," and 7-1.095, "Flagging Costs," of the California Standard Specifications.

Streets shall be open to through vehicular traffic during non-working hours. All public traffic shall be permitted to pass through the work with as little inconvenience and delay as possible.

Full costs for "Maintaining Traffic", including "Flagging Costs", shall be considered as included in the various items of work and no additional compensation will be made.

12.10. Stream Pollution. The Contractor shall exercise every reasonable precaution to prevent muddying or silting of live streams, and the Contractor's attention is called to the fact that the terms of this contract do not relieve him or her of responsibility for compliance with Sections 5650 and 12015 of the Fish and Game Code or other applicable statutes relating to pollution prevention or abatement.

12-11. Warranties. Unless otherwise indicated, the Contractor shall warrant all materials provided and work performed under this contract for a period of one year from the date of final acceptance. He shall replace promptly and at his own expense any materials and/or workmanship which fail during this warranty period.

12-12. Utilities. No water, sewer or electrical services will be provided by the owner. It is the Contractor's sole responsibility to arrange such services as necessary.

12-13. Preconstruction Conference. A preconstruction conference will be held before any work will be allowed to commence. This meeting will cover inspection, schedule for work, and among other items, the responsibilities and procedures of each of the interested parties to assure that the project will be completed in accordance with the contract documents.

12-14. Safety Requirements. The Contractor shall comply with all pertinent provisions of the Department of Labor "Safety and Health Regulations for Construction (29 FCS Part 1518, 36 CFR 7340)", with additions or modifications thereto, in effect during construction of this project.

SECTION 13 - CONSTRUCTION DETAILS

13-01. Volume 1 - Technical Specifications Division 00 through Division 13

13-02. Volume 2 - Technical Specifications Division 15 through Division 17 and Appendices
- Appendix A of the Specifications - Mitigation Monitoring and Reporting Program
- Appendix B of the Specifications - WWTP Geotechnical Report (Revision 2)
- Appendix C of the Specifications - Recycled Water Pipeline Geotechnical Report

13-03. Volume 3 - Drawings

SECTION 14. EXCLUSIONS FROM GENERAL CONDITIONS

14-01. Provisions to be Excluded from General Conditions. The following designated provisions of the General Conditions are hereby determined to be inapplicable to the proposed work and, therefore, are hereby excluded from the terms of the Notice to Bidders, Proposal, Agreement and other contract documents as though entirely omitted from said General Conditions:

No other exclusions.

SECTION 15. AMENDMENTS TO GENERAL CONDITIONS

15-01. Sections of General Conditions to be Amended.

The following designated sections of the Special Provisions are hereby amended to read as follows:

No amendments.

~~BID SUBMITTAL CHECKLIST~~

~~The following is a checklist to assist you in your submission of your bid documents. Please make sure you include the following when submitting your bid documents to reduce the risk of having your bid rejected:~~

~~Did you include?...~~

- ~~**Proposal** (Page ____)~~
  - ~~Unit prices filled out clearly.~~
  - ~~Extended prices filled out clearly and calculated correctly~~
  - ~~Total bid amount filled out clearly and calculated correctly~~
  - ~~Sign the proposal, and provide complete information~~
  - ~~CLSB No. and expiration date~~
  - ~~Department of Industrial Relations Public Works Contractor Registration Number~~

- ~~**Fair Employment Practices Certification** (Page ____)~~
  - ~~Filled out completely per instruction~~

- ~~**Worker's Compensation Certificate** (Page ____)~~
  - ~~Filled out completely per instruction~~

- ~~**Certification of Non-Discrimination in Employment** (Page ____)~~
  - ~~Filled out completely per instruction~~

- ~~**List of Proposed Subcontractors** (Page _____)~~
  - ~~Filled out completely per instruction~~

- ~~**Statement of Experience** (Page ____)~~

- ~~**Signature of Bidder** (Page _____)~~
  - ~~Filled out completely per instruction~~
  - ~~Authorized signature provided~~

- ~~**Bidder's Bond** (Page _____)~~
  - ~~Filled out completely per instruction~~

- ~~**Non-Collusion Affidavit** (Page _____)~~
  - ~~Filled out completely per instruction~~
  - ~~Notarized~~

- ~~**Addenda Issued**~~
  - ~~Check the City website for any addenda issued: www.cityofukiah.com/purchasing~~ AD1

BID SUBMITTAL CHECKLIST

The following is a checklist to assist you in your submission of your bid documents. Please make sure you include the following when submitting your bid documents to reduce the risk of having your bid rejected:

Did you include?...

- **Proposal** (Page ____)
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- **Statement of Experience** (Page ____)

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  - Authorized signature provided

- **Bidder's Bond** (Page ____)
  - Filled out completely per instruction

- **Non-Collusion Affidavit** (Page ____)
  - Filled out completely per instruction
  - Notarized

- **Certification of Compliance with WRFP/SRF Conditions** (Page ____)

- **Addenda Issued**
  - Check the City website for any addenda issued: www.cityofukiah.com/purchasing AD1

CITY OF UKIAH
MENDOCINO COUNTY, CALIFORNIA

PROPOSAL

FOR
RECYCLED WATER PROJECT – PHASE 4

Specification No. 23-01

The undersigned, as bidder,
declares that he or she has examined thoroughly all of the contract documents herein contained, that this proposal is made without collusion with any other person, firm or corporation and that all laws and ordinances relating to the interest of public officers in this contract have been complied with in every respect.

AND he or she proposes and agrees, if this proposal is accepted,

1) that he or she will contract with the City of Ukiah, Mendocino County, California, in the form of the copy of the agreement herein contained

   a) to provide all necessary machinery, tools, apparatus and other means of construction;

   b) to furnish all materials;

   c) to provide all superintendence, overhead expenses and all labor and expenses of whatever nature necessary to complete the job in conformity with the specifications and drawings and other contract provisions herein or reasonably implied hereby or as necessary to complete the work in the manner and within the time named herein and according to the requirements and to the reasonable satisfaction of the City Engineer;

   d) to pay all charges of freight transportation and hauling;

2) that he or she indemnifies the City against any loss or damage arising from any act of the undersigned as Contractor; and

3) that he or she will accept as full payment therefor the following sums:

The Bidder certifies the following:

1) This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation.
2) Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.
3) Bidder has not solicited or induced any individual or entity to refrain from bidding.
4) Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract as defined below:
   a) Corrupt practice means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process.
   b) Fraudulent practice means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition.
   c) Collusive practice means a scheme or arrangement between 2 or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels.
   d) Coercive practice means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

This Bid will remain subject to acceptance for [60] days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

In accordance with California Public Contract Code Section 2200 et seq., ("Iran Contracting Act of 2010"), Bidder certifies that Bidder is not identified on the list created by the California Department of General Services (DGS) in accordance with California Public Contract Code Section 2203(b) as a Person engaging in investment activities in Iran.

BIDDING SCHEDULE

In the case of any discrepancy between the unit price and the total set forth for the item, the unit price shall prevail; provided, however, that if the amount set forth as a unit price is ambiguous, unintelligible or uncertain for any reason, or is omitted, or in the case of lump sum items, is not the same amount as the entry in the "Total" column, then the amount set forth in the "Total" column for the item shall prevail in accordance with the following:

1. As to lump sum items, the amount set forth in the "Total" column shall be the unit price;
2. As to unit basis items, the amount set forth in the "Total" column shall be divided by the estimated quantity for the item and the price thus obtained shall be the unit price.

The Total Base Bid shall be the sum of the items in the "Total" column. In case of discrepancy between the sum of the items in the "Total" column and the amount entered as Total Base Bid, the sum of the "Total" column items shall prevail. The bid comparison will be based on the sum of the items in the "total" column for each bidder.

The Unit prices for the various Construction Items below include all costs associated with the General Conditions, Special Provisions, Requirements of the Construction Contract, and represent the total, complete, in-place cost for each specific Construction Item in accordance with the Construction Documents, including all elements, work components, accessories, and connections, shown in applicable details or required to yield a complete, sound and functional component or system appropriate for its intended function, whether or not such is specifically described or listed in any description of measurement or payment. The total amount of the Construction items below shall represent the total and complete cost of the fully functional Project. All work not specifically listed below be required to complete the work of the various construction items and the cost of such shall be considered as included throughout the various unit prices indicated.

Lowest bid will be based on the lowest Base Bid.

NAME OF BIDDER: _____

SPEC #: **23-01**

PROJECT NAME: **RECYCLED WATER PROJECT – PHASE 4** AD5

~~BIDDING SCHEDULE~~

~~In the case of any discrepancy between the unit price and the total set forth for the item, the unit price shall prevail; provided, however, that if the amount set forth as a unit price is ambiguous, unintelligible or uncertain for any reason, or is omitted, or in the case of lump sum items, is not the same amount as the entry in the "Total" column, then the amount set forth in the "Total" column for the item shall prevail in accordance with the following:~~

1. ~~As to lump sum items, the amount set forth in the "Total" column shall be the unit price;~~
2. ~~As to unit basis items, the amount set forth in the "Total" column shall be divided by the estimated quantity for the item and the price thus obtained shall be the unit price.~~

~~The Total Base Bid shall be the sum of the items in the "Total" column. In case of discrepancy between the sum of the items in the "Total" column and the amount entered as Total Base Bid, the sum of the "Total" column items shall prevail. The bid comparison will be based on the sum of the items in the "total" column for each bidder.~~

~~The Unit prices for the various Construction Items below include all costs associated with the General Conditions, Special Provisions, Requirements of the Construction Contract, and represent the total, complete, in-place cost for each specific Construction Item in accordance with the Construction Documents, including all elements, work components, accessories, and connections, shown in applicable details or required to yield a~~

complete, sound and functional component or system appropriate for its intended function, whether or not such is specifically described or listed in any description of measurement or payment. The total amount of the Construction items below shall represent the total and complete cost of the fully functional Project. All work not specifically listed below be required to complete the work of the various construction items and the cost of such shall be considered as included throughout the various unit prices indicated.

Lowest bid will be based on the lowest Base Bid.

NAME OF BIDDER: _____

SPEC #: 23-01

PROJECT NAME: RECYCLED WATER PROJECT – PHASE 4AD4AD5

BIDDING SCHEDULE

In the case of any discrepancy between the unit price and the total set forth for the item, the unit price shall prevail; provided, however, that if the amount set forth as a unit price is ambiguous, unintelligible or uncertain for any reason, or is omitted, or in the case of lump sum items, is not the same amount as the entry in the "Total" column, then the amount set forth in the "Total" column for the item shall prevail in accordance with the following:

3. As to lump sum items, the amount set forth in the "Total" column shall be the unit price;
4. As to unit basis items, the amount set forth in the "Total" column shall be divided by the estimated quantity for the item and the price thus obtained shall be the unit price.

The Total Base Bid shall be the sum of the items in the "Total" column. In case of discrepancy between the sum of the items in the "Total" column and the amount entered as Total Base Bid, the sum of the "Total" column items shall prevail. The bid comparison will be based on the sum of the items in the "total" column for each bidder.

The Unit prices for the various Construction Items below include all costs associated with the General Conditions, Special Provisions, Requirements of the Construction Contract, and represent the total, complete, in-place cost for each specific Construction Item in accordance with the Construction Documents, including all elements, work components, accessories, and connections, shown in applicable details or required to yield a complete, sound and functional component or system appropriate for its intended function, whether or not such is specifically described or listed in any description of measurement or payment. The total amount of the Construction items below shall represent the total and complete cost of the fully functional Project. All work not specifically listed below be required to complete the work of the various construction items and the cost of such shall be considered as included throughout the various unit prices indicated.

Lowest bid will be based on the lowest Base Bid.

NAME OF BIDDER: _____

SPEC #: 23-01

PROJECT NAME: RECYCLED WATER PROJECT – PHASE 4AD4

ITEM#	DESCRIPTION	UNIT OF MEASURE	QUANTITY	UNIT PRICE	TOTAL
1	Mobilization	%	5		
2	Traffic Control	LS	1		
3	Temporary Facilities and Controls (per Section 01500)	LS	1		
4	Temporary Excavation Support - WWTP	LS	1		
5	Dewatering - WWTP	LS	1		
6	Dechlorination Structure (Area 60)	LS	1		
7	Buried Sludge Piping	LS	1		
8	Packaged Water Treatment System Rehabilitation (per Specification Section 11802) (Area 85)				
8a	Scope of Supply provided by WesTech	LS	1		
8b	Tank Coating (per Specification Section 09960)	SF	10,000		
8c	Rotary-Lobe Blowers (per Specification Section 11376A)	LS	1		
8d	Coagulant Feed Pump (per Specification Section 11242)	LS	1		
8e	Rapid Mix Pump (per Specification Section 11312O)	LS	1		
8f	All other Work associated with Area 85	LS	1		
9	Backwash Pump Station (Area 87)	LS	1		
10	Carousel Pump Station (Area 89)	LS	1		
11	PAU Pump Station (Area 91)	LS	1		
12	PAU Excavation and Embankment	LS	1		
13	PAU Concrete Liner and Inlets	LS	1		
14	Yard Piping - WWTP	LS	1		
15	Electrical Work - WWTP				
15a	12 kV Work	LS	1		
15b	Electrical Ductbanks	LS	1		

~~15b~~	~~All other Electrical Work~~	~~LS~~	~~1~~		
~~16~~	~~Instrumentation & Controls Work - WWTP~~	~~LS~~	~~1~~		
~~17~~	~~Startup and Commissioning (per Specification Section 01756) - WWTP~~	~~LS~~	~~1~~		
~~18~~	~~All other Work - WWTP~~	~~LS~~	~~1~~		
~~19~~	~~Temporary Excavation Support - WTP~~	~~LS~~	~~1~~		
~~20~~	~~Dewatering - WTP~~	~~LS~~	~~1~~		
~~21~~	~~Recycled Water Storage Tank (per Specification Section 13207)~~	~~LS~~	~~1~~		
~~22~~	~~Recycled Water Pump Station~~	~~LS~~	~~1~~		
~~23~~	~~WTP Excavations and Embankments~~	~~LS~~	~~1~~		
~~24~~	~~WTP Yard Piping~~	~~LS~~	~~1~~		
~~25~~	~~21" Sewer Replacement~~	~~LS~~	~~1~~		
~~26~~	~~Concrete Manholes~~	~~EA~~	~~33~~		
~~27~~	~~Electrical Work - WTP~~	~~LS~~	~~1~~		
~~27a~~	~~Recycled Water Pump Station Electrical Building~~	~~LS~~	~~1~~		
~~27b~~	~~Other Miscellaneous Electrical Work - WTP~~	~~LS~~	~~1~~		
~~28~~	~~Instrumentation and Controls Work - WTP~~	~~LS~~	~~1~~		
~~29~~	~~Startup and Commissioning (per Specification Section 01756) - WTP~~	~~LS~~	~~1~~		
~~30~~	~~All other Work - WTP~~	~~LS~~	~~1~~		
~~31~~	~~Temporary Excavation Support - Distribution System~~	~~LS~~	~~1~~		
~~32~~	~~Dewatering - Distribution System~~	~~LS~~	~~1~~		
~~33~~	~~18-inch diameter PVC pipeline in trench~~	~~LF~~			
~~34~~	~~16-inch diameter PVC pipeline in trench~~	~~LF~~			
~~35~~	~~1 2-inch diameter PVC pipeline in trench~~	~~LF~~			
~~365~~	~~10-inch diameter PVC pipeline in trench~~	~~LF~~			
~~376~~	~~8-inch diameter PVC pipeline in trench~~	~~LF~~			
~~387~~	~~6-inch diameter PVC pipeline in trench~~	~~LF~~			

398	4-inch diameter PVC pipeline in trench	LF			
4039	Microtunnel Crossing (including pressure pipe and casing)	LS	1		
410	Pipeline Blow-off Assemblies	EA			
421	Pipeline Combination Air Valves	EA			
432	Pipeline Butterfly Valves	EA			
443	Meters and Service Lines	EA			
454	Pedestrian Bridge	LS	1		
	Tunneling	LS	1		
465	Startup and Commissioning (per Specification Section 01756) - Distribution System	LS	1		
47	All other Work - Distribution System	LS	1		
486	Demobilization	LS	1		
	TOTAL BID ==>>	$			

ITEM#	DESCRIPTION	UNIT OF MEASURE	QUANTITY	UNIT PRICE	TOTAL
1	Mobilization	%	5		
2	Traffic Control	LS	1		
3	Temporary Facilities and Controls (per Section 01500)	LS	1		
4	Temporary Excavation Support - WWTP	LS	1		
5	Dewatering - WWTP	LS	1		
6	Dechlorination Structure (Area 60)	LS	1		
7	Buried Sludge Piping	LS	1		
8	Packaged Water Treatment System Rehabilitation (per Specification Section 11802) (Area 85)				
8a	Scope of Supply provided by WesTech	LS	1		
8b	Tank Coating (per Specification Section 09960)	SF	10,000		
8c	Rotary-Lobe Blowers (per Specification Section 11376A)	LS	1		
8d	Coagulant Feed Pump (per Specification Section 11242)	LS	1		
8e	Rapid Mix Pump (per Specification Section 11312O)	LS	1		

8f	All other Work associated with Area 85	LS	1		
9	Backwash Pump Station (Area 87)	LS	1		
10	Carousel Pump Station (Area 89)	LS	1		
11	PAU Pump Station (Area 91)	LS	1		
12	PAU Excavation and Embankment	LS	1		
13	PAU Concrete Liner and Inlets	LS	1		
14	Yard Piping - WWTP	LS	1		
15	Electrical Work - WWTP				
15a	12 kV Work	LS	1		
15b	Electrical Ductbanks	LS	1		
15b	All other Electrical Work	LS	1		
16	Instrumentation & Controls Work - WWTP	LS	1		
17	Startup and Commissioning (per Specification Section 01756) - WWTP	LS	1		
18	All other Work - WWTP	LS	1		
19	Temporary Excavation Support - WTP	LS	1		
20	Dewatering - WTP	LS	1		
21	Recycled Water Storage Tank (per Specification Section 13207)	LS	1		
22	Recycled Water Pump Station	LS	1		
23	WTP Excavations and Embankments	LS	1		
24	WTP Yard Piping	LS	1		
25	21" Sewer Replacement	LS	1		
26	Concrete Manholes	EA	3		
27	Electrical Work - WTP	LS	1		
27a	Recycled Water Pump Station Electrical Building	LS	1		
27b	Other Miscellaneous Electrical Work - WTP	LS	1		
28	Instrumentation and Controls Work - WTP	LS	1		
29	Startup and Commissioning (per Specification Section 01756) - WTP	LS	1		
30	All other Work - WTP	LS	1		

31	Temporary Excavation Support - Distribution System	LS	1		
32	Dewatering - Distribution System	LS	1		
33	18-inch diameter PVC pipeline in trench	LF	3,781		
34	16-inch diameter PVC pipeline in trench	LF	20		
35	12-inch diameter PVC pipeline in trench	LF	3,857		
36	10-inch diameter PVC pipeline in trench	LF	3,145		
37	8-inch diameter PVC pipeline in trench	LF	827		
38	6-inch diameter PVC pipeline in trench	LF	2718		
39	4-inch diameter PVC pipeline in trench	LF	206		
40	12-inch diameter ductile iron pipeline	LF	150		
41	Microtunnel Crossing (including pressure pipe and casing)	LS	1		
42	Pipeline Blow-off Assemblies	EA	12		
43	Pipeline Combination Air Valves	EA	20		
44	Pipeline Butterfly Valves	EA	6		
45	Pipeline Gate Valves	EA	10		
46	Meters and Service Lines	EA	13		
47	Pedestrian Bridge	LS	1		
48	Startup and Commissioning (per Specification Section 01756) - Distribution System	LS	1		
49	All other Work - Distribution System	LS	1		
50	Demobilization	LS	1		
TOTAL BID ==>>		$			

AD1

ITEM#	DESCRIPTION	UNIT OF MEASURE	QUANTITY	UNIT PRICE	TOTAL
1	Mobilization	%	5		
2	Traffic Control	LS	1		
3	Temporary Facilities and Controls (per Section 01500)	LS	1		
4	Temporary Excavation Support - WWTP	LS	1		

ITEM#	DESCRIPTION	UNIT OF MEASURE	QUANTITY	UNIT PRICE	TOTAL
5	Dewatering - WWTP	LS	1		
6	Dechlorination Structure (Area 60)	LS	1		
7	Buried Sludge Piping	LS	1		
8	Packaged Water Treatment System Rehabilitation (per Specification Section 11802) (Area 85)				
8a	Scope of Supply provided by WesTech	LS	1		
8b	Tank Coating (per Section 09960)	SF	10,000		
8c	Rotary Lobe Blowers (per Section 11376A)	LS	1		
8d	Coagulant Feed Pump (per Section 11242)	LS	1		
8e	Rapid Mix Pump (per Section 11312O)	LS	1		
8f	All other Work associated with Area 85	LS	1		
9	Backwash Pump Station (Area 87)	LS	1		
10	Carousel Pump Station (Area 89)	LS	1		
11	PAU Pump Station (Area 91)	LS	1		
12	PAU Excavation and Embankment	LS	1		
13	PAU Concrete Liner and Inlets	LS	1		
14	Yard Piping - WWTP	LS	1		
15	Electrical Work - WWTP				
15a	12 kV Work	LS	1		
15b	Electrical Ductbanks	LS	1		
15b	All other Electrical Work	LS	1		
16	Instrumentation & Controls Work - WWTP	LS	1		
17	Startup and Commissioning (per Section 01756) - WWTP	LS	1		
18	All other Work - WWTP	LS	1		
19	Temporary Excavation Support - WTP	LS	1		
20	Dewatering - WTP	LS	1		
21	Recycled Water Storage Tank (per Section 13207)	LS	1		
22	Recycled Water Pump Station	LS	1		

ITEM#	DESCRIPTION	UNIT OF MEASURE	QUANTITY	UNIT PRICE	TOTAL
23	WTP Excavations and Embankments	LS	1		
24	WTP Yard Piping	LS	1		
25	21" Sewer Replacement	LS	1		
26	Concrete Manholes	EA	3		
27	Electrical Work - WTP	LS	1		
27a	Recycled Water Pump Station Electrical Building	LS	1		
27b	Other Miscellaneous Electrical Work - WTP	LS	1		
28	Instrumentation and Controls Work - WTP	LS	1		
29	Startup and Commissioning (per Section 01756) - WTP	LS	1		
30	All other Work - WTP	LS	1		
31	Temporary Excavation Support - Distribution System	LS	1		
32	Dewatering - Distribution System	LS	1		
33	18-inch diameter PVC pipeline in trench	LF	3,781		
34	16-inch diameter PVC pipeline in trench	LF	20		
35	12-inch diameter PVC pipeline in trench	LF	3,857		
36	10-inch diameter PVC pipeline in trench	LF	3,145		
37	8-inch diameter PVC pipeline in trench	LF	827		
38	6-inch diameter PVC pipeline in trench	LF	2718		
39	4-inch diameter PVC pipeline in trench	LF	206		
40	12-inch diameter ductile iron pipeline	LF	150		
41a	CalTrans Microtunnel Crossing (including pressure pipe and casing)	LS	1		
41b	Railroad Crossing (including pressure pipe and casing)	LS	1		
42	Pipeline Blow-off Assemblies	EA	12		
43	Pipeline Combination Air Valves	EA	20		
44	Pipeline Butterfly Valves	EA	6		
45	Pipeline Gate Valves	EA	10		
46	Meters and Service Lines	EA	13		

ITEM#	DESCRIPTION	UNIT OF MEASURE	QUANTITY	UNIT PRICE	TOTAL
47	Pedestrian Bridge	LS	1		
48	Startup and Commissioning (per Section 01756) - Distribution System	LS	1		
49	All other Work - Distribution System	LS	1		
50	Demobilization	LS	1		
TOTAL BID ==>>		$			

AD3AD4

ITEM #	DESCRIPTION	UOM	QTY	UNIT PRICE	TOTAL
1	Mobilization	LS	1		
2	Traffic Control	LS	1		
3	Temporary Facilities and Controls (per Section 01500)	LS	1		
4	Temporary Excavation Support - WWTP	LS	1		
5	Dewatering - WWTP	LS	1		
6	Dechlorination Structure (Area 60)	LS	1		
7	Buried Sludge Piping	LS	1		
8	Packaged Water Treatment System Rehabilitation (per Specification Section 11802) (Area 85)				
8a	Scope of Supply provided by WesTech	LS	1		
8b	Tank Coating (per Specification Section 09960)	SF	10,000		
8c	Rotary-Lobe Blowers (per Specification Section 11376A)	LS	1		
8d	Coagulant Feed Pump (per Specification Section 11242)	LS	1		
8e	Rapid Mix Pump (per Specification Section 11312O)	LS	1		
8f	All other Work associated with Area 85	LS	1		
9	Backwash Pump Station (Area 87)	LS	1		
10	Carousel Pump Station (Area 89)	LS	1		
11	PAU Pump Station (Area 91)	LS	1		
12a	PAU Excavation	CY	40,000		

~~12b~~	~~PAY Embankment~~	~~LS~~	~~1~~		
~~13~~	~~PAU Concrete Liner and Inlets~~	~~LS~~	~~1~~		
~~14~~	~~Yard Piping - WWTP~~	~~LS~~	~~1~~		
~~15~~	~~Electrical Work - WWTP~~				
~~15a~~	~~12 kV Work~~	~~LS~~	~~1~~		
~~15b~~	~~Electrical Ductbanks~~	~~LS~~	~~1~~		
~~15b~~	~~All other Electrical Work~~	~~LS~~	~~1~~		
~~16~~	~~Instrumentation & Controls Work - WWTP~~	~~LS~~	~~1~~		
~~17~~	~~Startup and Commissioning (per Specification Section 01756) - WWTP~~	~~LS~~	~~1~~		
~~18~~	~~All other Work - WWTP~~	~~LS~~	~~1~~		
~~19~~	~~Temporary Excavation Support - WTP~~	~~LS~~	~~1~~		
~~20~~	~~Dewatering - WTP~~	~~LS~~	~~1~~		
~~21~~	~~Recycled Water Storage Tank (per Specification Section 13207)~~	~~LS~~	~~1~~		
~~22~~	~~Recycled Water Pump Station~~	~~LS~~	~~1~~		
~~23~~	~~WTP Excavations and Embankments~~	~~LS~~	~~1~~		
~~24~~	~~WTP Yard Piping~~	~~LS~~	~~1~~		
~~25~~	~~21" Sewer Replacement~~	~~LS~~	~~1~~		
~~26~~	~~Concrete Manholes~~	~~EA~~	~~3~~		
~~27~~	~~Electrical Work - WTP~~	~~LS~~	~~1~~		
~~27a~~	~~Recycled Water Pump Station Electrical Building~~	~~LS~~	~~1~~		
~~27b~~	~~Other Miscellaneous Electrical Work - WTP~~	~~LS~~	~~1~~		
~~28~~	~~Instrumentation and Controls Work - WTP~~	~~LS~~	~~1~~		
~~29~~	~~Startup and Commissioning (per Specification Section 01756) - WTP~~	~~LS~~	~~1~~		
~~30~~	~~All other Work - WTP~~	~~LS~~	~~1~~		
~~31~~	~~Temporary Excavation Support - Distribution System~~	~~LS~~	~~1~~		
~~32~~	~~Dewatering - Distribution System~~	~~LS~~	~~1~~		

33	18-inch diameter PVC pipeline in trench	LF	3781		
34	16-inch diameter PVC pipeline in trench	LF	20		
35	12-inch diameter PVC pipeline in trench	LF	3857		
36	10-inch diameter PVC pipeline in trench	LF	3145		
37	8-inch diameter PVC pipeline in trench	LF	827		
38	6-inch diameter PVC pipeline in trench	LF	2718		
39	4-inch diameter PVC pipeline in trench	LF	206		
40	12-inch diameter ductile iron pipeline	LF	150		
41a	Microtunnel Crossing (including pressure pipe and casing)	LS	1		
41b	Railroad Crossing (including pressure pipe and casing)	LS	1		
42	Pipeline Blow-off Assemblies	EA	12		
43	Pipeline Combination Air Valves	EA	20		
44	Pipeline Butterfly Valves	EA	6		
45	Pipeline Gate Valves	EA	10		
46	Meters and Service Lines	EA	13		
47	Pedestrian Bridge	LS	1		
48	Startup and Commissioning (per Specification Section 01756) - Distribution System	LS	1		
49	All other Work - Distribution System	LS	1		
50	Demobilization	LS	1		
TOTAL BID ==>>		$			

AD4AD5

ITEM #	DESCRIPTION	UOM		QTY	UNIT PRICE	TOTAL
1	Mobilization	LS		1		
2	Traffic Control	LS		1		
3	Temporary Facilities and Controls (per Section 01500)	LS		1		

4	Temporary Excavation Support - WWTP	LS		1		
5	Dewatering - WWTP	LS		1		
6	Dechlorination Structure (Area 60)	LS		1		
7	Buried Sludge Piping	LS		1		
8	Packaged Water Treatment System Rehabilitation (per Specification Section 11802) (Area 85)					
8a	Scope of Supply provided by WesTech	LS		1		
8b.1	Tank Coating (per Specification Section 09960)	SF		10,000		
8b.2	Type II Corrosion Remediation (per drawing 85S01)	SF		200		
8b.3	Type III Corrosion Remediation (per drawing 85S01)	SF		200		
8c	Rotary-Lobe Blowers (per Specification Section 11376A)	LS		1		
8d	Coagulant Feed Pump (per Specification Section 11242)	LS		1		
8e	Rapid Mix Pump (per Specification Section 11312O)	LS		1		
8f	All other Work associated with Area 85	LS		1		
9	Backwash Pump Station (Area 87)	LS		1		
10	Carousel Pump Station (Area 89)	LS		1		
11	PAU Pump Station (Area 91)	LS		1		
12a	PAU Excavation	CY		40,000		
12b	PAU Embankment	LS		1		
13	PAU Concrete Liner and Inlets	LS		1		
14	Yard Piping - WWTP	LS		1		
15	Electrical Work - WWTP					
15a	12 kV Work	LS		1		
15b	Electrical Ductbanks	LS		1		
15b	All other Electrical Work	LS		1		
16	Instrumentation & Controls Work - WWTP	LS		1		
17	Startup and Commissioning (per Specification	LS		1		

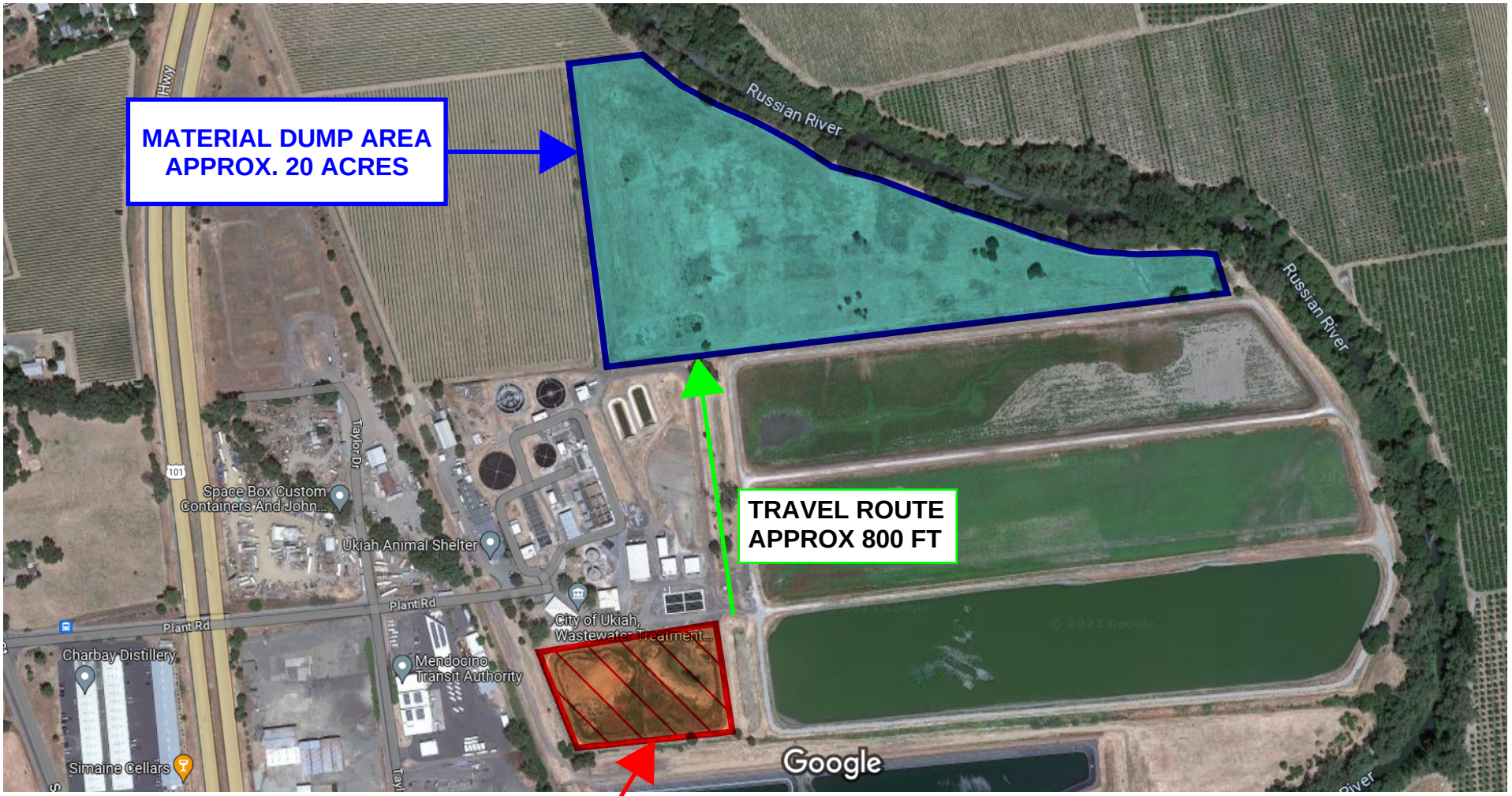
	Section 01756) - WWTP					
18	All other Work - WWTP	LS		1		
19	Temporary Excavation Support - WTP	LS		1		
20	Dewatering - WTP	LS		1		
21	Recycled Water Storage Tank (per Specification Section 13207)	LS		1		
22	Recycled Water Pump Station	LS		1		
23	WTP Excavations and Embankments	LS		1		
24	WTP Yard Piping	LS		1		
25	21” Sewer Replacement	LS		1		
26	Concrete Manholes	EA		3		
27	Electrical Work - WTP	LS		1		
27a	Recycled Water Pump Station Electrical Building	LS		1		
27b	Other Miscellaneous Electrical Work - WTP	LS		1		
28	Instrumentation and Controls Work - WTP	LS		1		
29	Startup and Commissioning (per Specification Section 01756) - WTP	LS		1		
30	All other Work - WTP	LS		1		
31	Temporary Excavation Support - Distribution System	LS		1		
32	Dewatering - Distribution System	LS		1		
33	18-inch diameter PVC pipeline in trench	LF		3781		
34	16-inch diameter PVC pipeline in trench	LF		20		
35	12-inch diameter PVC pipeline in trench	LF		3857		
36	10-inch diameter PVC pipeline in trench	LF		3145		
37	8-inch diameter PVC pipeline in trench	LF		827		
38	6-inch diameter PVC pipeline in trench	LF		2718		
39	4-inch diameter PVC pipeline in trench	LF		206		
40	12-inch diameter ductile iron pipeline	LF		150		

41a	Microtunnel Crossing (including pressure pipe and casing)	LS		1		
41b	Railroad Crossing (including pressure pipe and casing)	LS		1		
42	Pipeline Blow-off Assemblies	EA		12		
43	Pipeline Combination Air Valves	EA		20		
44	Pipeline Butterfly Valves	EA		6		
45	Pipeline Gate Valves	EA		10		
46	Meters and Service Lines	EA		13		
47	Pedestrian Bridge	LS		1		
48	Startup and Commissioning (per Specification Section 01756) - Distribution System	LS		1		
49	All other Work - Distribution System	LS		1		
50	Demobilization	LS		1		
TOTAL BASE BID ==>>			$			

ALTERNATE PRICE FOR LINE 12a OF BASE BID AS PER ADDENDUM 5

ITEM #	DESCRIPTION	UOM	QTY	UNIT PRICE	TOTAL
1	PAU Excavation to onsite location as per Addendum 5.	CY	40,000		

AD5



AD5

EXISTING POND TO BE EXCAVATED

We, the undersigned, acknowledge that the City Council has reserved the right to reject any or all bids and to determine which proposal is, in its opinion, the lowest responsive bid from a responsible bidder and that which it deems in the best interest of the City to accept. We, the undersigned, further agree, if this proposal shall be accepted, to sign the agreement and to furnish the required bonds with satisfactory surety, or sureties, within fifteen (15) calendar days after written notice that the contract is ready for signature; and, if the undersigned shall fail to contract, as aforesaid, it shall be understood that he or she has abandoned the contract and that, therefore, this proposal shall be null and void and the proposal guaranty accompanying this proposal, or the amount of said guaranty, shall be forfeited to and become the property of the City. Otherwise, the proposal guaranty accompanying this proposal shall be returned to the undersigned.

Witness our hands this day of _____, 20____.

Licensed in accordance with an act providing for the registration of California Contractors License No. _____, expiration date _____.

THE CONTRACTOR'S LICENSE NUMBER AND EXPIRATION DATE STATED HEREIN ARE MADE UNDER PENALTY OF PERJURY.

Department of Industrial Relations Public Works Contractor Registration Number:_____

Signature of bidder or bidders, with business name, address, phone number and fax number:

_____

_____

_____

_____

Notice: In the case of a corporation, give below the addresses of the principal office thereof and names and addresses of the President, Secretary, Treasurer.

_____

_____

_____

FAIR EMPLOYMENT PRACTICES CERTIFICATION

TO:_____

_____

The undersigned, in submitting a bid for performing the following work by Contract, hereby certifies that he or she has or will meet the standards of affirmative compliance with the Fair Employment Practices requirements of the Special Provisions contained herein.

RECYCLED WATER PROJECT – PHASE 4

_____
(Signature of Bidder)

Business Mailing Address:

_____

_____

_____

Business Location:

_____

_____

(The bidder shall execute the certification of this page prior to submitting his or her proposal.)

WORKER'S COMPENSATION CERTIFICATE

I am aware of the provisions of Section 3700 of the Labor Code which require every employer to be insured against liability for Worker's Compensation or undertake self-insurance in accordance with the provisions of that code and I will comply with such provisions before commencing the performance of the work of this contract.

Witness my hand this_____ day of _____, 2023

Signature of Bidder, with Business Address:

_____

_____

_____

_____

CERTIFICATION OF NONDISCRIMINATION IN EMPLOYMENT

The bidder represents that he or she has/has not, participated in a previous contract or subcontract subject to either the equal opportunity clause herein or the clause contained in Section 301 of Executive Order 10925; that he or she has/has not, filed all required compliance reports; and that representations indicating submission of required compliance prior to subcontract awards.

Signature and address of Bidder:

_____ Date_____

_____

_____

_____

(This certification shall be executed by the bidder in accordance with Section 60-1.6 of the Regulations of the President's Committee on Equal Employment Opportunity for implementing Executive Orders 10925 and 11114.)

LIST OF PROPOSED SUBCONTRACTORS

In compliance with the provisions of Sections 4100-4108 of the California Public Contract Code and any amendments thereof, each bidder shall set forth (a) the name and location of the place of business of each subcontractor who will perform work or labor or render service in or about the construction site or a subcontractor licensed by the State of California who, under subcontract to the prime contractor, specially fabricates and installs a portion of the work or improvement according to detailed drawings contained in the plans and specifications in an amount in excess of one-half of 1 percent of the total bid and (b) the California Contractor License Number for each subcontractor, and (c) the portion of the work to be done by each subcontractor.(See General Conditions Section 1-09.) Include with the name of each sub-contractor their Department of Industrial Relations Public Works Contractor Registration Number.

SUBCONTRACTOR NAME	SUBCONTRACTOR LICENSE NUMBER	SUBCONTRACTOR DIR REGISTRATION NUMBER	SUBCONTRACTOR BUSINESS ADDRESS	DESCRIPTION OF WORK

STATEMENT OF EXPERIENCE OF BIDDER

The bidder is required to state below what work of similar magnitude or character he or she has done and to give references that will enable the City Council to judge of his or her experience, skill and business standing and his or her ability to conduct work as completely and rapidly as required under the terms of the contract.

SIGNATURE(S) OF BIDDER

Accompanying this proposal is _____
(insert the words "cash ($)", "cashier's check" or "bidder's bond", as the case may be) in an amount equal to at least 10 percent of the bid.

The names of all persons interested in the foregoing proposal as principals are as follows:

IMPORTANT NOTICE: If bidder or other interested person is a corporation, provide the legal name of corporation and also the names of the president, secretary, treasurer and manager thereof. If a co-partnership, provide the true name of firm and also the names of all individual co-partners composing the firm. If bidder or other interested person is an individual, provide the first and last names in full.

_____

_____

_____

Licensed in accordance with an act providing for the registration of Contractors:

License No. _____, License Expiration Date _____.

Signature(s) of Bidder: _____

_____

_____

NOTE: If bidder is a corporation, the legal name of the corporation shall be set forth above together with the signature of the officer or officers authorized to sign contracts on behalf of the corporation; if bidder is a co-partnership, the true name of the firm shall be set forth above together with the signature of the partner or partners authorized to sign contracts in behalf of the co-partnership; and if bidder is an individual, his or her signature shall be placed above. If a member of a partnership, a Power of Attorney must be on file with the Department prior to opening bids or submitted with the bid; otherwise, the bid will be disregarded as irregular and unauthorized.

Business address: _____

_____

Place of residence: _____

_____

Dated: _____

CITY OF UKIAH
Mendocino County, California

BIDDER'S BOND

KNOW ALL MEN BY THESE PRESENTS,

That we, _____

_____, as PRINCIPAL and

_____

_____, as SURETY,

are held and firmly bound unto the City of Ukiah in the penal sum of 10 PERCENT OF THE TOTAL AMOUNT OF THE BID of the Principal above named, submitted by said Principal to the City of Ukiah, as the case may be, for the work described below, for the payment of which sum in lawful money of the United States, well and truly to be made, to the City Clerk to which said bid was submitted, we bind ourselves, our heirs, executors, administrators and successors jointly and severally, firmly by these presents. In no case shall the liability of the surety hereunder exceed the sum of $_____

THE CONDITION OF THIS OBLIGATION IS SUCH,

That whereas the Principal has submitted the above mentioned bid to the City of Ukiah, as aforesaid, for certain construction specifically described as follows, for which bids are to be opened at the Office of the City Clerk, Ukiah Civic Center, Ukiah, California, at 2:00p.m. on JUNE 20, 2023 for RECYCLED WATER PROJECT - PHASE 4.

NOW, THEREFORE, If the aforesaid Principal is awarded the contract and, within the time and manner required under the specifications, after the prescribed forms are presented to him or her for signatures, enters into a written contract, in the prescribed form, in accordance with the bid and files two bonds with the City of Ukiah, one to guarantee faithful performance and the other to guarantee payment for labor and materials, as required by law, then this obligation shall be null and void; otherwise, it shall be and remain in full force and virtue.

IN WITNESS WHEREOF, we have hereunto set our hands and seals on this _____ day of _____, A.D. 20_____.

_____(Seal)

_____(Seal)

_____(Seal)
Principal

_____(Seal)

_____(Seal)

_____(Seal)
Surety

Address: _____

_____

_____

AD2

CITY OF UKIAH
Mendocino County, California

BIDDER'S BOND

KNOW ALL MEN BY THESE PRESENTS,

That we, _____

_____, as PRINCIPAL and

_____

_____, as SURETY,

are held and firmly bound unto the City of Ukiah in the penal sum of 10 PERCENT OF THE TOTAL AMOUNT OF THE BID of the Principal above named, submitted by said Principal to the City of Ukiah, as the case may be, for the work described below, for the payment of which sum in lawful money of the United States, well and truly to be made, to the City Clerk to which said bid was submitted, we bind ourselves, our heirs, executors, administrators and successors jointly and severally, firmly by these presents. In no case shall the liability of the surety hereunder exceed the sum of $_____

THE CONDITION OF THIS OBLIGATION IS SUCH,

That whereas the Principal has submitted the above mentioned bid to the City of Ukiah, as aforesaid, for certain construction specifically described as follows, for which bids are to be opened at the Office of the City Clerk, Ukiah Civic Center, Ukiah, California, on JUNE 2JUNE 14[AD1], 2023 for RECYCLED WATER PROJECT - PHASE 4.

NOW, THEREFORE, If the aforesaid Principal is awarded the contract and, within the time and manner required under the specifications, after the prescribed forms are presented to him or her for signatures, enters into a written contract, in the prescribed form, in accordance with the bid and files two bonds with the City of Ukiah, one to guarantee faithful performance and the other to guarantee payment for labor and materials, as required by law, then this obligation shall be null and void; otherwise, it shall be and remain in full force and virtue.

IN WITNESS WHEREOF, we have hereunto set our hands and seals on this _____ day of _____, A.D. 20_____.

_____(Seal)

_____(Seal)

_____(Seal)
Principal

_____(Seal)

_____(Seal)

_____(Seal)
Surety

Address: _____

_____

_____[AD2]

NON-COLLUSION AFFIDAVIT

Note: Bidder shall execute the affidavit on this page prior to submitting his or her bid.

To City Council, City of Ukiah:

The undersigned in submitting a bid for performing RECYCLED WATER PROJECT – PHASE 4 by contract, being duly sworn, deposes and says:

> that he or she has not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding in connection with such contract.

_____

_____

_____
Signature(s) of Bidder

Business Address:_____

_____

_____

Place of Residence:_____

_____

_____

NOTARIZATION

Subscribed and sworn to before me this _____ day of _____, 20____.

_____

Notary Public in and for the County of_____, State of California.

My Commission Expires _____, 20 ____.

CITY OF UKIAH
Mendocino County, California

AGREEMENT

FOR

RECYCLED WATER PROJECT – PHASE 4

Specification No. 23-01

THIS AGREEMENT, made this _____ day of _____, 20____, by and between the City of Ukiah, Mendocino County, California, hereinafter called the City and _____ hereinafter called the Contractor,

WITNESSETH:

WHEREAS, the City has caused to be prepared in accordance with law, specifications, drawings and other contract documents for the work herein described and shown and has approved and adopted these contract documents, specifications and drawings and has caused to be published in the manner and for the time required by law a notice to bidders inviting sealed proposals for doing the work in accordance with the terms of this contract and

WHEREAS, the Contractor, in response to the notice to bidders, has submitted to the City a sealed proposal accompanied by a proposal guaranty in an amount of not less than 10 percent of the bid price for the construction of the proposed work in accordance with the terms of this contract and

WHEREAS, the City, in the manner prescribed by law, has publicly opened, examined and canvassed the proposals submitted and as a result has determined and declared the Contractor to be the lowest and best regular responsible bidder for the work and for the sums named in the proposal,

NOW, THEREFORE, THIS AGREEMENT WITNESSETH:

Article 1. Work to be Done and Contract Days Allowed.

That the Contractor shall provide all necessary machinery, tools, apparatus and other means of construction; shall furnish all materials, superintendence, overhead, expenses, all labor and expenses of whatever nature necessary for completion of the work in conformity with the Special Provisions and other contract documents hereto attached and according to such instructions as may be given by the Engineer. The Contractor shall complete the work within seven hundred and seven (707) calendar days. Contract days shall be counted starting with the 10th day following receipt of notice that the contract has been executed by the City. Contractor, at his or her option, may begin work prior to start of counting contract days, however, in no event shall the Contractor start work without giving notification to the Engineer at least 72 hours prior to the start of work, without obtaining an encroachment permit from the City, or without having submitted certificates of insurance that have been accepted and approved by the Engineer

Article II. Contract Prices.

That the City shall pay the Contractor the prices stated in the proposal submitted by the Contractor, for complete performance of the contract by the Contractor. The Contractor hereby agrees to accept the prices as full compensation for all material and appliances necessary to the work, for all labor and use of tools and other implements necessary to execute the work contemplated in this contract; for all loss or damage arising out of the nature of the work or from the action of the elements, or from any unforeseen obstructions or difficulties which may be encountered in the prosecution of the work; for all risks of every description connected therewith; for all expenses of the work, as herein specified; for all liability and other insurance, for all overhead and other expenses incident to the work; all according to the Contract Drawings, the Special Provisions, the Details, the instructions and the requirements of the City.

Article III. Labor Discrimination.

Attention is directed to Section 1735 of the Labor Code, which reads as follows:

> "No discrimination shall be made in the employment of persons upon public works because of the race, color, national origin or ancestry, or religion of such persons and every contractor for public works violating this section is subject to all the penalties imposed for a violation of this chapter."

In connection with the performance of work under this contract, the Contractor agrees as follows:

(a) The Contractor will not willfully discriminate against any employee or an applicant for employment because of race, color, religion, ancestry, or national origin. The Contractor will take affirmative action to ensure that applicants are employed and that employees are treated during employment without regard to their race, color, religion, ancestry, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by the awarding authority setting forth the provisions of this Fair Employment Practice section.

(b) The Contractor will send to each labor union or representative of workers with which he or she has a collective bargaining agreement or other contract or understanding, a notice, to be provided by the awarding authority, advising the said labor union or worker's representative of the Contractor's commitments under this section, to employees and applicants for employment.

(c) The Contractor will permit access to his or her records of employment, employment advertisements, application forms and other pertinent data and records by the Fair Employment Practices Commission, City of Ukiah or any other appropriate agency of the State of California designated by the awarding authority, for the purposes of investigation to ascertain compliance with the Fair Employment Practices section of this contract.

(d) A finding of willful violation of the Fair Employment Practices section of this Contract or of the Fair Employment Practices Act shall be regarded by the awarding authority as a basis for determining the Contractor to be not a "responsible bidder" as to future contracts for which such Contractor may submit bids, for revoking the Contractor's pre-qualification rating, if any and for refusing to establish, reestablish or renew a pre-qualification rating for the Contractor.

The City of Ukiah shall deem a finding of willful receipt of written notice from the Fair Employment Practices Act to have occurred upon that it has investigated and determined that the Contractor has violated the Fair Employment Practices Act and has issued an order under Labor Code Section 1426 or obtained an injunction under Labor Code Section 1429.

Upon receipt of such written notice from the Fair Employment Practices Commission, the City shall notify the Contractor that unless he or she demonstrates to the satisfaction of the awarding

authority within a stated period that the violation has been corrected, his or her pre-qualification rating will be revoked at the expiration of such period.

(e) The Contractor agrees that should the City determine that the Contractor has not complied with the Fair Employment Practices section of this Contract, then pursuant to Labor Code Section 1735 and 1775 the Contractor shall, as a penalty to the City, forfeit for each calendar day or portion thereof, for each person who was denied employment as a result of such non-compliance, the penalties provided in the Labor Code for violation of prevailing wage rates. Such monies may be recovered from the Contractor. The City may deduct any such damages from any monies due the Contractor.

(f) Nothing contained in this Fair Employment Practices section shall be construed in any manner of fashion so as to prevent the City or the State of California from pursuing any other remedies that may be available at law.

(g) Prior to awarding the Contract, the Contractor shall certify to the awarding authority that he or she has or will meet the following standards for affirmative compliance, which shall be evaluated in each case by the awarding authority:

(1) The Contractor shall provide evidence, as required by the City that he or she has notified all supervisors, foremen and other personnel officers in writing of the content of the anti-discrimination clause and their responsibilities under it.

(2) The Contractor shall provide evidence, as required by the City, that he or she has notified all sources of employees' referrals (including unions, employment agencies, advertisements, Department of Employment) of the content of the anti-discrimination clause.

(3) The Contractor shall file a basic compliance report, as required by the City. Willfully false statements made in such reports shall be punishable as provided by law. The compliance report shall also spell out the sources of the work force and who has the responsibility for determining whom to hire, or whether or not to hire.

(4) Personally, or through his or her representatives, the Contractor shall, through negotiations with the unions with whom he or she has agreements, attempt to develop an agreement which will:

a. Spell out responsibilities for nondiscrimination in hiring, referral, upgrading and training.

b. Otherwise implement an affirmative anti-discrimination program in terms of the unions' specific areas of skill and geography to the end that qualified minority workers will be available and given and equal opportunity for employment.

(5) The Contractor shall notify the City of opposition to the anti-discrimination clause by individuals, firms or organizations during the period of its pre-qualification.

(h) The Contractor will include the provisions of the foregoing paragraphs 1 through 5 in every first tier subcontract so that such provisions will be binding upon each such subcontractor.

(i) The "Fair Employment Practices Certification" must be completed and signed prior to the time of submitting the bid.

Article IV. Parts of the Contract.

That the complete contract consists of the following documents, all of which shall be considered a part of this agreement.

1. Notice to Bidders
2. Wage Rates
3. General Conditions
4. Technical Specifications
5. Proposal
6. Fair Employment Practices Certification
7. Agreement
8. Performance Bond
9. Payment Bond
10. Special Provisions
11. Contract Drawings and Construction Details
12. Standard Drawings
13. Indemnification Agreement
14. Addenda (numbers **[ ]** to **[ ]**, inclusive)
15. Exhibits to this Agreement:
    a. List of Proposed Subcontractors
    b. Non-Collusion Affidavit
    c. Bidding Schedule
    d. Statement of Experience of Bidder
    e. Signatures of Bidder
    f. Worker's Compensation Certificate
    g. Certification of Nondiscrimination in Employment
    h. List of Equipment Manufacturers
    i. Escrow Agreement for Security Deposits in Lieu of Retention
16. Notice to Proceed
17. Change Orders
18. Field Orders
19. Work Change Directives

IN WITNESS WHEREOF, this contract being executed in duplicate and the parties having caused their names to be signed by authority of their duly authorized office this _____ day of _____, 20____.

CITY OF UKIAH, MENDOCINO COUNTY, CALIFORNIA

By: _____
CITY MANAGER, CITY OF UKIAH

Attest: _____
CITY CLERK, CITY OF UKIAH

By: _____
CONTRACTOR

Attest: _____

Title: _____

The foregoing contract is approved as to form and legality this _____ day of _____, 20 ____.

_____
CITY ATTORNEY, CITY OF UKIAH

INDEMNIFICATION AGREEMENT

This Indemnification Agreement is made and entered in Ukiah, California, on _____, 20____, by and between the City of Ukiah (Ukiah) and _____ (Contractor).

Contractor is

_____

_____ for Ukiah.

As a condition of issuing the work order, attached hereto, Ukiah requires assurance that Contractor will protect Ukiah from damage or damage claims which arise from its performance of the work.

Accordingly, Contractor agrees as follows:

1. **Indemnification**. Contractor shall indemnify and hold harmless Ukiah and its officers, agents, and employees from and against any claim, loss, or damage, including the legal and other costs of defending against any claim of damage or loss which arises out of the Contractor's negligent or wrongful performance under the work order attached hereto, except for claims, losses, or damages resulting from the sole and exclusive negligence or other wrongful conduct of Ukiah or its officers, agents and employees.

CONTRACTOR

BY: _____

TITLE: _____

CITY OF UKIAH
Mendocino County, California

PERFORMANCE BOND

BOND No._____

KNOW ALL PERSONS BY THESE PREESNTS:

THAT WHEREAS, the City of Ukiah, organized and operating under the laws of the State of California, (hereinafter referred to as the "City") has awarded to _____, (hereinafter referred to as the "Contractor") an agreement for Contract No. _____ (hereinafter referred to as the "Project").

WHEREAS, the work to be performed by the Contractor is more particularly set forth in the Contract for the Project dated _____, (hereinafter referred to, together with all attachments and exhibits thereto, as "Contract Documents"), the terms and conditions of which are expressly incorporated herein by reference; and

WHEREAS, the Contractor is required by the Contract Documents to perform the terms thereof and to furnish a bond for the faithful performance of said Contract Documents.

NOW, THEREFORE, we, _____, the undersigned Contractor and _____, as Surety, a corporation organized and duly authorized to transact business under the laws of the State of California, are held firmly bound until the City in the sum of _____ ($_____), for which amount well and truly to be made, we bind ourselves, our heirs ,executors and administrators, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that, if the Contractor, his or its heirs, executors, administrators, successors or assigns, shall in all things stand to and abide by, and well and truly keep and perform the covenants, conditions and agreements in the Contract Documents and any alteration thereof made as therein provided, on its part, to be kept and performed at the time and in the manner therein specified, and in all respects according to their intent and meaning; and shall faithfully fulfill all obligations; and shall indemnify and save harmless the City, its officials, officers, employees, and authorized volunteers, as stipulated in said Contract Documents, then this obligation shall become null and void; otherwise it shall be and remain in full force and effect.

As part of the obligation secured hereby and in addition to the face amount specified therefore, there shall be included costs and reasonable expenses and fees including reasonable attorneys' fees, incurred by the City in enforcing such obligation.

As a condition precedent to the satisfactory completion of the Contract Documents, unless otherwise provided for in the Contract Documents, the above obligation shall hold good for a period of one (1) year after the acceptance of the work by the City, during which time if Contractor shall fail to make full, complete, and satisfactory repair and replacements and totally protect the City from loss or damage resulting from or caused by defective materials or faulty workmanship. The obligations of Surety hereunder shall continue so long as any obligation of Contractor remains. Nothing herein shall limit the City's rights or the Contractor or Surety's obligations under the Contract Documents, law or equity, including, but not limited to, California Code of Civil Procedure Section 337.15.

Whenever Contractor shall be, and is declared by the City to be, in default under the Contract Documents, the Surety shall remedy the default pursuant to the Contract Documents, or shall promptly, at the City's option:

i. Take over and complete the Project in accordance with all terms and conditions in the Contract Documents; or

ii. Obtain a bid or bids for completing the Project in accordance with all terms and conditions in the Contract Documents and upon determination by Surety of the lowest responsive and responsible bidder, arrange for a contract between such bidder, the Surety and the City, and make available as work progresses sufficient funds to pay the cost of completion of the Project, less the balance of the contract price, including other costs and damages for which Surety may be liable. The term "balance of the contract price" as used in this paragraph shall mean the total amount payable to Contractor by the City under the Contract and any modification thereto, less any amount previously paid by the City to the Contractor and any other set offs pursuant to the Contract Documents.

iii. Permit the City to complete the Project in any manner consistent with California law and make available as work progresses sufficient funds to pay the cost of completion of the Project, less the balance of the contract price, including other costs and damages for which Surety may be liable. The term "balance of the contract price" as used in this paragraph shall mean the total amount payable to Contractor by the City under the Contract and any modification thereto, less any amount previously paid by the City to the Contractor and any other set offs by the City pursuant to the Contract Documents.

Surety expressly agrees that the City may reject any contractor or subcontractor which may be proposed by Surety in fulfillment of its obligations in the event of default by the Contractor.

Surety shall not utilize Contractor in completing the Project nor shall Surety accept a bid from Contractor for completion of the Project if the City, when declaring the Contractor in default, notifies Surety of the City's objection to Contractor's further participation in the completion of the Project.

The Surety, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of the Contract Documents or to the Project to be performed thereunder shall in any way affect its obligation on this bond, and it does hereby waive notice of any such change, extension of time, alteration or addition to the terms of the Contract Documents or to the Project.

[REMAINDER OF PAGE LEFT INTENTIONALLY BLANK]

IN WITNESS WHEREOF, we have hereunto set our hands and seals this ____ day of _____, 2022.

(Corporate Seal)

_____
Contractor/Principal

By_____

Title_____

(Corporate Seal)

_____
Surety

By_____
Attorney-in-Fact

(Attach Attorney-in Fact Certificate)

Title_____

The rate of premium on this bond is _____ per thousand. The total amount of premium charges is $_____.

(The above must be filled in by corporate attorney.)

THIS IS A REQUIRED FORM.

Any claims under this bond may be addressed to:

(Name and Address of Surety) _____

_____

_____

(Name and Address of Agent or _____

Representative for service of process in _____

California, if different from above) _____

(Telephone number of Surety and Agent
or Representative for service of process in California) _____

CITY OF UKIAH
Mendocino County, California

PAYMENT BOND

BOND No. _____

KNOW ALL PERSONS BY THESE PRESENTS:

WHEREAS, the City of Ukiah ("City") has awarded to _____ ("Contractor/Principal") a contract (City Agreement No. _____, dated _____, _____, referred to as the "Agreement") for the work described as _____. The Agreement is incorporated by this reference into this Payment Bond ("Bond"); and

WHEREAS, Contractor/Principal is required to furnish a bond in connection with the Agreement and pursuant to California Civil Code section 9550;

NOW, THEREFORE, we _____, the undersigned Contractor/Principal, and _____ ("Surety"), a corporation organized and existing under the laws of the State of _____, and duly authorized to transact business under the laws of the State of California, as Surety, are held firmly bound until the City, and to any and all persons, companies, or corporations entitled by law to file stop payment notices under California Civil Code Section 9100, or any person, company, or corporation entitled to make a claim on this bond, in the sum of $_____, for which payment will and truly be made, we bind ourselves, our heirs, executors and administrators, successors and assigns, jointly and severally, firmly by these presents.

THE CONDITION OF THIS OBLIGATION IS SUCH that if Contractor/Principal, its heirs, executors, administrators, successors, or assigns, or subcontractor, shall fail to pay any person or persons named in Civil Code section 9100; or fail to pay for any materials, provisions, or other supplies, used in, upon, for , or about the performance of the work contracted to be done, or for any work or labor thereon of any kind, or for amounts due under the Unemployment Insurance Code, with respect to work or labor thereon of any kind; or shall fail to deduct, withhold, and pay over to the Employment Development Department, any amounts required to be deducted, withheld, and paid over by Unemployment Insurance Code Section 13020 with respect to work and labor thereon of any kind, then Surety will pay for the same, in an amount not exceeding the amount herein above set forth, and in the event suit is brought upon this bond, also will pay such reasonable attorneys' fees as shall be fixed by the court, awarded and taxed as provided in California Civil Code Section 9550, et seq.

It is further stipulated and agreed that the Surety of this bond shall not be exonerated or released from the obligation of the bond by any change, extension of time for performance, addition, alteration or modification in, to, or of any contract, plans, or specifications, or agreement pertaining or relating to any scheme or work of improvement herein above described; or pertaining or relating to the furnishing of labor, materials, or equipment therefor; nor by any change or modification of any terms of payment or extension of time for payment pertaining or relating to any scheme or work of improvement herein above described; nor by any rescissions or attempted rescission of the contract, agreement or bond; nor by any conditions precedent or subsequent in the bond attempting to limit the right of recovery of claimants otherwise entitled to recover under any such contract or agreement or under the bond; nor by any fraud practiced by any person other than the claimant seeking to recover on the bond; and that this bond be construed most strongly against the Surety and in favor of all persons for whose benefit such bond is give; and under no circumstances shall the Surety be released from liability to those for whose benefit such bond has been given, by reason of any breach of contract between the Owner and Contractor/Principal or on the part of any oblige named in such bond; that the sole condition of recovery shall be that the claimant is a person described in California Civil Code section 9100, and who has not been paid the full amount of his or her claim; and that the Surety does hereby waive notice of any such change, extension of time, addition, alteration or modification herein mentioned, including but not limited to the provisions of section 2819 and 2845 of the California Civil Code.

Any notice to Surety may be given in the manner specified in the Agreement and delivered or transmitted to Surety as follows:

Attn:_____

Address:_____

City/State/Zip:_____

Phone:_____

Fax:_____

Email:_____

IN WITNESS WHEREO, two identical counterparts of this Bond, each of which shall for all purposes be deemed an original thereof, have been duly executed by Contractor/Principal and Surety above named, on the __ day of _____, 202__.

_____ (SEAL)
Contractor/Principal

By_____
Contractor's Representative

_____
Contractor/Principal's Address

_____
City,State,Zip

_____(SEAL)
Surety

By_____
Surety's Representative

_____
Surety's Address

_____
City,State,Zip

_____
Telephone Number

NOTE: Signatures of those executing for Surety must be properly acknowledged, the bond must be accompanied by a properly acknowledged Power of Attorney from the Surety authorizing its agent to bind it to this bond. A copy of such Power of Attorney must be in file with the City.

DIRECTIONS FOR PREPARATION OF PERFORMANCE AND MATERIAL AND LABOR BOND

1. Individual sureties, partnerships, or corporations not in the surety business will not be acceptable.

2. The name of the Principal shall be shown exactly as it appears in the Contract.

3. The penal sum shall not be less than required by the Specifications.

4. If the Principals are partners or joint venturers, each member shall execute the bond as an individual and state his place of residence.

5. If the Principal is a corporation, the bond shall be executed under its corporate seal.
If the corporation has no corporate seal, it shall so state and affix a scroll or adhesive seal following the corporate name.

6. The official character and authority of the person(s) executing the bond for the Principal, if a corporation, shall be certified by the Secretary or Assistant Secretary thereof under the corporate seal, or copies attached to such records of the corporation as will evidence the official character and authority of the officer signing, duly certified by the Secretary or Assistant Secretary, under the corporate seal, to be true copies.

7. The current power-of-attorney of the person signing for the surety company must be attached to the bond.

8. The date of the bond must not be prior to the date of the Contract.

9. The following information must be placed on the bond by the surety company:

   a. The rate of premium in dollars per thousand; and

   b. The total dollar amount of premium charged.

10. The signature of a witness shall appear in the appropriate place attending to the signature of each party of the bond.

11. Type or print the name underneath each signature appearing on the bond.

12. An executed copy of the bond must be attached to each copy of the Contract (original counterpart) intended for signing.

CITY OF UKIAH
Mendocino County, California

DEFECTIVE MATERIAL AND WORKMANSHIP (MAINTENANCE) BOND

KNOW ALL MEN BY THESE PRESENTS,

That we, _____

_____, as **PRINCIPAL**

and_____

_____, as **SURETY**,

are held and firmly bound unto the **City of Ukiah** as Obligee, in the penal sum of

_____

_____($_____),
(5 PERCENT OF THE FINAL CONTRACT AMOUNT)

to which payment well and truly to be made, we do bind ourselves, our and each of our heirs, executors, administrators' successors and assigns jointly and severally, firmly by these presents.

WHEREAS, the said Principal entered into a Contract with the City of Ukiah
dated_____
for _____
_____

WHEREAS, said Contract has been completed, and was approved on the _____ day of _____, _____,

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION IS SUCH, that if the Principal shall guarantee that the work will be free of any defective materials or workmanship which become apparent during the period of one (1) year following completion of the Contract, then this obligation shall be void, otherwise to remain in full force and effect, provided however, any additional warranty or guarantee whether expressed or implied is extended by the Principal or Manufacturer only, and the surety assumes no liability for such a guarantee.

Signed, sealed, and dated this _____ day of _____, 20_____.

_____(Seal)

BY:_____(Seal)

_____(Seal)
Principal

_____(Seal)

BY:_____(Seal)

_____(Seal)
Surety

[AD2] Addendum No. 2
[AD1] Addendum No. 1
[AD5] Addendum No. 5
[AD4] Addendum No. 4
[AD3] Addendum No. 3

DOCUMENT 00436

LIST OF EQUIPMENT MANUFACTURERS

ARTICLE 1 — SELECTED MANUFACTURER/SUPPLIER

1.01 Bidder shall edit Table 1. List of Selected Equipment Manufacturers by circling the manufacturer or supplier that will furnish the respective item of equipment for the Work.

1.02 If Bidder fails to circle a manufacturer or supplier for each piece of equipment identified, the Bidder shall provide the first listed ("A") manufacturer or supplier for its Bid at no increase in the Contract amount or may be cause for rejection of the Bid.

1.03 Acceptance of a manufacturer or supplier listed by the Bidder shall not constitute a waiver of any provision of the Contract Documents.

Table 1. List of Selected Equipment Manufacturers:

Section	Equipment	Manufacturer/Supplier
11242	Liquid Chemical Diaphragm-Type Metering Pumps	A. Prominent Fluid Controls, Inc.
11294B	Heavy-Duty Fabricated Stainless Steel Slide Gates	A. A. H. Fontaine, Series 20. B. Whipps, Inc., Series 900. C. Waterman Industries, SS-250. D. Rodney Hunt, Series A-113 or A-114. E. Hydro Gate, Model HG-561. RW Gate, Model RW1000-S.
11312D	Vertical Turbine Short Setting Centrifugal Pumps	A. Flowserve. B. Sulzer/Johnson Pumps. C. Peerless Pump. D. Weir/Floway. E. National Pump Co. F. Cascade Pump Company.
11312O	Horizontal ANSI Centrifugal Pumps	A. Flowserve Co. B. ITT, Ind.
11313E	Horizontal Self-Priming Sample Centrifugal Pumps	A. Gorman Rupp Company, AMT. B. Barnes Pumps.
11376A	Rotary-Lobe Blowers	A. Kaeser Compressors, Com-paK Series. B. Aerzen. C. FPZ Inc.

Section	Equipment	Manufacturer/Supplier
13447	Electric Actuators	A. Rotork Controls Inc. B. Limitorque Corp. C. Auma.
16262	Variable Frequency Drives 0.50 - 50 Horsepower	A. Eaton. B. Allen-Bradley. C. Siemens-Robicon. D. Schneider Electric. E. GE by ABB. F. ABB.

BIDDER

_____

(Signature)

_____

(Date)

END OF DOCUMENT

DOCUMENT 00602

ESCROW AGREEMENT FOR SECURITY DEPOSITS IN LIEU OF RETENTION

This escrow agreement is made and entered into by and between _____ whose address is _____ hereinafter called "Owner," _____ whose address is _____ hereinafter called "Contractor," and _____ whose address is _____ hereinafter called "Escrow Agent."

For the consideration hereinafter set forth, Owner, Contractor, and Escrow Agent agree as follows:

1. In accordance with California Public Contract Code, Section 22300, the Contractor has the option to deposit securities with Escrow Agent as a substitute for retention earnings required to be withheld by Owner pursuant to the construction contract entered into between Owner and Contractor for _____ in the amount of _____ dated _____ (hereafter referred to as the "contract"). Alternatively, on written request of Contractor, Owner shall make payments of the retention earnings directly to Escrow Agent. When Contractor deposits the securities as a substitute for the contract earnings, Escrow Agent shall notify Owner within 10 days of the deposit. The market value of the securities at the time of the substitution shall be at least equal to the cash amount then required to be withheld as retention under the terms of the contract between Owner and Contractor. Securities shall be held in the name of the _____ and shall designate Contractor as the beneficial owner.
2. Owner shall make progress payments to Contractor for those funds which otherwise would be withheld from progress payments pursuant to the contract provision, provided that Escrow Agent holds securities in the form and amount specified above.
3. When Owner makes payment of retentions earned directly to Escrow Agent, Escrow Agent shall hold them for the benefit of Contractor until such time as the escrow created under this contract is terminated. Contractor may direct the investment of the payments into securities. All terms and conditions of this Agreement and the rights and responsibilities of the parties shall be equally applicable and binding when Owner pays Escrow Agent directly.
4. Contractor shall be responsible for paying all fees for the expenses incurred by Escrow Agent in administering the escrow account. These expenses and payment terms shall be determined by the Contractor and Escrow Agent.
5. The interest earned on the securities or the money market accounts held in escrow and all interest earned on the interest shall be for the sole account of Contractor and shall be subject to withdrawal by Contractor at any time and from time to time without notice to Owner.
6. Contractor shall have the right to withdraw all or any part of the principal in the escrow account only by written notice to the Escrow Agent accompanied by written authorization from Owner to the Escrow Agent that Owner consents to the withdrawal of the amount sought to be withdrawn by Contractor.
7. Owner shall have a right to draw upon the securities in the event of default by Contractor. Upon 7 days' written notice to the Escrow Agent from Owner of the

default, Escrow Agent shall immediately convert the securities to cash and shall distribute the cash as instructed by Owner.

8. Upon receipt of written notification from Owner certifying that the contract is final and complete, and that Contractor has complied with all requirements and procedures applicable to the contract, Escrow Agent shall release to Contractor all securities and interest on deposit less escrow fees and charges of the escrow account. The escrow shall be closed immediately upon disbursement of all moneys and securities on deposit and payments of fees and charges.
9. Escrow Agent shall rely on the written notifications from Owner and Contractor pursuant to Sections above, inclusive, of this Agreement and Owner and Contractor shall hold the Escrow Agent harmless from the Escrow Agent's release, conversion, and disbursement of the securities and interest as set forth above.
10. The names of the persons who are authorized to give written notice or to receive written notice on behalf of Owner and on behalf of Contractor in connection with the foregoing, and exemplars of their respective signatures are as follows:

On behalf of Owner:	On behalf of Contractor:
Title	Title
Name	Name
Signature	Signature
Address	Address

On behalf of the Escrow Agent:

Title

Name

Signature

Address

At the time the escrow account is opened, Owner and Contractor shall deliver to the Escrow Agent a fully executed counterpart of this Agreement.

END OF DOCUMENT

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DOCUMENT 00625

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner:	Owner's Project No.:
Engineer:	Engineer's Project No.:
	Contractor's Project No.:
Contractor:	
Project:	
Contract Name:	

This ☐ Preliminary ☐ Final Certificate of Substantial Completion applies to:

☐ All Work ☐ The following specified portions of the Work:

[Describe the portion of the work for which Certificate of Substantial Completion is issued]

Date of Substantial Completion: **[Enter date, as determined by Engineer]**

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see the General Conditions.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work must be as provided in the Contract, except as amended as follows:

Amendments to Owner's Responsibilities: ☐ None ☐ As follows:

[List amendments to Owner's Responsibilities]

Amendments to Contractor's Responsibilities: ☐ None ☐ As follows:

[List amendments to Contractor's Responsibilities]

The following documents are attached to and made a part of this Certificate:

[List attachments such as punch list; other documents]

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents.

Engineer

By *(signature)*: _____

Name *(printed)*: _____

Title: _____

END OF DOCUMENT

DOCUMENT 00632

REQUEST FOR INFORMATION OR INTERPRETATION (RFI)

Owner:	Click here to enter text.	**Date:**	XX/XX/XXXX
Contractor:	Click here to enter text.	**Project No.:**	00000.00
Project Name:	Click here to enter text.	**RFI No.:**	000
RFI Title:	Click here to enter text.	**Spec/Dwg. Reference:**	00000

Information or Interpretation and Reason Requested			
Click here to enter text.			
Authored By:	Click here to enter text.	**Date Submitted:**	XX/XX/XXXX

Response to Request:			
Click here to enter text.			
In the event, Contractor believes the RFI response does or will cause a change to the requirements of the Contract, Contractor shall immediately give written notice stating that Contractor considers the response to be a Change Order.			
Firm Name:	Click here to enter text.	**Date Returned:**	XX/XX/XXXX
Signature:		**Printed Name:**	

END OF DOCUMENT

SECTION 00820

FEDERAL AND STATE FUNDING REQUIREMENTS

ARTICLE 1 — GENERAL

1.01 This section comprises the construction contract provisions required by funding programs.

A. The provisions, regulations, code references, certifications and other items included apply to this Project.

ARTICLE 2 — SRF REQUIREMENTS

2.01 Anticipated funding sources for this project includes the state of California's Water Recycling Funding Program (WRFP), through the Clean Water State Revolving Fund (SRF). This section summarizes the SRF program requirements the contractor is required to comply with. If there are conflicts between this section and other provisions or sections, the requirements stated in this section shall take precedence over the other provisions, except where similar provisions are more stringent, in which case the more stringent conditions will be implemented.

2.02 Bids must include a signed copy of Attachment A - Certification of Compliance with WRFP/SRF Conditions.

2.03 The loan or grant recipient is the City of Ukiah and will be referenced as the Owner.

2.04 Project records

A. Contractor and Subcontractors shall maintain separate books, records and other materials relative to Project. Contractor shall submit a copy of all such records to the Owner as a condition for final payment. Contractor and Subcontractors shall make such books, records, and other material available at all reasonable times (at a minimum during normal business hours) to inspection, copying, and audit by the Owner, the United States Environmental Protection Agency (USEPA), State Water Resources Control Board (SWRCB), or any authorized representatives of the aforementioned. Contractor and Subcontractors shall allow interviews during normal business hours of any employees who might reasonably have information related to such records. Contractor shall include a similar duty regarding audit, interviews, and records retention in all subcontracts related to the Contract. Obligations under this provision shall survive the expiration or termination of the Contract.

ARTICLE 3 — DEBARMENT AND SUSPENSION

3.01 Contractor certifies that it will not knowingly enter into a contract with anyone who is ineligible under the 2 CFR part 180 and part 1532 (per Executive Order 12549, 51 FR 6370, February 21, 1986) or who is prohibited under Section 306 of the Clean Air Act or Section 508 of the Clean Water Act to participate in the Project. Suspension and debarment information can be accessed at http://www.sam.gov. Contractor represents

and warrants that it has or will include a term or conditions requiring compliance with this provision in all of its subcontracts under this Agreement.

3.02 The contract is a covered transaction for purposes of 2 CFR Part 180 and 2 CFR Part 3000. As such, the Contractor is required to verify that none of the Contractors, its principals (defined at 2 CFR § 180.995), or its affiliates (defined at 2 CFR § 180.905) are excluded (defined at 2 CFR § 180.940) or disqualified (defined at 2 CFR § 180.935).

3.03 The Contractor must comply with 2 CFR Part 180, Subpart C and 2 CFR Part 3000, Subpart C and must include a requirement to comply with these regulations in any subcontract.

3.04 If it is later determined that the Contractor did not comply with 2 CFR Part 180, Subpart C and 2 CFR Part 3000, Subpart C, in addition to remedies available to the Owner, the Federal Government may pursue available remedies, including, but not limited to, suspension and/or debarment.

3.05 The bidder or proposer agrees to comply with the requirements of 2 CFR Part 180, Subpart C and 2 CFR Part 3000, Subpart C while this offer is valid and throughout the period of any contract that may arise from this offer. The bidder or proposer further agrees to include a provision requiring such compliance in its subcontracts.

3.06 Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion - Lower Tier Covered Transactions

A. The Contractor certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared negligible, or voluntarily excluded from participation in this transaction by any federal department or agency.

B. Where the Contractor is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to the bid.

C. The Contractor also certifies that it and its principals:
   1. Have not within a three-year period preceding this bid been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (federal, state or local) transaction or contract under a public transaction; violation of federal or state anti-trust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
   2. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (federal, state or local) with commission of any of the offenses enumerated this certification; and
   3. Have not within a three-year period preceding this bid had one or more public transactions (federal, state or local) terminated for cause or default. Where the Contractor is unable to certify to any of the above, such owner shall attach an explanation to the bid;
   4. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the federal

government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment;

D. The Contractor shall incorporate the foregoing requirements in all subcontracts.

ARTICLE 4 — PREVAILING WAGE REQUIREMENTS

4.01 Contractor shall comply with State of California Prevailing wage determinations.

A. Contractor agrees to be bound by all applicable provisions of State Labor Code regarding prevailing wages. California Division of Industrial Relations (DIR) requirements may be found at: http://www.dir.ca.gov/lcp.asp. For more information, please refer to DIR's Public Works Manual at: http://www.dir.ca.gov/dlse/PWManualCombined.pdf.

B. This contract is subject to enforcement by DIR with regard, specifically but not limited to, the following:
   1. Pursuant to Section 1773 of the Labor Code, the general prevailing wage rates in the county, or counties, in which the work is to be done have been determined by the DIR. These wages are available from the DIR website at https://www.dir.ca.gov. The effective general prevailing wage rates, which have been determined and are on file with the DIR are referenced but not printed in the Contract Documents.
   2. Pursuant to Section 1725.5 of the Labor Code, no contractor or subcontractor may be listed on a bid proposal, or awarded a contract, for public work on a public works project unless registered with the DIR.

ARTICLE 5 — RUSSIAN SANCTIONS

5.01 Contractor is required to comply with the economic sanctions imposed in response to Russia's actions in Ukraine, including with respect to, but not limited to, the federal executive orders identified in California Executive Order N-6-22, located at https://www.gov.ca.gov/wp-content/uploads/2022/03/3.4.22-Russia-Ukraine-Executive-Order.pdf and the sanctions identified on the United States Department of the Treasury website (https://home.treasury.gov/policy-issues/financial-sanctions/sanctions-programs-and-country-information/ukraine-russia-related-sanctions).

5.02 Contractor is required to comply with all applicable reporting requirements regarding compliance with the economic sanctions, including, but not limited to, those reporting requirements set forth in California Executive Order N-6-22 for all Recipients with one or more agreements with the State of California with an aggregated value of Five Million Dollars ($5,000,000) or more, including:

A. Desisting from making any new investments or engaging in financial transactions with Russian institutions or companies that are headquartered or have their principal place of business in Russia;

B. Not transferring technology to Russia or companies that are headquartered or have their principal place of business in Russia; and

C. Direct support to the government and people of Ukraine.

ARTICLE 6 — PROJECT RECORDS

6.01 Contractor and Subcontractors shall maintain separate books, records and other materials relative to Project. Contractor shall submit a copy of all such records to the Owner as a condition for final payment. Contractor and Subcontractors shall make such books, records, and other material available at all reasonable times (at a minimum during normal business hours) to inspection, copying, and audit by the Owner, the United States Environmental Protection Agency (USEPA), or any authorized representatives of the aforementioned. Contractor and Subcontractors shall allow interviews during normal business hours of any employees who might reasonably have information related to such records. Contractor shall include a similar duty regarding audit, interviews, and records retention in all subcontracts related to the Contract. Obligations under this provision shall survive the expiration or termination of the Contract.

ARTICLE 7 — DRUG FREE WORKPLACE REQUIREMENTS

7.01 Comply with 55 FR 21690, 21694, MAY 25, 1990.

7.02 Workplaces under grants, for contractors other than individuals, need not be identified on the certification. If known, they may be identified in the grant application. If the contractor does not identify the workplaces at the time of application, or upon award, if there is no application, the contractor must keep the identity of the workplace(s) on file in its office and make the information available for federal inspection. Failure to identify all known workplaces constitutes a violation of the contractor's drug-free workplace requirements.

7.03 Workplace identifications must include the actual address of buildings (or parts of buildings) or other sites where work under the grant takes place. Categorical descriptions may be used (e.g., all vehicles of a mass transit authority or state highway department while in operation, state employees in each local unemployment office, performers in concert halls or radio studios).

7.04 If the workplace identified to the board changes during the performance of the grant, the contractor shall inform the board of the change(s), if it previously identified the workplaces in question.

7.05 Definitions of terms in the non-procurement suspension and debarment common rule and drug-free workplace common rule apply to this certification. Contractors' attention is called, in particular, to the following definitions from these rules: controlled substance means a controlled substance in schedules i through v of the controlled substances act (21 U.S.C. 812) and as further defined by regulation (21 CFR 1308.11 through 1308.15);conviction means a finding of guilt (including a plea of nolo contendere) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the federal or state criminal drug statutes; criminal drug statute means a federal or non-federal criminal statute involving the manufacture, distribution, dispensing, use, or possession of any controlled substance; employee means the employee of a contractor directly engaged in the performance of work under a grant, including: (i) all direct charge employees; (ii) all indirect charge employees unless their impact or involvement is insignificant to the performance of the grant; and, (iii) temporary personnel and consultants who are directly engaged in the performance of work under the grant and who are on the contractor's payroll. This definition does not include

workers not on the payroll of the contractor (e.g., volunteers, even if used to meet a matching requirement; consultants or independent contractors not on the contractor's payroll; or employees of subrecipients or subcontractors in covered workplaces.

7.06 Certification regarding drug-free workplace requirements for alternate i. (contractors other than individuals)

A. The contractor certifies that it will or will continue to provide a drug-free workplace by:

1. Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the contractor's workplace and specifying the actions that will be taken against employees for violation of such prohibition;
2. Establishing an ongoing drug-free awareness program to inform employees about—
    a. The dangers of drug abuse in the workplace;
    b. The contractor's policy of maintaining a drug-free workplace;
    c. Any available drug counseling, rehabilitation, and employee assistance programs; and
    d. The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;
3. Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the published statement;
4. Notifying the employee in the published statement that, as a condition of employment
5. Under the grant, the employee will—
    a. Abide by the terms of the statement; and
    b. Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction;
6. Notifying the board in writing, within ten calendar days after receiving notice from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to every grant officer or other designee on whose grant activity the convicted employee was working, unless the federal agency has designated a central point for the receipt of such notices. Notice shall include the identification number(s) of each affected grant;
7. Taking one of the following actions, within 30 calendar days of receiving notice, with respect to any employee who is so convicted—
    a. Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the rehabilitation act of 1973, as amended; or
    b. Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a federal, state, or local health, law enforcement, or other appropriate agency;
8. Making a good faith effort to continue to maintain a drug-free workplace through implementation of these requirements.

ARTICLE 8 — EEOC: AFFIRMATIVE ACTION REQUIREMENTS

8.01 Comply with Notice of Requirement for Affirmative Action to Ensure Equal Employment Opportunity (Executive Order 11246) located at 41 CFR § 60-4.2.

ARTICLE 9 — ENVIRONMENTAL COMPLIANCE

9.01 The Contractor, and all subcontractors at any tier, shall comply with all applicable standards, orders, or requirements issued under Section 306 of the Clean Air Act (42 U.S.C. 1857[h]), Section 508 of the Clean Water Act (33 U.S.C. 1368), Executive Order 11738 (Administration of the Clean Air Act and the Federal Water Pollution Control Act with Respect to Federal Contracts, Grants, or Loans), and 40 CFR Part 15.

9.02 Permits and environmental compliance requirements: As indicated in Section 01150 - Mitigation and Monitoring Requirements.

ARTICLE 10 — EQUAL EMPLOYMENT OPPORTUNITY AUTHORITIES EO 11246

10.01 The Contractor shall comply with Executive Order 11246, entitled 'Equal Employment Opportunity,' as amended by Executive Order 11375, and as supplemented in Department of Labor regulations (41 CFR Part 60). (EO 11246, 30 FR 12319, September 28, 1965).

10.02 Contractor's compliance with Executive order 11246 shall be based on implementation of the Equal Opportunity Clause, and specific affirmative active obligations required by the Standard Federal Equal Employment Opportunity Construction Contract Specifications, as set forth in 41 CFR Part 60-4.

ARTICLE 11 — RIGHTS TO INVENTIONS MADE UNDER A CONTRACT OR AGREEMENT

11.01 Contractor shall report to Construction Manager any discovery or invention that arises during the course of the Work to the non-federal entity. Contractor shall promptly report inventions to the Construction Manager (within 60 days) after the inventor discloses it in writing to Contractor. The awarding agency shall determine how rights in the invention/discovery shall be allocated consistent with Government Patent Policy and Title 37 CFR § 401.

ARTICLE 12 — SIGNAGE REQUIREMENTS

12.01 Comply with signage requirements as specified in Section 01500 - Temporary Facilities and Controls.

12.02 Add SRF required information and logos as directed by Engineer.

ARTICLE 13 — CIVIL RIGHTS OBLIGATIONS

13.01 Contractor shall comply with the following federal non-discrimination requirements:

A. Title VI of the Civil Rights Act of 1964, which prohibits discrimination based on race, color, and national origin, including limited English proficiency (LEP). (42 U.S.C 2000D, *et. seq)*

B. Section 504 of the Rehabilitation Act of 1973, which prohibits discrimination against persons with disabilities. (29 U.S.C. 794, supplemented by EO 11914, 41 FR 17871, April 29, 1976 and EO 11250, 30 FR 13003, October 13, 1965)

C. The Age Discrimination Act of 1975, which prohibits age discrimination. (42 U.S.C 6101 *et. seq)*

D. Section 13 of the Federal Water Pollution Control Act Amendments of 1972, which prohibits discrimination on the basis of sex.

E. 40 CFR Part 7, as it relates to the foregoing.

ARTICLE 14 — EEOC: ELIMINATION OF SEGREGATED FACILITIES. (41 CFR 60-1.8)

14.01 The contractor must ensure that facilities provided for employees are provided in such a manner that segregation on the basis of race, color, religion, sex, sexual orientation, gender identity, or national origin cannot result. The contractor may neither require such segregated use by written or oral policies nor tolerate such use by employee custom. The contractor's obligation extends further to ensuring that its employees are not assigned to perform their services at any location, under the contractor's control, where the facilities are segregated. This obligation extends to all contracts containing the equal opportunity clause regardless of the amount of the contract. The term “facilities,” as used in this section, means waiting rooms, work areas, restaurants and other eating areas, time clocks, restrooms, washrooms, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing provided for employees; Provided, that separate or single-user restrooms and necessary dressing or sleeping areas shall be provided to assure privacy between the sexes.

END OF SECTION

ATTACHMENT A - CERTIFICATION OF COMPLIANCE WITH WATER RECYCLING FUNDING PROGRAM/STATE REVOLVING FUND CONDITIONS

CERTIFICATION OF COMPLIANCE WITH WATER RECYCLING FUNDING PROGRAM/STATE REVOLVING FUND CONDITIONS

This certification relates to the City of Ukiah's Water Recycling Project – Phase 4 Refinements Contract proposed by the Owner which expects to finance the proposed Construction Contract with assistance from the Water Recycling Funding Program (WRFP)/State Revolving Fund (SRF) loan program supported in part with funds directly made available by the State of California - Proposition 68 and Senate Bill 129. I am the undersigned prospective construction contractor or subcontractor.

I certify that I have read the SRF Program Requirements and agree to incorporate the following into the bid and/or contract:

- DEBARMENT AND SUSPENSION (EXECUTIVE ORDER 2549)
- EQUAL EMPLOYMENT OPPORTUNITY (EXECUTIVE ORDER 1246)
- PREVAILING WAGE STANDARDS PROVISION

I agree that I will obtain identical certifications from prospective lower-tier construction subcontractors prior to the award of any lower-tier construction subcontracts with a price exceeding $10,000. I also agree that I will retain such certifications in my files.

The Contractor certifies that neither it nor its principals is presently debarred.

_____ _____

(Signature of Authorized Official) (Date)

- - - -

DOCUMENT 00823

ESCROW BID DOCUMENTS

ARTICLE 1—SCOPE

1.01 The 3 lowest Bidders shall submit, within the specified time after receipt of Bids, 1 copy of all documentary information generated in preparation of Bid prices for this Project. This material is hereinafter referred to as "Escrow Bid Documents." The Escrow Bid Documents of the Successful Bidder will be held in escrow for the duration of the contract.

1.02 The Successful Bidder agrees, as a condition of award of the contract, that the Escrow Bid Documents constitute the complete, only, and all documentary information used in preparation of his Bid. No other Bid preparation information shall be considered in resolving disputes.

1.03 Nothing in the Escrow Bid Documents shall change or modify the terms or conditions of the Contract Documents.

ARTICLE 2—OWNERSHIP

2.01 The Escrow Bid Documents are, and shall always remain, the property of Contractor, subject only to joint review by Owner and Contractor, as provided in this Document.

2.02 Owner stipulates and expressly acknowledges that the Escrow Bid Documents, as defined in this Document, constitute trade secrets. This acknowledgment is based on Owner's express understanding that the information contained in the Escrow Bid Documents is not known outside the Bidder's business, is known only to a limited extent and only by a limited number of employees of the Bidder, is safeguarded while in Bidder's possession, is extremely valuable to Bidder, and could be extremely valuable to Bidder's competitors by virtue of it reflecting Bidder's contemplated techniques of construction. Owner acknowledges that the Bidder expended substantial sums of money in developing the information included in the Escrow Bid Documents and further acknowledges that it would be difficult for a competitor to replicate the information contained therein. Owner further acknowledges that the Escrow Bid Documents and the information contained therein are made available to Owner only because such action is an express prerequisite to award of the contract. Owner further acknowledges that the Escrow Bid Documents include a compilation of information used in the Bidder's business, intended to give the Bidder an opportunity to obtain an advantage over competitors who do not know of or use the contents of the documentation. Owner agrees to safeguard the Escrow Bid Documents, and all information contained therein, against disclosure to the fullest extent permitted by law.

ARTICLE 3—PROGRAM

3.01 Escrow Bid Documents will be used to assist in the negotiation of price adjustments and Change Orders and in the settlement of disputes, claims, and other controversies. They will not be used for pre-award evaluation of Contractor's anticipated methods of construction or to assess Contractor's qualifications for performing the Work.

ARTICLE 4—FORMAT AND CONTENTS

4.01 Bidders may submit Escrow Bid Documents in their usual cost-estimating format. It is not the intention of this section to cause the Bidder extra work during the preparation of the Bid, but to ensure that the Escrow Bid Documents will be adequate to enable complete understanding and proper interpretation for their intended use. The Escrow Bid Documents shall be in the language of the Specifications.

4.02 It is required that the Escrow Bid Documents clearly itemize the estimated costs of performing the work of each Bid item contained in the Bid schedule. Bid items should be separated into subitems as required to present a complete and detailed cost estimate and allow a detailed cost review. The Escrow Bid Documents shall include all quantity takeoffs; crew; equipment; calculations of rates of production and progress; copies of quotations from equipment manufacturers, Subcontractors, and Suppliers; and memoranda, narratives, consultants' reports, add/deduct sheets, and all other information used by the Bidder to arrive at the prices contained in the Bid Form. Estimated costs should be broken down into the Bidder's usual estimate categories, such as direct labor, repair labor, equipment operation, equipment ownership, expendable materials, permanent materials, and subcontract costs as appropriate. Plant and equipment and indirect costs should be detailed in the Bidder's usual format. Contractor's allocation of plant and equipment, indirect costs, contingencies, markup, and other items to each Bid item shall be included.

4.03 All costs shall be identified. For Bid items amounting to less than $10,000, estimated unit costs are acceptable without a detailed cost estimate, provided that labor, equipment, materials, and subcontracts, as applicable, are included, and provided that indirect costs, contingencies, and markup, as applicable, are allocated.

4.04 Bidding Documents provided by the Owner should not be included in the Escrow Bid Documents unless needed to comply with the requirements of this section.

ARTICLE 5—SUBMITTAL

5.01 The Escrow Bid Documents shall be submitted in a sealed container within 72 hours after the time of receipt of Bids. The container shall be clearly marked on the outside with the Bidder's name, date of submittal, project name, and the words "Escrow Bid Documents."

5.02 The Escrow Bid Documents shall be accompanied with the completed Attachment A Certificate of Bid Documentation, signed by an individual authorized by the Bidder to execute the Bid Form, stating that the material in the Escrow Documentation constitutes the complete, only, and all documentary information used in preparation of the Bid and that he has personally examined the contents of the Escrow Bid Documents container and has found that the documents in the container are complete.

5.03 Prior to award, Escrow Bid Documents of the apparent Successful Bidder will be unsealed, examined, organized, and inventoried by representatives of Owner, together with members of Contractor's staff who are knowledgeable in how the Bid was prepared.

5.04 This examination is to ensure that the Escrow Bid Documents are authentic, legible, and complete. It will not include review of, and will not constitute approval of, proposed construction methods, estimating assumptions, or interpretations of Contract Documents. This examination is subject to the condition that, as trade secrets, the Escrow Bid Documents are proprietary and confidential as described in this Document. Examination will not alter any condition(s) or term(s) of the contract.

5.05 If all the documentation required in this Document has not been included in the original submittal, additional documentation shall be submitted, at Owner's discretion, prior to award of the contract. The detailed breakdown of estimated costs shall be reconciled and revised, if appropriate, by agreement between Contractor and Owner before making the award.

5.06 If the contract is not awarded to the apparent Successful Bidder, the Escrow Bid Documents of the Bidder next to be considered for award shall be processed as described above.

5.07 Timely submission of complete Escrow Bid Documents is an essential element of the Bidder's responsibility and a prerequisite to contract award. Failure to provide the necessary Escrow Bid Documents will be sufficient cause for Owner to reject the Bid.

5.08 If the Bidder's proposal is based on subcontracting any part of the Work, each Subcontractor whose total subcontract price exceeds 5 percent of the total Contract Price proposed by the Bidder shall provide separate Escrow Bid Documents to be included with those of the Bidder. These documents will be opened and examined in the same manner and at the same time as the examination described above for the apparent Successful Bidder.

5.09 If Contractor subcontracts any portion of the Work after award, Owner retains the right to require Contractor to submit Escrow Bid Documents from the Subcontractor before the subcontract is approved.

5.10 Escrow Bid Documents submitted by unsuccessful Bidders will be returned unopened, unless opened as provided above, as soon as they are no longer needed by Owner and no later than immediately following award of the contract.

ARTICLE 6—STORAGE

6.01 The Escrow Bid Documents of the Successful Bidder will be placed in escrow prior to award of the contract, for the life of the contract, in a mutually agreeable institution. The cost of storage will be paid by Owner.

ARTICLE 7—EXAMINATION AFTER AWARD OF CONTRACT

7.01 The Escrow Bid Documents shall be examined by both Owner and Contractor, at any time deemed necessary after award of the contract by either Owner or Contractor, to assist in the negotiation of price adjustments and Change Orders, or the settlement of disputes.

7.02 Examination of the Escrow Bid Documents after award of the contract is subject to the following conditions:

7.03 As trade secrets, the Escrow Bid Documents are proprietary and confidential as described in this Document.

7.04 Owner and Contractor shall each designate, in writing to the other party and a minimum of 10 days prior to examination, representatives who are authorized to examine the Escrow Bid Documents. No other person shall have access to the Escrow Bid Documents.

7.05 Access to the Escrow Bid Documents will take place only in the presence of duly designated representatives of both Owner and Contractor.

ARTICLE 8—FINAL DISPOSITION

8.01 The Escrow Bid Documents will be returned to Contractor at such time as the contract has been completed and final settlement has been achieved.

END OF DOCUMENT

ATTACHMENT A - CERTIFICATE OF BID DOCUMENTATION

CERTIFICATE OF BID DOCUMENTATION

I, THE UNDERSIGNED, HEREBY CERTIFY THAT THE BID DOCUMENTATION CONTAINED IN THIS DOCUMENT CONSTITUTES THE COMPLETE, ONLY, AND ALL DOCUMENTARY INFORMATION USED IN PREPARATION OF THE BID AND THAT I HAVE PERSONALLY EXAMINED THESE CONTENTS AND HAVE FOUND THAT THIS BID DOCUMENTATION IS COMPLETE.

BY: _____

TITLE: _____

FIRM: _____

DATE: _____

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DOCUMENT 00940

WORK CHANGE DIRECTIVE

Owner:	Owner's Project No.:
Engineer:	Engineer's Project No.:
Contractor:	Contractor's Project No.:
Project:	
Contract Name:	
Date Issued:	Effective Date of Work Change Directive:

Contractor is directed to proceed promptly with the following change(s):

Description:

[Description of the change to the Work]

Attachments:

[List documents related to the change to the Work]

Purpose for the Work Change Directive:

[Describe the purpose for the change to the Work]

Directive to proceed promptly with the Work described herein, prior to agreeing to change in Contract Price and Contract Time, is issued due to:

Notes to User—Check one or both of the following

☐ Non-agreement on pricing of proposed change. ☐ Necessity to proceed for schedule or other reasons.

Estimated Change in Contract Price and Contract Times (non-binding, preliminary):

Contract Price:	$ _____	**[increase][decrease][not yet estimated]**.
Contract Time:	_____ days	**[increase][decrease][not yet estimated]**.

Basis of estimated change in Contract Price:

☐ Lump Sum ☐ Unit Price ☐ Cost of the Work ☐ Other

	Recommended by Engineer	Authorized by Owner
By:		
Title:		
Date:		

END OF DOCUMENT

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DOCUMENT 00941

CHANGE ORDER

Owner:	Owner's Project No.:
Engineer:	Engineer's Project No.:
Contractor:	Contractor's Project No.:
Project:	
Contract Name:	
Date Issued:	Effective Date of Change Order:

The Contract is modified as follows upon execution of this Change Order:

Description:

[Description of the change]

Attachments:

[List documents related to the change]

In signing a Change Order, the Owner and Contractor acknowledge and agree that:

1. The Change Order constitutes full mutual accord and satisfaction for the change to the Work. The stipulated compensation (Contract Price or Contract Times, or both) set forth in the Change Order includes not only all direct costs of Contractor such as labor, material, job overhead, and profit markup, but also includes any costs for modifications or changes in sequence of work to be performed, delays rescheduling, disruptions, extended direct overhead or general overhead, acceleration, material, or other escalation which includes wages and other impact costs.

2. This Change Order will become a supplement to the Contract and all Contract provisions will apply hereto.

3. It is understood that this Change Order shall be effective on the date the Owner authorizes the Change Order by their signature.

4. No reservation of rights to pursue subsequent claims on the Change Order will be made by either party.

5. No subsequent claim or amendment of the Contract Documents will arise out of or as a result of the Change Order.

Change in Contract Price	Change in Contract Times [State Contract Times as either a specific date or a number of days]
Original Contract Price: $ _____	Original Contract Times: Substantial Completion: _____ Ready for final payment: _____
[Increase] [Decrease] from previously approved Change Orders No. 1 to No. **[Number of previous Change Order]**: $ _____	**[Increase] [Decrease]** from previously approved Change Orders No. 1 to No. **[Number of previous Change Order]**: Substantial Completion: _____ Ready for final payment: _____
Contract Price prior to this Change Order: $ _____	Contract Times prior to this Change Order: Substantial Completion: _____ Ready for final payment: _____
[Increase] [Decrease] this Change Order: $ _____	**[Increase] [Decrease]** this Change Order: Substantial Completion: _____ Ready for final payment: _____
Contract Price incorporating this Change Order: $ _____	Contract Times with all approved Change Orders: Substantial Completion: _____ Ready for final payment: _____

Recommended by Engineer (if required)	Authorized by Owner
By: _____	_____
Title: _____	_____
Date: _____	_____
Authorized by Contractor	**Approved by Funding Agency (if applicable)**
_____	_____
By: _____	_____
Title: _____	_____
Date: _____	_____

END OF DOCUMENT

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DOCUMENT 00942

FIELD ORDER

Owner:	Owner's Project No.:
Engineer:	Engineer's Project No.:
	Contractor's Project No.:
Contractor:	
Project:	
Contract Name:	
	Effective Date of Field Order:
Date Issued:	

Contractor is hereby directed to promptly perform the Work described in this Field Order, issued in accordance with the General Conditions, for minor changes in the Work without changes in Contract Price or Contract Times. If Contractor considers that a change in Contract Price or Contract Times is required, submit a Change Proposal before proceeding with this Work.

Reference:

Specification Section(s):

Drawing(s) / Details (s):

Description:

[Description of the change to the Work]

Attachments:

[List documents supporting change]

Issued by Engineer

By: _____

Title: _____

Date: _____

END OF DOCUMENT

SECTION 01110

SUMMARY OF WORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Detailed description of the Work.

1.02 THE WORK

A. The Work consists of:
   1. Construction of Recycled Water Project Phase 4 - Specification No. 23-01, including: construction of new and rehabilitation of existing facilities related to the City of Ukiah's recycled water production, storage, and distribution; repair and reconstruction of existing improvements affected by the Work; and incidentals for complete and usable facilities**.**
   2. Commissioning of the Work.

1.03 LOCATION OF PROJECT

A. The Work is primarily located at the following locations and as indicated on the Drawings:
   1. City of Ukiah Water Treatment Plant: 935 River Street, Ukiah, CA 95482.
   2. City of Ukiah Wastewater Treatment Plant: 300 Plant Road, Ukiah, CA 95482.
   3. Various locations within the City of Ukiah for the recycled water distribution system pipelines.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01116

CONTRACT DOCUMENT LANGUAGE

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Explanation of arrangement, language, reference standards, and format.

1.02 REFERENCES

A. Construction Specifications Institute (CSI):
   1. MasterFormat™.
   2. SectionFormat™.
   3. PageFormat™.

1.03 PROJECT MANUAL ARRANGEMENT

A. Document and Section numbers used in Project Manual, and Project Manual arrangement are in accordance with CSI MasterFormat™, except where departures have been deemed necessary.

B. Sections are written in CSI SectionFormat™, Three-Part Section Format, except where departures have been deemed necessary.

C. Page format for Sections in the Project Manual is in PageFormat™, except where departures have been deemed necessary.

1.04 CONTRACT DOCUMENT LANGUAGE

A. Specification Section Paragraphs entitled "Section Includes" summarize briefly what is generally included in the section.
   1. Requirements of Contract Documents are not limited by "Section Includes" paragraphs.

B. Specifications have been partially streamlined by intentionally omitting words and phrases, such as "the Contractor shall," "in conformity therewith," "shall be" following "as indicated," "a," "an," "the" and "all."
   1. Assume missing portions by inference.

C. Phrase "by Engineer" modifies words such as "accepted," "directed," "selected," "inspected," and "permitted," when they are unmodified.

D. Phrase "to Engineer" modifies words such as "submit," "report," and "satisfactory," when they are unmodified.

E. Colons (:) are used to introduce a list of particulars, an appositive, an amplification, or an illustrative quotation:
   1. When used as an appositive after designation of product, colons are used in place of words "shall be."

F. Word "provide" means to manufacture, fabricate, deliver, furnish, install, complete, assemble, erect in place, test, or render ready for use or operation, including necessary related material, labor, appurtenances, services, and incidentals.

G. Words "Contractor shall" are implied when direction is stated in imperative mood.

H. Term "products" includes materials and equipment as specified in Section 01600 - Product Requirements - Plant and Section 01601 - Product Requirements - Linear Infrastructure.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01140

WORK RESTRICTIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for sequencing and scheduling the Work affected by existing site and facility, work restrictions, and coordination between construction operations and plant operations.

1.02 SUBMITTALS

A. Method of Procedure (MOP) Submittals:
   1. Baseline Schedule with MOP tasks.
      a. Submit Baseline Schedule, as specified in Section 01321 - Schedules and Reports with proposed MOPs.
   2. Progress Schedules with MOP tasks.
   3. MOP Forms.
   4. MOP Logs.
      a. Submit MOP Log at construction progress meetings.

1.03 METHOD OF PROCEDURE (MOP)

A. Comply with MOP Instructions as specified in Attachment A - Method of Procedure (MOP).

B. Prepare MOP for the following conditions:
   1. Shutdowns, diversions, and tie-ins to the existing facility.
   2. Process start-up activities.
   3. Power interruption and tie-ins.
   4. Switch over between temporary and permanent facilities, equipment, piping, and electrical and instrumentation systems.
   5. Process constraints requiring interruption of operating processes or utilities.

C. Other Work not specifically listed may require MOPs as determined necessary by the Contractor, Owner, or Engineer.

D. No consideration will be given to claims of additional time and cost associated to preparing MOPs required by the Owner and Engineer to complete this work in a manner that facilitates proper operation of the facility and compliance with effluent discharge criteria.

E. Where required to minimize treatment process interruptions while complying with specified constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.

1.04 GENERAL CONSTRAINTS ON WORK AND SCHEDULING OF WORK

A. Plant access for Contractor will be at the discretion of the Owner.

B. Perform abandoned pipe Work as specified in Section 01738 -Selective Alterations and Demolition.

C. Wastewater projects:
   1. The City of Ukiah Wastewater Treatment Plant is the City of Ukiah's only means of treating domestic and industrial wastewater prior to discharging to the Russian River. Impairing the operational capabilities of this treatment plant will result in serious environmental damage and monetary fines.
   2. Conduct Work in a manner that will not impair the operational capabilities of essential elements of the treatment process or reduce the capacity of the entire treatment plant below levels sufficient to treat the quality of raw wastewater to the water quality limitations specified in the discharge permit.
   3. Conduct commissioning activities as specified in Section 01756 - Commissioning in a manner that will not impair the operational capabilities of essential elements of the treatment process or reduce the capacity of the entire treatment plant below levels sufficient to treat the quality of raw wastewater to the water quality limitations specified in the discharge permit.
      a. Conduct PCIS Optimization and Fine-Tuning as specified in Section 01756 - Commissioning.
   4. The status of the treatment plant shall be defined as "operational" when it is capable of treating the entire quantity of wastewater received to the water quality limits specified in the discharge permit.

1.05 COMPLIANCE WITH NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT

A. The existing facility is operating under the terms of a National Pollutant Discharge Elimination System permit issued by the State Water Resources Control Board.
   1. This permit specifies the water quality limits that the plant must meet prior to discharge of effluent.
   2. A copy of the existing permit is on file for review from the Owner.

B. Perform work in a manner that will not prevent the existing facility from achieving the finished water quality requirements established by regulations.

C. Bear the cost of penalties imposed on the Owner for discharge violations caused by actions of the Contractor.

D. Conduct the Work and provide temporary facilities required to keep the existing plant continuously operational

E. Do not remove or demolish existing facilities required to keep the existing plant operational at the capacities specified until the existing facilities are replaced by temporary, new, or upgraded facilities or equipment.
   1. Test replacement facilities to demonstrate operational success prior to removing or demolishing existing facilities.

1.06 UTILITIES

A. Provide advance notice to and utilize services of Underground Services Alert (U.S.A.) for location and marking of underground utilities operated by utility agencies other than the Owner.

B. Maintain electrical, telephone, water, gas, sanitary facilities, and other utilities within existing facilities in service. Provide temporary utilities when necessary.

C. New yard utilities were designed using existing facility drawings.
   1. Field verification of utilities locations was not performed during design.
   2. Services crossed or located nearby by new yard utilities may require relocation and possible shutdowns.
   3. Pipe alignments as indicated on the Drawings.

1.07 WORK BY OTHERS

A. Where proper execution of the Work depends upon work by others, inspect and promptly report discrepancies and defects.

1.08 SHUTDOWN CONSTRAINTS

A. General shutdown constraints:
   1. Execute the Work while the existing facility is in operation.
   2. Some activities may be accomplished without a shutdown.
   3. Apply to activities of construction regardless of process or work area.
   4. Activities that disrupt plant or utilities operations must comply with these shutdown constraints.
   5. Organize work to be completed in a minimum number of shutdowns.
   6. Provide thorough advanced planning, including having required equipment, materials, and labor on hand at time of shutdown.
   7. Shutdown MOPs:
      a. Advise the Engineer a minimum of 3 weeks prior to need for any complete or partial plant shutdown for tie-ins.
      b. Prepare and submit MOP to Engineer for any complete or partial plant shutdown required a minimum of 2 weeks prior to the shutdown.
      c. Owner’s written approval of MOP is required prior to beginning Work.
   8. Where required to minimize treatment process interruptions while complying with specified constraints, provide temporary pumping, power, lighting, controls, instrumentation, and safety devices.
   9. Final determination of the permitting of shutdowns will be the sole judgment of the Owner.
   10. Owner maintains the ability to abort on the day of the scheduled shutdown.
   11. Unplanned shutdowns due to emergencies are not specified in this Section.

B. Unit process availability work limitations:
   1. Shutdowns and tie-ins or other activities that disrupt plant operations are prohibited unless the following unit process availability conditions exist and unless otherwise approved in writing by the Owner and Engineer.

2. At a minimum, the following facilities must be in service in order to proceed with a scheduled shutdown.
    a. Headworks including screening and grit removal and pumping.
    b. Aeration basins.
    c. Secondary sedimentation.
    d. Filters.
    e. Existing solids dewatering and hauling.

C. Plant water system.
1. Maximum shutdown duration: 2 hours.
2. Only 1 shutdown of the plant water system will be allowed to make piping connections.

D. Process, electrical and instrumentation - tie-in shutdowns:
1. Schedule no more than 1 tie-in shutdown per day.

1.09 WORK RESTRICTIONS

A. General:
1. Maximum plant flow work limitation:
    a. Activities that disrupt plant operations are prohibited during the following flow conditions, unless otherwise approved in writing by the Owner and Engineer.
        1) Flow condition: Flow above 4.0 million gallons per day.

B. Seasons:
1. Dry Weather: June 1 to September 30.
2. Wet Weather: October 1 to May 31.

C. Constraints and Possible Work Sequence for Key Project Elements:
1. Advanced Water Treatment (AWT) System:
    a. Constraints:
        1) General:
            a) Conduct work on AWT units during the dry weather season.
            b) All AWT units shall be operational during the wet weather season.
            c) Work on each tank shall be completed within 4 months after initiation.
            d) At least two tanks need to be online at a time while performing work that does not require all AWT units to be offline.
            e) It may be necessary to shut down all four AWT units for portions of the work. When this occurs, all four AWT units may be shut down for no more than 8 hours; depending on the recycled water demand in the distribution system, this duration may be reduced at the discretion of the Owner.
        2) Air Scour Piping (8 inch AA) and Supports:
            a) Penetrate new air scour piping to the filter side of the AWT tanks before the tank has been recoated and filter media has been replaced.
            b) New air scour piping supports shall be field welded before the AWT tanks are recoated.

b. Possible Work Sequence:
    1) AWT Units:
        a) Procure all equipment and materials required for AWT improvements.
        b) Isolate the first two AWT units via the MOP process:
            (1) Drain the AWT units in coordination with the Owner.
            (2) Perform demolition work as indicated on the drawings:
                (a) Remove the surface wash sweeps and associated piping.
                (b) Remove pneumatic actuator from waste gate.
                (c) Remove filter media and gravel support.
                (d) Remove adsorption clarifier media.
            (3) Install new air scour piping and weld pipe supports onto AWT tank.
            (4) Penetrate air scour piping into AWT tank.
            (5) Recoat the interior and exterior of the AWT tank.
            (6) Place new filter gravel support and filter media into the filter side of the AWT tank.
            (7) Place the adsorption clarifier media into the clarifier side of the AWT tank.
            (8) Perform testing and commissioning as specified in 11802 and 01756.
        c) Isolate the other two AWT units via the MOP process:
            (1) Drain the AWT units in coordination with the Owner.
            (2) Perform demolition work as indicated on the drawings:
                (a) Remove the surface wash sweeps and associated piping.
                (b) Remove pneumatic actuator from waste gate.
                (c) Remove air compressor from the blower room.
                (d) Remove filter media and gravel support.
                (e) Remove adsorption clarifier media.
            (3) Install new air scour piping and weld pipe supports onto AWT tank.
            (4) Penetrate air scour piping into AWT tank.
            (5) Recoat the interior and exterior of the AWT tank.
            (6) Place new filter gravel support and filter media into the filter side of the AWT tank.
            (7) Place the adsorption clarifier media into the clarifier side of the AWT tank.
        d) Perform testing and commissioning as specified in 11802 and 01756.
    2) Replacing Valves on the Clarifier and Filter Sides:
        a) Procure all valves and materials required for valve improvements.
        b) Shut down all four AWT units via the MOP process.
        c) Demolish the valves.
        d) Install the new valves and actuators.
        e) Operations personnel to resume normal operation of the plant and bring at least two AWT units back online.
        f) Perform testing and commissioning as specified in 11802 and 01756.

2. Air Wash Blowers:
    a. Constraints:
        1) Conduct work on blowers during the dry weather season.
        2) Work on each blower shall be completed within 4 months after initiation.
        3) The blower system may be offline for no more than 6 hours.
        4) Keep one decommissioned blower onsite until all commissioning has been completed per Section 01756.
    b. Possible Work Sequence:
        1) Procure all equipment and materials required for air system improvements.
        2) Via the MOP process, isolate the western air wash blower.
        3) Demolish the isolated blower and its associated piping and concrete pad.
        4) Remove the air compressor from the blower room and relocate it while pneumatic waste gate rams are still in use.
        5) Install the new tee at the elbow of the existing air piping (6-inch AA) and a valve in the closed position to divert air to the clarifiers while installing the new blowers.
        6) Install at least one new blower, its associated piping, and concrete pad, as space in the room allows.
        7) Connect the new air blowers to the AWT system using a tee downstream of the newly installed tee and valve on the existing air piping (6-inch AA).
        8) Once sufficient air can be supplied by the new blowers, open the valve for new blowers to provide air to the clarifiers and demolish the remaining existing blower and air piping (6-inch AA).
        9) Blind flange the tee that connected the demolished existing air piping (6-inch AA) from the demolished existing blower.
        10) Perform testing and commissioning as specified in 11802 and 01756.
3. Coagulant Feed Pump:
    a. Constraints:
        1) Work on coagulant pump shall be completed within a month after initiation.
    b. Possible Work Sequence:
        1) Procure all equipment and materials required for backwash piping improvements.
        2) Isolate the existing pump to be replaced via the MOP process.
        3) Demolish existing pump.
        4) Install the new pump.
        5) Perform testing, start-up, and commissioning as specified in Section 01756.
4. Rapid Mix System:
    a. Constraints:
        1) Conduct work on the rapid mix system during the dry weather season.
        2) Work on the rapid mix pump system shall be completed within 3 months after initiation.
        3) It may be necessary to shut down all four AWT units to complete the Work related to this element. All four AWT units may be shut down for no more than 8 hours; depending on the recycled water demand

in the distribution system, this duration may be reduced at the discretion of the Owner.

b. Possible Work Sequence:
    1) Procure all equipment and materials required for rapid mix pump installation.
    2) Install the rapid mix pump and assemble all necessary piping for the system prior to final connection.
    3) Excavate around the final effluent pipe for access to install the rapid mix diffuser and piping.
    4) Operations personnel to shut down the AWT pumps and close valves to the clarifier side of all AWT tanks.
    5) Open the drain valves on the piping entering the AWT tanks to drain the pipe as much as possible. Use sump pumps routed to the nearest plant drain as required.
    6) Assemble the rapid mix diffuser assembly prior to installation.
    7) Access the pipe using the vault and use a sump pump to remove excess water as needed.
    8) Install rapid mix diffuser assembly.
    9) Operations personnel to resume normal operation of the plant, which will fill the pipe.
    10) Perform testing, start-up, and commissioning as specified in Section 01756.

5. Chlorine Sampler at Backwash Pump Station:
    a. Constraints:
        1) Work on the chlorine sampler shall be completed within 4 weeks after initiation.
        2) The final connection to the existing piping shall be completed in a single shutdown of less than 8 hours.
    b. Possible Work Sequences:
        1) Procure all equipment and materials required for the chlorine analyzer replacement.
        2) Isolate the existing pump and chlorine analyzer.
        3) Perform demolition work as indicated on the drawings:
            a) Remove existing sample pump.
            b) Remove existing chlorine analyzer.
        4) Install new sample pump and chlorine analyzer.
        5) Perform testing, start-up, and commissioning as specified in Section 01756.
6. Backwash Piping (Area 87):
    a. Constraints:
        1) Conduct work on AWT units during the dry weather season.
        2) Work on valve shall be completed within 4 months after initiation.
        3) This Work shall be completed prior to completion of the rehabilitation of the first AWT.
        4) The final connection to the existing piping shall be completed in a single shutdown of less than 8 hours.
        5) Contractor shall field verify dimensions of the backwash discharge header and prepare pipe layout drawings prior to installation of new piping configuration.

b. Possible Work Sequence:
    1) Field verify dimensions and pipe material of backwash discharge header prior to submitting new shop drawings.
    2) Procure all equipment and materials required for backwash piping improvements.
    3) Assemble the piping configuration prior to installation.
    4) Install new configuration.
    5) Perform testing, start-up, and commissioning as specified in Section 01756.

7. Chorine Sampler at Dechlorination Structure:
    a. Constraints:
        1) Replace valve during the dry weather season.
        2) Work on valve shall be completed within a week after initiation.
        3) The final connection to the existing piping shall be completed in a single shutdown of less than 8 hours.
        4) Discharge to the Russian River is not allowed while replacing the chlorine analyzer.
    b. Possible Work Sequence:
        1) Procure all equipment and materials required for replacing the chlorine sampler.
        2) Assemble required new piping prior to installation.
        3) Close valve leading to the Russian River and divert flow to the Carousel Pump Station.
        4) Perform demolition work as indicated on the drawings:
            a) Remove piping exiting the three-way valve and entering the chlorine analyzer.
            b) Remove existing chlorine analyzer.
        5) Install new piping and chlorine analyzer.
        6) Perform testing, start-up, and commissioning as specified in Section 01756.

8. Valves at Dechlorination Structure:
    a. Constraints:
        1) Northern-most Valve (FCV-60102):
            a) Replace valve during the dry weather season.
            b) Work on valve shall be completed within a week after initiation.
            c) The final connection of the valve to the existing piping shall be completed in a single shutdown of less than 8 hours. Actuation of valve maybe be completed later.
        2) Southern-most Valve (FCV-60100):
            a) Replace valve between July 1 and September 1.
                (1) Work shall occur during a low flow day, defined as 2.5 million gallons per day (mgd) or less.
            b) Work on this valve shall not occur concurrently with any other shutdown.
            c) Work on valve shall be completed within a week after initiation.
            d) The final connection to the existing piping shall be completed in a single shutdown of less than 8 hours. Actuation of valve maybe be completed later.
    b. Possible Work Sequences:
        1) Procure all equipment and materials required for replacing the valves.

2) FCV-60102:
    a) Shut down operation and draw down the level in the wet well.
    b) Drain the 24-inch pipe entering the dechlorination structure.
    c) Remove the existing valve.
    d) Install the new valve and leave it in the closed position.
    e) Operations personnel to resume normal operation of the plant, which will fill the pipeline behind the closed valve.
    f) Complete work by actuating the valve.
    g) Perform testing, start-up, and commissioning as specified in Section 01756.
3) FCV-60100:
    a) Stop work in all other areas to focus on replacing valve.
    b) Excavate the area to access the valve.
    c) Divert flow to a secondary clarifier.
    d) Shut down operation and drain the 24-inch pipe as much as possible.
    e) Install the new valve and leave it in the closed position.
    f) Operations personnel to resume normal operation of the plant, which will fill the pipeline behind the closed valve.
    g) Complete work by actuating the valve.
    h) Perform testing, start-up, and commissioning as specified in Section 01756.

9. Carousel Pump Station:
    a. Constraints:
        1) Conduct work during the dry weather season.
        2) Work shall be completed within 4 months after initiation.
        3) Installation of the new pump shall be completed in a single shutdown of less than 8 hours.
        4) Perform pipe work before work starts on the Production Augmentation Unit (PAU).
    b. Possible Work Sequence:
        1) Procure all equipment and materials required for the Carousel Pump Station.
        2) Install new pump.
        3) Excavate trench for pipe entering PAU and lay the pipe.
        4) Perform testing, start-up, and commissioning as specified in Section 01756.
10. Production Augmentation Unit (PAU):
    a. Constraints:
        1) General:
            a) Work shall be completed within 4 months after initiation.
        2) Penetration into Structure 80:
            a) Conduct work during the dry weather season.
                (1) Work shall occur during a low flow day, defined as 2.5 million gallons per day (mgd) or less.
            b) Work shall be completed within a week after initiation.
            c) Penetration into Structure 80 shall be completed in a single shutdown of less than 8 hours.

b. Possible Work Sequence:
    1) PAU and PAU Pump Station:
        a) Procure all equipment and materials required for the PAU pump station and PAU.
        b) Excavate area to construct the PAU Pump station.
        c) Construct structure.
        d) Install new pump and slide gate.
        e) Excavate trench for pipe alignment entering the PAU pump station and lay piping.
        f) Grade PAU and line it.
        g) Excavate trench for pipe alignment going to Structure 80.
        h) Lay piping to Structure 80.
        i) Connect pipe to the penetration at Structure 80.
        j) Perform testing, start-up, and commissioning as specified in Section 01756.
    2) Penetration into Structure 80:
        a) Procure all equipment and materials required for the PAU pump station and PAU.
        b) Excavate the area around Structure 80 where penetration will be made.
        c) Operations personnel to stop normal operation and drain Structure 80's wet well.
        d) Penetrate into Structure 80's wall.
        e) Blind flange pipe until ready to connect to the PAU Pump Station.

11. Digester Overflow Routing:
    a. Constraints:
        1) Work shall be completed within 7 months after initiation.
        2) Contractor shall field the location, condition, pipe material, and outside diameter for existing 6 inch and 12 inch buried sludge piping prior to submitting new steel pipe shop drawings.
        3) Perform work before work starts on the PAU.
    b. Possible Work Sequence:
        1) Excavate to field location, condition, pipe material, and outside diameter for existing 6 inch and 12 inch buried sludge piping prior to submitting new shop drawings.
        2) Procure all equipment and materials required for digester overflow routing.
        3) Isolate the existing 6 inch sludge piping.
        4) Excavate and cut existing 6 inch sludge piping to provide a new 90-degree elbow.
        5) Remove the cut portion of the 6 inch sludge pipe extending into the PAU.
        6) Excavate trench for new 6 inch sludge pipe and lay it.
        7) Perform testing, start-up, and commissioning as specified in Section 01756.

12. Electrical Work:
    a. Constraints:
        1) Electrical, communication, instrumentation and process control improvements must be completed prior to or concurrently with the rest of the associated Work.
        2) All existing loads shall remain powered and functional at all times except for up to 2 hours during relocation(s).
13. Instrumentation and Controls Work:
    a. Constraints:
        1) Electrical, communication, instrumentation and process control improvements must be completed prior to or concurrently with the rest of the associated Work.
        2) All existing I/O points shall remain uninterrupted and functional at all times except for up to 2 hours during relocation(s).

D. Yard piping, electrical duct banks, and trenches:
    1. Provide 1 open fire lane, designed for H-20 loadings, at all times during construction.

E. Provide safe, continuous access to process control equipment for plant operations and maintenance personnel.

F. Maintain truck access as required for plant operations and personnel.

G. Piping:
    1. Provide temporary piping during construction for existing and new equipment to maintain plant operation in service during construction.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT A - METHOD OF PROCEDURE (MOP)

“METHOD OF PROCEDURE” (MOP)
Instructions and Forms

Definition and Purpose

“Method of Procedure” (MOP) is a detailed document submitted by the Contractor to request process shutdown(s), utility tie-in(s), work in areas that may risk unanticipated outages, or flow diversions to accommodate site construction activities during a project. Such activities may include (but are not limited to) new tie-ins to utilities or structures, mechanical modifications to process piping or equipment, demolition, bulkhead installation, and cleaning processes.

The MOP provides a detailed plan to the Owner and Engineer that describes specific aspects of the work including purpose, time of execution, and anticipated impacts on treatment processes. The MOP also includes contingency measures and provisions for rapid closure in the event that shutdown or work progress difficulties are encountered. Information from relevant trades associated with the requested shutdown, diversion, or tie-in is also included.

The Owner should use the information within the MOP to define operational procedures and methods to safely and successfully assist the Contractor.

MOP Process Summary

WHO	STEP	TIMING
Contractor	1. Identify MOPs needed on MOP Log and Baseline Schedule.	No later than 7 days prior to Preconstruction Scheduling Meeting
Contractor, Owner, Engineer	2. Pre-MOP Meeting.	More than 28 days prior to work
Contractor	3. Submits MOP.	No later than 28 days prior to work
Owner	4. Reviews MOP.	
Owner	5. MOP finalized.	No later than 7 days prior to work
Contractor	6. Complete Readiness Checklist.	No later than 5 days prior to work
Contractor	7. Complete Safety Checklist.	Immediately prior to commencing work
Contractor	8. Complete Work.	
Contractor	9. Update MOP Log and Progress Schedules.	Monthly

MOP Process Detail

STEP 1. Identifies MOPs needed on MOP Log and Baseline Schedule.

Contractor submits a preliminary list of anticipated project MOPs on MOP Log. MOPs identified but not limited to those shutdowns, diversions, or tie-ins described in the Contract Documents. Incorporate MOPs as tasks in Baseline Schedule. Date scheduled MOPs to coincide with the appropriate construction activities.

STEP 2. Pre-MOP Meeting.

Contractor requests a Pre-MOP Meeting with the Owner and Engineer to discuss the nature of the shutdown, diversion, or tie-in, and to gather the information necessary to complete the MOP Form. The pre-MOP meeting may be waived by the Owner or Engineer if the work is deemed to be minor.

STEP 3. Submits MOP.

Contractor completes the MOP Form and submit 3 copies for approval to the Owner's Project Manager (OPM).

STEP 4. Reviews MOP.

OPM distributes MOP Form for review by the Owner's Construction Coordinator, O&M Representative, and Engineer's Project Representative. Review MOP Form for completeness, accuracy, compliance with both the construction schedule, constraints defined in contract documents, and to ensure that the requested work does not negatively impact plant operations or other concurrent project activities. Additional information may be requested to better understand the nature of and method for completing the Work.

STEP 5. MOP finalized.

Once the MOP is agreed to by all parties, the MOP will be finalized by signature. Copies are distributed to the Owner, Engineer, and Contractor.

STEP 6. Complete Readiness Checklist.

Contractor verifies everything is ready for the work.

STEP 7. Complete Safety Checklist.

Contractor ensures safety.

STEP 8. Complete work.

Contractor complete work.

STEP 9. Update MOP Log and Progress Schedules.

Contractor updates MOP Log weekly and distributes at the regularly scheduled construction progress meetings.

ATTACHMENT B - METHOD OF PROCEDURE (MOP) FORM

METHOD OF PROCEDURE (MOP) FORM

Owner: City of Ukiah **Date:**

Contractor: **Carollo Project No.:** 08660F10M

Project Name: **Submittal No.:**

Submittal Title: **Spec/Dwg. Reference:**

MOP #	Task Title *(Provide <10 word title)*:	Submittal Date: *(No later than 28 days prior to work)*

SCHEDULE OF WORK ACTIVITY START: *(Date/Time)* END: (Date/Time)

REQUESTOR:

PRIMARY POINT OF CONTACT: PHONE/PAGER:

SECONDARY POINT OF CONTACT: PHONE/PAGER:

NOTIFY ☐ Control Room, Phone ☐ Security, Phone

BUILDING: LOCATION OF WORK FLOOR/LEVEL:

DESCRIPTION OF WORK: *(Provide sufficient details on process isolation, work sequencing, and safety (i.e., control of significant hazards unique to the work) to demonstrate an understanding of the work and how it will be completed within the constraints, and its impact on the processes and facility.)*

Task Summary:

Processes Affected:

Trades Affected:

WORK PLAN:

Work Sequencing:

Process Isolation:

Spill Prevention Plan:

Contingency Plans:

CRITICAL EQUIPMENT/TOOLS: *(pumps and discharge hoses with correct fittings, blind flanges and pipe plugs, no-hub fittings, properly sized electrical service components, generators, portable lighting, chlorine for potable water pipe breaks, etc.)*

☐	Acoustic Ceiling/or Walls Access	☐	Excavation Permit	☐	Lock Out/Tag Out
☐	Chemical Use Approval	☐	Fire Sprinkler Impairment	☐	Life Safety Systems
☐	Confined Space Permit	☐	Flammable Materials	☐	Roof Protocol
☐	Critical Lift Plan	☐	Flush / Discharge	☐	Work After Dark
☐	Energized Electrical Work	☐	High Pressure Test	☐	
☐	Elect. Panel Schedules	☐	Hot Work/Open Flame	☐	

EXISTING SERVICE(S) AT RISK:

☐	Breathing Air	☐	Elect Normal	☐	Process Access	☐	Telephones
☐	Chemical Distribution	☐	Fire Protection	☐	Safety Showers	☐	UPS
☐	City Water	☐	HVAC	☐	SCADA	☐	VAX/DATA
☐	Communication	☐	Inert Gas	☐	Security	☐	
☐	Domestic Drain	☐	Instrument - Air	☐	Solvent Drain	☐	

☐	Elect-Bus Duct	☐	Life Safety System	☐	Specialty Gases	☐	
☐	Elect Emergency	☐	Natural Gas	☐	Storm Drain	☐	
REVIEWER'S INSTRUCTIONS / COMMENTS:							
☐	PREJOB BRIEFING MUST BE COMPLETED PRIOR TO COMMENCING WORK:						

	Full Name (printed)	**Signature**	**Phone**	**Date**
Submitted By				
System Owner				
Reviewer (if needed)				
Reviewer (if needed)				
Reviewer (if needed)				
Reviewer (if needed)				

ATTACHMENT C - READINESS CHECKLIST

READINESS CHECKLIST
(5 days prior to work)

Checklist provided as a guide but is not all inclusive.

1. Confirm all parts and materials are on site: _____
2. Review work plan: _____
3. Review contingency plan: _____

ATTACHMENT D - SAFETY CHECKLIST

SAFETY CHECKLIST
(Just prior to commencing work)

Checklist provided as a guide but is not all inclusive.

1. Location awareness:
   a. Emergency exits: _____
   b. Emergency shower and eyewash: _____
   c. Telephones and phone numbers: _____
   d. Shut-off valve: _____
   e. Electrical disconnects: _____
2. Inspect work area:
   a. Take time to survey the area you are working in. Ensure that what you want to do will work. Do you have enough clearance? Is your footing secure? Do you have adequate lighting and ventilation? Are surrounding utilities out of the way for you to perform your work?
3. SDS (Safety Data Sheets):
   a. Understand the chemicals and substances in the area you are working in by reading the SDS.
4. Lockout/Tagout Procedure:
   a. Lockout/tagout energy sources before beginning work.
   b. Make sure all valves associated with the work are locked out and tagged out on each side of the penetration.
   c. Make sure the lines are depressurized.
5. Overhead work:
   a. Use appropriate personal protective equipment; i.e., safety harness, lifeline, etc.
   b. Select appropriate tie-off points; i.e., structurally adequate, not a pipe or conduit, etc.
   c. Spotter assigned and in position.
   d. Pipe rack access; i.e., check design capacity, protective decking or scaffolding in place, exposed valves or electrical switches identified and protected.
6. Safety equipment:
   a. Shepherd's hook.
   b. ARC flash protection.
   c. Fire extinguisher.
   d. Other: _____.
7. Accidents:
   a. Should accidents occur, do not shut off and do not attempt to correct the situation, unless you are absolutely positive that your action will correct the problem and not adversely affect other people or equipment.
8. Review process start-up documents:
   a. In the event the system is shutdown, the Control Center should have a working knowledge of the process start-up procedures in order to deal effectively with unforeseen events.
9. Evacuation procedures:
   a. Do not obstruct evacuation routes.
   b. Take time to survey the area for evacuation routes.

ATTACHMENT E - METHOD OF PROCEDURE (MOP) LOG

METHOD OF PROCEDURE (MOP) LOG
Sample

MOP Number	Task Title	Date Requested	Date Approved	Date Work Planned	Work Completed (yes/no)
001					
002					
003					

SECTION 01150

MITIGATION AND MONITORING REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Mitigation and monitoring requirements relating to environmental impacts.

1.02 REFERENCES

A. California Code of Regulations (CCR).
   1. Title 13, Section 2485 - Airborne Toxics Control Measure to Limit Diesel-Fueled Commercial Motor Vehicle Idling.

1.03 SUBMITTALS

A. General:
   1. Submit data as specified in Section 01330 - Submittal Procedures.
   2. As described in Appendix A - Mitigation Monitoring and Reporting Program.

B. Dust abatement program:
   1. Certifications that construction equipment is maintained and properly tuned.

C. Qualifications of wildlife biologist performing worker education and biological resource surveys.

D. Pre-construction biological resource surveys.

E. Archeological reports.

F. Qualifications of archaeological monitor present during construction activities impacting soils below fill deposits.

G. Daily site report for archaeological monitor.

H. Cultural sensitivity training materials and certificates of completion for construction crew.

PART 2 MITIGATION AND MONITORING REQUIREMENTS FOR ENVIRONMENTAL IMPACTS

2.01 GENERAL

A. Contractor is responsible for implementation of all of the mitigation measures described in Table A of Appendix A - Mitigation Monitoring and Reporting Program.

B. If any discovery of any potential tribal cultural resource and/or archaeological or historical resource is made, the following actions must occur:
   1. Contractor must notify the Party Contacts and the Division's Deputy Director by phone and email as well as the Division by phone at 916-327-9978 and by emailing CleanWaterSRF@waterboards.ca.gov within 24 hours.
      a. Party Contacts:

	State Water Board	City of Ukiah
Section:	Division of Financial Assistance	-
Name:	Jody Hack, Project Manager	Sage Sangiacomo, City Manager
Phone:	916-341-5811	707-463-6221
Email:	Jody.Hack@waterboards.ca.gov	ssangiacomo@cityofukiah.com

      b. Division's Deputy Director:

	State Water Board
Section:	Division of Financial Assistance
Name:	Joe Karkoski, Deputy Director
Phone:	916-341-5618
Email:	Joe.Karkoski@waterboards.ca.gov

   2. If discovery is made during construction or Project implementation, Contractor must ensure that all work in the area of the find will cease until a qualified archaeologist has evaluated the situation and made recommendations regarding preservation of the resource, and the Division has determined what actions should be taken to protect and preserve the resource.
   3. Contractor must implement appropriate actions as directed by the Division.

2.02 HAZARDS AND HAZARDOUS MATERIAL

A. As described in Table A of Appendix A - Mitigation Monitoring and Reporting Program and as specified in Section 01354 - Hazardous Material Procedures.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01220

MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Procedures for measurement and payment of Work under this Contract for lump sum items and unit prices.

1.02 REFERENCES

A. Occupational Safety and Health Administration (OSHA).

1.03 LUMP SUM ITEMS

A. Items 4, 19, and 31: Temporary Excavation Support:
   1. Measurement:
      a. Sheeting, shoring, and bracing, or equivalent method for the protection of life and limb in trenches and open excavation, in accordance with California Labor Code §6707.
      b. Requirements as specified in Section 02260 - Excavation Support and Protection.
      c. Measurement for payment will be Lump Sum.
   2. Payment:
      a. Lump sum.

B. Items 3, 6, 7, 8a, 8c, 8d, 8e, 8f, 9, 10, 11, 12, 13, 14, 15a, 15b, 16, 17, 18, 21, 22, 23, 24, 25, 27a, 27b, 28, 29, 30, 40, 45, 46, 47, and 48: Lump sum Item:
   1. Measurement:
      a. Includes costs including Contractor's fee for overhead and profit for continuous, full-time management of the Contract as described in the Contract Documents, covering a period of time not less than from the Notice to Proceed through the entire length of the allowable Contract Times specified in the Contract Documents.
   2. Payment:
      a. Lump sum.

C. Item 2: Traffic Control:
   1. Measurement:
      a. Includes work required for management including but not limited to temporary striping, signage, delineators, K-rails, cones, labor, flagmen, temporary fence, and equipment necessary for traffic control during the course of the work.
      b. Measurement for payment shall be by percent complete.
   2. Payment:
      a. Lump sum.

D. Items 5, 20, and 32: Dewatering:
   1. Measurement:
      a. Includes work for dewatering and other appurtenant work and materials.
      b. Measurement for payment shall be based on each.
   2. Payment:
      a. Per lump sum.

1.04 UNIT PRICE ITEMS

A. Measurement of quantities:
   1. Work paid at a unit price times number of units measured will be measured by Engineer in accordance with United States Standard Measures:
      a. 1 ton shall consist of 2,000 pounds avoirdupois.
   2. Provide and pay for accurate scales:
      a. Use platform scales of sufficient size and capacity to permit the entire vehicle or combination of vehicles to rest on the scale platform while being weighed.
      b. Combination vehicles may be weighed as separate units provided they are disconnected while being weighed.
      c. Have scales inspected and certified as often as necessary to ascertain accuracy.
      d. Furnish weigh slips and daily summary weigh sheets to Engineer.
      e. When material is shipped by rail, certified car weights will be acceptable, provided that not more than the actual weight of material will be paid, without consideration of minimum car weight used for assessing freight tariff:
      f. Car weight will not be acceptable for materials passing through mixing plants.
      g. Daily, or at shorter intervals when necessary to ensure accuracy, weigh empty trucks used to haul material paid by weight:
      h. Provide such trucks with plain, unique, permanent, legible identification marks.
   3. Reinforcing steel, steel shapes, castings, and similar items paid by weight will be measured by handbook weights for the type and quantity indicated for the Work.

B. Item 8b: AWT Tank Coating (per Specification Section 09960):
   1. Measurement:
      a. Includes removal of existing coating as required and surface preparation.
      b. Includes environmental controls as required for coating application.
      c. Includes new coating as specified in Section 09960 - High-Performance Coatings.
      d. Measurement and payment shall be by square foot of coating applied.
   2. Payment:
      a. Per square foot applied.

C. Items 33, 34, 35, 36, 37, 38, and 39: PVC pipeline in trench:
   1. Measurement:
      a. Includes work for pipe materials and installation; protection and support of utilities adjacent to the Work; excavation, temporary excavation support, soil hauling and disposal, geogrid, stabilization fabric, backfilling,

compaction, fine grading, elevation adjustments; pipe testing; marking tape; and other appurtenant work and materials.
        b. Includes work for completely restoring property affected by construction operations to its original or required condition, including fence replacement, preliminary grading, placement of topsoil, fine grading, grass sodding or seeding (if required), and final cleanup including removal of stormwater pollution prevention systems and removal of equipment or materials related to construction.
        c. Includes work for hydrostatic testing, disinfection (water line only), and activation of pipeline, if applicable.
        d. Measurement for payment shall be by linear foot from starting point through center of manholes (sewer only) or to the outside face of launching and receiving shafts at the tunnel break-out or break-in.
    2. Payment:
        a. Per linear foot installed.

D. Item 26: Construct New Manholes:
    1. Measurement:
        a. Includes work for constructing new manholes as indicated on the Drawings.
        b. Also included is saw cutting and removal of existing pavement outside of the limits of trenching for new pipeline, excavation outside the limits of the new piping, furnishing and installing cast-in-place concrete manhole base with smooth shaped channels, bedding, backfill, compaction, elevation adjustments, pipe stub outs, connections to pipes, joint seals, patch liner at joints and pipe penetrations, air testing of manholes, and temporary pavement or surfacing, restoration of existing improvements and installation of manhole frames and covers.
        c. Measurement for payment shall be based on each.
    2. Payment:
        a. Unit price.

E. Items 41, 42, 43, 44: Recycled Water Pipeline Valves and Appurtenances:
    1. Measurement:
        a. Includes work as indicated on the Drawings.
        b. Measurement for payment shall be based on each.
    2. Payment:
        a. Unit price.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01260

CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Administrative and procedural requirements for executing a change in the Work.

1.02 PRELIMINARY REQUIREMENTS

A. Change Order Cost Basis Summary Form:
   1. Submit a sample to Engineer for review within 15 calendar days following Notice to Proceed.
      a. Items will be reviewed and their value, percentage, or calculation method mutually agreed to by the Contractor and Owner prior to executing a Change Order on the Project.
   2. Used by the Contractor for pricing each Change Order required for additions, deletions, or revisions in the Work.
   3. Include the following information:
      a. Agreed upon markups, percentages, and procedures for calculating all surcharges, etc. associated with the Cost of the Change Order Work.
      b. References for unit price information and special unit price information.
      c. Attachments with the following information:
         1) Certified labor rates breakdown.
         2) Equipment rates.
         3) Bond and insurance rates (PI&I).

1.03 REQUEST FOR INFORMATION OR INTERPRETATION (RFI)

A. Contractor may issue RFIs to request interpretation of the documents or to request for information that may be missing.

B. General Instructions:
   1. Number RFIs consecutively.
      a. Add a consecutive letter to the RFI number on modified submittals of the same RFI (i.e., RFI 4B).
   2. Provide RFI for 1 item.
      a. There may be exceptions when multiple items are so functionally related that expediency indicates review of the group of items as a whole.
      b. RFIs with multiple items will be rejected without review.

3. Contractor sign and date RFIs indicating review and approval.
    a. Contractor’s signature indicates that they have satisfied RFI review responsibilities and constitutes Contractor's written approval of RFI.
    b. RFIs without Contractor's signature will be returned to the Contractor unreviewed. Subsequent submittal of this information will be counted as the first resubmittal.

C. Engineer will render a written clarification, interpretation, or decision on the issue submitted or initiate an amendment or supplement to the Contract within 21 days.
    1. In the event the Contractor identifies an RFI as critical to the progress of the project, Engineer will make every effort to reduce the RFI response time.

1.04 PRELIMINARY PROCEDURES

A. Owner or Engineer may initiate changes by submitting a Request for Proposal (RFP) to Contractor including the following information:
    1. Detailed description of the Change, Products, and location of the change in the Project.
    2. Supplementary or revised drawings or specifications.
    3. Projected time span for making the change, and a specific statement if overtime work is authorized.
    4. A specific period of time during which the requested price will be considered valid.
    5. Such request is for information only, and is not an instruction to execute the changes, or to stop work in progress.

B. Contractor may initiate changes by submitting a Change Proposal to Engineer containing the following:
    1. Description of proposed changes.
    2. Reason for making changes.
    3. Specific period of time during which requested price will be considered valid.
    4. Effect on Total Contract Cost and/or Contract Time.
    5. Documentation supporting any change in Total Contract Cost and/or Contract Time, as appropriate.

1.05 WORK CHANGE DIRECTIVE AUTHORIZATION

A. In lieu of a Request for Proposal (RFP), Engineer may issue a Work Change Directive Authorization for Contractor to proceed with a change for subsequent inclusion in a Change Order.

B. Authorization will describe changes in the Work, both additions and deletions, with attachments of revised Contract Documents to define details of the change and will designate method of determining any change in the Contract Sum and/or the Contract Time, as appropriate.

C. Owner and Engineer will sign and date the Work Change Directive Authorization as authorization for the Contractor to proceed with the changes.

D. Contractor may sign and date the Work Change Directive Authorization to indicate agreement with the terms.

1.06 DOCUMENTATION OF CHANGE PROPOSALS

A. Change proposal:
   1. Support with sufficient substantiating data to allow Engineer to evaluate the quotation.
      a. Lump sum.
      b. Unit prices: Use previously established unit prices.
      c. Time-and-material/force account basis:
         1) Name of the Owner's authorized agent who ordered the work, and date of the order.
         2) Dates and times work was performed, and by whom.
         3) Time record, summary of hours worked, and hourly rates paid.
         4) Receipts and invoices for:
            a) Equipment used, listing dates and times of use.
            b) Products used, listing of quantities.
            c) Subcontracts.
   2. Provide additional data to support time and cost computations:
      a. Labor required.
      b. Equipment required.
      c. Products required:
         1) Recommended source of purchase and unit cost.
         2) Quantities required.
      d. Taxes, insurance, and bonds.
      e. Credit for work deleted from Contract, similarly documented.
      f. Overhead and profit.
      g. Justification for change to Contract Time.

1.07 PREPARATION OF CHANGE ORDERS AND FIELD ORDERS

A. Engineer will prepare each Change Order and Field Order.

B. Change Orders:
   1. Will describe changes in the Work, both additions and deletions, with attachments of revised Contract Documents to define details of the change.
   2. Will provide an accounting of the adjustment in the Contract Sum and in the Contract Time.
   3. Recommendation of Change Proposal is indicated by Engineer's signature.
   4. Upon signature and execution by Owner, the Change Proposal becomes a Change Order altering the Contract Time and Total Contract Cost, as indicated.
      a. Owner's Representative will transmit one signed copy each to Contractor and Engineer.
   5. Contractor may only request payment for changes in the Work against an approved Change Order.
   6. If either Engineer or Owner's Representative disapproves the Change Proposal, the reason for disapproval will be stated.
      a. A request for a revised proposal or cancellation of the proposal will be shown.

C. Field Orders:
   1. Order minor changes in the Work without changes in Contract Price or Contract Times.

1.08 LUMP-SUM/FIXED PRICE CHANGE ORDER

A. Content of Change Orders will be based on, either:
   1. Engineer's Proposal Request and Contractor's responsive Change Proposal as mutually agreed between Owner and Contractor.
   2. Contractor's Change Proposal for a change, as recommended by Engineer.

B. Owner and Engineer will sign and date the Change Order to establish the change in Contract Sum and in Contract Time and serve as authorization for the Contractor to proceed with the changes.

C. Contractor will sign and date the Change Order to indicate agreement with the terms.

1.09 UNIT PRICE CHANGE ORDER

A. Content of Change Orders will be based on, either:
   1. Engineer's definition of the scope of the required changes.
   2. Contractor's Change Proposal for a change, recommended by Engineer.
   3. Survey of completed work.

B. The amounts of the unit prices to be:
   1. Those stated in the Contract.
   2. Those mutually agreed upon between Owner and Contractor.

C. When quantities of each of the items affected by the Change Order can be determined prior to start of the work:
   1. Owner and Engineer will sign and date the Change Order as authorization for Contractor to proceed with the changes.
   2. Contractor will sign and date the Change Order to indicate agreement with the terms.

D. When quantities of the items cannot be determined prior to start of the work:
   1. Engineer or Owner will issue a Work Change Directive authorization directing Contractor to proceed with the change on the basis of unit prices, and will cite the applicable unit prices.
   2. At completion of the change, Engineer will determine the cost of such work based on the unit prices and quantities used.
   3. Contractor shall submit documentation to establish the number of units of each item and any claims for a change in Contract Time.

E. Owner and Engineer will sign and date the Change Order to establish the change in Contract Sum and in Contract Time and serve as authorization for the Contractor to proceed with the changes.

F. Contractor will sign and date the Change Order to indicate their agreement with the terms.

1.10 TIME AND MATERIAL/FORCE ACCOUNT CHANGE ORDER/WORK CHANGE DIRECTIVE AUTHORIZATION

A. Engineer will issue a Work Change Directive for the Owner's signature authorizing Contractor to proceed with the changes.

B. At completion of the change, Contractor shall submit itemized accounting and supporting data as specified in this Section.

C. Engineer will determine the allowable cost of such work, as provided in the Contract Documents.

D. Owner and Engineer will sign and date the Change Order to establish the change in Contract Sum and in Contract Time and serve as authorization for the Contractor to proceed with the changes.

E. Contractor will sign and date the Change Order to indicate their agreement.

1.11 CORRELATION WITH CONTRACTOR'S SUBMITTALS

A. Periodically revise Schedule of Values and Applications for Payment forms to record each Change Order as a separate item of Work, and to record the adjusted Contract Sum.

B. Periodically revise the Construction Schedule to reflect each change in Contract Time. Revise subschedules to show changes for other items of work affected by the changes.

C. Upon completion of work under a Change Order, enter pertinent changes in Record Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01292

SCHEDULE OF VALUES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for preparation, format, and submittal of Schedule of Values.

1.02 PREPARATION

A. Schedule of Values shall be a listing of all cost loaded, on-site construction activities from the progress schedule, listed in numerical order, showing that the sum total of all cost-loaded activities equal the Contract value.

B. When the schedule is changed or revised to include added or deleted work, the Schedule of Values shall also be revised such that the sum total of all cost-loaded activities continuously equal the current Contract value.
   1. Equate the aggregate of these costs to the Lump Sum Contract Price.

C. Prepare Schedule of Values identifying costs of Major Items of Work.

1.03 SUBMITTALS

A. Submit Schedule of Values for the Preliminary Schedule as specified in, Section 01321 - Schedules and Reports.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01294

APPLICATIONS FOR PAYMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Procedures for preparation and submittal of Applications for Payment.

1.02 FORMAT

A. Develop satisfactory spreadsheet-type form generated by downloading cost data from the Progress Schedule.
   1. Submit payment requests and attach spreadsheet with cost data related to Progress Schedule.

B. Fill in information required on form.

C. When Change Orders are executed, add Change Orders at end of listing of scheduled activities:
   1. Identify change order by number and description.
   2. Provide cost of change order in appropriate column.

D. After completing, submit Application for Payment.

E. Engineer will review application for accuracy. When accurate, Engineer will transmit application to Owner for processing of payment.

F. Execute application with signature of responsible officer of Contractor.

1.03 SUBSTANTIATING DATA

A. Provide Substantiating Data identifying:
   1. Project.
   2. Application number and date.
   3. Cost flow summary.
   4. Updated schedule of values.
   5. Progress schedule.
   6. Detailed list of enclosures.
   7. Stored products log.
   8. Equipment log.
   9. Submit “certified” payroll, if applicable.
   10. Record (as-built) documents.
   11. Photos and videos from current pay period.
   12. Applicable unconditional waiver and release on progress payment for previous payment made by Owner.

1.04 SUBMITTALS

A. Submit Application for Payment and Substantiating Data with cover letter.

1.05 PAYMENT REQUESTS

A. Prepare progress payment requests on a monthly basis. Base requests on the breakdowns of costs for each scheduled activity and the percentage of completion for each activity.

B. Indicate total dollar amount of work planned for every month of the project. Equate sum of monthly amounts to Lump Sum Contract Price.

C. Generate Progress Payment request forms by downloading cost data from the schedule information to a spreadsheet type format.

D. Identify each activity on the Progress Schedule that has a cost associated with it, the cost for each activity, the estimated percent complete for each activity, and the value of work completed for both the payment period and job to date.

E. Prepare summary of cost information for each Major Item of Work listed in the Schedule of Values. Identify the value of work completed for both the payment period and job to date.

F. Payment period:
   1. Monthly Application for Payment period shall begin on the 1st day of each month, and end on the last day of each month.
   2. Submit Application for Payment to Engineer no later than the 5th day of each month for work completed the previous month.
   3. Engineer will finalize and submit recommendation for Application for Payment to Owner by the 15th day of each month to allow time for processing and approval.

1.06 COST SUMMARIES

A. Prepare Summary of Cost Information for each Major Item of Work listed in the Schedule of Values. Identify the Value of Work Completed for both the payment period and job to date.

B. Cash flow summary: Prepare cash flow summary, indicating total dollar amount of work planned for each month of the project. Equate sum of monthly amounts to Lump Sum contract price.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01312

PROJECT MEETINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for conducting conferences and meetings for the purposes of addressing issues related to the Work, reviewing and coordinating progress of the Work and other matters of common interest, and includes the following:
   1. Qualifications of Meeting Participants.
   2. Basic Meeting Requirements
   3. Pre-construction Conference.
   4. Pre-construction Safety Conference.
   5. Pre-submittal Conference.
   6. Web Based Construction Document Management Software Training.
   7. Progress Meetings.
   8. Schedule Update Meetings.
   9. Quality Control Meetings.
   10. Pre-Installation Meetings.
   11. Maintenance Of Plant Operations (MOPO) Meetings.
   12. Commissioning Coordination Meetings.
   13. Instrumentation and Control Coordination Meetings.
   14. Close-out Meeting.
   15. Post Construction Meeting.

1.02 QUALIFICATIONS OF MEETING PARTICIPANTS

A. Representatives of entities participating in meetings shall be qualified and authorized to act on behalf of entity each represents.

1.03 BASIC MEETING REQUIREMENTS

A. Attendees:
   1. Meeting leader shall require attendance of parties directly affecting, or affected by, Work being discussed at the meeting.

B. Location:
   1. In location convenient for most invitees.

C. Notification:
   1. Meeting leader shall notify attendees of meeting, including an agenda, a minimum of 7 days prior to meeting.

D. Agenda:
   1. Meeting leader shall prepare copies of agenda for participants and distribute at the meeting.
   2. Minimum requirements:
      a. Meeting purpose.
      b. Review minutes of previous meeting.
      c. Safety and security.
      d. Discuss issues.
      e. Action items.
      f. Next meeting.

E. Meeting minutes:
   1. Meeting leader shall provide draft minutes within 7 days of meeting and send to all attendees for comment within 7 days.
   2. Meeting leader shall incorporate comments from attendees and submit final meeting minutes to attendees within 7 days of receipt of comments.

1.04 PRE-CONSTRUCTION CONFERENCE

A. Engineer leads the meeting.

B. Timing:
   1. Upon issuance of Notice to Proceed, or earlier when mutually agreeable.

C. Attendees:
   1. Contractor's project manager and superintendent, Owner, Engineer, representatives of utilities, major subcontractors and others involved in performance of the Work, and others necessary to agenda.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. To establish working understanding between parties and to discuss Construction Schedule, shop drawing and other submittals, cost breakdown of major lump sum items, processing of submittals and applications for payment, and other subjects pertinent to execution of the Work.
   2. Review minutes of previous meeting.
   3. Adequacy of distribution of Contract Documents.
   4. Distribution and discussion of list of major subcontractors and suppliers.
   5. Proposed progress schedules and critical construction sequencing.
   6. Major equipment deliveries and priorities.
   7. Project coordination.
   8. Designation of responsible personnel.
   9. Procedures and processing of:
      a. Field decisions.
      b. Proposal requests.
      c. Submittals.
      d. Change Orders.
      e. Request for Information/Interpretations.
      f. Applications for Payment.
      g. Record Documents.

10. Use of premises:
    a. Office, construction, and storage areas.
    b. Owner's requirements.
11. Construction facilities, controls, and construction aids.
12. Temporary utilities.
13. Safety and first aid procedures.
14. Security procedures.
15. Housekeeping procedures.
16. Safety and security.
17. Review proposed photographer submittal.
18. Action items.
19. Next meeting.

1.05 PRE-CONSTRUCTION SAFETY CONFERENCE

A. Engineer leads the meeting.

B. Timing:
    1. Upon issuance of Notice to Proceed, or earlier when mutually agreeable.

C. Attendees:
    1. Contractor's project manager, safety representative, and superintendent; Owner, Engineer, representatives of utilities, major subcontractors and others involved in performance of the Work, and others necessary to agenda.

D. Agenda minimum requirements:
    1. Meeting purpose:
        a. To establish safety procedures and identify lead participants.
    2. Review minutes of previous meeting.
    3. Safety and first aid procedures.
    4. Review of Experience Modification Rating for Contractor and each subcontractor.
    5. Security procedures.
    6. Housekeeping procedures.
    7. Safety and security.
    8. Action items.
    9. Next meeting.

1.06 PRE-SUBMITTAL CONFERENCE

A. Engineer leads the meeting.

B. Timing:
    1. Prior to producing any submittals.

C. Attendees:
    1. Contractor's project manager and superintendent, Owner, Engineer, representatives of utilities, major subcontractors, individual equipment manufacturers furnishing major pieces of equipment, and others involved in performance of the Work, and others necessary to agenda.

D. Agenda minimum requirements:
    1. Meeting purpose:
        a. Reviewing the entire Project, equipment, schedules, and submittal requirements.
    2. Review equipment list.
    3. Review submittal schedule.
    4. Format of submittals.
    5. Procedures and processing of submittals.
        a. Review turn-around time.
    6. Discuss specific electrical and instrumentation and controls submittal requirements.
    7. Safety and security.
    8. Action items.
    9. Next meeting.

1.07 PROGRESS MEETINGS

A. Engineer will lead the meeting.

B. Timing:
    1. Hold meetings throughout progress of the Work at maximum weekly intervals.

C. Attendees:
    1. Owner, Engineer, Contractor, Contractor's Project Manager, superintendent, quality control manager, project scheduler, major subcontractors and suppliers as appropriate to agenda topics for each meeting.
    2. Additional invitees:
        a. Owner utility companies when the Work affects their interests, and others necessary to agenda.

D. Agenda minimum requirements:
    1. Meeting purpose:
        a. To discuss project progress.
    2. Review minutes of previous meeting.
    3. Safety and security.
    4. Construction schedule summary.
    5. Review of 6 weeks schedule.
        a. Contractor shall provide printed hard copies for each attendee.
    6. Review of off-site fabrication and delivery schedules.
    7. Review of submittals schedule and status of submittals.
    8. Request for information (RFI's) status.
    9. MOP's/shutdown coordination.
    10. Change order management status.
    11. Maintenance of quality standards (QA/QC).
    12. Field observations, problems, and conflicts.
    13. Commissioning.
    14. Partnering recognition status (optional).
    15. General Items.
    16. Action items.
    17. Next meeting.

1.08 SCHEDULE UPDATE MEETINGS

A. Contractor leads the meeting.

B. Timing:
   1. Hold meetings throughout progress of the Work at maximum monthly intervals.

C. Attendees:
   1. Owner, Engineer, Contractor, Contractor's Project Manager, General Superintendent, project scheduler, major subcontractors and suppliers as appropriate to agenda topics for each meeting.
   2. Additional invitees:
      a. Owner utility companies when the Work affects their interests and others necessary to the agenda.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. Discuss project schedule.
   2. Review minutes of previous meeting.
   3. Review Monthly Schedule, (Actual Progress and Variance).
      a. "Activities Started/Completed" this period.
      b. "Activities Started/Completed" "Variance" Baseline vs. current.
      c. "Added/Deleted Activities".
      d. "Revised Activity Descriptions".
      e. Any significant Proposed Logic Changes.
   4. Review milestone "Substantial Completion" Schedule:
      a. "Critical" Activities - "Critical Area, Float and Vital Statistics".
   5. Review "Cumulative and Monthly Costs" graph.
   6. Review "Budgeted Cost" indicating the Current Project Budgeted Cost.
   7. Safety and security.
   8. Action items.
   9. Next meeting.

1.09 QUALITY CONTROL MEETINGS

A. Contractor leads the meeting.

B. Timing:
   1. Hold meetings throughout progress of the Work at maximum weekly intervals.

C. Attendees:
   1. Engineer, Construction Manager and staff, Contractor's Quality Control Manager, and staff.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. Discuss quality control activities.
   2. Review minutes of previous meeting.
   3. Review of Work progress and schedule.
   4. Review of out-of-compliance inspection or test results.
   5. Field observations, problems, and decisions.

6. Review of offsite fabrication and delivery schedules.
7. Planned progress during succeeding work period.
8. Coordination of required inspections and tests.
9. Review 6-week schedule report with upcoming inspections and special tests.
10. Maintenance of quality and work standards.
11. Other business relating to Work.
12. Safety and security.
13. Action items.
14. Next meeting.

1.10 PRE-INSTALLATION MEETINGS

A. Contractor leads the meeting.

B. Timing:
   1. When specified in Technical Sections or requested by Engineer, convene pre-installation meeting at Project site before commencing Work of specific section.

C. Attendees:
   1. Require attendance of parties directly affecting, or affected by installation, including Engineer, specific work crews, Owner's construction, operations, and maintenance staff.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. Review conditions of installation, preparation and installation procedures.
      b. Review coordination with related work.
   2. Review minutes of previous meeting.
   3. Safety and security.
   4. Action items.
   5. Next meeting.

1.11 PRE-SHUTDOWN MEETINGS

A. Contractor leads the meeting.

B. Timing:
   1. Short-term and longer-term shutdowns and other tie-ins that require an Owner approved MOP require a pre-shutdown meeting at Project site at least 3 working days prior to commencing shutdown for tie-in or modification of specific plant systems.

C. Attendees:
   1. Require attendance of parties directly affecting, or affected by shutdown, including Engineer, specific work crews, Owner's construction, operations, and maintenance staff.

D. Agenda minimum requirements:
    1. Meeting purpose:
        a. Coordinate shutdown activities.
    2. Review minutes of previous meeting.
    3. Review accepted Construction Method of Procedure (MOP), as specified in Attachment A of Section 01140 - Work Restrictions, including conditions of shutdown, preparation, and installation procedures.
    4. Review timelines and sequences.
    5. Review responsibilities.
    6. Review dry run plan and schedule, as necessary.
    7. Review coordination with related work.
    8. Safety and security.
    9. Action items.
    10. Next meeting.

1.12 COMMISSIONING COORDINATION MEETINGS

A. Contractor leads the meeting.

B. Timing:
    1. Separate commissioning coordination meetings will be scheduled as required by Engineer.

C. Attendees:
    1. Require attendance of parties directly affecting, or affected by process start-up and testing, including Engineer, Commissioning Coordinator, specific work crews, Owner’s operations, and maintenance staff.

D. Agenda minimum requirements:
    1. Meeting purpose:
        a. Coordinate commissioning activities.
    2. Review minutes of previous meeting.
    3. Review Commissioning Schedule.
    4. Review Owner Training Schedule.
    5. Review test plans.
    6. Review accepted Construction Method of Procedure (MOP), as specified in Attachment A of Section 01140 - Work Restrictions.
    7. Owner makes final decision for commissioning GO or NO GO.
    8. Safety and security.
    9. Action items.
    10. Next meeting.

1.13 INSTRUMENTATION AND CONTROL COORDINATION MEETINGS

A. Meetings and conferences as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.14 CLOSE-OUT MEETING

A. Engineer leads the meeting.

B. Timing:
   1. After punch list items are completed.

C. Attendees:
   1. Owner, Engineer, Contractor, Contractor's Project Manager, and Superintendent.

D. Agenda minimum requirements:
   1. Meeting purpose:
      a. Coordinate close-out activities.
   2. Review minutes of previous meeting.
   3. Review punch list completion.
   4. Transfer of record documents.
   5. Finalize payment.
   6. Safety and security.
   7. Action items.
   8. Next meeting.

1.15 POST CONSTRUCTION MEETING

A. Engineer leads the meeting.

B. Attendees:
   1. Engineer, Contractor, appropriate manufacturers, and installers of major units of constructions, affected subcontractors, and Owner's operations and maintenance staff.

C. Timing:
   1. About 11 months after date of Substantial Completion.

D. Location:
   1. Meet in Owner's office or other mutually agreed upon place.

E. Agenda minimum requirements:
   1. Meeting purpose:
      a. Review project for compliance with Contract Documents.
   2. Inspect the Work and draft list of items to be completed or corrected.
   3. Review service and maintenance contracts and take appropriate corrective action when necessary.
   4. Complete or correct defective work and may extend correction period .
   5. Safety and security.
   6. Action items.
   7. Next meeting.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01321

SCHEDULES AND REPORTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Schedules and reports.

1.02 SUBMITTAL REQUIREMENTS

A. Submit preliminary and baseline schedule.

B. Submit preliminary and baseline schedule of values.

C. Submit preliminary and baseline schedule of submittals.

D. Submit, on a monthly basis, updated schedules as specified.

E. Submit final schedule update as specified.

F. Submit revised schedules and time impact analyses as specified.

G. Submit schedules in the media and number of copies as follows:
   1. Provide each submittal in PDF format and in other formats specified in this Section.
   2. 3 sets of the CPM network and/or bar chart (as specified by the Owner) on D-size sheets.
      a. Color-coding to be specified by the Owner.
   3. 3 sets of tabular reports listing all activities sorted numerically identifying duration, early start, late start, early finish, late finish, total float, and all predecessor/successor information.
   4. 2 sets of CPM Schedule data electronic files in a native backed-up file (.xer).

1.03 SCHEDULER

A. Designate, in writing and within 5 calendar days after Notice of Award, the person responsible for preparation, maintenance, updating, and revision of all schedules.

B. Qualifications of scheduler:
   1. Authority to act on behalf of Contractor.
   2. A minimum of 5 years verifiable experience in preparation of construction schedules for projects of similar value, size, and complexity.
   3. Knowledge of critical path method (CPM) scheduling utilizing Primavera P6 Professional software.

C. References:
   1. Submit written reference of 3 project Owners who have personal experience with this scheduler on previous projects.
   2. Identify name, address, telephone number, project name, and cost.

D. Owner reserves the right to disapprove scheduler when submitted by Contractor if not qualified.

E. Owner reserves the right to remove scheduler from the project if found to be unqualified.

1.04 SCHEDULING FORMAT AND SOFTWARE

A. Schedule format: Utilize CPM format.

B. Prepare computerized schedule utilizing Primavera P6 Professional software, most current version.
   1. Provide 1 licensed copy of the scheduling software to the engineer, registered in the Engineer's name, for the duration of the project.
   2. The provided copy of the software shall be a standalone version for installation on a standalone computer.

C. Contractor and Engineer must agree on the format.

1.05 PRECONSTRUCTION SCHEDULING MEETING

A. Engineer will conduct Preconstruction Scheduling Meeting with Contractor's Project Manager, General Superintendent, and scheduler within 7 calendar days after Notice to Proceed.
   1. This meeting is separate from the Preconstruction Conference Meeting and is intended to exclusively cover schedule issues.

B. At the meeting, review scheduling requirements.
   1. These include schedule preparation, reporting requirements, labor and equipment loading, updates, revisions, and schedule delay analysis
   2. Present schedule methodology, planned sequence of operations, cost and resource loading methodology, and proposed activity coding structure.
   3. Naming convention: Name schedule files with the year, month and day of the data date, revision identifier, and a description of the schedule.
      a. Example 1: 2014_07_30 rev 1 draft baseline schedule.xer.
      b. Example 2: 2014_09_30 rev 2 sep final update.xer.
   4. Coding structure:
      a. Submit proposed coding structure, identifying the code fields and the associated code values it intends to use in the project schedule.
      b. A minimum, include code fields for Project Segment or Phase, Area of Work, Type of Work, Submittal/Procurement/Construction and Responsibility/Subcontractor. Refer to NETWORK DETAILS AND GRAPHICAL OUTPUT for listing of activity categories to be included in the schedule.

C. Filing: Post submitted files to Owner's construction document control system.

1.06 REVIEW AND ACCEPTANCE OF SCHEDULES

A. Engineer will review Baseline Schedule, Schedule Updates, Schedule Revisions and Time Impact Analyses to ascertain compliance with specified project constraints, compliance with milestone dates, reasonableness of durations and sequence, accurate inter-relationships, and completeness.

B. Engineer and Owner will issue written comments following completion of review of Baseline Schedule within 21 calendar days after receipt.

C. Written comments on review of Schedule Updates and Schedule Revisions and Time Impact Analyses will be returned to Contractor within 14 calendar days after receipt by Engineer.

D. Revise and resubmit schedule in accordance with Engineer’s comments within 7 calendar days after receipt of such comments or request joint meeting to resolve objections.

E. If Engineer requests a meeting, the Contractor and all major subcontractors must participate in the meeting with Engineer.
   1. Revise and resubmit schedule within 7 calendar days after meeting.

F. Use accepted schedule for planning, organizing, and directing the work and for reporting progress.

G. Engineer’s submittal review response:
   1. When schedule reflects Owner's and Contractor's agreement of project approach and sequence, schedule will be accepted by Owner.
   2. Engineer’s submittal review response for schedule submittal will be “Receipt Acknowledged - Filed for Record” including applicable comments.
   3. Acceptance of the schedules by the Owner is for general conformance with the Contract Documents and for Owner’s planning information and does not relieve the Contractor of sole responsibility for planning, coordinating, and executing the Work within the contract completion dates. Omissions and errors in the accepted schedules shall not excuse performance less than that required by the Contract Documents. Acceptance by the Owner in no way constitutes an evaluation or validation of the Contractor’s plan, sequence or means, methods, and techniques of construction.

1.07 SCHEDULE UPDATES

A. Any update:
   1. Prepare update using most recent accepted version of schedule including:
      a. Actual start dates of activities that have been started.
      b. Actual finish dates of activities that have been completed.
      c. Percentage of completion of activities that have been started but not finished.
      d. Actual dates on which milestones were achieved.
      e. Update activities by inputting percent complete figures with actual dates.
      f. Use retained logic in preparing Schedule Updates.

g. When necessary, input remaining durations for activities whose finish dates cannot be calculated accurately with a percent complete figure only.
h. Revisions to the schedule may be included that have been previously approved as specified in this Section under Revisions to Schedule.

B. Monthly updates:
1. Submit written narrative report in conjunction with each Schedule Update including descriptions of the following:
a. Activities added to or deleted from the schedule are to adhere to cost and other resource loading requirements.
1) Identify added activities in manner distinctly different from original activity designations.
b. Changes in sequence or estimated duration of activities.
c. Current or anticipated problems and delays affecting progress, impact of these problems and delays and measures taken to mitigate impact.
d. Assumptions made and activities affected by incorporating change order work into the schedule.
2. Submit updated schedule and materials specified under Submittal of Progress Schedules, 5 calendar days before the monthly schedule update meeting.
3. Since Monthly Schedule Update is the application for progress payment required as specified in Section 01294 - Applications for Payment, submittal and acceptance of the monthly Schedule Update is a condition precedent to the making of any progress payments.

C. Weekly progress meeting:
1. Update the schedule prior to weekly progress meeting.
a. Identify overall progress of each Major Item of Work in the Summary Schedule.
b. If there are significant changes to the schedule, submit a written report at the weekly progress meeting.
2. Should monthly Schedule Update show project completion earlier than current Contract completion date, show early completion time as schedule activity, identified as “Project Float”.
3. Should monthly Schedule Update show project completion later than current Contract completion date, prepare and submit a Schedule Revision in accordance with the Revisions to Schedule.

1.08 REVISIONS TO SCHEDULE

A. Submit Revised Schedule within 5 days:
1. When delay in completion of any activity or group of activities indicates an overrun of the Contract Time or milestone dates by 20 working days or 5 percent of the remaining duration, whichever is less.
2. When delays in submittals, deliveries, or work stoppages are encountered making necessary the replanning or rescheduling of activities.
3. When the schedule does not represent the actual progress of activities.
4. When any change to the sequence of activities, the completion date for major portions of the work, or when changes occur which affect the critical path.
5. When Contract modification necessitates schedule revision, submit schedule analysis of change order work with cost proposal.

B. Create a separate submittal for Schedule Revisions.
   1. Comply with schedule updates as specified in this Section.
   2. Do not submit with Schedule Updates.

C. Schedule Revisions will not be reflected in the schedule until after the revision is accepted by the Owner.
   1. This includes Schedule Revisions submitted for the purpose of mitigating a Contractor-caused project delay (Recovery Schedule).

1.09 ADJUSTMENT OF CONTRACT TIMES

A. Contract Time will be adjusted only for causes specified in Contract Documents.
   1. Non-excusable delay:
      a. Non-excusable delays include actions or inactions of the Contractor, or events for which the Contractor has assumed contractual responsibility (including actions or inactions of subcontractors, suppliers, or material manufacturers at any tier) that would independently delay the completion of the Work beyond the current Contract completion date).
      b. No time extensions will be granted for non-excusable delays.
   2. Excusable delay:
      a. Events which are unforeseeable, outside the control of, and without the fault or negligence of either the Owner or the Contractor (or any party for whom either is responsible), which would independently delay the completion of the Work beyond the current Contract completion date.
      b. The Contractor is entitled to a time extension only.
      c. No other damages will be approved.
   3. Compensable delay:
      a. Actions or inactions of the Owner, or events for which the Owner has assumed contractual responsibility, which would independently delay the completion of the Work beyond the current Contract completion date.
      b. The Contractor is entitled to a time extension and delay damages.
   4. Concurrent delay:
      a. Concurrent delay is any combination of the above 3 types of delay occurring on the same calendar date.
      b. Exception to concurrent delay: Cases where the combination consists of 2 or more instances of the same type of delay occurring on the same calendar date. When one cause of delay is Owner-caused or caused by an event which is beyond the control and without the fault or negligence of either the Owner or the Contractor and the other Contractor-caused, the Contractor is entitled only to a time extension and no delay damages.

B. If the Contractor believes that the Owner has impacted its work, such that the project completion date will be delayed, the Contractor must submit proof demonstrating the delay to the critical path.
   1. This proof, in the form of a Time Impact Analysis, may entitle the Contractor to an adjustment of Contract Time.

C. Time Impact Analysis:
    1. Use the accepted schedule update that is current relative to the time frame of the delay event (change order, third party delay, or other Owner-caused delay). Represent the delay event in the schedule by:
        a. Inserting new activities associated with the delay event into the schedule.
        b. Revising activity logic.
        c. Revising activity durations.
    2. If the project schedule's critical path and completion date are impacted as a result of adding this delay event to the schedule, a time extension equal to the magnitude of the impact may be warranted.
    3. The Time Impact Analysis submittal must include the following information:
        a. A fragment of the portion of the schedule affected by the delay event.
        b. A narrative explanation of the delay issue and how it impacted the schedule.
        c. A schedule file used to perform the Time Impact Analysis.

D. When a delay to the project as a whole can be avoided by revising preferential sequencing or logic, and the Contractor chooses not to implement the revisions, the Contractor will be entitled to a time extension and no compensation for extended overhead.

E. Indicate clearly that the Contractor has used, in full, all project float available for the work involved in the request, including any float that may exist between the Contractor's planned completion date and the Contract completion date.
    1. Utilize the latest version of the Schedule Update accepted at the time of the alleged delay, and all other relevant information, to determine the adjustment of the Contract Time.

F. Adjustment of the Contract Times will be granted only when the Contract Float has been fully utilized and only when the revised date of completion of the Work has been pushed beyond the Contract completion date.
    1. Adjustment of the Contract Times will be made only for the number of days that the planned completion of the work has been extended.

G. Actual delays in activities which do not affect the critical path work or which do not move the Contractor's planned completion date beyond the Contract completion date will not be the basis for an adjustment to the Contract Time.

H. If completion of the project occurs within the specified Contract Time, the Contractor is not entitled to job-site or home office overhead beyond the Contractor's originally planned occupancy of the site.

I. Notify Engineer of a request for Contract Time adjustment.
    1. Submit request as specified in the Contract Documents.
    2. In cases where the Contractor does not submit a request for Contract Time adjustment for a specific change order, delay, or Contractor request within the specified period of time, then it is mutually agreed that the particular change order, delay, or Contractor request has no time impact on the Contract completion date and no time extension is required.

J. The Engineer will, within 30 calendar days after receipt of a Contract Time adjustment, request any supporting evidence, review the facts, and advise the Contractor in writing.
    1. Include the new Progress Schedule data, if accepted by the Owner, in the next monthly Schedule Update.
    2. When the Owner has not yet made a final determination as to the adjustment of the Contract Time, and the parties are unable to agree as to the amount of the adjustment to be reflected in the Progress Schedule, reflect that amount of time adjustment in the Progress Schedule as the Engineer may accept as appropriate for such interim purpose.
    3. It is understood and agreed that any such interim acceptance by the Engineer shall not be binding and shall be made only for the purpose of continuing to schedule the Work, until such time as a final determination as to any adjustment of the Contract Time acceptable to the Engineer has been made.
    4. Revise the Progress Schedule prepared thereafter in accordance with the final decision.

1.10 SCHEDULE PREPARATION

A. Preparation and submittal of Progress Schedule represents Contractor's intention to execute the Work within specified time and constraints.
    1. Failure to conform to requirement may result in termination for cause.

B. Contractor's bid covers all costs associated with the execution of the Work in accordance with the Progress Schedule.

C. During preparation of the preliminary Progress Schedule, Engineer will facilitate Contractor's efforts by being available to answer questions regarding sequencing issues, scheduling constraints, interface points, and dependency relationships.

D. Prepare schedule utilizing Precedence Diagramming Method (PDM).

E. Prepare schedule utilizing activity durations in terms of working days.
    1. Do not exceed 15 working day duration on activities except concrete curing, submittal review, and equipment fabrication and deliveries.
    2. Where duration of continuous work exceeds 15 working days, subdivide activities by location, stationing, or other sub-element of the Work.
    3. Coordinate holidays to be observed with the Owner and incorporate them into the schedule as non-working days.

F. Failure to include an activity required for execution of the Work does not excuse Contractor from completing the Work and portions thereof within specified times and at price specified in Contract.
    1. Contract requirements are not waived by failure of Contractor to include required schedule constraints, sequences, or milestones in schedule.
    2. Contract requirements are not waived by Owner’s acceptance of the schedule. In event of conflict between accepted schedule and Contract requirements, terms of Contract govern at all times, unless requirements are waived in writing by the Owner.

G. Reference schedule to working days with beginning of Contract Time as Day "1".

H. Baseline Schedule and Project Completion:
   1. Should Contractor submit a Baseline Schedule showing project completion more than 20 working days prior to Contract completion date, Owner may issue Change Order, at no cost to Owner, revising time of performance of Work and Contract completion date to match Contractor's schedule completion date.
   2. Adjust accordingly any Contract milestone dates.

I. Imposed dates, hidden logic prohibited: Do not use imposed dates or hidden logic in preparation of schedule.

J. Interim milestone dates, operational constraints:
   1. In event there are interim milestone dates and/or operational constraints set forth in Contract, show them on schedule.
   2. Do not use Zero Total Float constraint or Mandatory Finish Date on such Contract requirements.

K. Contract float is for the mutual benefit of both Owner and Contractor.
   1. Changes to the project that can be accomplished within this available period of float may be made by Owner without extending the Contract Time, by utilizing float.
   2. Time extensions will not be granted nor delay damages owed until Work extends beyond currently accepted Contract completion date.
   3. Likewise, Contractor may utilize float to offset delays other than delays caused by Owner.
   4. Mutual use of float can continue until all available float shown by schedule has been utilized by either Owner or Contractor, or both. At that time, extensions of the Contract Time will be granted by Owner for valid Owner-caused or third party-caused delays which affect the planned completion date and which have been properly documented and demonstrated by Contractor.
   5. Non-sequestering of float: Pursuant to float sharing requirements of Contract, schedule submittals can be rejected for, use of float suppression techniques such as preferential sequencing or logic, special lead or lag logic restraints, extended activity durations or imposed dates.

L. Resource loading and leveling: Input labor and equipment data on each schedule activity.
   1. Manpower data consist of the man-hours estimated to perform each task, categorized by trade.
   2. Equipment data consist of equipment hours estimated to perform each task, categorized by piece of equipment. Optimize and level manpower and equipment requirements.
   3. Resource leveling reflect a reasonable plan for accomplishing Work.
   4. Individual activities may be sequenced within limits of available float.
   5. Keep to a minimum critical or near critical paths resulting from use of labor or equipment restraints.
   6. Near critical path identified as path with 15 or less working days of float.

M. Schedule logic:
    1. Assembled to show order in which Contractor proposes to carry out Work, indicate restrictions of access, availability of Work areas, and availability and use of manpower, materials, and equipment.
    2. Form basis for assembly of schedule logic on the following criteria:
        a. Which activities must be completed before subsequent activities can be started?
        b. Which activities can be performed concurrently?
        c. Which activities must be started immediately following completed activities?
        d. What major facility, equipment, or manpower restrictions are required for sequencing these activities?

N. Major subcontractor, parallel prime contractor sign off:
    1. Provide written confirmation of concurrence from all major subcontractors and independent prime contractors on site with all schedule submittals.
    2. Term “major subcontractor” as used in this Section means any subcontractor, at any tier, with a subcontract worth 5 percent or more of the total cost of the Work.

O. Schedule windows for Owner-furnished, Contractor-installed equipment or materials:
    1. Immediately after Award of Contract, obtain from Engineer anticipated delivery dates of Owner furnished equipment or materials.
    2. Show these dates in the schedule in same manner indicated by Engineer.

P. Commissioning schedule:
    1. Commissioning activities and milestones shall be an integral part of the overall project schedule.
    2. Commissioning activities and milestones shall be extracted from the main project schedule to provide a separate commissioning schedule that is submitted each time the project schedule is submitted.

Q. Cost loading: All schedules:
    1. Only on-site construction activities.
    2. The sum total of all cost loaded activities equal to the current value of the Contract, including change orders, at all times.
    3. Payment for mobilization or payment for materials or equipment delivered to the site, not yet incorporated into the Work,
    4. Owner acceptance of the Baseline Schedule creates the Schedule of Values required as specified in Section 01292 - Schedule of Values
    5. Provide updated Schedule of Values as the monthly Payment Application as specified in Section 01294 - Applications for Payment.
    6. Payments will not be made until updated Schedule of Values is accepted.

1.11 NETWORK DETAILS AND GRAPHICAL OUTPUT

A. Produce a clear, legible, and accurate calendar based, time scaled, and graphical network diagram.
    1. Group activities related to the same physical areas of the Work. Produce the network diagram based upon the early start of all activities.

B. Include for each activity, the description, activity number, estimated duration in working days, total float, and all activity relationship lines.

C. Illustrate order and interdependence of activities and sequence in which Work is planned to be accomplished.
   1. Incorporate the basic concept of the precedence diagram network method to show how the start of 1 activity is dependent upon the start or completion of preceding activities and its completion restricts the start of following activities.

D. Indicate the critical path for the project.

E. Delineate the specified contract duration and identify the planned completion of the Work as a milestone.
   1. Show the time period between the planned and Contract completion dates, if any, as an activity identified as project float unless a Change Order is issued to officially change the Contract completion date.

F. Identify system shutdown dates, system tie-in dates, specified interim completion or milestone dates and contract completion date as milestones.

G. Include, in addition to construction activities:
   1. Submission dates and review periods for major equipment submittals, shoring submittals, and indicator pile program:
      a. Shoring reviews: Allow 4-week review period for each shoring submittal.
      b. Pile indicator program: Allow 3-week review period for analysis of program.
   2. Any activity by the Owner or the Engineer that may affect progress or required completion dates.
   3. Equipment and long-lead material deliveries over 8 weeks.
   4. Approvals required by regulatory agencies or other third parties.

H. Produce network diagram on 22-inch by 34-inch sheets with grid coordinate system on the border of all sheets utilizing alpha and numeric designations.

I. Identify the execution of the following:
   1. Bid items as indicated in Section 01220 - Measurement and Payment.

1.12 WEATHER DAY ALLOWANCE

A. Definition:
   1. Weather conditions that prevent or inhibit the Contractor’s performance of the Work and affect the Critical Path indicated on the Schedule shall be referred to as a Weather Day.
   2. A Weather Day is defined as the Contractor being unable to perform at least 4 hours of work on the Critical Path.

B. Allowance:
   1. Include as a separate identifiable activity on the critical path, an activity labeled "Weather Days Allowance".

C. Actual weather day:
    1. Insert a weather delay activity in critical path to reflect actual weather day occurrences when weather days are experienced and accepted by Engineer.
    2. Reduce duration of Weather Days Allowance activity as weather delays are experienced and inserted into the Schedule. Remaining weather days in Weather Day Allowance at completion of project is considered float.
    3. The Contractor shall provide a written notice to the Engineer of the occurrence of a weather day within 2 days after the onset of such weather and shall describe in reasonable detail the type of weather encountered and the Work interfered with or interrupted.
        a. A schedule update will not suffice as a written notice.
        b. The Engineer will determine if the weather day constitutes a use of a portion of the Weather Day Allowance.
        c. After use of all the Weather Day Allowance, the Engineer will determine if the Contractor is entitled to an extension of the Contract Time due to weather conditions.
        d. Weather days are considered excusable delay as defined in this Section.

1.13 ALLOWANCE FOR OWNER-CAUSED DELAY

A. Allowance:
    1. Include as a separate identifiable activity on the critical path, an activity labeled "Allowance for Owner-Caused Delay."
    2. Insert this activity at the end of the schedule, following the Project Completion Milestone.
    3. Duration of this activity is specified in Bid Form.
        a. The duration of this Owner-Caused Delay Allowance is in addition to the contractual time frame.

B. Actual delay:
    1. Insert an activity in critical path to reflect actual Owner-caused delay occurrences when Owner-caused delay days are experienced and accepted by Engineer.
        a. Identify this activity as an Owner-caused delay.
    2. Reduce duration of Owner-Caused Delay Allowance activity as Owner-caused delays are experienced and inserted into the schedule. Remaining days in Owner-Caused Delay Allowance at completion of project is considered float.

1.14 PRELIMINARY SCHEDULE AND PRELIMINARY SCHEDULE OF VALUES

A. Due date:
    1. Submit proposed preliminary schedule and Preliminary Schedule of Values within 14 calendar days after Notice to Proceed.
    2. Meet with Engineer within 7 calendar days after receipt of Preliminary Schedule and Preliminary Schedule of Values to review and make necessary adjustments.
    3. Submit revised preliminary schedule and Preliminary Schedule of Values within 5 calendar days after meeting.

4. Update Preliminary Schedule and Preliminary Schedule of Values monthly during first 90 calendar days after Notice to Proceed.
    a. Use Preliminary Schedule and Preliminary Schedule of Values as the payment application as specified in Section 01294 - Applications for Payment.

B. Format:
    1. Schedule of manpower and costs for all activities for first 90 calendar days of Work after receipt of Notice to Proceed.
        a. Provide realistic and level manpower and costs so as not to have unusual manpower requirements.
    2. Schedule of costs:
        a. Schedule of Values as specified in Section 01292 - Schedule of Values for first 90 calendar days of Work.
        b. Submittal and acceptance of Preliminary Schedule is condition precedent to making of progress payments as specified in Section 01294 - Applications for Payment and payments for mobilization costs otherwise provided for in the Contract.
        c. Proceed with pay item Work after Preliminary Schedule and schedule of costs have been accepted by Owner.

C. Incorporate unchanged, the accepted Preliminary Schedule as first 90 calendar days of activity in Contractor's Baseline Schedule.

1.15 SCHEDULE OF SUBMITTALS

A. Schedule of Submittals shall include submittals required in the Contract Documents but not limited to test plans, training plans, test procedures, operation and maintenance manuals, shop drawings, samples, record documents, and specifically required certificates, warranties, and service agreements.
    1. Data for "Or Equals" or substitutions shall be submitted with the Schedule of Submittals.

B. Preliminary Schedule of Submittals:
    1. Due date: After Preliminary Schedule has been submitted and accepted by Owner.
    2. Format:
        a. Include submittals anticipated in the first 90 calendar days after award of contract using early start dates.
        b. Indicate week and month anticipated for submittal to Engineer.
        c. Indicate "Priority" submittals where review time can impact Contractor's schedule.
            1) "Priority" indication will not alter review times specified in Section 01330 - Submittal Procedures.
            2) Engineer will endeavor to provide early review of "Priority" submittals where possible.
        d. List of "Or Equals" or substitutions.
    3. Submittal of Preliminary Schedule of Submittals shall be a condition precedent to Owner making progress payments during the first 90 calendar days after award of contract.

C. Final Schedule of Submittals:
   1. Due date: 30 days after Baseline Schedule has been submitted and accepted by Owner.
   2. Format:
      a. Include submittals using early start dates.
      b. Include all submittals, including those required in the Preliminary Schedule of Submittals.
      c. Indicate week and month anticipated for submittal to Engineer.
      d. Indicate “Priority” submittals where review time can impact Contractor’s schedule.
         1) “Priority” indication will not alter review times specified in Section 01330 - Submittal Procedures.
         2) Engineer will endeavor to provide early review of “Priority” submittals where possible.
      e. Data for “Or Equals” or substitutions.
   3. Submittal of Final Schedule of Submittals shall be a condition precedent to Owner making progress payments after the first 90 calendar days after Notice to Proceed.

D. Provide updated Schedule of Submittals with updated schedules if schedule revisions change listing and timing of submittals.

1.16 BASELINE SCHEDULE AND BASELINE SCHEDULE OF VALUES

A. Due date: No more than 45 calendar days after Notice to Proceed.

B. Format:
   1. Schedule: Show sequence and interdependence of all activities required for complete performance of all Work, beginning with date of Notice to Proceed and concluding with date of final completion of Contract.
   2. Schedule of Values: As specified in Section 01292 - Schedule of Values.

C. Acceptance of the Baseline Schedule and Baseline Schedule of Values by the Owner is a condition precedent to making payments as specified in Section 01294 - Applications for Payment after the first 90 calendar days after Notice to Proceed.

1.17 SUMMARY SCHEDULE

A. Due date: At weekly progress meetings and after each Schedule Update or Schedule Revision.

B. Format:
   1. Consolidate groups of activities associated with Major Items of Work shown on Baseline Schedule.
   2. intended to give an overall indication of the project schedule without a large amount of detail.

1.18 COST FLOW SUMMARY

A. Due date: After Baseline Schedule has been submitted and accepted by the Owner, submit on a monthly basis as specified in Section 01294 - Applications for Payment.

B. Format:
   1. Tabular and graphic report showing anticipated earnings each month of the Contract period.
   2. Base tabulation on the summation of the cost-loaded activities each month.
   3. Show planned amounts.
   4. Show actual earned amounts and anticipated remaining earnings.
   5. Spreadsheet format of all schedule activities showing cost and percentage completion during the current month for which payment is sought.

1.19 PROGRESS SCHEDULE AND UPDATED SCHEDULE OF VALUES

A. Due date: Submit on a monthly basis as specified in Section 01294 - Applications for Payment.

B. Format: Schedule of Values: As specified in Section 01292 - Schedule of Values.

1.20 WEEKLY SCHEDULE

A. Due date: At every weekly progress meeting.

B. Format:
   1. Contractor and Engineer must agree on the format.
   2. 6-Week Schedule showing the activities completed during the previous week and the Contractor’s schedule of activities for following 5 weeks.
   3. Use the logic and conform to the status of the current progress schedule when producing a Weekly Schedule in CPM schedule or a bar chart format.
      a. In the event that the Weekly Schedule no longer conforms to the current schedule, Contractor may be required to revise the schedule as specified in this Section.
   4. The activity designations used in the Weekly Schedule must be consistent with those used in the Baseline Schedule and the monthly Schedule Updates.

1.21 MANPOWER SCHEDULE

A. Due date: With progress payments after Baseline Schedule has been submitted and accepted by Owner.

B. Format:
   1. Schedule histogram depicting total craft manpower and craft manpower for Contractor’s own labor forces and those of each subcontractor.
   2. Submit electronically in Excel format, with 1 paper copy.

C. Progress payments after the first 90 calendar days after Notice to Proceed will not be made until manpower schedule is provided.

1.22 EQUIPMENT SCHEDULE

A. Due date: With any progress payment after Baseline Schedule has been submitted and accepted by Owner if it includes payment for equipment.

B. Format:
   1. Tabular report listing each major piece of construction equipment to be used in performing the Work.
   2. Include major equipment for Contractor and each subcontractor.
   3. Submit electronically in Excel format with 1 paper copy.

C. Progress payments after the first 90 calendar days after Notice to Proceed will not be made until equipment schedule is provided.

1.23 COMMISSIONING SCHEDULE

A. Proposed Commissioning Schedule:
   1. Schedule requirements: As specified in Section 01756 - Commissioning.
   2. Submittal due date: Within 120 days after Notice to Proceed.
   3. Engineer response due within 20 calendar days of receipt.
   4. Contractor responsible for updating schedule and resubmitting within 10 calendar days of receipt of Engineer and Owner comments.

B. Construction Schedule can include the Commissioning Schedule after Engineer acceptance of the Proposed Commissioning Schedule.
   1. Capable of extracting a stand-alone Commissioning Schedule.
   2. Capable of extracting a stand-alone Owner Training Schedule.

C. Monthly update requirements:
   1. Highlight percentages of completion, actual start and finish dates, and remaining durations, as applicable.
   2. Include activities not previously included in the previously accepted detail work plan Commissioning Schedule.
   3. Change Order required for any change to contractual dates.
   4. Reviews of these submittals by Engineer will not be construed to constitute acceptance within the time frames, durations, or sequence of work for each added activity.

1.24 FINAL SCHEDULE

A. The final Schedule Update becomes the As-Built Schedule.
   1. The As-Built Schedule reflects the exact manner in which the project was constructed by reflecting actual start and completion dates for all activities accomplished on the project.
   2. Contractor’s Project Manager and scheduler sign and certify the As-Built Schedule as being an accurate record of the way the project was actually constructed.

B. Retainage will not be released until final Schedule Update is provided.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01322

WEB BASED CONSTRUCTION DOCUMENT MANAGEMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Requirements for web-based construction document management.

1.02 REQUIREMENTS

A. Owner, Engineer, Construction Manager, and Contractor shall utilize Autodesk Build web-based construction management software for submission of data and documents.
   1. Web based construction management software is available to all Contractor's personnel, subcontractor personnel, suppliers, consultants, Owner, Construction Manager, and Engineer at no cost.
   2. The joint use of this system is to facilitate electronic exchange of information, automation of key processes, and overall management of Contract Documentation.
   3. Web based construction management software shall be the primary means of project information submission and management.

1.03 USER ACCESS LIMITATIONS

A. Provide a list of Contractor's key web based construction management software personnel for the Engineer's acceptance.

B. The Engineer reserves the right to perform a security check on all potential users.
   1. The Contractor will be allowed to add additional personnel and subcontractors to the web-based construction management software.
   2. Subcontractors and suppliers will be given access to web-based construction management software by and through the Contractor.
   3. Contractor is responsible for adding and removing users from the system after the initial setup by the Engineer.

C. The Engineer will grant initial access to the web-based construction management software by creating user profiles to accepted Contractor personnel.
   1. User profiles will define levels of access into the system; determine assigned function based authorizations and user privileges.

1.04 JOINT OWNERSHIP OF DATA

A. Data entered in a collaborative mode (entered with the intent to share as determined by permissions and workflows within the web-based construction management software system) by Engineer and Contractor will be jointly owned.

1.05 AUTOMATED SYSTEM NOTIFICATION AND AUDIT LOG TRACKING

A. Review comments made (or lack thereof) by Owner on Contractor submitted documentation shall not relieve Contractor from compliance with requirements of the Contract Documents.

B. Contractor is responsible for managing, tracking, and documenting the Work to comply with the requirements of the Contract Documents.

C. Owner’s acceptance via automated system notifications or audit logs extends only to the face value of the submitted documentation and does not constitute validation of the Contractor's submitted information.

1.06 COMPUTER REQUIREMENTS

A. Contractor shall use computer hardware and software that meets the requirements of the web-based construction management software system as recommended by the web-based construction management software to access and utilize the web-based construction management software.

B. As recommendations are modified by the web-based construction management software, Contractor will upgrade their system(s) to meet or exceed the recommendations.
   1. Upgrading of Contractor's computer systems will not be justification for a cost or time modification to the Contract.

C. Contractor shall ensure that connectivity to the web-based construction management software system is accomplished through DSL, cable, T-1, or wireless communications systems.
   1. The minimum bandwidth requirements for using the system is 128 kb/s. It is recommended a faster connection be used when uploading pictures and files into the system.

D. Web-based construction management software supports the current and prior 2 major versions of Chrome, Mozilla's Firefox, Microsoft’s Internet Explorer, and Apple’s Safari on a rolling basis.
   1. Each time a new version of one of these browsers is released the web-based construction management software will begin supporting the update and stop supporting the fourth-oldest version.

1.07 CONTRACTOR RESPONSIBILITY

A. Contractor shall be responsible for the validity of their information placed in the web-based construction management software and for the abilities of their personnel.

B. Entry of information exchanged and transferred between the Contractor and its subcontractors and suppliers on the web-based construction management software shall be the responsibility of the Contractor.

C. Accepted users shall be knowledgeable in the use of computers, including Internet Browsers, email programs, cad drawing applications, and Adobe Portable Document Format (PDF) document distribution program.

D. Contractor shall utilize the existing forms in the web-based construction management software to the maximum extent possible. If a form does not exist in the web-based construction management software the Contractor must include a form of their own or provided by Engineer as an attachment to a submittal.

E. Adobe PDF documents will be created through electronic conversion rather than optically scanned whenever possible. Contractor is responsible for the training of their personnel in the use of the web-based construction management software (outside what is provided by Owner) and the other programs indicated above as needed.

1.08 TRAINING

A. The Owner has arranged and paid for web-based training on using web-based construction management software for the Contractor.

B. Contractor shall arrange and pay for the facilities and hardware/software required to facilitate Contractor's training.

PART 2 PRODUCTS

2.01 DESCRIPTION

A. Web-based construction management software provided by Autodesk Build.

PART 3 EXECUTION

3.01 WEB-BASED CONSTRUCTION MANAGEMENT SOFTWARE UTILIZATION

A. Web-based construction management software shall be utilized in connection with all document and information management required by these Contract Documents.

3.02 SUBMITTALS

A. Use the web-based construction management software feature for Master Submittals List.
   1. Contractor shall select from the predefined submittals list.

B. Content: As specified in Section 01330 - Submittal Procedures.

C. Format: As specified in Section 01330 - Submittal Procedures.

D. Submit Portable Document Format (PDF) documents to the web-based construction management software submittal work flow process and forms.
   1. Consolidate electronic format submittals with multiples pages into a single file.

E. Hardcopy submittals:
   1. Contractor shall provide 3 hard copies of submittals within 14 days of the Submittal being closed.
   2. Hardcopy requirements as specified in Section 01330 - Submittal Procedures.

F. Samples:
   1. Contractor shall enter submittal data information into the web-based construction management software.
   2. Attach a copy of the submittal form(s) to the sample.

G. Record And Closeout Submittals:
   1. Operation and maintenance data as specified in Section 01782 - Operation and Maintenance Manuals.
   2. Extra materials, spare parts, etc.

3.03 REQUESTS FOR INFORMATION/INTERPRETATION (RFI)

A. Use web-based construction management software for RFIs as specified in Section 01260 - Contract Modification Procedures.

3.04 OFFICIAL CORRESPONDENCE

A. Use web-based construction management software for memos, notices, change proposals, or any official correspondence.

3.05 INSPECTION REQUESTS

A. Use web-based construction management software to request inspection for a portion of Work that is ready for inspection and prior to covering up the Work.

3.06 FINANCIAL SUBMITTALS

A. Use web-based construction management software for financial submittals as specified in Section 01330 - Submittal Procedures.

3.07 OTHER

A. Use web-based construction management software for daily reports, meeting agendas and minutes, and other construction documents.

END OF SECTION

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements and procedures for submittals to confirm compliance with Contract Documents.

1.02 GENERAL INSTRUCTIONS

A. Contractor is responsible to determine and verify field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and check and coordinate each item with other applicable approved shop drawings and Contract Document requirements.

B. Provide submittals:
   1. That are specified or reasonably required for construction, operation, and maintenance of the Work.
   2. That demonstrate compliance with the Contract Documents.

C. Where multiple submittals are required, provide a separate submittal for each specification section.
   1. In order to expedite construction, the Contractor may make more than 1 submittal per specification section, but a single submittal may not cover more than 1 specification section:
      a. The only exception to this requirement is when 1 specification section covers the requirements for a component of equipment specified in another section.
      b. For example, circuit breakers are a component of switchgear. The switchgear submittal must also contain data for the associated circuit breakers, even though they are covered in a different specification section.

D. Prepare submittals in the English language. Do not include information in other languages.

E. Present measurements in customary American units (feet, inches, pounds, etc.).

F. Must be clear and legible, and of sufficient size for presentation of information.

G. Page size other than drawings:
   1. Minimum page size will be 8 1/2 inches by 11 inches:
   2. Maximum page size will be 11 inches by 17 inches.

H. Drawing sheet size:
   1. Maximum sheets size: 22-inch by 34-inch.
      a. Minimum plan scale: 1/8-inch equals 1 foot-0 inches.
      b. Minimum font size: 1/8 inch minimum.
   2. 11-inch by 17-inch sheet:
      a. Minimum plan scale: 1/8-inch equals 1 foot-0 inches.
      b. Minimum font size: 1/8 inch minimum.

I. Show dimensions, construction details, wiring diagrams, controls, manufacturers, catalog numbers, and all other pertinent details.

J. Provide submittal information from only 1 manufacturer for a specified product. Submittals with multiple manufacturers for 1 product will be rejected without review.

1.03 SUBMITTAL ORGANIZATION

A. Organize submittals in exactly the same order as the items are referenced, listed, and/or organized in the specification section.

B. For submittals that cover multiple devices used in different areas under the same specification section, the submittal for the individual devices must list the area where the device is used.

C. Bookmarks:
   1. Bookmarks shall match the table of contents.
   2. Bookmark each section (tab) and heading.
   3. Drawings: Bookmark at a minimum, each discipline, area designation, or appropriate division.
   4. At file opening, display all levels of bookmarks as expanded.

D. Where applicable (i.e., except for drawings, figures, etc.) submittal content shall be electronically searchable utilizing the PDF file as submitted.

E. Thumbnails optimized for fast web viewing.

F. Sequentially number pages within the tabbed sections:
   1. Submittals that are not fully indexed and tabbed with sequentially numbered pages, or are otherwise unacceptable, will be returned without review.

G. Attachments:
   1. Specification section: Include with each submittal a copy of the relevant specification section.
      a. Indicate in the left margin, next to each pertinent paragraph, either compliance with a check (√) or deviation with a consecutive number (1, 2, 3).
      b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
   2. Drawings: Include with each submittal a copy of the relevant Drawing, including relevant addendum updates.
      a. Indicate either compliance with a check (√) or deviation with a consecutive number (1, 2, 3).

b. Provide a list of all numbered deviations with a clear explanation and reason for the deviation.
c. Provide field dimensions and relationship to adjacent or critical features of the Work or materials.

H. Contractor: Prepare submittal information in sufficient detail to show compliance with specified requirements.
1. Determine and verify quantities, field dimensions, product dimensions, specified design and performance criteria, materials, catalog numbers, and similar data.
2. Coordinate submittal with other submittals and with the requirements of the Contract Documents.
3. Check, verify, and revise submittals as necessary to bring them into conformance with Contract Documents and actual field conditions.

I. Contractor: Prepare "Or Equal" submittal information.
1. Provide standard submittal requirements.
a. In addition, provide in sufficient detail to show reason for variance from specified product and impacts.
2. Provide reason the specified product is not being provided.
3. Explain the benefits to the Owner for accepting the "Or Equal".
4. Itemized comparison of the proposed "Or Equal" with product specified including a list of significant variations:
a. Design features.
b. Design dimensions.
c. Installation requirements.
d. Operations and maintenance requirements.
e. Availability of maintenance services and sources of replacement materials.
5. Reference projects where the product has been successfully used:
a. Name and address of project.
b. Year of installation.
c. Year placed in operation.
d. Name of product installed.
e. Point of contact: Name and phone number.
6. Define impacts:
a. Impacts to other contracts.
b. Impacts to other work or products.
7. Contractor represents the following:
a. Contractor bears the burden of proof of the equivalency of the proposed "Or Equal".
b. Proposed "Or Equal" is equal or superior to the specified product.
c. Contractor will provide the warranties or bonds that would be provided on the specified product on the proposed "Or Equal", unless Owner requires a Special Warranty.
d. Contractor will coordinate installation of accepted "Or Equal" into the Work and will be responsible for the costs to make changes as required to the Work.
e. Contractor waives rights to claim additional costs caused by proposed "Or Equal" which may subsequently become apparent.

J. Contractor: Prepare substitution submittal information.
    1. Provide standard submittal requirements.
        a. In addition, provide in sufficient detail to show reason for variance from specified product and impacts.
    2. Provide reason the specified product is not being provided.
    3. Explain the benefits to the Owner for accepting the substitution.
    4. Itemized comparison of the proposed substitution with product specified including a list of significant variations:
        a. Design features.
        b. Design dimensions.
        c. Installation requirements.
        d. Operations and maintenance requirements.
        e. Availability of maintenance services and sources of replacement materials.
    5. Reference projects where the product has been successfully used:
        a. Name and address of project.
        b. Year of installation.
        c. Year placed in operation.
        d. Name of product installed.
        e. Point of contact: Name and phone number.
    6. Define impacts:
        a. Impacts to Contract Price.
            1) Required license fees or royalties.
            2) Do not include costs under separate contracts.
            3) Do not include Engineer’s costs for redesign or revision of Contract Documents.
        b. Impacts to Contract Time.
        c. Impacts to Contract Scope.
        d. Impacts to other contracts.
        e. Impacts to other work or products.
    7. Contractor represents the following:
        a. Contractor shall pay associated costs for Engineer to evaluate the substitution.
        b. Contractor bears the burden of proof of the equivalency of the proposed substitution.
        c. Proposed substitution does not change the design intent and will have equal performance to the specified product.
        d. Proposed substitution is equal or superior to the specified product.
        e. Contractor will provide the warranties or bonds that would be provided on the specified product on the proposed substitution, unless Owner requires a Special Warranty.
        f. Contractor will coordinate installation of accepted substitution into the Work and will be responsible for the costs to make changes as required to the Work.
        g. Contractor waives rights to claim additional costs caused by proposed substitution which may subsequently become apparent.

1.04 SUBMITTAL IDENTIFICATION NUMBERING

A. Number each submittal using the format defined below:

	Spec Section Number	Dash	Initial Submittal - Sequential Number	Decimal Point	Subsequent Submittal Revisions Sequential Number
Example 1 Description	*Cast-In-Place Concrete*		*8th initial submittal*		
	03300	-	0008		
Example 2 Description	*Cast-In-Place Concrete*		*8th initial submittal*		*First revision to the 8th initial submittal*
	03300	-	0008	.	1

1.05 SUBMITTALS IN ELECTRONIC MEDIA FORMAT

A. General: Provide all information in PC-compatible format using Windows® operating system as utilized by the Owner and Engineer.

B. Text: Provide text documents and manufacturer's literature in Portable Document Format (PDF).

C. Graphics: Provide graphic submittals (drawings, diagrams, figures, etc.) utilizing Portable Document Format (PDF).

1.06 SUBMITTAL PROCEDURE

A. Engineer: Review submittal and provide response:
   1. Review description:
      a. Engineer will be entitled to rely upon the accuracy or completeness of designs, calculations, or certifications made by licensed professionals accompanying a particular submittal whether or not a stamp or seal is required by Contract Documents or Laws and Regulations.
      b. Engineer's review of submittals shall not release Contractor from Contractor's responsibility for performance of requirements of Contract Documents. Neither shall Engineer's review release Contractor from fulfilling purpose of installation nor from Contractor's liability to replace defective work.
      c. Engineer's review of shop drawings, samples, or test procedures will be only for conformance with design concepts and for compliance with information given in Contract Documents.
      d. Engineer's review does not extend to:
         1) Accuracy of dimensions, quantities, or performance of equipment and systems designed by Contractor.

2) Contractor's means, methods, techniques, sequences, or procedures except when specified, indicated on the Drawings, or required by Contract Documents.
3) Safety precautions or programs related to safety which shall remain the sole responsibility of the Contractor.

e. Engineer can Approve or Not Approve any exception at their sole discretion.

2. Review timeframe:
   a. Except as may be provided in technical specifications, a submittal will be returned within 30 days.
   b. When a submittal cannot be returned within the specified period, Engineer will, within a reasonable time after receipt of the submittal, give notice of the date by which that submittal will be returned.
   c. Engineer's acceptance of progress schedule containing submittal review times less than those specified or agreed to in writing by Engineer will not constitute Engineer's acceptance of review times.
   d. Critical submittals:
      1) Contractor will notify Engineer in writing that timely review of a submittal is critical to the progress of Work.
3. Schedule delays:
   a. No adjustment of Contract Times or Contract Price will be allowed due to Engineer's review of submittals, unless all of the following criteria are met:
      1) Engineer has failed to review and return first submission within the agreed upon time frame.
      2) Contractor demonstrates that delay in progress of Work is directly attributable to Engineer's failure to return submittal within time indicated and accepted by Engineer.
4. Review response will be returned to Contractor with one of the following dispositions:
   a. Approved:
      1) No Exceptions:
         a) There are no notations or comments on the submittal and the Contractor may release the equipment for production.
      2) Make Corrections Noted - See Comments:
         a) The Contractor may proceed with the Work, however, all notations and comments must be incorporated into the final product.
         b) Resubmittal not required.
      3) Make Corrections Noted - Confirm:
         a) The Contractor may proceed with the Work, however, all notations and comments must be incorporated into the final product.
         b) Submit confirmation specifically addressing each notation or comment to the Engineer within 15 calendar days of the date of the Engineer's transmittal requiring the confirmation.

b. Not approved:
    1) Correct and resubmit:
        a) Contractor may not proceed with the Work described in the submittal.
        b) Contractor assumes responsibility for proceeding without approval.
        c) Resubmittal of complete submittal package is required within 30 calendar days of the date of the Engineer's submittal review response.
    2) Rejected - See Remarks:
        a) Contractor may not proceed with the Work described in the submittal.
        b) The submittal does not meet the intent of the Contract Documents. Resubmittal of complete submittal package is required with materials, equipment, methods, etc. that meet the requirements of the Contract Documents.
c. Receipt acknowledged - Filed for record:
    1) This is used in acknowledging receipt of informational submittals that address means and methods of construction such as schedules and work plans, conformance test reports, health and safety plans, etc.
d. Receipt acknowledged with comments - Resubmit:
    1) This is used in acknowledging receipt of informational submittals that address means and methods of construction such as schedules and work plans, conformance test reports, health and safety plans, etc. Feedback regarding missing information, conflicting information, or other information that makes it incomplete can be made with comments.

B. Contractor: Prepare resubmittal, if applicable:
    1. Clearly identify each correction or change made.
    2. Include a response in writing to each of the Engineer's comments or questions for submittal packages that are resubmitted in the order that the comments or questions were presented from the 1st and subsequent submittals and numbered consistent with the Engineer's numbering.
        a. Acceptable responses to Engineer's comments are listed below:
            1) "Incorporated" Engineer's comment or change is accepted and appropriate changes are made.
            2) "Response" Engineer's comment not incorporated. Explain why comment is not accepted or requested change is not made. Explain how requirement will be satisfied in lieu of comment or change requested by Engineer.
        b. Reviews and resubmittals:
            1) Contractor shall provide resubmittals which include responses to all submittal review comments separately and at a level of detail commensurate with each comment.
            2) Contractor responses shall indicate how the Contractor resolved the issue pertaining to each review comment
                a) Responses such as "acknowledged" or "noted" are not acceptable.
            3) Resubmittals which do not comply with this requirement may be rejected and returned without review.

4) Contractor shall be allowed no extensions of any kind to any part of their contract due to the rejection of non-compliant submittals.
5) Submittal review comments not addressed by the Contractor in resubmittals shall continue to apply whether restated or not in subsequent reviews until adequately addressed by the Contractor to the satisfaction of the reviewing and approving authority.

c. Any resubmittal that does not contain responses to the Engineer's previous comments shall be returned for Revision and Resubmittal. No further review by the Engineer will be performed until a response for previous comments has been received.

3. Resubmittal timeframe:
   a. Contractor shall provide resubmittal within 15 days.
   b. When a resubmittal cannot be returned within the specified period, Contractor shall notify Engineer in writing.
4. Review costs:
   a. Costs incurred by Owner as a result of additional reviews of a particular submittal after the second time it has been reviewed shall be borne by Contractor.
   b. Reimbursement to Owner will be made by deducting such costs from Contractor's subsequent progress payments.

1.07 PRODUCT DATA

A. Edit submittals so that the submittal specifically applies to only the product furnished.

B. Neatly cross out all extraneous text, options, models, etc. that do not apply to the product being furnished, so that the information remaining is only applicable to the product being furnished.

1.08 SHOP DRAWINGS

A. Contractor to field verify elevation, coordinates, and pipe material for pipe tie-in to pipeline or structure prior to the preparation of shop drawings.

B. Indicate project designated equipment tag numbers for submittal of devices, equipment, and assemblies.

1.09 SAMPLES

A. Details:
   1. Submit labeled samples.
   2. Samples will not be returned.
   3. Provide number of sample submittals as below:
      a. Total: 3 minimum.
         1) Owner: 1.
         2) Engineer: 2.
         3) Contractor: None.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT A - CONTRACTOR SUBMITTAL TRANSMITTAL FORM

CONTRACTOR SUBMITTAL TRANSMITTAL FORM

Owner:	Click here to enter text.	**Date:**	MM/DD/YYYY
Contractor:	Click here to enter text.	**Project No.:**	XXXXX.XX
Project Name:	Click here to enter text.	**Submittal Number:**	000
Submittal Title:	Click here to enter text.		
To:	Click here to enter text.		
From:	Click here to enter text.	Click here to enter text.	
	Click here to enter text.	Click here to enter text.	

Specification No. and Subject of Submittal / Equipment Supplier			
Spec ##:	Spec ##.	**Subject:**	Click here to enter text.
Authored By:	Click here to enter text.	**Date Submitted:**	XX/XX/XXXX

Submittal Certification	
Check Either (A) or (B):	
☐ (A)	We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings with no exceptions.
☐ (B)	We have verified that the equipment or material contained in this submittal meets all the requirements specified in the project manual or shown on the contract drawings except for the deviations listed.
Certification Statement: By this submittal, I hereby represent that I have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and similar data, and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements.	
General Contractor's Reviewer's Signature:	
Printed Name:	
In the event, Contractor believes the Submittal response does or will cause a change to the requirements of the Contract, Contractor shall immediately give written notice stating that Contractor considers the response to be a Change Order.	
Firm: Click here to enter text. **Signature:**	**Date Returned:** XX/XX/XXXX

PM/CM Office Use	
Date Received GC to PM/CM:	
Date Received PM/CM to Reviewer:	
Date Received Reviewer to PM/CM:	
Date Sent PM/CM to GC:	

SECTION 01340

PHOTOGRAPHIC AND VIDEOGRAPHIC DOCUMENTATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes requirements for photographs and videos.

B. The purpose of the photographs and videos is to document the condition of the facilities prior to the Contractor beginning work at the Project site, the progress of the Work, and the Project site after Substantial Completion of the Work.

C. The scope of the photographic and videographic documentation shall be the sole responsibility of the Contractor but shall be acceptable to the Engineer.

1.02 SUBMITTALS

A. Photographer qualifications.

B. Pre-construction photographs and videos: Submit prior to beginning work at the Project site or prior to the Preconstruction Conference specified in Section 01312 - Project Meetings, whichever occurs earlier.

C. Construction photographs and videos: Submit with each application for payment.

D. Post-construction photographs and videos: Submit with project closeout documents as specified in Section 01770 - Closeout Procedures.

1.03 PHOTOGRAPHER

A. Photographer qualified and equipped to photograph either interior or exterior exposures, with lenses ranging from wide angle to telephoto.

B. Submit example work of previous photographs and video recording meeting the requirements of this Section.
   1. Provide to Engineer no later than the pre-construction conference.
   2. Provide photographs used for site examination.
   3. Provide video of site examination.
   4. Provide samples that used same camera and lighting equipment proposed for the Work.
   5. Engineer will review work examples to determine if the quality of the images is acceptable.
   6. Contractor is responsible for modifications to equipment and/or inspection procedures to achieve report material of acceptable quality.
   7. Do not commence Work prior to approval of the material by the Engineer.
   8. Once accepted, the standard report material shall serve as a standard for the remaining work.

1.04 KEY PLAN

A. Submit key plan of Project site with notation of vantage points marked for location and direction of each photograph.

B. Include the same label information as the corresponding set of photographs.

1.05 PHOTOGRAPHS

A. Provide prints of each photograph for each area of Work.

B. Provide a digital copy of each photograph for each area of Work.
   1. Monthly: Indexed digital flash drive.
   2. Project record documents:
      a. Catalog and index prints in chronological sequence.
      b. Include typed table of contents.

C. Provide flyover aerial digital photographs of each area of Work.
   1. Prior to first flight, meet with Owner and Engineer to define required photo views and Work areas to be photographed.
   2. Take 5 photos from each view.
   3. Views:
      a. Take photos at oblique angles from the north, south, east, and west directions.
      b. Take photos directly overhead.
   4. Some shots may cover the entire Project site and some may detail the areas under construction at the time of photography.
   5. Submit 5 proofs of each view within 7 calendar days of the date the photographs were taken.
      a. Engineer will select the preferred photograph from each view that will be printed.
   6. Frequency of flyover aerial digital photos: Quarterly.

1.06 PRE-CONSTRUCTION PHOTOGRAPHS AND VIDEOS

A. Provide photographs and video of the condition entire site including each area of Work prior to the start of Work.
   1. Areas to be photographed and videoed shall include the site of the Work and all existing facilities, either on or adjoining the Project site, including the interior of existing structures, that could be damaged as a result of the Contractor's Work.
   2. Include general condition, structures, vegetation, staging, storing, working, parking areas and excavation areas.

1.07 CONSTRUCTION PHOTOGRAPHS AND VIDEOS

A. Provide photographs and videos of construction in each area of Work throughout progress of Work including a key plan designating where each photograph was taken.

B. Take site and interior photographs and videos from differing directions of building demolition, pre-excavation, footing excavation, soil testing, utility crossings, installation of bypass piping, excavation of access pits, installation of lining system in pipes, rehabilitation of manholes, building modifications, utilities, electrical and instrumentation modifications, and other applicable activities indicating relative progress of the work.

C. Take photos a maximum of 7 calendar days prior to submittal.

1.08 POST-CONSTRUCTION PHOTOGRAPHS AND VIDEOS

A. Provide photographs of the entire site including each area of Work at the completion of Work.
   1. Include general condition, structures, vegetation, staging, storing, working, parking areas and excavation areas.
   2. Take photos and video from same points in same direction as pre-construction examination.

B. Submittal of photos and videos is a condition of final payment.

PART 2 PRODUCTS

2.01 MEDIA

A. Paper media:
   1. Commercial grade, glossy surface, acid-free photographic paper.
   2. Submit 3 prints of each photographic view within 7 days of taking photographs.
   3. Format:
      a. Ground photos: Color, matte finish, 8-1/2-inch by 11-inch size, mounted on soft card stock.
      b. Aerial photos: Color, matte finish, 11-inch by 17-inch size, mounted on soft card stock.
      c. Mount each print in a separate, archival type, non-glare, 3-hole punched protector.
   4. Identification: On photograph, provide the following information:
      a. Name of project.
      b. Date stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken so stamp is integral to photograph.
      c. Description of vantage point, indicating location and direction by compass point.
   5. Provide a suitably sized 3-ring binder for each set of prints.
      a. Furnish binders in sufficient quantities to hold entire set of prints taken for the duration of the Contract.
      b. Label binder spine and front with project name.

B. Digital media:
   1. Flash drive compatible with current Microsoft Windows.
   2. Provide photos as individual, indexed JPG files with the following characteristics:
      a. Compression shall be set to preserve quality over file size.

b. Highest resolution JPG images shall be submitted. Resizing to a smaller size when high resolution JPGs are available shall not be permitted.
c. JPG image resolution shall be 5 megapixels at 2,400 by 1,800 or higher.
d. Images shall have rectangular clean images. Artistic borders, beveling, drop shadows, etc., are not permitted.

3. Identification: On photograph, provide the following information:
   a. Name of project.
   b. Date stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken so stamp is integral to photograph.
   c. Description of vantage point, indicating location and direction by compass point.

C. Videos:
1. Video quality shall be 720p HD or greater in MPG, AVCHD, AVI, or MP4 format.
2. Digital color video format.
3. Provide audio portion of the composite video sufficiently free from electrical interference and background noise to provide complete intelligibility of oral report.
4. Identification: On each copy provide a label with the following information:
   a. Name of project.
   b. Date video was recorded.
5. Submit 1 copy of each video within 7 days of recording.
6. Display continuous running time.
7. At start of each video recording, record weather conditions from local newspaper or television and the actual temperature reading at Project site.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01354

HAZARDOUS MATERIAL PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Procedures required when encountering hazardous materials at the Work site.

1.02 REFERENCES

A. California Code of Regulations (CCR):
   1. Title 8 - Industrial Relations.
   2. Title 22 Division 4.5 - Environmental Health Standards for the Management of Hazardous Waste.

B. California Occupational Safety and Health Administration (Cal-OSHA).

C. Occupational Safety and Health Administration (OSHA).

D. United States Code of Federal Regulation (CFR):
   1. Title 29 - Labor:
      a. 1926.62 - Lead.
   2. Title 40 - Protection of Environment:
      a. 261 - Identification and Listing of Hazardous Waste.

1.03 SUBMITTALS

A. Submit laboratory reports, hazardous material removal plans, and certifications.

1.04 OPERATING DIGESTERS

A. Observe safety precautions in vicinity of operating digesters which contain digester gases, including methane, hydrogen sulfide, and carbon dioxide.

1.05 HAZARDOUS MATERIALS PROCEDURES

A. Hazardous materials are those defined by 40 CFR and State specific codes.

B. Forward to Engineer, copies of reports, permits, receipts, and other documentation related to remedial work.

C. Assume responsibility for worker health and safety, including health and safety of subcontractors and their workers.
   1. Instruct workers on recognition and reporting of materials that may be hazardous.

D. File requests for adjustments to Contract Times and Contract Price due to the finding of Hazardous Materials in the Work site in accordance with Contract Documents.
   1. Minimize delays by continuing performance of the Work in areas not affected by hazardous materials operations.

E. When hazardous materials have been found:
   1. Prepare and initiate implementation of plan of action.
   2. Notify immediately Owner, Engineer, and other affected persons.
   3. Notify such agencies as are required to be notified by laws and regulations with the times stipulated by such laws and regulations.
   4. Designate a Certified Industrial Hygienist to issue pertinent instructions and recommendations for protection of workers and other affected persons' health and safety.
   5. Identify and contact subcontractors and licensed personnel qualified to undertake storage, removal, transportation, disposal, and other remedial work required by, and in accordance with, laws and regulations.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01357

DELEGATED DESIGN PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Delegated Design Procedures.

1.02 GENERAL

A. Delegated Design - Professional design services assigned to the Contractor by express delegation in the Contract Documents. Work is “Delegated Design” where the Technical Sections require the Contractor to provide professional design services and to submit signed and sealed documents from a registered Professional Engineer.

B. Contractor’s Professional Engineer - The design professional retained by the Contractor to perform Delegated Design.

C. Owner may require Contractor to provide professional design services for a portion of the Work by express delegation in the Contract Documents.
   1. Requirements of Delegated Design component as specified in the technical section and as indicated on the Drawings.
   2. Such delegation will specify the performance and design criteria that such services must satisfy, and the Submittals that Contractor must furnish to Engineer with respect to the Delegated Design.

D. Contractor shall cause such Delegated Design services to be provided pursuant to the professional standard of care by a properly licensed design professional, whose signature and seal shall appear on drawings, calculations, specifications, certifications, and submittals prepared by such design professional.
   1. Contractor shall not be responsible for the adequacy of performance or design criteria specified by Owner or Engineer.
   2. Contractor is not required to provide professional services in violation of applicable Laws and Regulations.
   3. Such design professional shall issue certifications of design required by Laws and Regulations.
   4. If a Shop Drawing or other Submittal related to the Owner-delegated design is prepared by Contractor, a Subcontractor, or others for submittal to Engineer, then such Shop Drawing or other Submittal shall bear the written approval of Contractor’s design professional when submitted by Contractor to Engineer.

E. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, and approvals performed or provided by the design professionals retained or employed by Contractor under Delegated Design, subject to the professional standard of care and the performance and design criteria stated in the Contract Documents.

F. Engineer's review, approval, and other determinations regarding design drawings, calculations, specifications, certifications, and other Submittals furnished by Contractor pursuant to a Delegated Design will be only for the following limited purposes:
    1. Confirming that submittal is in conformance with the performance and design criteria specified in the Contract Documents.

1.03 CONTRACTOR'S PROFESSIONAL ENGINEER

A. Contractor or Subcontractor shall retain a licensed professional engineer to perform Delegated Design.

B. Qualifications:
    1. Holding a current license to perform the specified design in the same jurisdiction as the Project site.
    2. Experienced in designing similar systems of similar complexity.

C. Insurance:
    1. Provide Contractor's Professional Engineer's Professional Liability Insurance as specified Section 5 of the General Conditions.

D. Responsibilities:
    1. Review and design in accordance with system performance and design criteria stated in the Contract Documents.
        a. Prepare written requests for clarifications or interpretations of performance or design criteria for submittal to Engineer by Contractor.
    2. Sign and seal design reports, calculations, design drawings and specifications, and other design Submittals for the Delegated Design Work.
    3. Review and submit written approval of submittals related to the Delegated Design Work.
    4. Design modifications to the Delegated Design Work as required.
    5. Visit the Site, as required, to verify that installation of the Delegated Design Work is in conformance with the Delegated Design drawings and specifications.
    6. Submit through Contractor to Engineer written, signed, and sealed certification that the installed Delegated Design Work complies with Contractor's professional engineer's design.

1.04 SUBMITTALS

A. Prior to the start of Delegated Design:
    1. Contractor's Professional Engineer's qualifications:
        a. Experience for the Delegated Design.
        b. Evidence of professional engineering license.
    2. Contractor's Professional Engineer Professional Liability Insurance certificate.

B. Delegated Design:
    1. Product data:
        a. Details related to the Delegated Design as specified in technical sections to completely describe the system.

2. Design documents with signature and seal from the Contractor's Professional Engineer.
    a. Design documents include but are not limited to drawings, calculations, specifications, inspection reports, and certifications.
3. Lists and schedules:
    a. Prepare and submit lists or schedules of items where delegated design is required by the Contract Documents.
    b. Group items by location in the Work.
        1) When "Area Numbers" are indicated on the Contract Drawings, group lists in accordance with those "areas."
        2) For work without area numbers, group using logical divisions acceptable to Engineer.
        3) Group items within each "area" as follows:
            a) Systems.
            b) Components.
            c) Supports.
            d) Anchorage.
            e) Bracing.

C. Construction services:
1. Contractor's Professional Engineer's comments on submittals.
2. Other construction documents, as required.

1.05 ENGINEER RESPONSE TO DELEGATED DESIGN SUBMITTALS

A. The Engineer response will be either of the following:
1. Approved. Make Corrections Noted - See Comments:
    a. The Contractor may proceed with the Work, however, all notations and comments must be incorporated into the final product.
    b. The review was for the limited purpose of determining that the document was stamped by a Professional Engineer and that such design is generally consistent with and will not negatively affect the design concept presented in the Contract Documents.
2. Rejected - See Remarks:
    a. Contractor may not proceed with the Work described in the submittal.
    b. The submittal does not meet the intent of the Contract Documents.
    c. Resubmittal of complete submittal package is required with materials, equipment, methods, etc. that meet the requirements of the Contract Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01410

REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Regulatory authorities and codes.

1.02 AUTHORITIES HAVING JURISDICTION (AHJ)

A. Also referred to as the permitting agency.

B. Building Department: City of Ukiah.

C. Fire Department: City of Ukiah.

D. California Department of Fish and Wildlife.

E. California Department of Transportation (Caltrans).

1.03 APPLICABLE CODES

A. Products in contact with drinking water
   1. Materials in contact with drinking waters: In accordance with NSF 61 and NSF 372.
      a. Certification by an independent ANSI accredited third party, including, but not limited to, NSF International, as being lead free.
   2. Materials in contact with drinking waters: In accordance with California Health and Safety Code, Section 116875.

B. California Code of Regulations (CCR), California Building Standards Code, CCR Title 24:
   1. Building code:
      a. California Building Code (CBC), Title 24, Part 2 – 2022.
   2. Electrical code:
      a. California Electrical Code (CEC), Title 24, Part 3 – 2022.
   3. Mechanical code:
      a. California Mechanical Code (CMC), Title 24, Part 4 – 2022.
   4. Plumbing code:
      a. California Plumbing Code (CPC), Title 24, Part 5 – 2022.
   5. Energy code:
      a. California Energy Code (CEC), Title 24, Part 6 – 2022.
   6. Historical building code:
      a. California Historical Building Code (CHBC), Title 24, Part 8 – 2019.
   7. Fire code:
      a. California Fire Code (CFC), Title 24, Part 9 – 2022.

8. Existing building code:
   a. California Existing Building Code (CEBC), Title 24, Part 10 – 2019.
9. Green building standards code:
   a. California Green Building Standards Code (CALGreen), Title 24, Part 11 – 2022.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01439

MOCKUPS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Mockups of specific assemblies to be installed on this Project.

1.02 VISUAL MOCKUPS

A. Definition:
   1. Visual mockup:
      a. Separate mockup construction incorporating elements specified in various Sections, intended to illustrate materials and workmanship in an assembly, and used for technical and aesthetic evaluation. Mockup shall not be a part of the finished construction. Mockup shall be accepted by Engineer prior to beginning this work on the building.
         1) Configuration and extent of mockup: As required to illustrate the design intent for Engineer's evaluation.
         2) Place mockup on-site in a location where it will not be disturbed or damaged during construction.

B. Maintain and protect Visual Mockups from damage during construction, and dispose of mockups when no longer required, as determined by Engineer.

1.03 BENCHMARK MOCKUPS

A. Definition:
   1. Benchmark mockup:
      a. In-place portions of assemblies to be repeated throughout the Work.
      b. Accepted benchmark mockups are intended to serve as a standard by which the work will be judged.
      c. Accepted benchmark mockups may be incorporated into the final construction.

B. Construct benchmark mockups to verify selections made under sample submittals, to demonstrate aesthetic effects, to set quality standards for materials and execution, and to set quality standards for fabrication and installation.

C. Acceptance of benchmark mockups incorporated in the Work does not constitute approval of deviations from the Contract Documents unless Engineer specifically approves such deviations in writing.

D. Protect benchmark mockup from damage and ensure it is not disturbed at time of Project Completion.

1.04 MOCKUP DESCRIPTION

A. General: Provide mockups as specified below:
   1. Mockup construction schedule: Indicate time required for mockup construction, Engineer's and Owner's review and acceptance, and removal/demolition work associated with mockups, in Construction Progress Schedule.

B. Building façade colored and textured concrete (visual mockup):
   1. Provide building façade mock-up involving the following Sections:
      a. Section 03300 - Cast-in-Place Concrete.
   2. Mockup shall consist of a 4-inch thick vertical concrete panel divided into three-36 inch by 36-inch sections.
      a. Each section shall have the texture imparted by specified formliner and be finished with specified concrete stain in color selected by Engineer.
      b. The stain shall be applied at a 1:1 dilution ratio at the first section, a 1:10 dilution ratio at the second section, and a 1:20 dilution ratio at the third section.

C. Structural Concrete F4 Finish and tie-hole repair (visual mockup):
   1. Provide concrete finish mock-up involving the following Sections:
      a. Section 03300 - Cast-in-Place Concrete.
      b. Section 03366 - Tooled Concrete Finishes.
   2. Mockup shall consist of a 4-inch thick vertical concrete panel divided into two-36 inch by 36-inch sections.
      a. One section shall demonstrate the F4 concrete. The section shall include 1 horizontal and 1 vertical form joint.
      b. The other section shall demonstrate the tie-hole repair. A minimum of 4 tie-holes shall be included.

PART 2 PRODUCTS

2.01 MATERIALS

A. Materials as specified in the following Sections:
   1. Section 03300 - Cast-in-Place Concrete.
   2. All other products and materials as required for a complete mockup.

PART 3 EXECUTION

3.01 MOCKUP MATERIALS

A. Contractor is cautioned to not purchase all materials for the project that are involved in any one mockup until after the mockup has been reviewed and accepted by the Engineer.

END OF SECTION

SECTION 01450

QUALITY CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Quality control and control of installation.
   2. Tolerances.
   3. References.
   4. Mock-up requirements.
   5. Authority and duties of Owner's representative or inspector.
   6. Sampling and testing.
   7. Testing and inspection services.
   8. Contractor's responsibilities.

1.02 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturers' instructions, including each step in sequence.

C. When manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce required and specified quality.

F. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

H. When specified, products will be tested and inspected either at point of origin or at Work site:
   1. Notify Engineer in writing well in advance of when products will be ready for testing and inspection at point of origin.
   2. Do not construe that satisfactory tests and inspections at point of origin is final acceptance of products. Satisfactory tests or inspections at point of origin do not preclude retesting or re-inspection at Work site.

I. Do not ship products which require testing and inspection at point of origin prior to testing and inspection.

1.03 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. When Manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.04 REFERENCES

A. ASTM International (ASTM):
   1. E329 - Standard for Agencies Engaged in Construction Inspection, Testing or Special Inspection.

B. National Institute of Standards and Technology (NIST).

1.05 PRODUCT REQUIREMENTS

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date of Contract Documents, except where specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. When specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

1.06 MOCK-UP REQUIREMENTS

A. Tests will be performed under provisions identified in this Section and identified in respective product specification sections.

B. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.

C. Accepted mock-ups shall be comparison standard for remaining Work.

D. Where mock-up has been accepted by Engineer and is specified in product specification sections to be removed; remove mock-up and clear area when directed to do so by Engineer.

1.07 AUTHORITY AND DUTIES OF OWNER'S REPRESENTATIVE OR INSPECTOR

A. Owner’s Project Representative employed or retained by Owner is authorized to inspect the Work.

B. Inspections may extend to entire or part of the Work and to preparation, fabrication, and manufacture of products for the Work.

C. Deficiencies or defects in the Work which have been observed will be called to Contractor’s attention.

D. Inspector will not:
   1. Alter or waive provisions of Contract Documents.
   2. Inspect Contractor’s means, methods, techniques, sequences, or procedures for construction.
   3. Accept portions of the Work, issue instructions contrary to intent of Contract Documents, or act as foreman for Contractor. Supervise, control, or direct Contractor’s safety precautions or programs; or inspect for safety conditions on Work site, or of persons thereon, whether Contractor’s employees or others.

E. Inspector will:
   1. Conduct on-site observations of the Work in progress to assist Engineer in determining when the Work is, in general, proceeding in accordance with Contract Documents.
   2. Report to Engineer whenever Inspector believes that Work is faulty, defective, does not conform to Contract Documents, or has been damaged; or whenever there is defective material or equipment; or whenever Inspector believes the Work should be uncovered for observation or requires special procedures.

1.08 SAMPLING AND TESTING

A. General:
   1. Prior to delivery and incorporation in the Work, submit listing of sources of materials, when specified in sections where materials are specified.
   2. When specified in sections where products are specified:
      a. Submit sufficient quantities of representative samples of character and quality required of materials to be used in the Work for testing or examination.
      b. Test materials in accordance with standards of national technical organizations.

B. Sampling:
   1. Furnish specimens of materials when requested.
   2. Do not use materials which are required to be tested until testing indicates satisfactory compliance with specified requirements.
   3. Specimens of materials will be taken for testing whenever necessary to determine quality of material.
   4. Assist Engineer in preparation of test specimens at site of work, such as soil samples and concrete test cylinders.

1.09 TESTING AND INSPECTION SERVICES

A. Contractor will employ and pay for specified services of an independent firm to perform Contractor quality control testing as required in the technical specifications for various work and materials.

B. Owner will employ and pay for specified services of an “Owner’s independent testing firm” certified to perform testing and inspection as required in the technical specifications for various work and materials or stipulated in Section 01455 - Regulatory Quality Assurance to confirm Contractor’s compliance with Contract Documents.

C. The Owner’s independent testing firm will perform tests, inspections and other services specified in individual specification sections and as required by Owner and requested by the Engineer.

D. The qualifications of laboratory that will perform the testing, contracted by the Owner or by the Contractor, shall be as follows:
   1. Has authorization to operate in the state where the project is located.
   2. Meets “Recommended Requirements for Independent Laboratory Qualification,” published by American Council of Independent Laboratories.
   3. Meets requirements of ASTM E329.
   4. Laboratory Staff: Maintain full time specialist on staff to review services.
   5. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to NIST or accepted values of natural physical constants.
   6. Will submit copy of report of inspection of facilities made by Materials Reference Laboratory of NIST during most recent tour of inspection, with memorandum of remedies of deficiencies reported by inspection.

E. Testing, inspections, and source quality control may occur on or off project site. Perform off-site testing inspections and source quality control as required by Engineer or Owner.

F. Contractor shall cooperate with Owner’s independent testing firm, furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
   1. Notify Engineer and Owner’s independent testing firm 48 hours prior to expected time for operations requiring testing.
   2. Make arrangements with Owner’s independent testing firm and pay for additional samples and tests required for Contractor’s use.

G. Limitations of authority of testing Laboratory: Owner’s independent testing firm or Laboratory is not authorized to:
   1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency or laboratory may not approve or accept any portion of the Work.
   3. Agency or laboratory may not assume duties of Contractor.
   4. Agency or laboratory has no authority to stop the Work.

H. Testing and employment of an Owner's independent testing firm or laboratory shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

I. Re-testing or re-inspection required because of non-conformance to specified requirements shall be performed by same Owner's independent testing firm on instructions by Engineer. Payment for re-testing or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.

J. The Owner's independent testing firm responsibilities will include:
   1. Test samples of mixes submitted by Contractor.
   2. Provide qualified personnel at site. Cooperate with Engineer and Contractor in performance of services.
   3. Perform specified sampling and testing of products in accordance with specified standards.
   4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
   5. Promptly notify Engineer and Contractor of observed irregularities or non-conformance of Work or products.
   6. Perform additional tests required by Engineer.
   7. Attend preconstruction meetings and progress meetings when requested.

K. Owner's independent testing firm individual test reports:
   1. After each test, Owner's independent testing firm will promptly submit electronically report to Engineer and to Contractor.
   2. Test reports shall include at least the following information:
      a. Date issued.
      b. Project title and number.
      c. Name of inspector.
      d. Date and time of sampling or inspection.
      e. Identification of product and specifications section.
      f. Location in Project.
      g. Type of inspection or test.
      h. Date of test.
      i. Certified test results stamped and signed by a registered Engineer in the state where the project is located.
      j. Summary of conformance with Contract Documents.
      k. When requested by Engineer, the Owner's independent testing firm will provide interpretation of test results.

1.10 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with Owner's independent testing firm or laboratory personnel and provide access to construction and manufacturing operations.

B. Secure and deliver to Owner's independent testing firm or laboratory adequate quantities of representative samples of materials proposed to be used and which require testing.

C. Provide to Owner's independent testing firm or laboratory and Engineer preliminary mix design proposed to be used for concrete, and other materials mixes which require control by testing laboratory.

D. Submit product test reports electronically.

E. Furnish incidental labor and facilities:
   1. To provide access to construction to be tested.
   2. To obtain and handle samples at Work site or at source of product to be tested.
   3. To facilitate inspections and tests.
   4. For storage and curing of test samples.

F. Notify Owner's independent testing firm or laboratory 48 hours in advance of when observations, inspections and testing is needed for laboratory to schedule and perform in accordance with their notice of response time.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01455

REGULATORY QUALITY ASSURANCE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: This Section describes project regulatory requirements for quality assurance that includes special inspections, special certification, and structural observation.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 318 - Building Code Requirements for Structural Concrete.
   2. 530 - Building Code Requirements for Masonry Structures.
   3. 530.1 - Specification for Masonry Structures.

B. American Institute of Steel Construction (AISC):
   1. 360 - Specification for Structural Steel Buildings.

C. American Society of Civil Engineers (ASCE):
   1. 7 - Minimum Design Loads for Buildings and Other Structures.

D. American Welding Society (AWS):
   1. D1.3 - Structural Welding Code - Sheet Steel.
   2. D1.4 - Structural Welding Code - Reinforcing Steel.

E. ASTM International (ASTM):
   1. A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
   2. C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   3. C172 - Standard Practice for Sampling Freshly Mixed Concrete.
   4. C1611 - Standard Test Method for Slump Flow of Self-Consolidating Concrete.

F. California Building Code (CBC) 2022 with City of Ukiah amendments.

G. The Masonry Society (TMS):
   1. 402 - Building Code for Masonry Structures.
   2. 602 - Specifications for Masonry Structures.

1.03 DEFINITIONS

A. Special Certification: Certification for designated seismic systems that demonstrates compliance with performance requirements.

B. Special Inspection: Inspection of the materials, installation, fabrication, erection, or placement of components and connections requiring special expertise to ensure compliance with approved construction documents and referenced standards.

C. Special Inspection, Continuous: The full-time observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed.

D. Special Inspection, Periodic: The part-time, or intermittent observation of work requiring special inspection by an approved special inspector who is present in the area where the work is being performed and at the completion of the work.

E. Structural Observation: The visual observation of the structural system by a registered design professional for general conformance to the approved construction documents at significant construction stages and at completion of the structural system.

1.04 DESCRIPTION

A. This Section describes special inspections, special certification and structural observation of structural assemblies and components to be performed in compliance with the building code specified in Section 01410 - Regulatory Requirements.

B. The special certification and special inspections specified in this Section are in addition to the requirements specified in Section 01450 - Quality Control, and by the individual Sections.

1.05 SUBMITTALS

A. Contractor shall submit special certifications for designated seismic systems.

B. Contractor shall schedule and coordinate the submittal of Special Inspection reports and test results prepared by others.

1.06 SPECIAL INSPECTION

A. Owner will employ 1 or more special inspectors who will provide special inspections during construction.

B. Special inspector(s) shall be qualified for inspection of the particular type of materials or operations requiring special inspection.

C. Testing laboratory: Testing that is required to satisfy the requirements of special inspection will be performed by the Owner's testing laboratory as specified in Section 01450 - Quality Control.

D. Duties of Special Inspector:
   1. General: Required duties of the special inspector(s) shall be as described in Chapter 17 of the building code specified in Section 01410 - Regulatory Requirements.
   2. Reporting: Special inspector(s) shall provide reports of each inspection to the Owner and shall distribute copies of inspection reports to the Engineer and Contractor as required.
      a. Reports shall, at a minimum, include the following items:
         1) Date and time of inspection, and name(s) of individual(s) performing the inspection.
         2) Structures and areas of the structure where work or testing was observed.
         3) Discrepancies between the requirements of the Contract Documents and the work or testing observed.
         4) Other areas of deficiency in the Work.

E. Special inspections shall not be construed as fulfilling the requirements for structural observation.

F. Owner or special inspector are responsible to select materials for special inspection.
   1. It is not acceptable for Contractor to select materials for special inspection.

1.07 SPECIAL CERTIFICATION

A. Contractor shall be responsible for providing equipment that meets the special certification requirements of the building code specified in Section 01410 - Regulatory Requirements.

B. The following designated seismic systems shall be subject to the testing and qualification requirements of the regulatory building code, as specified in Section 01410 - Regulatory Requirements and shall require special certification as set forth in ASCE 7, Section 13.2:
   1. Mechanical equipment that is assigned an importance factor of 1.50 as specified in Section 01850 - Design Criteria.
   2. All electrical equipment.

C. Special certification requirements for designated seismic systems:
   1. Submittals for mechanical and electrical equipment identified in this Section as designated seismic systems shall include certification that the equipment is seismically qualified. Certifications shall be subject to review and acceptance by Owner.
   2. Certifications may be at least 1 of the following in accordance with ASCE 7, Section 13.2:
      a. Analysis.
      b. Testing.
      c. Experience data.

1.08 STRUCTURAL OBSERVATION

A. Owner will employ 1 or more registered design professionals who will provide structural observation(s) during construction.
   1. Registered design professional shall be a civil or structural engineer currently licensed as such in the state where the project is located and regularly engaged in structural design equivalent to or similar to those indicated on the Drawings.

B. Structural observations shall not be construed as fulfilling the requirements for special inspections.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SPECIAL INSPECTIONS

A. The Owner will provide special inspection of following types of work as described in in Section 1705 of the building code as specified in Section 01410 - Regulatory Requirements wherever such work occurs unless otherwise specified.
   1. Attachment A - Concrete Special Inspection Schedule.
   2. Attachment B - Architectural, Mechanical, and Electrical Components - Special Inspection Schedule.
   3. Attachment C - Masonry Special Inspection Schedule - “Level C".
   4. Attachment D - Soils Verification and Inspection Schedule.
   5. Attachment E - Structural Steel Special Inspection Schedule.
   6. Attachment F - Structural Steel Bolting Special Inspection Schedule.
   7. Attachment G - Steel Construction - Steel Deck - Special Inspection Schedule.
   8. Attachment H - Deep Foundations, Cast-in-Place - Special Inspection Schedule.

3.02 SPECIAL CERTIFICATION

A. Special inspector shall examine the designated seismic system(s) specified and determine whether the designated system components, including anchorage, are consistent with the evidence of compliance submitted for special certification.

3.03 STRUCTURAL OBSERVATION

A. The following work requires structural observation in accordance with Section 1704.5 of the building code specified in Section 01455 - Regulatory Requirements.
   1. All structures in all areas:
      a. Foundations.
      b. Elevated slabs.

3.04 SCHEDULE

A. Contractor shall allow time necessary for special inspections and structural observation specified herein.

B. Sufficient notice shall be given so that the special inspections and structural observations can be performed. Contractor shall allow time for individuals performing special inspection and structural observation to travel to the site.

3.05 PROCEDURE

A. The special inspector will immediately notify the Engineer of any corrections required and follow notification with appropriate documentation.

B. Contractor shall not proceed until the work is satisfactory to the Engineer.

END OF SECTION

ATTACHMENT A - CONCRETE SPECIAL INSPECTION SCHEDULE

CONCRETE SPECIAL INSPECTION SCHEDULE
(Includes: cast-in-place, precast, prestressed, precast-prestressed, and shotcrete.)

Verification and Inspection	Reference Standard ACI 318-14 AWS D1.4-18 CBC 2022	Frequency of Inspection[(1)] (During Task Listed)	
		Continuous	Periodic
1. Inspect reinforcement, including prestressing tendons, and verify placement.	ACI 318: 20, 25.2, 25.3, 26.6.1-26.6.3 CBC: 1908.4		●
2. Reinforcing bar welding:			
a. Verify weldability of reinforcing bars other than ASTM A706;	AWS D1.4 ACI 318: 26.6.4		●
b. Inspect single-pass fillet welds, maximum 5/16”; and	AWS D1.4 ACI 318: 26.6.4		●
c. Inspect all other welds.	AWS D1.4 ACI 318: 26.6.4	●	
3. Inspect anchors cast in concrete.	ACI 318: 17.8.2		●
4. Inspect anchors post-installed in hardened concrete members.			
a. Adhesive anchors installed in horizontally or upwardly inclined orientations to resist sustained tension loads.	ACI 318: 17.8.2.4	●	
b. Mechanical anchors and adhesive anchors not defined in 4.a.	ACI 318: 17.8.2		●
5. Verify use of required design mix.	ACI 318: 19, 26.4.3, 26.4.4 CBC: 1904.1, 1904.2, 1908.2, 1908.3		●
6. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete.	ASTM C172 ASTM C31 ACI 318: 26.5, 26.12 CBC: 1908.10	●	
7. Inspect concrete and shotcrete placement for proper application techniques.	ACI 318: 26.5 CBC: 1908.6, 1908.7, 1908.8	●	

Verification and Inspection	Reference Standard ACI 318-14 AWS D1.4-18 CBC 2022	Frequency of Inspection[1] (During Task Listed)	
		Continuous	Periodic
8. Verify maintenance of specified curing temperature and techniques.	ACI 318: 26.5.3-26.5.5 CBC: 1908.9		●
10. Inspect erection of precast concrete members.	ACI 318: 26.9		●
11. Verify in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs.	ACI 318: 26.11.2		●
12. Inspect formwork for shape, location and dimensions of the concrete member being formed.	ACI 318: 26.11.1.2.(b)		●
Notes: (1) The "●" represents a required inspection activity for the project where it occurs.			

ATTACHMENT B - ARCHITECTURAL, MECHANICAL AND ELECTRICAL COMPONENTS SPECIAL INSPECTION SCHEDULE

ARCHITECTURAL, MECHANICAL AND ELECTRICAL COMPONENTS SPECIAL INSPECTION SCHEDULE

Verification and Inspection	Reference Standard CBC 2022	Frequency of Inspection[1] (During Task Listed)	
		Continuous	Periodic
1. Architectural components:			
a. Cladding - exterior, weighing more than 5 psf: erection and fastening.	CBC: 1705.12.5		●
b. Exterior insulation and finish system (EIFS): NTS: Review CBC and edit for project.	CBC: 1705.16		
c. Non-bearing walls – exterior: erection and fastening.	CBC: 1705.12.5		●
d. Non-bearing walls – interior, weighing more than 15 psf.	CBC: 1705.12.5		●
e. Veneer, exterior and interior, weighing more than 5 psf: erection and fastening.	CBC: 1705.12.5		●
f. Access floors: erection and anchorage.	CBC: 1705.12.5.1		●
g. Suspended ceiling system: bracing.			●
h. Storage racks – 8 feet or greater in height: anchorage.	CBC: 1705.12.7		●
i. Skylight: verification of safety compliance and labeling and installation.	CBC: 1709.6		●
2. Plumbing, mechanical, and electrical components:			
a. Anchorage of electrical equipment for emergency and standby power systems.	CBC: 1705.12.6.1		●
b. Anchorage of other electrical and mechanical equipment over 400 lb. on floors or roofs.	CBC: 1705.12.6.2		●
c. Installation and anchorage of pipelines carrying hazardous chemicals and their associated mechanical units.	CBC: 1705.12.6.3		●
d. Installation and anchorage of pipelines greater than 8 inches in diameter.			●
e. Installation and anchorage of ductwork designed to carry hazardous materials.	CBC: 1705.12.6.4		●

Verification and Inspection	Reference Standard CBC 2022	Frequency of Inspection(1) (During Task Listed) Continuous	Periodic
f. Installation and anchorage of ductwork greater than 6 sf in cross section.			●
g. Installation and anchorage of vibration isolation systems where contract documents require nominal clearance of 1/4 inch or less between the equipment support frame and its support/restraint.	CBC: 1705.12.6.5		●
h. Installation of mechanical and electrical equipment, including duct work, piping systems and their structural supports, where automatic fire sprinkler systems are installed.	CBC: 1705.12.6.6		●
3. Fire-resistance elements:			
a. Sprayed fire-resistant coatings.	CBC: 1705.14		
b. Mastic and intumescent coatings.	CBC: 1705.15		
c. Fire-resistant penetrations and joint systems.	CBC: 1705.17,		
4. Smoke control systems.	CBC: 1705.18		

Notes:
(1) The "●" represents a required inspection activity for the project where it occurs.

ATTACHMENT C - MASONRY SPECIAL INSPECTION SCHEDULE - “LEVEL C”

MASONRY SPECIAL INSPECTION SCHEDULE - "LEVEL C"

MINIMUM TESTS

Verification of Slump flow and Visual Stability Index (VSI) as delivered to the project site as determined by ASTM C1611 for self-consolidating grout.

Verification of proportions of materials in premixed or pre-blended mortar and grout as delivered to the project site.

Verification of f_m in accordance with Specification Section 04220 - Concrete Unit Masonry prior to construction.

MINIMUM SPECIAL INSPECTION - LEVEL C			
Verification and Inspection	**Reference Standard TMS 402/ACI 530-13 TMS 602/ACI 530.1-13**	**Frequency of Inspection[1] (During Task Listed)**	
		Continuous	**Periodic**
1. Verify compliance with the approved submittals.	TMS 602/ACI 530.1: Art. 1.5		●
2. As masonry construction begins, verify that the following are in compliance:			
a. Proportions of site-prepared mortar.	TMS 602/ACI 530.1: Art. 2.1, 2.6A		●
b. Placement of masonry units and construction of mortar joints.	TMS 602/ACI 530.1: Art. 3.3B		●
c. Placement of reinforcement, connectors, and anchors.	TMS 602/ACI 530.1: Art 3.4 TMS 402/ACI 530: Sec 6.1, 6.2.6, 6.2.7	●	
a. Reinforcing bar couplers and terminators.	ICC-ES Evaluation Report	●	
3. Prior to grouting, verify that the following are in compliance:			
a. Placement of masonry units and construction of mortar joints.	TMS 602/ACI 530.1: Art. 3.3B		●
b. Grout space.	TMS 602/ACI 530.1: Art. 3.2D, 3.2F	●	

MINIMUM SPECIAL INSPECTION - LEVEL C			
Verification and Inspection	Reference Standard TMS 402/ACI 530-13 TMS 602/ACI 530.1-13	Frequency of Inspection(1) (During Task Listed)	
		Continuous	Periodic
c. Grade, type, and size of reinforcement and anchor bolts.	TMS 602/ACI 530.1: Art. 2.4, 3.4 TMS 402/ACI 530: Sec. 6.1		●
d. Placement of reinforcement, connectors, and anchors.	TMS 602/ACI 530.1: Art. 3.2E, 3.4 TMS 402/ACI 530: Sec. 6.1, 6.2.6, 6.2.7	●	
4. Verify during construction:			
a. Size and location of structural elements:	TMS 602/ACI 530.1: Art. 3.3F		●
b. Type, size, and location of anchors, including details of anchorage of masonry to structural members, frames, or other construction.	TMS 402/ACI 530: Sec. 1.2.1(e), 6.1.4.3, 6.2.1	●	
c. Welding of reinforcement.	TMS 402/ACI 530: Sec 8.1.6.7.2, 9.3.3.4(c), 11.3.3.4(b)	●	
d. Preparation, construction, and protection of masonry during cold weather (temperature below 40 degrees F) or hot weather (temperature above 90 degrees F).	TMS 602/ACI 530.1: Art. 1.8C, 1.8D		●
5. Observe preparation of grout specimens, mortar specimens, and/or prisms.	TMS 602/ACI 530.1: Art. 1.4 B.2.a.3, 1.4 B.2.b.3, 1.4 B.2.c.3, 1.4 B.3, 1.4 B.4	●	
Notes: (1) The "●" represents a required inspection activity for the project where it occurs.			

ATTACHMENT D - SOILS VERIFICATION AND INSPECTION SCHEDULE

SOILS VERIFICATION AND INSPECTION SCHEDULE

Verification and Inspection	Reference Standard CBC 2022	Frequency of Inspection(1) (During Task Listed)	
		Continuous	Periodic
1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity.	CBC: T-1705.6		●
2. Verify excavations are extended to proper depth and have reached proper material.	CBC: T-1705.6		●
3. Perform classification and testing of fill and backfill materials.	CBC: T-1705.6		●
4. Verify use of proper materials, densities, and lift thicknesses during placement and compaction of fill and backfill.	CBC: T-1705.6	●	
5. Prior to placement of fill, observe subgrade and verify that site has been prepared properly.	CBC: T-1705.6		●

Notes:
(1) The "●" represents a required inspection activity for the project where it occurs.

ATTACHMENT E - STRUCTURAL STEEL SPECIAL INSPECTION SCHEDULE

STRUCTURAL STEEL SPECIAL INSPECTION SCHEDULE

Verification and Inspection	Referenced Standard AISC 360-10	Frequency of Inspection[1] (During Task Listed) Continuous	Periodic
Inspection Tasks Prior to Welding	AISC 360, Table N5.4-1		
1. Welding procedure specifications (WPSs) available.		●	
2. Manufacturer certifications for welding consumables available.		●	
3. Material identification (type/grade).			●
4. Welder identification system.			●
5. Fit-up groove welds (including joint geometry): • Joint preparation. • Dimensions (alignment, root opening, root face, bevel). • Cleanliness (condition of steel surfaces). • Tacking (tack weld quality and location). • Backing type and fit (if applicable).			●
5. Configuration and finish of access holes.			●
6. Fit-up of fillet welds: • Dimensions (alignment, gaps at root). • Cleanliness (condition of steel surfaces). • Tacking (tack weld quality and location).			●
7. Check welding equipment.			●
Inspection Tasks During Welding	AISC 360, Table N5.4-2		
8. Use of qualified welders.			●
9. Control and handling of welding consumables: • Packaging. • Exposure control.			●
10. No welding over cracked tack welds.			●
11. Environmental conditions: • Wind speed within limits. • Precipitation and temperature.			●

Verification and Inspection	Referenced Standard AISC 360-10	Frequency of Inspection(1) (During Task Listed)	
		Continuous	Periodic
12. WPS followed: • Settings on welding equipment. • Travel speed. • Selected welding materials. • Shielding gas type/flow rate. • Preheat applied. • Interpass temperature maintained (min/max). • Proper position (F, V, H, OH).			●
13. Welding techniques: • Interpass and final cleaning. • Each pass within profile limitations. • Each pass meets quality requirements.			●
Inspection Tasks After Welding	AISC 360, Table N5.4-3		
14. Welds cleaned.			●
15. Size, length, and location of welds.		●	
16. Welds meet visual acceptance criteria: • Crack prohibition. • Weld/base-metal fusion. • Crater cross section. • Weld profiles. • Weld size. • Undercut. • Porosity.		●	
17. Arc strikes.		●	
18. k-area.		●	
19. Backing removed and weld tabs removed (if required).		●	
20. Repair activities.		●	
21. Document acceptance or rejection of welded joint or member.		●	
Notes: (1) The "●" represents a required inspection activity for the project where it occurs.			

ATTACHMENT F - STRUCTURAL STEEL BOLTING SPECIAL INSPECTION SCHEDULE

STRUCTURAL STEEL BOLTING SPECIAL INSPECTION SCHEDULE

Verification and Inspection	Referenced Standard ASIC 360-10	Frequency of Inspection(1) (During Task Listed) Continuous	Periodic
Inspection Tasks Prior to Bolting	AISC 360, Table N5.6-1		
1. Manufacturer's certifications available for fastener materials.		●	
2. Fasteners marked in accordance with ASTM requirements.			●
3. Proper fasteners selected for the joint detail (grade, type, bolt length if threads are to be excluded from shear plane).			●
4. Proper bolting procedure selected for joint detail.			●
5. Connecting elements, including the appropriate faying surface condition and hole preparation, if specified, meet applicable requirements.			●
6. Pre-installation verification testing by installation personnel observed and documented for fastener assemblies and methods used.			●
7. Proper storage provided for bolts, nuts, washers and other fastener components.			●
Inspection Tasks During Bolting	AISC 360, Table N5.6-2		
8. Fastener assemblies, of suitable condition, placed in all holes and washers (if required) are positioned as required.			●
9. Joint brought to the snug-tight condition prior to the pretensioning operation.			●
10. Fastener component not turned by the wrench prevented from rotating.			●
11. Fasteners are pretensioned in accordance with the RCSC Specification, progressing systematically from the most rigid point toward the free edges.			●
Inspection Tasks After Bolting	AISC 360, Table N5.6-3		
12. Document acceptance or rejection of bolted connections.		●	

Notes:
(1) The "●" represents a required inspection activity for the project where it occurs.

ATTACHMENT G - STEEL CONSTRUCTION - STEEL DECK - SPECIAL INSPECTION SCHEDULE

STEEL CONSTRUCTION - STEEL DECK - SPECIAL INSPECTION SCHEDULE

Verification and Inspection	Referenced Standard CBC 2022	Frequency of Inspection[1] (During Task Listed) Continuous	Periodic
1. Cold-formed steel deck:			
a. Materials: Identification markings conform to ASTM standards specified in the approved construction documents.	Applicable ASTM material standards		●
b. Materials: Manufacturer's certified test reports.			●
c. Welding: Floor and roof deck welds.	AWS D1.3		●

Notes:
(1) The "●" represents a required inspection activity for the project where it occurs.

ATTACHMENT H - DEEP FOUNDATIONS, CAST-IN-PLACE - SPECIAL INSPECTION SCHEDULE

DEEP FOUNDATIONS, CAST-IN-PLACE - SPECIAL INSPECTION SCHEDULE

Verification and Inspection	Reference Standard CBC 2022	Frequency of Inspection(1) (During task listed)	
		Continuous	Periodic
1. Observe drilling operations and maintain complete and accurate records for each element.	CBC 1705.8	●	
2. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock or specified stratum (if applicable), and adequate end-bearing strata capacity. Record concrete or grout volumes.	CBC 1705.8	●	
3. For concrete or grout installations, perform additional special inspection in accordance with Attachment A - Concrete Special Inspection.	CBC 1705.8	-	-

Notes:
(1) The "●" represents a required inspection activity for the project where it occurs.

SECTION 01460

CONTRACTOR QUALITY CONTROL PLAN

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Contractor Quality Control Plan.

1.02 SUBMITTALS

A. Qualifications of the Contractor's Quality Control (CQC) Plan Manager.

B. Contractor's Daily Quality Control Report:
   1. Submit to Engineer within 1 day of completion of each inspection using the approved form.

C. Daily Inspection Report:
   1. Submit to Engineer at the end of each working day or no later than prior to the beginning of the next working day using the approved form.

1.03 CONTRACTOR'S INSPECTION OF THE WORK

A. Work performed by Contractor shall be inspected by the Contractor's CQC Plan Manager. Non-conforming Work and any safety hazards in the Work area shall be noted and promptly corrected.

B. No materials or equipment shall be used in Work without inspection and acceptance by Contractor's CQC Plan Manager.

1.04 QUALIFICATIONS

A. Contractor's CQC Plan Manager: Demonstrate having performed similar CQC functions on similar type projects. Submit records of personnel experience, training, and qualifying registrations.

B. Minimum qualifications: Candidate must have a minimum of 10 years of experience on projects of similar type and size.

1.05 COVERING WORK

A. Whenever Contractor intends to backfill, bury, cast in concrete, or otherwise cover any Work, notify Engineer not less than 24 hours in advance to request inspection before beginning any such Work of covering. Failure of Contractor to notify Engineer in accordance with this requirement shall be resolved according to Article 14 of the General Conditions.

1.06 CONTRACTOR'S QUALITY CONTROL PROGRAM

A. General: Establish and execute a Quality Control (CQC) Plan for Work. The plan shall establish adequate measures for verification and conformance to defined requirements by Contractor personnel and lower-tier Subcontractors (including Fabricators, Suppliers, and Subcontractors). This program shall be described in a Plan responsive to this Section.

B. CQC personnel:
   1. Contractor's CQC Plan Manager shall report to a Senior Project Manager of the Contractor and shall have no supervisory or managerial responsibility over the workforce.
   2. The Contractor CQC Plan Manager shall be on-site as often as necessary, but not less than the daily working hours specified in the Contract Documents to remedy and demonstrate that Work is being performed properly and to make multiple observations of Work in progress.
   3. The Contractor is to furnish personnel with assigned CQC functions reporting to the CQC Manager. Persons performing CQC functions shall have sufficient qualifications, authority, and organizational freedom to identify quality problems and to initiate and recommend solutions.

C. CQC Plan:
   1. Contractor's CQC Plan shall include a statement by the Senior Project Manager designating the CQC Plan Manager and specifying the authority delegated to the CQC Plan Manager to direct cessation or removal and replacement of defective Work.
   2. Describe the CQC program and include procedures, work instructions, and records. Describe methods relating to areas that require special testing and procedures as required by the specifications.
   3. Include specific instructions defining procedures for observing Work in process and comparing this Work with the Contract requirements (organized by specifications section).
   4. Describe procedures to ensure that equipment or materials that have been accepted at the Site are properly stored, identified, installed and tested.
   5. Include procedures to verify that procured products and services conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to lower-tier Suppliers and/or Subcontractors.
   6. Commissioning quality control: Include procedures to verify that the commissioning requirements of the Contract Documents are integrated into the Contractor's CQC Plan and conform to the requirements of the Specifications. Requirements of these procedures shall be applied, as appropriate, to the Contractor and the lower-tier Suppliers and/or Subcontractors.
   7. Include instructions for recording inspections and requirements for demonstrating through the Daily Inspection Reports that Work inspected was in compliance or a deficiency was noted and action to be taken.
   8. Procedures to preclude the covering of deficient or rejected Work.
   9. Procedures for halting or rejecting Work.

10. Procedures for resolution of differences between the CQC Plan Manager and the production personnel.
11. Identify contractual hold/inspection points as well as any Contractor-imposed hold/inspection points.

D. Daily Inspection Report: Include, at a minimum:
   1. Inspection of specific work.
   2. Quality characteristics in compliance.
   3. Quality characteristics not in compliance.
   4. Corrective/remedial actions taken.
   5. Statement of certification.
   6. CQC Manager's signature, electronic signature is acceptable.
   7. Information provided on the daily report shall not constitute notice of delay or any other notice required by the Contract Documents.

E. Deficient and Non-conforming Work and Corrective Action: Include procedures for handling deficiencies and non-conforming Work. Deficiencies and non-conforming Work are defined as documentation, drawings, material, equipment, or Work not conforming to the indicated requirements or procedures. The procedure shall prevent non-conformances by identification, documentation, evaluation, separation, disposition, and corrective action to prevent reoccurrence. Conditions having adverse effects on quality shall be promptly identified and reported to the senior level management. The cause of conditions adverse to quality shall be determined and documents and measures implemented to prevent recurrence. In addition, at a minimum, this procedure shall address:
   1. Personnel responsible for identifying deficient and non-complying items within Work.
   2. How and by whom deficient and non-compliant items are documented "in the field."
   3. The personnel and process utilized for logging deficient and non-compliant Work at the end of each day onto a deficiency log.
   4. Tracking processes and tracking documentation for deficient and non-conforming Work.
   5. Personnel responsible for achieving resolution of outstanding deficiencies.
   6. Include detailed procedures for the performance and control of special process (e.g., welding, soldering, heat treating, cleaning, plating, nondestructive examination, etc.).

F. Audits: The CQC program shall provide for regularly scheduled documented audits to verify that CQC procedures are being fully implemented by Contractor and its Subcontractors. Audit records shall be made available to Engineer upon request.

G. Documented control/quality records:
   1. Establish methods for control of Contract Documents that describe how Drawings and Specifications are received and distributed to ensure the correct issue of the document being used. Describe how record document/drawing data are documented and furnished to Engineer.
   2. Maintain evidence of activities affecting quality. Including operating logs, records of inspection, audit reports, personnel qualification and certification records, procedures, and document review records.

3. Maintain quality records in a manner that provides for timely retrieval and traceability. Protect quality records from deterioration, damage and destruction.
4. Develop a list of specific records as required by the Contract Documents that will be furnished to Engineer at the completion of activities.

H. Acceptance of CQC Plan: Engineer's acceptance of the CQC Plan shall not relieve Contractor from any of its obligations for performance of Work. Contractor's CQC staffing is subject to Engineer's review and continued acceptance. Owner, at its sole discretion, and without cause, may direct Contractor to remove and replace the CQC Plan Manager.
1. Acceptance of the CQC Plan by the Engineer is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction.
2. After acceptance of the CQC Plan, notify the Engineer in writing of any proposed change. Proposed changes are subject to acceptance by the Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Furnishing, maintaining, and removing construction facilities and temporary controls, including temporary utilities, construction aids, barriers and enclosures, security, access roads, temporary controls, project sign, field offices and sheds, and removal after construction.

1.02 REFERENCE

A. American National Standards Institute (ANSI).

B. Occupational Safety and Health Administration (OSHA).

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

1.04 TEMPORARY UTILITIES

A. Temporary electrical power:
   1. Arrange with local utility to provide adequate temporary electrical service.
   2. Provide and maintain adequate jobsite power distribution facilities conforming to applicable Laws and Regulations.
   3. Provide, maintain, and pay for electric power for performance of the Work except for power required for operational testing.

B. Temporary electrical lighting:
   1. In work areas, provide temporary lighting sufficient to maintain lighting levels during working hours not less than lighting levels required by OSHA and state agency which administers OSHA regulations where Project is located.
   2. When available, permanent lighting facilities may be used in lieu of temporary facilities:
      a. Prior to Substantial Completion of the Work, replace bulbs, lamps, or tubes used by Contractor for lighting.

C. Temporary heating, cooling, and ventilating:
   1. Heat and ventilate work areas to protect the Work from damage by freezing, high temperatures, weather, and to provide safe environment for workers.
   2. Permanent heating system may be utilized when sufficiently completed to allow safe operation.

D. Temporary water:
   1. Pay for and construct facilities necessary to furnish potable water for human consumption and non-potable water for use during construction.
   2. Remove temporary piping and connections and restore affected portions of the facility to original condition before Substantial Completion.
   3. Pay for water used for construction prior to Substantial Completion.
   4. Development of non-potable water supply:
      a. Post ample signs throughout the work area warning that plant water is not potable.
      b. Non-potable water is available from hydrants or hose valves within plant without cost. When combined demand of the Work and plant exceeds plant supply capacity, provide additional temporary supply capacity.

E. Temporary sanitary facilities:
   1. Provide suitable and adequate sanitary facilities that are in compliance with applicable Laws and Regulations.
   2. Existing facility use is not allowed.
   3. At completion of the Work, remove sanitary facilities and leave site in neat and sanitary condition.

F. Temporary fire protection:
   1. Provide fire protection required to protect the Work and ancillary facilities.

G. First aid: Post first aid facilities and information posters conforming to requirements of OSHA and other applicable Laws and Regulations in readily accessible locations.

H. Utilities in existing facilities: As specified in Section 01140 - Work Restrictions.

I. Temporary piping systems:
   1. Submit layout drawings showing proposed routing of piping, including proposed pipe support and pipe restraint locations.
   2. Submit product data for piping, fittings, appurtenances, restraints, supports, and other components of the temporary piping system.
   3. Submit information at least 28 days prior to when each temporary piping system is scheduled to be installed and allow 14 days for review and comment.

J. Temporary pumping systems:
   1. Submit pump data, performance curves, and other operating information as specified in Section 15050 - Common Work Results for Mechanical Equipment.
   2. Submit sketches showing layout of temporary pumping system, including pump quantity, configuration in wet well, and proposed piping layout specified in this Section.
   3. Submit piping headloss calculations based on proposed temporary piping system layout.
   4. Submit information at least 28 days prior to when the temporary pumping system is scheduled to be installed and allow 14 days for review and comment.

1.05 CONSTRUCTION AIDS

A. Provide railings, kick plates, enclosures, safety devices, and controls required by Laws and Regulations and as required for adequate protection of life and property.

B. Use construction hoists, elevators, scaffolds, stages, shoring, and similar temporary facilities of ample size and capacity to adequately support and move loads.

C. Design temporary supports with adequate safety factor to ensure adequate load bearing capability:
   1. When requested, submit design calculations by professional registered engineer prior to application of loads.
   2. Submitted design calculations are for information and record purposes only.

D. Accident prevention:
   1. Exercise precautions throughout construction for protection of persons and property.
   2. Observe safety provisions of applicable Laws and Regulations.
   3. Guard machinery and equipment and eliminate other hazards.
   4. Make reports required by authorities having jurisdiction, and permit safety inspections of the Work.
   5. Before commencing construction work, take necessary action to comply with provisions for safety and accident prevention.

E. Barricades:
   1. Place barriers at ends of excavations and along excavations to warn pedestrian and vehicular traffic of excavations.
   2. Provide barriers with flashing lights after dark.
   3. Keep barriers in place until excavations are entirely backfilled and compacted.
   4. Barricade excavations to prevent persons from entering excavated areas in streets, roadways, parking lots, treatment plants, or other public or private areas.

F. Warning devices and barricades: Adequately identify and guard hazardous areas and conditions by visual warning devices and, where necessary, physical barriers:
   1. Provide devices in accordance with minimum requirements of OSHA and State agency which administers OSHA regulations where Project is located.

G. Hazards in public right-of-way:
   1. Comply with local jurisdiction standards and requirements for right-of-way barricades and other safety devices.
   2. Mark at reasonable intervals, trenches, and other continuous excavations in public right-of-way, running parallel to general flow of traffic, with traffic cones, barricades, or other suitable visual markers during daylight hours:
      a. During hours of darkness, provide markers with torches, flashers, or other adequate lights.
   3. At intersections or for pits and similar excavations, where traffic may reasonably be expected to approach head on, protect excavations by continuous barricades:
      a. During hours of darkness, provide warning lights at close intervals.

H. Hazards in protected areas: Mark or guard excavations in areas from which public is excluded, in manner appropriate for hazard.

I. Above grade protection: On multi-level structures, provide safety protection that meets requirements of OSHA and State agency which administers OSHA regulations where Project is located.

J. Protect existing structures, trees, shrubs, and other items to be preserved on Project site from injury, damage, or destruction by vehicles, equipment, worker or other agents with substantial barricades or other devices commensurate with hazards.

K. Fences:
   1. Enclose site of the Work with fence adequate to protect the Work against acts of theft, violence, and vandalism.
   2. Enclose temporary offices and storage areas with fence adequate to protect temporary facilities against acts of theft, violence, and vandalism.
   3. When entire or part of site is to be permanently fenced, permanent fence may be built to serve for both permanent and temporary protection of the work site, provided that damaged or defaced fencing is replaced prior to Substantial Completion.
   4. Protect temporary and permanent openings and close openings in existing fences to prevent intrusion by unauthorized persons.
      a. Bear responsibility for protection of plant and material on site of the Work when openings in existing fences are not closed.
   5. During night hours, weekends, holidays, and other times when no work is performed at site, provide temporary closures or enlist services of security guards to protect temporary openings.
   6. Fence temporary openings when openings are no longer necessary.

1.06 SECURITY

A. Make adequate provision for protection of the work area against fire, theft, and vandalism, and for protection of public against exposure to injury.

1.07 ACCESS ROADS

A. General:
   1. Build and maintain access roads to and on site of the Work to provide for delivery of material and for access to existing and operating plant facilities on site.
   2. Build and maintain dust free roads which are suitable for travel at 20 miles per hour.

B. Off-site access roads:
   1. Build and maintain graded earth roads.
   2. Build roads only in public right-of-way or easements obtained by Owner.
   3. Obtain rights-of-way or easements when electing to build along other alignment.

C. On-site access roads:
   1. Maintain access roads to storage areas and other areas to which frequent access is required.
   2. Maintain similar roads to existing facilities on site of the Work to provide access for maintenance and operation.
   3. Protect buried vulnerable utilities under temporary roads with steel plates, wood planking, or bridges.
   4. Maintain on-site access roads free of mud.
   5. Provide controls to prevent vehicles leaving the site from tracking mud off the site onto the public right-of-way.

1.08 TEMPORARY CONTROLS

A. Dust control:
   1. Prevent dust nuisance caused by operations, unpaved roads, excavation, backfilling, demolition, or other activities.
   2. Control dust by sprinkling with water, use of dust palliatives, modification of operations, or other means acceptable to agencies having jurisdiction.

B. Noise control:
   1. Comply with noise and work hours regulations by local jurisdiction.
   2. In or near inhabited areas, particularly residential, perform operations in manner to minimize noise.
   3. In residential areas, take special measures to suppress noise during night hours.

C. Mud control:
   1. Prevent mud nuisance caused by construction operations, unpaved roads, excavation, backfilling, demolition, or other activities.

1.09 PROJECT SIGN

A. Place a professionally prepared Project identification sign at least 8 feet wide and 4 feet tall made of 3/4-inch thick exterior grade plywood or other approved material in a prominent location on the Project site with a minimum 10-foot long, 4 by 4 lumber posts, set in ground at least 3 feet. Maintain the sign in good condition for the duration of the Project implementation. Exhibit lettering by professional sign painter shall use no more than 5 sign colors.

B. The sign may include another agency's required information and must include, prominently displayed, the following:
   1. "Funding for this project has been approved in full or in part under the Proposition 68 through an agreement with the State Water Resources Control Board."
   2. Colorized logos provided by the Engineer.
   3. List at least the title of the Project, and names of the Owner, Engineer, Construction Manager and Contractor.

C. Erect Project identification sign where directed by Engineer within 14 days after the issuance of the Notice to Proceed.

D. Replace or repair the project sign if it is damaged or covered with graffiti within 2 working days of observation or notification of damage or graffiti.

1.10 CONTRACTOR FIELD OFFICES AND SHEDS

A. Maintain on Project Site weather tight space in which to keep copies of Contract Documents, progress schedule, shop drawings, and other relevant documents.

B. Provide field office with adequate space to examine documents and provide lighting and telephone service in that space.

C. Construction Manager field office:
   1. Provide separate field office on project site for the exclusive use of the Construction Manager, as follows:
      a. Size: Approximately 12 feet by 50 feet with 8-foot minimum ceiling height.
      b. Construction: Weather tight building constructed at the site, pre-manufactured building, or trailer.
      c. Layout approved by Construction Manager.
         1) Private offices: 2.
         2) Conference area: 1.
         3) Washroom: 1.
            a) Room partitioned off from the working area.
            b) Single water discharge to nearest approved sanitary facility.
            c) Flush toilet.
            d) Vented exhaust fan.
            e) Sink with hot and cold water.
            f) Mirror.
            g) Water heater: 10-gallon capacity.
            h) Toilet tissue holder.
            i) Paper towel holder.
         4) Closet with shelving: 1.
      d. Exterior materials:
         1) Weather-resistant and finished in one color acceptable to Engineer.
         2) Skirting for under pinning of field office.
      e. Provide wood stairs with handrails for each entry.
         1) Porch landing 5 feet by 5 feet for each entry.
      f. Interior materials in offices:
         1) Sheet-type materials for walls and ceilings, prefinished or painted; resilient floors and bases.
         2) Insulate interior walls for noise attenuation.
      g. Openings:
         1) At least 8 windows (with operable sash, insect screens, and blinds).
         2) Entrance doors: Provide 2, each with cylinder lock and 4 keys.
      h. Exterior lighting over entrance doors.
      i. Fire extinguishers:
         1) Appropriate type fire extinguisher(s) for field office.
      j. Twenty 110 volts AC duplex receptacles with at least 4 in each office, 1 on each wall.

2. Arrange and pay for:
    a. Daily janitorial service, including dusting, floor cleaning (sweeping, vacuuming or mopping), and trash removal, and monthly comprehensive cleaning, including windows.
    b. Heating, ventilating, and air conditioning equipment in operating condition.
        1) Furnish maintenance and consumables.
    c. Electric wiring, power, and lighting fixtures capable of providing at least 75-foot candles of light on work surfaces.
    d. A continuous supply of toilet paper, paper hand towels and hand soap for each washroom.
    e. Private telephone line(s).
    f. Bottled drinking water service with hot and cold dispenser including water cups.
    g. Provide and maintain First Aid Kit and Cabinet in accordance with ANSI Z 308.1, and OSHA requirements.
    h. Provide boot scraper and brush at each entrance.
    i. Maintain approach walks, decking, porches, and parking lot free of mud, water, and snow.
3. Provide following furnishings and equipment:
    a. Office desks: 36 inches by 72 inches, with 6 drawers (2 with locks).
    b. Padded, upholstered swivel arm multi-function ergonomic chairs.
    c. Plan/conference table: 1, not less than 48 inches by 120 inches.
    d. Drafting table: 1, not less than 36 inches by 72 inches.
    e. Metal drafting stools with backs: 2.
    f. Straight chairs (fully padded): 8.
    g. Swivel chairs (adjustable and fully padded): 4.
    h. Metal filing cabinet: 2, 18 inches by 30 inches by 52 inches, 4 drawers with locks.
    i. Supply cabinet: 1, with not less than 15 square feet of shelves.
    j. Bookcases: 2, with not less than 12 linear feet of shelves for each bookcase.
    k. Plan hold rolling stand of 12 binders: 2, with binders.
    l. Wastebaskets: 3.
    m. Dry erase board 96 by 48 inches, magnetic: 2.
    n. Provide: 1 tackboard 36 by 48 inches.
    o. Refrigerator: 15.0 cubic feet capacity.
    p. Microwave oven: 1.0 cubic feet.
    q. K-cup coffee maker with direct water hookup and coffee cups.
    r. 1 multiline telephone system with 10 lines and voicemail capabilities, 9 speaker capable phones with handsets, 1 for each desk and table and 1 conference phone for meeting room.
4. Locate field office where directed.
5. Have field office ready for occupancy within 2 weeks after start of the Work.
6. Parking: 10 hard surfaced parking spaces for use by Construction Manager connected to office by a hard surfaced walkway.

1.11 FIELD OFFICE DATA SERVICE AND EQUIPMENT

A. Provide the following data services for the duration of the project.

B. Contractor is responsible for maintenance of service and hardware.

C. Data service will be dedicated to the Construction Manager and not shared with any other party.

D. Contractor provide a durable and weather tight system for connecting the Construction Manager trailer to the service provider's facilities at the jobsite boundary.

E. Data service
   1. Broadband Internet.
      a. Minimum Internet bandwidth speed:
         1) Download: 100 Million bits per second (Mbps).
         2) Upload: 10 Million bits per second (Mbps).
      b. Modem, if applicable: Disable the wireless radio.

F. Printer/Scanner:
   1. Manufacturers: The following or equal:
      a. Canon Color Digital Multifunction printer (ImageRUNNER Advance C3330i).
   2. Functions:
      a. Print, scan, and sort 11 inch by 17 inch and smaller paper size.
      b. Send and receive Fax.
   3. Maintenance contract: Onsite maintenance for duration of project.
   4. Supplies: Paper (8 1/2 inch by 11 inch, 8 1/2 inch by 14 inch, and 11 inch by 17 inch) trays, toner, and other supplies for duration of project.

1.12 REMOVAL

A. Remove temporary facilities and controls before inspection for Substantial Completion or when directed.

B. Clean and repair damage caused by installation or use of temporary facilities.

C. Remove underground installations to minimum depth of 24 inches and grade to match surrounding conditions.

D. Restore existing facilities used during construction to specified or original condition.

1.13 TEMPORARY PROCESS PIPING SYSTEMS

A. Provide piping, appurtenances, and other materials as required to provide temporary piping systems as specified in this Section, as indicated on the Drawings, and as needed to perform the Work.

B. Provide field route piping as needed and as field conditions dictate, unless otherwise indicated on the Drawings, and determine appropriate lengths of piping and quantity/type of pipe fittings needed to construct temporary piping system. Do not block access points such as stairs, doors, and walkways to existing facilities unless approved in writing by the Owner.

C. Restrain piping at valves and at fittings where piping changes direction, changes sizes, and at ends:
   1. When piping is buried, use concrete thrust block or mechanical restraints.
   2. When piping is exposed or under water, use mechanical or structural restraints.
   3. Determine thrust forces by multiplying the nominal cross sectional area of the piping by the operating pressure of the piping.

D. Install temporary piping systems in a manner that will not damage existing or new facilities.

E. Piping material, including gaskets: Suitable for the process fluid requiring temporary piping, unless indicated otherwise.

F. After temporary piping system is no longer required:
   1. Remove temporary piping system.
   2. Clean and repair damage caused by installation or use of temporary piping system.
   3. Restore existing facilities to original condition.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01550

TRAFFIC CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Traffic control requirements to keep streets and traffic ways open for the passage of vehicles and pedestrians during the construction period.

1.02 SUBMITTALS

A. Approved and signed copies of:
   1. Encroachment permit.
   2. Traffic control plan (TCP).
   3. Notification plan.

1.03 AUTHORITIES HAVING JURISDICTION (AHJ)

A. Authorities Having Jurisdiction (AHJ) as specified in Section 01410 - Regulatory Requirements.

B. AHJ traffic control requirements supersede the requirements of this Section.

C. Comply with AHJ traffic control requirements.

1.04 MEASUREMENT AND PAYMENT

A. Contractor is responsible for costs associated with permits, plans, implementation, and maintenance as specified in Section 01220 - Measurement and Payment.

1.05 ENCROACHMENT PERMIT

A. Obtain Encroachment Permit approved by AHJ.

1.06 TRAFFIC CONTROL PLAN (TCP)

A. Approval of the TCP by the AHJ shall in no way relieve the Contractor of the responsibility for traffic and safety requirements.

B. Include labor, material, equipment, tools, and services used in the regulation of construction traffic to and from the project site as well as public vehicular and pedestrian traffic within the project limits.

C. Provide a TCP for each phase or segment of the construction meeting the requirements of the AHJ and this Section.
   1. Each TCP shall be considered separately.

D. Obtain TCP approved by AHJ.

E. Submit approved TCP to the Engineer within 48 hours of approval by the AHJ. Changes to the TCP:
   1. If, during the execution of the work, the Contractor determines that the traffic control is not functioning as intended, the Contractor shall submit revised TCP to AHJ for approval.
   2. Submit revised approved TCP to the Engineer within 48 hours of completing a change.

F. Provide for the protection of the traveling public, pedestrians, and workers within the area covered by the limits of construction, at all times when the area is affected by construction facilities or activities including the following:
   1. Public traffic access.
   2. Business access.
   3. Private property access.
      a. Warn, control, protect, and expedite vehicular and pedestrian traffic through the private property.
   4. Driveway access.
   5. Pedestrian access.
   6. Bus stop access.
      a. Provide Bus Stop Closure Schedule (BSCS) attached to TCP.
      b. BSCS shall identify specific durations and times of day for all proposed bus stop closures.
      c. Closures are not to exceed 2 consecutive bus stops at a time or 1,000 feet at a time.
      d. During construction, coordinate with AHJ regarding specific dates of bus stop closures.
         1) Inform Owner of coordination details.
   7. Sanitation (trash) truck access
   8. Bike access.
      a. Maintain safe bike facilities through the work zone and associated traffic control layouts.
      b. Provide alternative bike facilities or designated detour routes when necessitated by temporary removal of existing bike lanes.
   9. Emergency vehicle access.
      a. Maintain access for emergency vehicles at all times.
   10. School zones and safe routes to school.
      a. When a designated Safe Route to School is encroached upon by a construction work zone or the AHJ identifies a need for students to be assisted in the safe crossing through the work zone, provide a qualified crossing guard approved by the AHJ.
         1) Crossing guard shall be present for the full duration of time that children are likely to be present, as determined by the AHJ.
         2) Contractor is responsible for fees associated with the use of crossing guards.
   11. Protection from excavations.
   12. Limit access to work sites.

1.07 NOTIFICATION PLAN

A. Submit Notification Plan to Engineer for approval.

B. Define who will notify, how they will notify, and when they will notify.
   1. Notify affected emergency agencies, residences, and businesses within the area of current work 15 days prior to start of operations.
   2. Notify AHJ for any traffic control or work areas affecting traffic signals, public bus routes, or bus stops at a minimum of 72 hours prior to any the work.

C. Notify Engineer 15 days prior to start of construction.

D. Notify the AHJ a minimum of 2 working days prior to the anticipated beginning of construction.
   1. Emergency services, such as police and fire.
   2. Other services, such as bus service, mail and garbage collection.

E. Residential areas:
   1. Notify adjacent residents as applicable at least 4 days prior to restricting driveway access or starting any work, using "door knob type" Notices approved by the Engineer.
      a. Notices shall describe the impending work.
      b. Notices shall also identify dates and stages of work.
   2. Give special consideration to multi-family residential complexes and other high-density uses.
   3. Notices shall also identify dates and stages of work.

F. Vehicular Traffic: Define placement of the following:
   1. Project signs.
      a. Locate project signs as indicated on the Drawings.
   2. Text message boards.
      a. Locate text message boards as indicated on the Drawings.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01562

TEMPORARY TREE AND PLANT PROTECTION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Tree and plant protection.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. A300 - For Tree Care Operations - Tree, Shrub, and Other Woody Plant Maintenance Standard Practices (Pruning).

B. American Society of Consulting Arborists (ASCA).

C. International Society of Arboriculture (ISA).

1.03 MEASUREMENT AND PAYMENT

A. Payment for tree protection, including tree pruning or tree removal, shall be paid as a lump sum basis that shall include all items specified in this Section unless payment is specified otherwise in this Section.

B. Unit price procedures: As specified in Section 01220 - Measurement of Payment.

1.04 SUBMITTALS

A. As specified in Section 01330 - Submittal Procedures.

B. Certification of a Registered Consulting Arborist (designated ASCA or ISA) to review and approve temporary protection measures for trees indicated to remain.

C. Protection Zone Exhibit indicating intended location of tree protection fencing.

D. Tree maintenance plan: Arborist recommendations for care of trees, both during construction and after work is completed.

1.05 PROJECT CONDITIONS

A. Preserve and protect existing trees and plants to remain from foliage, branch, trunk, or root damage that could result from construction operations.

B. Prevent damage including, but not limited to, the following:
   1. Trunk damage from equipment operations, material storage, or from nailing or bolting.

2. Trunk and branch damage caused by ropes or guy wires.
3. Root or soil contamination from spilled solvents, gasoline, paint, lime slurry, and other noxious materials.

1.06 QUALITY ASSURANCE

A. Arborist qualifications: Certified by ISA.

B. Pre-construction conference: To establish schedule and procedures for tree protection.

C. Pre-construction documentation: To establish pre-construction condition of existing tree to remain that might be misconstrued as damage caused by construction.

PART 2 PRODUCTS

2.01 MATERIALS

A. Pruning paint: Black latex, water-based paint, free of all petroleum products.

B. Tree protection fencing: As indicated on the Drawings.
1. Provide continuous fencing between posts, pulled taut prior to securing to posts, and firmly attached to the posts with a minimum of 4 wire ties.

PART 3 EXECUTION

3.01 PROTECTION OF EXISTING TREES AND SHRUBS

A. Site preparation work and/or construction work shall not begin in any area where tree preservation measures have not been completed and approved.

B. Tree protection zone: Install temporary fencing outside the drip line of tree to be protected from construction damage.
1. Install fencing with a radius of 1.5 times the drip line, unless otherwise indicated by Consulting Arborist.
2. Protect tree and shrub root systems from damage due to noxious materials caused by runoff or spillage while mixing, placing, or storing construction materials.
3. Protect root systems from flooding, eroding, or excessive wetting.
4. Do not store construction materials, equipment, debris, or other material within the drip line of remaining trees.
5. Do not permit vehicles or foot traffic within the drip line; prevent soil compaction over root systems.
6. Designate limited areas as concrete washout areas away from root zones.

C. Install tree protection fencing around each tree to be preserved as indicated in the tree treatment schedule and on the tree protection plan.
1. Each tree to be preserved shall be protected with a tree protection fence. Install tree protection fencing prior to site work or construction activity.

2. Immediately repair damage to tree fences occurring during the progress of the work at no additional cost to Owner.
3. Workers shall be clearly instructed to exercise caution in performance of work near trees being preserved.

D. Pruning of trees:
1. Prune trees in accordance with the ANSI A300 for tree pruning.
   a. Pruning shall be completed by professional arborists who have received training in proper pruning techniques.
2. Make cuts sufficiently close to the parent limb or trunk without cutting into the branch collar or leaving a protruding stub, so that closure can readily start under normal conditions.
   a. All lateral cuts shall be made to a lateral that is least 1/3 the diameter of the parent limb.
   b. Clean cuts shall be made at all times.
3. Prune trees in a manner that will not destroy or alter the natural shape and character of the tree.
   a. Apply black latex paint to fresh wounds on Oak (Quercus) species immediately after each cut is made.
4. Crown cleaning prune designated trees shall include selective removal of dead, diseased, and/or broken limbs.

3.02 EXCAVATION

A. Do not excavate within drip line of protected trees.

B. Within drip line of trees, hand clear to minimize damage to root systems.

3.03 TREE REPAIR AND REPLACEMENT

A. Promptly treat damaged trunks, limbs, and roots according to written instructions of Consulting Arborist.

3.04 DISPOSAL OF FENCING MATERIALS

A. Promptly remove protective fencing upon completion of construction activities.

END OF SECTION

SECTION 01573

EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Installation of erosion and sediment control filter fabric fences.
   2. Triangular filter fabric fences.
   3. Straw bale fences and brush berms used during construction and prior to final development of site.

B. Purpose of control fences is to contain pollutants from overland flow.
   1. Control fences are not for use in channelized flow areas.

1.02 UNIT PRICES

A. Measure and pay for filter fabric fence by linear foot of completed and accepted filter fabric fence installed around construction site. Limits of construction site are indicated on the Drawings.

B. Measure and pay for triangular filter fabric fence by linear feet of completed and accepted triangular filter fabric fence between limits of beginning and ending of wooden stakes.

C. Measure and pay for straw bale barrier by linear feet of completed and accepted straw bale barrier.

D. Measure and pay for brush berm by linear feet of completed and accepted brush berm.

1.03 SUBMITTALS

A. Manufacturer’s catalog sheets and other product data on geotextile fabric.

1.04 REFERENCES

A. ASTM International (ASTM):
   1. D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).
   2. D4355 - Standard Test Method for Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus.
   3. D4491- Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
   4. D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
   5. D4833 - Standard Test Method for Index Puncture Resistance of Geomembranes, and Related Products.

6. D5665- Standard Specification for Thermoplastic Fabrics Used in Cold-Applied Roofing and Waterproofing.
7. D6459 - Standard Test Method for Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Hillslopes from Rainfall-Induced Erosion.
8. D6475 - Standard Test Method for Measuring Mass per Unit Area of Erosion Control Blankets.
9. D6525 - Standard Test Method for Measuring Nominal Thickness of Rolled Erosion Control Products.
10. D6567 - Standard Test Method for Measuring the Light Penetration of a Rolled Erosion Control Product (RECP).
11. D6818 - Standard Test Method for Ultimate Tensile Properties of Rolled Erosion Control Products.

1.05 QUALITY ASSURANCE FOR EROSION CONTROL BLANKETS

A. Product shall be manufactured in accordance to a documented Quality Control Program. At a minimum, the following procedures and documentation shall be provided:
   1. Manufacturing Quality Control Program Manual.
   2. First piece inspection of products produced to assure component materials and finished product tolerances are within manufacturer specifications.
   3. Additional inspections for product conformance shall be conducted during the run after the first piece inspection.
   4. Every roll shall be visually inspected.
   5. Moisture content of straw and coconut fibers measured upon receipt.
   6. At a minimum, every third roll shall be weighed to insure conformance of manufacturer's specifications.
   7. Each individual erosion control blanket shall be inspected prior to packaging for conformance to manufacturing specifications.

1.06 PERFORMANCE REQUIREMENTS FOR EROSION CONTROL BLANKETS

A. Erosion control blanket shall provide a temporary, biodegradable cover material to reduce slope and enhance vegetation. Erosion control blanket performance capabilities shall be in accordance with ASTM D6459, "Determination of Erosion Control Blanket (ECB) Performance in Protecting Hillslopes from Rainfall-Induced Erosion."

PART 2 PRODUCTS

2.01 FILTER FABRIC

A. Provide woven or nonwoven geotextile filter fabric made of either polypropylene, polyethylene, ethylene, or polyamide material.

B. Geotextile fabric:
   1. Grab strength of 100 pounds per square inch in any principal direction in accordance with ASTM D4632.

2. Puncture strength exceeding 115 pounds per square inch in accordance with ASTM D4833.
3. Equivalent opening size between 50 and 140 for soils with more than 15 percent by weight passing No. 200 sieve and between 20 and 50 for soil with less than 15 percent by weight passing No. 200 sieve.
4. Maximum water flow rate of 40 gallons per minute per square feet in accordance with ASTM D4491.

C. Filter fabric material shall contain ultraviolet inhibitors and stabilizers to provide expected usable life comparable to anticipated construction period.
1. Ultraviolet stability shall exceed 70 percent after 500 hours of exposure in accordance with ASTM D4355.

D. Manufacturers: The following or equal:
1. Mirafi, Inc.

2.02 EROSION CONTROL BLANKETS

A. Manufacturers: One of the following or equal:
1. American Excelsior Co., AEC Premier Straw/Coconut™ Blankets.
2. Proper Geotextile Systems.

B. Product requirements:
1. Erosion control blanket shall be furnished in rolls and wrapped with suitable material to protect against moisture intrusion and extended ultraviolet exposure prior to placement.
2. Erosion control blanket shall be of consistent thickness with fibers distributed evenly over the entire area of the blanket.
3. Erosion control blanket shall be free of defects and voids that would interfere with proper installation or impair performance.

C. Materials:
1. Blend of 70 percent straw and 30 percent coconut fibers.
   a. The straw fibers shall consist of straw with 75 percent of fibers greater than 4 inches in length, and certified weed seed free.
   b. Product shall be 100 percent biodegradable.
   c. The blended fibers shall be evenly distributed throughout the entire area of the blanket.
   d. The top and bottom of each blanket is covered with biodegradable jute netting.
2. Blanket performance requirements:
   a. C factor: 0.15.
   b. Shear stress: 2.0 lb/ft^2.
   c. Velocity: 8.5 feet per second.
   d. Functional longevity: Less than 24 months.
3. Material characteristics:
   a. Width: 8.0 feet.
   b. Length: 112.5 feet.
   c. Area: 100.0 $yard^2$.
   d. Weight: 50.0 pounds.
   e. Mass per unit area: 0.50 lv/yd^2.

f. Net openings: 0.5 inch by 1.0 inch.
g. Minimum Index Values:

Index Property	Test Method	Value
Thickness	ASTM D6525	0.331 in (8.41 mm)
Light Penetration	ASTM D6567	5.8%
Mass per Unit Area	ASTM D6475	0.81 lb/yd^2 (437 g/m^2)
MD-Tensile Strength Max.	ASTM D6818	321.6 lb/ft (4.69 kN/m)
TD-Tensile Strength Max.	ASTM D6818	159.6 lb/ft (2.33 kN.m)
MD-Elongation	ASTM D6818	4.1%
TD-Elongation	ASTM D6818	4.8%
Water Absorption	ASTM D5665	382%

D. Staples:
1. Staples shall be 100 percent biodegradable with a U-shaped top. Staples shall be a minimum 4 inch biodegradable staple for cohesive soils and 6 inches for non-cohesive soils.

PART 3 EXECUTION

3.01 PREPARATION AND INSTALLATION

A. Provide erosion and sediment control systems at locations as indicated on the Drawings.
1. Construct in accordance with requirements as indicated on the Drawings and of type indicated as specified in this Section.

B. No clearing, grubbing or rough cutting permitted until erosion and sediment control systems are in place, other than site work specifically directed by Project Manager to allow soil testing and surveying.

C. Maintain existing erosion and sediment control systems located within project site until acceptance of Project or until directed by Project Manager to remove and discard existing system.

D. Regularly inspect and repair or replace damaged components of erosion and sediment control systems as specified in this Section.
1. Unless otherwise directed, maintain erosion and sediment control systems until project area stabilization is accepted by the Authority.
2. Remove erosion and sediment control systems promptly when directed by Project Manager.
3. Discard removed materials off site.

E. Remove and dispose sediment deposits at designated spoil site for Project.
1. If a project spoil site is not indicated on the Drawings, dispose of sediment off site at location not in or adjacent to stream or floodplain.

2. Assume responsibility for off-site disposal.
3. Spread sediment evenly throughout site, compacted and stabilized.
4. Prevent sediment from flushing into a stream or drainage way.
5. If sediment has been contaminated, dispose of in accordance with existing federal, state, and local rules and regulations.

F. Unless otherwise indicated, compact embankments, excavations, and trenches by mechanically blading, tamping, and rolling soil in maximum of 8-inch layers.
1. Compaction density shall be at a minimum of 90 percent Standard Proctor ASTM D698 density.
2. Make at least 1 test per 500 cubic yards of embankment.

G. Prohibit equipment and vehicles from maneuvering on areas outside of dedicated rights-of-way and easements for construction.
1. Immediately repair damage caused by construction traffic to erosion and sediment control.

H. Conduct all construction operations under this Contract in conformance with erosion control practices described in Section 02370 - Riprap and Gabions Erosion and Sedimentation Control.

3.02 GENERAL CONSTRUCTION METHODS

A. Provide erosion and sedimentation control systems as indicated on the Drawings.
1. Install erosion and sedimentation control systems in manner that surface runoff shall percolate through system in sheet flow fashion and allow retention and accumulation of sediment.

B. Inspect erosion and sedimentation control systems after each rainfall, daily during periods of prolonged rainfall, and at minimum once each week.
1. Repair or replace damaged sections immediately.
2. Remove sediment deposits when silt reaches depth 1/3 height of fence or 6 inches, whichever is less.

3.03 SITE PREPARATION FOR EROSION CONTROL BLANKETS

A. Before placing erosion control blanket, Contractor shall certify that the subgrade has been properly compacted, graded smooth, has no depressions, voids, soft or uncompacted areas, is free from obstructions such as tree roots, protruding stones or other foreign matter, and is seeded and fertilized according to project specifications.
1. Contractor shall not proceed until all unsatisfactory conditions have been remedied.
2. By beginning construction, Contractor signifies that the proceeding work is in conformance with this Section.

B. Contractor shall fine grade the subgrade by hand dressing where necessary to remove local deviations.

C. No vehicular traffic shall be permitted directly on the erosion control blanket.

D. Slope installation
    1. Erosion control blanket shall be installed as directed by Owner's representative in accordance with manufacturer's Installation Guidelines, Staple Pattern Guides, and CAD details. The extent of erosion control blanket shall be as indicated on the Drawings.
    2. Erosion control blanket shall be oriented in vertical strips and anchored with staples, as identified in the Staple Pattern Guide.
        a. Adjacent strips shall be overlapped to allow for installation of a common row of staples that anchor through the nettings of both blankets.
        b. Horizontal joints between erosion control blankets shall be sufficiently overlapped with the uphill end on top for a common row of staples so that the staples anchor through the nettings of both blankets.
    3. Where exposed to overland sheet flow, a trench shall be located at the uphill termination erosion control blanket shall be stapled to the bottom of the trench.
        a. The trench shall be backfilled and compacted.
        b. Where feasible, the uphill end of the blanket shall be extended 3 feet over the crest of the slope.

3.04 FILTER FABRIC FENCE CONSTRUCTION METHODS

A. Attach filter fabric to 1-inch by 2-inch wooden stakes or driven steel rods spaced a maximum of 3 feet apart and embedded minimum of 8 inches or deeper to hold fence in place.
    1. If filter fabric is factory preassembled with support netting, then maximum spacing allowable is 8 feet.
    2. Install anchoring stakes or rods at slight angle toward source of anticipated runoff.
    3. Contractor is responsible for providing adequate fence anchoring appropriate for the varying soil and rock conditions at the well sites.

B. Trench in toe of filter fabric fence with spade or mechanical trencher so that downward face of trench is flat and perpendicular to direction of flow.
    1. V-trench configuration as indicated on the Drawings may also be used.
    2. Lay filter fabric along edges of trench.
    3. Backfill and compact trench.

C. Filter fabric fence shall have a minimum height of 18 inches and a maximum height of 36 inches above natural ground.

D. Provide filter fabric in continuous rolls and cut to length of fence to minimize use of joints.
    1. When joints are necessary, splice fabric together only at support post with minimum 6-inch overlap and seal securely.

3.05 TRIANGULAR FILTER FABRIC FENCE CONSTRUCTION METHODS

A. Attach filter fabric to fence structure fashioned from 6 gauge, 6-inch by 6-inch wire mesh, 18 inches on each side as indicated on the Drawings.
    1. Fabric cover and skirt should be continuous wrapping of fabric.
    2. Skirt should form continuous extension of fabric on upstream side of fence.

B. Secure triangular fabric filter fence in place using one of the following methods:
   1. Toe-in skirt 6 inches with mechanically compacted material.
   2. Weight down skirt with continuous layer of 3-inch to 5-inch graded rock.
   3. Trench-in entire structure 4 inches.

C. If provided, anchor triangular fabric filter fence structure and skirt securely in place using 6-inch wire staples on 2-foot centers on both edges and on skirt, or staked using 18-inch by 3/8-inch diameter re-bar with tee ends.

D. Lap over fabric filter material by 6 inches to cover segment joints.
   1. Fasten joints with galvanized shoat rings.

3.06 STRAW BALE FENCE CONSTRUCTION METHODS

A. Bound bales with either wire, nylon or polypropylene rope tied across hay bales.
   1. Do not use jute or cotton bindings.

B. Place bales in row with ends tightly abutting adjacent bales.
   1. Place bales with bindings parallel to ground surface.

C. Embed bale in soil a minimum of 4 inches.

D. Securely anchor bales in place by 3/8-inch rebar stakes driven through bales a minimum of 18 inches into ground.
   1. Angle first stake in each bale toward previously laid bale to force bales together.

E. Fill gaps between bales with straw to prevent water from escaping between bales.
   1. Wedge carefully in order not to separate bales.

F. Replace with new straw bale fence every 2 months.

3.07 BRUSH BERM CONSTRUCTION METHODS

A. Construct brush berm along contour lines by hand placing method.
   1. Do not use machine placement of brush berm.

B. Use woody brush and branches having diameter less than 2-inches with 6-inches overlap.
   1. Avoid incorporation of annual weeds and soil into brush berm.

C. Use minimum height of 18-inches measured from top of existing ground at upslope toe to top of berm.
   1. Top width shall be 24 inches minimum and side slopes shall be 2:1 or flatter.

D. Embed brush berm into soil a minimum of 4-inches and anchor using either wire, nylon or polypropylene rope across berm with a minimum tension of 50 pounds.
   1. Tie rope securely to 18-inch x 3/8-inch diameter rebar stakes driven into ground on 4-foot centers on both sides of berm.

END OF SECTION

SECTION 01600

PRODUCT REQUIREMENTS - PLANT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for tangible materials, raw or manufactured, that become part of the project.

1.02 REFERENCES

A. International Organization for Standardization (ISO):
   1. 9001 - Quality Management Systems - Requirements.

B. NSF International (NSF).

C. Underwriters Laboratories, Inc. (UL).

1.03 TERMINOLOGY

A. The words and terms listed below, are not defined terms that require initial capital letters, but, when used in this Section have the indicated meaning.
   1. Calculations:
      a. Documentation of the process of transforming the design and prescriptive criteria into a design meeting the performance criteria.
   2. Certificates:
      a. An official document that attests a fact is in accordance with the Contract Documents.
   3. Manufacturer's instructions:
      a. Stipulations, directions, and/or recommendations issued form by the manufacturer of the product addressing handling, installation, erection, and/or application of the product.
   4. Products:
      a. Raw materials, finished goods, equipment, systems, and shop fabrications that will become part of the Work.
   5. Product data:
      a. Public information about the product which is found in the manufacturer's catalogs or on their web site including catalog pages, data sheets, bulletins, layout drawings, exploded views, and brochures.
   6. Samples:
      a. As defined in the General Conditions and Supplementary Conditions.
      b. Full-size actual products or pieces of products intended to illustrate the products to be incorporated into the project. Sample submittals are often necessary for such characteristics as colors, textures, and other appearance issues.
   7. Schedules:
      a. Product parts and materials lists.

8. Shop drawings:
    a. As defined in the General Conditions and Supplementary Conditions.
    b. Shop drawings are prepared specifically for the project to illustrate details, dimensions, and other data necessary for satisfactory fabrication or construction that are not shown completely in the Drawings.
    c. Shop drawings could include graphic line-type drawings and single-line diagrams.
9. Spare parts and materials:
    a. Duplicate parts necessary to replace a damaged or worn part of the product.
    b. Consumables such as operating fluids.
10. Special tools:
    a. Special wrenches, gauges, circuit setters, and other similar devices required for the proper operation or maintenance of a system that would not normally be in the Owner's tool kit and that have been specifically made for use on a product for assembly, disassembly, repair, or maintenance.
11. Special tools:
    a. Special wrenches, gauges, circuit setters, and other similar devices required for the proper operation or maintenance of a system that would not normally be in the Owner's tool kit and that have been specifically made for use on a product for assembly, disassembly, repair, or maintenance.
12. Submittals:
    a. As defined in the General Conditions and Supplementary Conditions.
    b. Samples, product data, shop drawings, and others that demonstrate how Contractor intends to conform to the Contract Documents.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Provide products as Engineer has approved by the submittal process or by other written documents.

B. Provide products by same manufacturer when units are of similar nature, unless otherwise specified.

C. Provide like parts of duplicate units that are interchangeable.

D. Provide equipment or product that has not been in service prior to delivery, except as required by tests.

E. Provide products produced by manufacturers regularly engaged in the production of these products.

F. Provide products that bear approvals and labels as specified such as Factory Mutual(FM), Underwriters Laboratory (UL), or National Sanitation Foundation (NSF International).

2.02 MATERIAL

A. Dissimilar metals:
   1. Separate contacting surfaces with dielectric material.
   2. Neoprene, bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other materials as specified.

B. Edge grinding:
   1. Sharp projections of cut or sheared edges of ferrous metals which are not to be welded shall be ground to a radius required to ensure satisfactory paint adherence.

C. Use anti-galling compound on threads of stainless steel fasteners during factory assembly.

D. Provide anti-galling compound with stainless steel fasteners shipped for field assembly.

E. Aluminum in contact with concrete or masonry: Apply epoxy mastic as specified in Section 09960 - High-Performance Coatings, coating system EPX-M-5.

F. Pipes:
   1. Provide new pipe manufactured for the project, not from manufacturer's inventory, under the following conditions:
      a. Pipes 24-inch diameter and larger.
      b. Except steel pipes 6-inch diameter and larger.
   2. Prove pipe manufactured more than 6 months prior to delivery if the pipe material or its coating is subject to ultraviolet (UV) degradation.
   3. Provide ductile iron pipe with cement-mortar lining manufactured more than 6 months prior to delivery to the project.

G. Mark each length of pipe in accordance with applicable standards.

2.03 PRODUCT SELECTION

A. When products are specified without named manufacturers, provide products that meet or exceed the Specifications.

B. When products are specified with names of manufacturers but no model numbers or catalog designations, provide Products by one of named manufacturers that meet or exceed specifications.

C. When products are specified with names of manufacturers and model numbers or catalog designations, provide Products with model numbers or catalog designations by one of the named manufacturers.

D. When products are specified with names of manufacturers, but with brand or trade names, model numbers, or catalog designations by one manufacturer only, provide:
   1. Products specified by brand or trade name, model number, or catalog designation.
   2. Products by another named manufacturers proven, in accordance with requirements for an "or equal", including Engineer's approval, to meet or exceed quality, appearance and performance of specified brand or trade name, model number, or catalog designation.

E. When Products are specified with only one manufacturer followed by "or Equal," provide:
   1. Products meeting or exceeding Specifications by specified manufacturer.
   2. Engineer deemed "or equal" evidenced by an approved shop drawing or other written communication.

F. When Products are specified by naming 2 or more manufacturers with 1 manufacturer as a "Basis of Design":
   1. Any of the named manufacturers can be submitted.
   2. If the product submitted is not by the named "Basis of Design" product and requires a change in the scope (dimensions, configuration, physical properties, etc.), schedule (longer lead time), or budget, the Contractor must submit a substitution request.

2.04 SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS

A. Provide spare parts and maintenance products as required by Technical Sections.
   1. Submit completed Attachment A - Spare Parts, Maintenance Products, and Special Tools Inventory List.

B. Provide one set of special tools required to install or service the equipment.

C. Box, tag, and clearly mark items.

D. Contractor is responsible for spare parts, maintenance products, and special tools until acceptance by Owner.

PART 3 EXECUTION

3.01 SHIPMENT

A. Requirements prior to shipment of equipment:
   1. Engineer approved submittals or other written documentation.
   2. Engineer approved Manufacturer's Certificate of Source Testing as specified in the Technical Sections.
   3. Draft operations and maintenance manuals, as specified in Section 01782 - Operation and Maintenance Manuals as specified in the Technical Sections.

B. Transport products by methods that avoid product damage.

C. Deliver products in undamaged condition in manufacturer's unopened containers or packaging.

3.02 DELIVERY AND HANDLING

A. Handle equipment in accordance with manufacturer's instructions.

B. Deliver products in undamaged condition in manufacturer's unopened containers or packaging.

C. Provide construction equipment and personnel to handle products by methods in accordance with manufacturer’s instructions.

D. Upon delivery, promptly inspect shipments:
   1. Verify compliance with Contract Documents, correct quantities, and undamaged condition of products.
   2. Acceptance of shipment does not constitute final acceptance of equipment.

E. Spare parts, maintenance products, special tools.
   1. Immediately store in accordance with the manufacturer's instructions.
   2. Store spare parts, maintenance products, and special tools in enclosed, weather-proof, and lighted facility during the construction period.
      a. Protect parts subject to deterioration, such as ferrous metal items and electrical components with appropriate lubricants, desiccants, or hermetic sealing.
   3. With Owner's written request for advanced delivery of spare parts, maintenance products, and special tools.
      a. Deliver requested items and deduct them from the inventory list.
      b. Provide transmittal documentation.
   4. Store large items individually:
      a. Weight: Greater than 50 pounds.
      b. Size: Greater than 24 inches wide by 18 inches high by 36 inches long.
      c. Clearly labeled:
         1) Equipment tag number.
         2) Equipment manufacturer.
         3) Subassembly component, if appropriate.
         4) Store smaller items in spare parts box:
      d. Weight: Less than 50 pounds.
      e. Size: Less than 24 inches wide by 18 inches high by 36 inches long.
      f. Clearly labeled:
         1) Equipment tag number.
         2) Equipment manufacturer.
         3) Subassembly component, if appropriate.
         4) Spare parts and special tools box:
      g. Box material: Waterproof, corrosion resistant.
      h. Hinged cover:
         1) Locking hasp.
      i. Spare parts inventory list taped to underside of cover.

j. Clearly labeled:
    1) The words “Spare Parts and/or Special Tools”.
    2) Equipment tag number.
    3) Equipment manufacturer.
    4) Subassembly component, if appropriate.

3.03 STORAGE AND PROTECTION DURING STORAGE

A. Storage of equipment to be in accordance with the manufacturer’s instructions.
    1. Including connection of motor heaters, lubrication, manually rotating shafts, etc.
    2. The Contractor shall furnish a copy of the manufacturer’s instructions for storage to the Engineer prior to storage of equipment and materials.

B. Immediately store and protect products until installed in Work.

C. Furnish covered, weather-protected storage structures providing a clean, dry, noncorrosive environment for mechanical equipment, valves, architectural items, electrical and instrumentation equipment and special equipment to be incorporated into this project.

D. Store products with seals and legible labels intact.

E. Protect painted or coated surfaces against impact, abrasion, discoloration, and damage.

F. Storage of spare parts, maintenance products, special tools.
    1. Immediately store in accordance with the manufacturer's instructions.
    2. Store spare parts, maintenance products, and special tools in enclosed, weather-proof, and lighted facility during the construction period.
    3. Protect parts subject to deterioration, such as ferrous metal items and electrical components with appropriate lubricants, desiccants, or hermetic sealing.
    4. Store large items individually:
        a. Weight: Greater than 50 pounds.
        b. Size: Greater than 24 inches wide by 18 inches high by 36 inches long.
        c. Clearly labeled:
            1) Equipment tag number.
            2) Equipment manufacturer.
            3) Subassembly component, if appropriate.
    5. Store smaller items in spare parts boxes:
        a. Weight: Less than 50 pounds.
        b. Size: Less than 24 inches wide by 18 inches high by 36 inches long.
        c. Clearly labeled:
            1) Equipment tag number.
            2) Equipment manufacturer.
            3) Subassembly component, if appropriate.
    6. Spare parts and special tools box:
        a. Box material: Waterproof, corrosion resistant.
        b. Hinged cover with locking hasp:

c. Inventory list taped to underside of cover.
    1) Clearly labeled:
    2) The words “Spare Parts and/or Special Tools”.
    3) Equipment tag number.
    4) Equipment manufacturer.
    5) Subassembly component, if appropriate.

G. Exterior storage of fabricated products:
    1. Place on aboveground supports that allow for drainage.
    2. Cover products subject to deterioration with impervious sheet covering.
    3. Provide ventilation to prevent condensation under covering.

H. Store moisture sensitive products in watertight enclosures.

I. Store loose granular materials on solid surfaces in well-drained area.
    1. Prevent materials mixing with foreign matter.
    2. Provide access for inspection.

J. Provide an equipment log and stored products log with monthly pay applications.
    1. Data includes as a minimum: The storage location, equipment or product identification, date stored, date of inspection/maintenance, date removed from storage, copy of manufacturer’s recommended storage guidelines, description of inspection/maintenance activities performed, and signature of party performing inspection/maintenance.

K. When needed and approved by the Engineer, offsite storage location shall be within 20 miles of the project site.
    1. Provide proof of insurance coverage for products stored offsite.

L. Payment will not be made for equipment and materials improperly stored or stored without providing Engineer with the manufacturer's instructions for storage.

3.04 INSTALLATION

A. Inspect equipment or product prior to product installation.

B. Repaint or recoat damaged painted or coated surfaces.

C. Use anti-galling compound on stainless steel threads used for field assembly.

3.05 PROTECTION AFTER INSTALLATION

A. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations.
    1. Remove covering when no longer needed.
    2. Replace corroded, damaged, or deteriorated equipment, product, or parts before acceptance of the project.

B. Update equipment log with monthly pay applications.
   1. Data includes as a minimum: Description of maintenance activities performed in accordance with the manufacturer's recommendation and industry standards and signature of party performing maintenance.

END OF SECTION

ATTACHMENT A - SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS INVENTORY LIST

SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS INVENTORY LIST

Owner: _____ **Date:** _____

Contractor: _____ **Project No.:** _____

Project Name: _____

Inventory List				
Spec Number: _____		Spec Title _____		
Equipment Tag No.: _____		Equipment Manufacturer: _____		
Quantity	**Subassembly Component**	**Description**	**Manufacturer's Part Number**	**Storage Location**

SECTION 01601

PRODUCT REQUIREMENTS - LINEAR INFRASTRUCTURE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for tangible materials, raw or manufactured, that become part of the project.

1.02 REFERENCES

A. International Organization for Standardization (ISO):
   1. 9001 - Quality Management Systems - Requirements.

B. NSF International (NSF).

C. Underwriters Laboratories, Inc. (UL).

1.03 TERMINOLOGY

A. The words and terms listed below, are not defined terms that require initial capital letters, but, when used in this Section have the indicated meaning.
   1. Calculations:
      a. Documentation of the process of transforming the design and prescriptive criteria into a design meeting the performance criteria.
   2. Certificates:
      a. An official document that attests a fact is in accordance with the Contract Documents.
   3. Manufacturer's Certificate of Source Testing:
      a. Form used to confirm that the applicable source tests have been performed and the results conform to the Contract Documents. The form template is provided at the end of this Section.
   4. Manufacturer's instructions:
      a. Stipulations, directions, and/or recommendations issued form by the manufacturer of the product addressing handling, installation, erection, and/or application of the product.
   5. Products:
      a. Raw materials, finished goods, equipment, systems, and shop fabrications that will become part of the Work.
   6. Product data:
      a. Public information about the product which is found in the manufacturer's catalogs or on their web site including catalog pages, data sheets, bulletins, layout drawings, exploded views, and brochures.
   7. Samples:
      a. As defined in the General Conditions and Supplementary Conditions.
      b. Full-size actual products or pieces of products intended to illustrate the products to be incorporated into the project. Sample submittals are often

necessary for such characteristics as colors, textures, and other appearance issues.

8. Schedules:
    a. Product parts and materials lists.
9. Shop drawings:
    a. As defined in the General Conditions and Supplementary Conditions.
    b. Shop drawings are prepared specifically for the project to illustrate details, dimensions, and other data necessary for satisfactory fabrication or construction that are not shown completely in the Drawings.
    c. Shop drawings could include graphic line-type drawings and single-line diagrams.
10. Source Quality Control:
    a. Testing and inspections at the location of fabrication or assembly.
        1) Includes Factory Acceptance Testing (FAT), Factory Testing, and Source Testing.
    b. Test reports including the following information:
        1) Test description.
        2) List of equipment used.
        3) Name of the person conducting the test.
        4) Date and time the test was conducted.
        5) Ambient temperature and weather conditions.
        6) Raw data collected.
        7) Calculated results.
        8) Clear statement if the test passed or failed the requirements stated in Contract Documents.
        9) Signature of the person responsible for the test.
11. Special tools:
    a. Special wrenches, gauges, circuit setters, and other similar devices required for the proper operation or maintenance of a system that would not normally be in the Owner's tool kit and that have been specifically made for use on a product for assembly, disassembly, repair, or maintenance.
12. Submittals:
    a. As defined in the General Conditions and Supplementary Conditions.
    b. Samples, product data, shop drawings, and others that demonstrate how Contractor intends to conform to the Contract Documents.

1.04 QUALITY CONTROL

A. Manufacturer to provide permanent quality control department and laboratory facility capable of performing inspections and testing as required by the Contract Documents.
    1. Material testing, inspection procedures, and manufacturing process are subject to inspection by Engineer.
    2. Contractor shall notify Engineer in writing of the manufacturing start date not less than 14 days prior to the start of manufacturer of project pipe.
    3. Perform manufacturer’s tests and inspections required by the referenced standards and as specified in this Section including the following:
        a. Provide the Manufacturer's Certificate of Source Testing.

b. Calibration within last 12 months for equipment such as scales, measuring devices and calibration tools used in the manufacturing of pipe as required by ISO 9001.
    1) Each device used in the manufacturer of pipe is required to have a tag recording date of last calibration.
    2) Provide calibration certificate.
    3) Devices are subject to inspection by Engineer.

1.05 SERVICES OF MANUFACTURER'S REPRESENTATIVES

A. Qualification of manufacturer's representative as specified in the Contract Documents technical Sections include the following:
    1. Authorized representative of the manufacturer, factory trained and experienced in the technical applications and installation of respective products with full authority by the product manufacturer to issue the certifications required of the manufacturer.
    2. Competent, experienced technical representative of the product manufacturer for installation.
    3. Additional qualifications may be specified in the individual sections.
    4. No substitute representatives will be allowed until written approval by Owner and Engineer has been obtained.

B. Completion of manufacturer on-site services: Engineer approval required.
    1. The manufacturer’s representative will advise aspects of installation including but not limited to:
        a. Handling.
        b. Storing.
        c. Cleaning and inspecting.
        d. Coating and lining repairs.
        e. Tapping.
        f. General construction methods.

C. Manufacturer is responsible for determining the time required to perform the specified services.
    1. No additional costs associated with performing the required services will be approved.
    2. Manufacturer required to schedule services in accordance with the Contractor's project schedule up to and including making multiple trips to project site when there are separate milestones associated with installation of each occurrence of manufacturer's product.

D. Manufacturer's on-site services as specified in the Contract Documents include the following:
    1. Assistance during Construction.
    2. Provide 1 copy of daily manufacturer's representative’s field notes and data to Engineer.
    3. Other requirements as specified in the Contract Documents.

1.06 GENERAL TEST REQUIREMENTS

A. Testing prerequisites:
   1. Prior to testing, verify equipment protective devices and safety devices have been installed, calibrated, and tested.

B. Acceptable test definition:
   1. Demonstrate the product performance meets the requirements stated in the Contract Documents.
      a. When the product fails to meet the specified requirements, perform additional, more detailed, testing to determine the cause, correct, repair, or replace the causative components and repeat the testing that revealed the deficiency.

C. Test Plan requirements:
   1. As specified in this Section and other technical sections.
   2. Prepared by Contractor as a result of discussions and planning emerging from regularly conducted meetings for test planning.
   3. Define the following items for each Test:
      a. Purpose of the test.
      b. Identification of each item of equipment/system, including system designation, location, tag number, control loop identifier, etc.
      c. Description of the pass/fail criteria that will be used.
      d. Listing of pertinent reference documents (Contract Documents and industry standards or sections applicable to the testing).
      e. Credentials of test personnel.
      f. Test equipment:
         1) Product data.
         2) Appropriate calibration records.
         3) Drawings or photographs of test stands and/or test apparatus.
      g. Duration: Determine test durations with Owner's input.
      h. Detailed step-by-step test procedures.
         1) Setup.
         2) The level of detail shall be sufficient for any witness with a rudimentary technical aptitude to be able to follow the steps and develop confidence that the tests were being performed as planned.
         3) Include all steps in the procedures.
         4) Define temporary systems (pumps, piping, etc.), shutdown requirements for existing systems.
         5) Furnish labor, power, tools, equipment, instruments, and services required for and incidental to completing testing activities.
      i. Test forms: Include, but not limited to, the following information:
         1) Name of product to be tested.
         2) Test date.
         3) Names of persons conducting the test.
         4) Names of persons witnessing the test, where applicable.
         5) Test data.
         6) Applicable project requirements.
         7) Check offs for each completed test or test step.
         8) Place for signature of person conducting tests and for the witnessing person, as applicable.

D. Submit Test Plan.
   1. Submit forms as specified in the technical sections.
   2. Submit a copy of the Test Plan at least 21 days before any scheduled test date.
   3. Engineer approval of Test Plan required prior to beginning testing.

E. Request proposed test dates.
   1. Notify the Engineer of the scheduled tests a minimum of 15 days before the date of the test.

F. Implement approved Test Plans.

G. Submit Test Report.

1.07 SOURCE TESTING

A. As specified in Section 01450 - Quality Control.

B. Also referred to as factory testing or factory acceptance testing (FAT).

C. Source Test Plan:
   1. As specified in this Section and other technical Sections.
   2. Purpose: Test products for proper performance at point of manufacture or assembly as specified in the technical Sections.
   3. Source testing requirements as specified in technical Sections.
      a. Non-witnessed:
         1) Provide completed Attachment A - Manufacturer's Certificate of Source Testing.
      b. Witnessed:
         1) 2 Owner's representative and 2 Engineer's representative present during testing, unless otherwise specified.
         2) Provide completed Attachment A - Manufacturer's Certificate of Source Testing.
   4. Duration: Define.
   5. Contractor is responsible for providing fuel, chemicals, and other consumables needed for Source Testing.

D. Contractor is responsible for witness trip costs associated with Owner's representatives and Engineer’s representative.
   1. Include costs for at least the following:
      a. Transportation:
         1) Travel on commercial airline to and from site including related fees.
         2) Rental car to and from airport, hotel, and test site including related fees.
      b. Hotel/Meals:
         1) Hotel costs at a facility with an American Automobile Association 4-star rating or higher equivalent for single occupancy room per person per day.
         2) Meal allowance based on government per diem guidelines per location.

c. Witness labor costs:
1) The greater of $200 per hour or $1,600 per day.

2. If Source Test is not ready when the witnesses arrive or if the Source Test fails, the witnesses will return home with Contractor responsible for costs associated with the trip including costs described above.
a. Contractor is responsible for rescheduling the Source Test and witnesses' costs associated with the second trip including costs described above.
b. Contractor is responsible for witnesses' costs associated with retests including costs described above.

1.08 INSTALLATION VERIFICATION

A. Installation Verification Plan:
1. Purpose:
a. Has been properly installed, adjusted, and aligned.
b. Is free of any stresses imposed by connecting piping or anchor bolts.
c. Is able to be operated as necessary for Functional Testing.
2. Field test backfill, welded joints, alignment and grade, and pipeline pressure as specified in the Technical Sections.
3. Duration: Define.
4. Coordinate Installation Verification with restrictions and requirements as specified in Section 01140 - Work Restrictions.

1.09 FUNCTIONAL TESTING

A. Functional Test Plan:
1. Purpose: Test piping system to verify conformance with the Contract Documents.
2. Duration: Define.
3. Perform testing in the presence of the Engineer.
4. Contractor is responsible for providing fuel, chemicals, and other consumables needed.
5. Coordinate Functional Testing with restrictions and requirements as specified in Section 01140 - Work Restrictions.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Provide products as Engineer has approved by the submittal process or by other written documents.

B. Provide products by same manufacturer when units are of similar nature, unless otherwise specified.

C. Provide like parts of duplicate units that are interchangeable.

D. Provide equipment or product that has not been in service prior to delivery, except as required by tests.

E. Provide products produced by manufacturers regularly engaged in the production of these products.

F. Provide products that bear approvals and labels as specified such as Factory Mutual(FM), Underwriters Laboratory (UL), or National Sanitation Foundation (NSF International).

2.02 MATERIAL

A. Dissimilar metals:
   1. Separate contacting surfaces with dielectric material.
   2. Neoprene, bituminous impregnated felt, heavy bituminous coatings, nonmetallic separators or washers, or other materials as specified.

B. Edge grinding:
   1. Sharp projections of cut or sheared edges of ferrous metals which are not to be welded shall be ground to a radius required to ensure satisfactory paint adherence.

C. Use anti-galling compound on threads of stainless steel fasteners during factory assembly.

D. Provide anti-galling compound with stainless steel fasteners shipped for field assembly.

E. Aluminum in contact with concrete or masonry: Apply epoxy mastic as specified in Section 09960 - High-Performance Coatings, coating system EPX-M-5.

F. Pipes:
   1. Provide new pipe manufactured for the project, not from manufacturer's inventory, under the following conditions:
      a. Pipes 24-inch diameter and larger.
      b. Except steel pipes 6-inch diameter and larger.
   2. Prove pipe manufactured more than 6 months prior to delivery if the pipe material or its coating is subject to ultraviolet (UV) degradation.
   3. Provide ductile iron pipe with cement-mortar lining manufactured more than 6 months prior to delivery to the project.

G. Mark each length of pipe in accordance with applicable standards.

2.03 PRODUCT SELECTION

A. When products are specified without named manufacturers, provide products that meet or exceed the Specifications.

B. When products are specified with names of manufacturers but no model numbers or catalog designations, provide Products by one of named manufacturers that meet or exceed specifications.

C. When products are specified with names of manufacturers and model numbers or catalog designations, provide Products with model numbers or catalog designations by one of the named manufacturers.

D. When products are specified with names of manufacturers, but with brand or trade names, model numbers, or catalog designations by one manufacturer only, provide:
   1. Products specified by brand or trade name, model number, or catalog designation.
   2. Products by another named manufacturers proven, in accordance with requirements for an "or equal", including Engineer's approval, to meet or exceed quality, appearance and performance of specified brand or trade name, model number, or catalog designation.

E. When Products are specified with only one manufacturer followed by "or Equal," provide:
   1. Products meeting or exceeding Specifications by specified manufacturer.
   2. Engineer deemed "or equal" evidenced by an approved shop drawing or other written communication.

F. When Products are specified by naming 2 or more manufacturers with 1 manufacturer as a "Basis of Design":
   1. Any of the named manufacturers can be submitted.
   2. If the product submitted is not by the named "Basis of Design" product and requires a change in the scope (dimensions, configuration, physical properties, etc.), schedule (longer lead time), or budget, the Contractor must submit a substitution request.

PART 3 EXECUTION

3.01 SHIPMENT

A. Prepare products for shipment by:
   1. Tagging or marking to agree with delivery schedule or shop drawings.
   2. Including complete packing lists and bills of material with each shipment.
   3. Packaging products to facilitate handling and protection against damage during transit, handling, and storage.
   4. Securely attach special instructions for proper field handling, storage, and installation to each piece of equipment before packaging and shipment.

B. Transport products by methods that avoid product damage.

C. Deliver products in undamaged condition in manufacturer's unopened containers or packaging.

3.02 DELIVERY AND HANDLING

A. Handle or product in accordance with manufacturer's instructions.

B. Deliver products in undamaged condition in manufacturer's unopened containers or packaging.

C. Provide construction equipment and personnel to handle products by methods in accordance with manufacturer’s instructions.

D. Upon delivery, promptly inspect shipments:
   1. Verify compliance with Contract Documents, correct quantities, and undamaged condition of products.
   2. Acceptance of shipment does not constitute final acceptance of or product.

3.03 STORAGE AND PROTECTION DURING STORAGE

A. Immediately store and protect products until installed in Work.

B. Store products with seals and legible labels intact.

C. Protect painted or coated surfaces against impact, abrasion, discoloration, and damage.

D. Storage of spare parts, maintenance products, special tools.
   1. Immediately store in accordance with the manufacturer's instructions.
   2. Store spare parts, maintenance products, and special tools in enclosed, weather-proof, and lighted facility during the construction period.
   3. Protect parts subject to deterioration, such as ferrous metal items and electrical components with appropriate lubricants, desiccants, or hermetic sealing.
   4. Store large items individually:
      a. Weight: Greater than 50 pounds.
      b. Size: Greater than 24 inches wide by 18 inches high by 36 inches long.
      c. Clearly labeled:
         1) Equipment tag number.
         2) Equipment manufacturer.
         3) Subassembly component, if appropriate.
   5. Store smaller items in spare parts boxes:
      a. Weight: Less than 50 pounds.
      b. Size: Less than 24 inches wide by 18 inches high by 36 inches long.
      c. Clearly labeled:
         1) Equipment tag number.
         2) Equipment manufacturer.
         3) Subassembly component, if appropriate.
   6. Spare parts and special tools box:
      a. Box material: Waterproof, corrosion resistant.
      b. Hinged cover with locking hasp:
      c. Inventory list taped to underside of cover.
         1) Clearly labeled:
         2) The words “Spare Parts and/or Special Tools”.
         3) Equipment tag number.
         4) Equipment manufacturer.
         5) Subassembly component, if appropriate.

E. Exterior storage of fabricated products:
   1. Place on aboveground supports that allow for drainage.
   2. Cover products subject to deterioration with impervious sheet covering.
   3. Provide ventilation to prevent condensation under covering.

F. Store moisture sensitive products in watertight enclosures.

G. Store loose granular materials on solid surfaces in well-drained area.
   1. Prevent materials mixing with foreign matter.
   2. Provide access for inspection.

H. When needed and approved by the Engineer, offsite storage location shall be within 20 miles of the project site.
   1. Provide proof of insurance coverage for products stored offsite.

I. Payment will not be made for product and materials improperly stored or stored without providing Engineer with the manufacturer's instructions for storage.

3.04 INSTALLATION

A. Inspect equipment or product prior to product installation.

B. Repaint or recoat damaged painted or coated surfaces.

C. Use anti-galling compound on stainless steel threads used for field assembly.

3.05 PROTECTION AFTER INSTALLATION

A. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations.
   1. Remove covering when no longer needed.
   2. Replace corroded, damaged, or deteriorated or product before acceptance of the project.

END OF SECTION

ATTACHMENT A - MANUFACTURER'S CERTIFICATE OF SOURCE TESTING

MANUFACTURER'S CERTIFICATE OF SOURCE TESTING

OWNER _____ EQPT/SYSTEM _____
PROJECT NAME _____ EQPT TAG NO. _____
PROJECT NO. _____ EQPT SERIAL NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

Comments: _____

_____

_____

_____

_____

I hereby certify Source Testing has been performed on the above-referenced product as defined in the Contract Documents, and the results conform to the Contract Document requirements. Testing data is attached.

Date of Execution: _____

Manufacturer: _____

Manufacturer's Authorized Representative Name *(print)*: _____

_____
(Authorized Signature)

If applicable, Witness Name *(print)*: _____

_____
(Witness Signature)

SECTION 01722

FIELD ENGINEERING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Field engineering to establish lines and grades for the Work.

1.02 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Qualifications of the professional land surveyor or licensed civil engineer with the authority to provide land surveying in California that will be performing the field engineering.

C. Pre-Excavation Report.

1.03 PRE-EXCAVATION REPORT

A. Prior to the start of the Work, create a report confirming the verification of the following data:
   1. Site elevation.
   2. Existing structures including but not limited to buildings, manholes (sanitary, storm, electrical, and other), drainage inlets:
      a. Location coordinates.
      b. Top of wall elevation and coordinates.
      c. Floor elevations.
      d. Invert elevations.
   3. Existing utilities as specified in Section 02280 - Subsurface Utility Engineering.
   4. Proposed building corners, tank, and equipment locations.
   5. Verify existing electrical, instrumentation, and phone utilities.

B. Incorporate information from Pre-Excavation Report into the record drawings.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SURVEY REFERENCE POINTS

A. Basic reference line, a beginning point on basic reference line, points with referenced coordinates, and a benchmark will be provided by Owner.

B. From these reference points, establish other control and reference points as required to properly lay out the Work.

C. Locate and protect control points prior to starting site work, and preserve permanent reference points during construction:
   1. Make no changes or relocations without prior written notice.
   2. Replace Project control point, when lost or destroyed, in accordance with original survey control.

D. Set monuments for principal control points and protect them from being disturbed and displaced:
   1. Re-establish disturbed monuments.
   2. When disturbed, postpone parts of the Work that are governed by disturbed monuments until such monuments are re-established.

3.02 PROJECT SITE SURVEY REQUIREMENTS

A. Perform verifications and checking in accordance with industry standard surveying practice.

B. Maintain complete, accurate log of control points and survey.

C. Affix civil engineer's or professional land surveyor's signature and license number to Record Drawings to certify accuracy of information shown.

3.03 CONSTRUCTION STAKES, LINES, AND GRADES

A. Execute the Work in accordance with the lines and grades indicated.

B. Make distances and measurements on horizontal planes, except elevations and structural dimensions.

3.04 QUALITY CONTROL

A. Accuracy of stakes, alignments, and grades may be checked randomly by Engineer:
   1. Notice of when checking will be conducted will be given.
   2. When notice of checking is given, postpone parts of the Work affected by stakes, alignments, or grades to be checked until checked.
   3. Engineer's check does not substitute or complement required field quality control procedures.

3.05 RECORD DOCUMENTS

A. Prepare and submit Record Documents as specified in Section 01770 - Closeout Procedures.

END OF SECTION

SECTION 01734

WORK WITHIN PUBLIC RIGHT-OF-WAY

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for maintenance, support, protection, relocation, reconstruction and adjusting-to-grade, restoration, construction of temporary and new facilities, and abandonment of existing utilities affected by construction work within the public right-of-way.

1.02 DEFINITIONS

A. Utility: For purpose of this Section, utility means any public or private service, such as electric light and power systems; gas distribution systems; telephone, telegraph, cable television and other communication services; water distribution; storm drain and sanitary sewer services; police and fire communication systems; street lighting and traffic signs and signals; parking meters; and steam distribution systems.

B. Trenching:
   1. Open trench:
      a. General: Includes excavation, pipe laying, backfilling, and pavement replacement.
   2. Any excavated areas shall be considered as "open trench" until all pavement replacement has been made, or until all trenches outside of pavement replacement areas have been backfilled and compacted in accordance with these Contract Documents.

1.03 SUBMITTALS

A. Traffic control plan: Submit detailed traffic control plan for acceptance by jurisdictional agency.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Trenching:
   1. Except where otherwise specified, indicated on the Drawings, or accepted in writing by the Engineer, the maximum length of open trench, where construction is in any stage of completion, shall not exceed the linear footage as set forth below. Descriptions under following area designations are general in nature and may be amended in writing by the Engineer due to particular or peculiar field conditions:
      a. Business District Areas maximum 100 linear feet: Store front areas.

b. Commercial Areas maximum 400 linear feet: Industrial, shopping centers, churches, schools, hotels, motels, markets, gas stations, government and private office buildings, hospitals, fire and police stations, and nursing homes.
c. Residential Areas maximum 1 Block or 600 linear feet, whichever is the least: Single and multi-family residences, apartments, and condominiums.
d. Undeveloped Areas maximum 1,000 linear feet: Parks, golf courses, farms, undeveloped subdivided land.

2. Completely backfill trenches across streets and install temporary or permanent pavement as soon as possible after pipe laying.

B. Site conditions:
1. Use substantial steel plates with adequate trench bracing to bridge across trenches at street and alley crossings, commercial driveways, and residential driveways where trench backfill and temporary patch have not been completed during regular working hours.
2. Provide safe and convenient passage for pedestrians.
3. Maintain access to fire stations, fire hydrant, and hospitals at all times.
4. Provide traffic control devices, barricades, and signage as required by the regulating agency.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01738

SELECTIVE ALTERATIONS AND DEMOLITION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Cutting or modifying of existing and new work.
   2. Partial demolition of structures.
   3. In-place abandonment of pipe.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. A10.6 - Safety and Health Program Requirements for Demolition Operations.

B. International Concrete Repair Institute (ICRI):
   1. Guideline No. 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
   2. Guideline No. 310.3R - Guide for the Preparation of Concrete Surfaces for Repair Using Hydrodemolition Methods.

1.03 DEFINITIONS

A. Chipping hammer: A hand-operated electrical or pneumatic demolition device for removal of hardened concrete or masonry materials having a weight of less than 15 pounds and an impact frequency of greater than 2,000 blows/minute.

B. Concrete breaker: A hand-operated electrical or pneumatic demolition device for removal of hardened concrete or masonry materials having a weight greater or impact frequency less than the limits defined for a chipping hammer.

C. Coring equipment: Non-impact rotary drill with diamond cutting edges.

D. Heavy abrasive blast: Cleaning procedure by which various abrasives materials, or steel shot, are forcibly propelled by high pressure against a surface to remove loose material and produce a concrete surface roughened to ICRI Surface Profile CSP-7, or higher, as specified in ICRI 301.3R.

E. Salvage material: Materials removed from existing facilities and stored for Owner's future reuse.

1.04 DESCRIPTION OF WORK

A. The work includes partial demolition, cutting, and modifying of existing facilities, utilities, and/or structures.

B. These facilities may be occupied and/or operational. Satisfactory completion of the work will require that the Contractor plan activities carefully to work around unavoidable obstacles and to maintain overall stability of structures and structural elements. It will further require restoration of existing facilities, utilities, and structures that are to remain in place and that are damaged by demolition or removal operations.

1.05 SUBMITTALS

A. General:
   1. Submit specified in Section 01330 - Submittal Procedures.

B. Shop drawings: Include:
   1. The location of all embedded items shall be documented using diagrams and/or other media that clearly show dimensions and locations of existing structural elements, existing embedded items and any new embedded items and their relationship to each other.

C. Submittals for information only:
   1. Permits and notices authorizing demolition.
   2. Certificates of severance of utility services.
   3. Permit for transport and disposal of debris.
   4. Selective Demolition Plan.
   5. Pipe Abandonment Plan.

D. Quality assurance submittals:
   1. Qualifications of non-destructive testing agency/agencies.

E. Project record documents.

F. Drawings and/or other media documenting locations of service lines and capped utilities.

1.06 QUALITY ASSURANCE

A. Qualifications:
   1. Assign relocation, removal, cutting, coring and patching to trades and workers qualified to perform the Work in manner that causes the least damage and that provides means of returning surfaces to an appearance at least equal to that of the surrounding areas unaffected by the Work.
   2. Non-destructive testing agencies: Minimum of 5 years' experience performing non-destructive testing for location of steel reinforcement in existing concrete under conditions similar to that required for this Work.

1.07 SEQUENCING

A. Perform Work in sequences and within times specified in Section 01140 - Work Restrictions.

B. If the facility or utility to be modified cannot be removed from service, perform the Work while the facility is in operation using procedures and equipment that do not jeopardize operation or materially reduce the efficiency of that facility.

C. Coordinate the Work with operation of the facility:
   1. Do not begin alterations of designated portions of the Work until specific permission for activities in each area has been granted by Owner in writing.
   2. Engineer will coordinate the planned procedure with facility manager.
   3. Complete Work as quickly and with as little delay as possible.

D. Operational functions of the facility that are required to be performed to facilitate the Work will be performed by facility personnel only.

E. Owner will cooperate to assist in expediting the Work.

F. When necessary for the proper operation or maintenance of portions of the facility, reschedule operations so the Work will not conflict with required operations or maintenance.

1.08 REGULATORY REQUIREMENTS

A. Dispose of debris in accordance with governing regulatory agencies.

B. Comply with applicable air pollution control regulations.

C. Obtain permits for building demolition, transportation of debris to disposal site and dust control.

1.09 PROJECT CONDITIONS

A. Do not interfere with use of adjacent structures and elements of the facility not subject to the Work described in this Section. Maintain free and safe passage to and from such facilities.

B. Provide, erect, and maintain barricades, lighting, guardrails, and protective devices as required to protect building occupants, general public, workers, and adjoining property:
   1. Do not close or obstruct roadways without permits.
   2. Conduct operations with minimum interference to public or private roadways.

C. Prevent movement, settlement, or collapse of structures adjacent services, sidewalks, driveways and trees:
   1. Provide and place bracing or shoring.
   2. Cease operations and notify Engineer immediately when safety of structures appears to be endangered. Take precautions to properly support structure. Do not resume operations until safety is restored.
   3. Assume liability for movement, settlement, or collapse. Promptly repair damage.

D. Arrange and pay for capping and plugging utility services. Disconnect and stub off.
   1. Notify affected utility company in advance and obtain approval before starting demolition.
   2. Place markers to indicate location of disconnected services.

E. Unknown conditions:
   1. The drawings may not represent all conditions at the site and adjoining areas. Compare actual conditions with drawings before commencement of Work.
   2. Existing utilities and drainage systems below grade are located from existing documents and from surface facilities such as manholes, valve boxes, area drains, and other surface fixtures.
   3. If existing active services encountered are not indicated or otherwise made known to the Contractor and interfere with the permanent facilities under construction, notify the Engineer in writing, requesting instructions on their disposition. Take immediate steps to ensure that the service provided is not interrupted, and do not proceed with the Work until written instructions are received from the Engineer.

PART 2 PRODUCTS

2.01 SALVAGE MATERIALS

A. Materials designated for temporary salvage:
   1. One of the existing blowers, until the new blowers are installed and commissioned.

B. Handling and storage:
   1. Prevent damage to salvaged materials during removal, handling, and transportation.
   2. Store salvaged materials in the following locations:
      a. Contractor provided, secure, protected storage.

C. Pay costs associated with salvaging materials, including handling, transporting, and storage.

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to beginning selective demolition operations, perform a thorough inspection of the facility and site.
   1. Report to the Engineer defects, structural damage, and deterioration of existing construction to remain in place.

B. Examine areas affected by the Work and verify the following conditions prior to commencing demolition:
   1. Disconnection of utilities as required.
   2. Verify that utilities serving occupied or active portions of surrounding facilities will not be disturbed, except as otherwise indicated.

C. If unsatisfactory conditions exist, notify the Engineer, and do not begin demolition operations until such conditions have been corrected.

3.02 PREPARATION

A. Plan and organize Work to minimize inconvenience to adjacent buildings and to plant operations.

B. Selective Demolition Plan:
   1. Prepare and submit a comprehensive selective demolition plan for the Work including the following elements, at a minimum:
      a. Proposed sequence, methods, temporary support, and equipment for demolition, removal, and disposal of portions of structure(s).
      b. Provisions and procedures for salvage and delivery to Owner of salvaged items, if required.
   2. Submit plan a minimum 4 weeks before demolition is scheduled to begin.

C. Pipe Abandonment Plan:
   1. Prepare and submit a comprehensive Pipe Abandonment Plan for the Work.
      a. Include provisions to demonstrate and verify with camera inspection that all solids have been removed and that pipe is free of residuals.
   2. At a minimum, define the following elements:
      a. Proposed sequence, methods, cleaning procedures, or demolition, removal, and disposal of contents of the piping.
      b. Method of verification of final pipe condition.
      c. Detailed drawings showing treatment of pipe ends**.**
   3. Submit plan a minimum 4 weeks before abandonment is scheduled to begin.

D. Protection:
   1. Erect weatherproof closures to protect the interior of facilities and elements or equipment that are not designed for exposure to the weather.
   2. Provide temporary heat, cooling, and humidity control as necessary to prevent damage to existing and new equipment and construction.
   3. Maintain existing exiting paths and/or provide new paths in compliance with Building Code requirements.

4. Erect and maintain dustproof partitions as required to prevent spread of dust, to other parts of building. Maintain negative pressure in the area where the Work is being performed to prevent the accidental spread of dust and to minimize the spread of fumes related to the Work.
5. Upon completion of Work, remove weatherproof closures and dustproof partitions.
6. Repair damaged surfaces to match adjacent surfaces.
7. Provide and maintain protective devices to prevent injury from falling objects.
8. Locate guardrails in stairwells and around open shafts to protect workers. Post clearly visible warning signs.
9. Protect the following from damage or displacement during Work.
    a. Benchmarks and survey points.
    b. Existing construction that will remain in place.
    c. Trees and landscaping designated to remain in place.
10. Carefully remove designated materials and equipment to be salvaged by Owner or reinstalled.
11. Store and protect materials and equipment to be reinstalled.

E. Layout:
1. The limits of selective demolition are indicated on the Drawings. Confine demolition operations within the limits indicated on the Drawings.
2. Lay out demolition and removal work at the site and coordinate with related Work for which demolition and removal is required.
3. Clearly mark the extent of structural elements to be removed on the actual surfaces that will be removed.
4. Arrange for Engineer's inspection of the lay out extents.
5. Do not begin demolition/removal operations until the lay out markings have been reviewed by the Engineer.

3.03 DEMOLITION

A. General:
1. Perform demolition work in accordance with ANSI A10.6.
2. Demolish designated portions of structures and appurtenances in orderly and careful manner in accordance with the Selective Demolition Plan.
3. Conduct demolition and removal work in a manner that will minimize dust and flying particles.
    a. Use water or dust palliative when necessary to prevent airborne dust.
    b. Provide and maintain hoses and connections to water main or hydrant.
4. Remove materials carefully, to the extent indicated and as required.
    a. Provide neat and orderly junctions between existing and new materials.
    b. Use methods that terminate surfaces in straight lines at natural points of division.
5. Do not remove anything beyond the limits of Work indicated without prior written authorization from the Engineer.
    a. If in doubt about whether to remove an item, obtain written authorization from the Engineer prior to proceeding.
6. Perform work so as to provide the least interference and most protection to existing facilities to remain.

7. Demolished materials:
    a. Assume possession of materials unless otherwise indicated on the Drawings or specified.
    b. Owner claims the following materials:
        1) Valves.
        2) Circuit breakers.
        3) Programmable logic controllers.
        4) Fuses.
        5) Wire.
    c. Remove demolished materials from site at least weekly and dispose of them in accordance with Laws and Regulations.
    d. Do not burn or bury materials on site.

B. Demolition of concrete and masonry:
    1. Demolish concrete and masonry in small sections.
        a. Perform demolition with small tools as much as possible.
        b. Blasting with explosive charges is not permitted.
    2. Sawcut concrete to establish the edges of demolition, wherever possible.
        a. Do not use a concrete breaker within 6 inches of reinforcing or structural metals that are designated to remain in place.
        b. At edges that are not sawcut, remove the final 6 inches of material with a chipping hammer as defined herein. At surfaces where material is removed with a chipping hammer, follow with a heavy abrasive blast to remove all loose material and microcracking.
        c. Alternate techniques to remove concrete may be used if acceptable to the Engineer; however, techniques other than those deemed by ICRI Guideline No. 310.2R to provide a low risk of introducing microcracking will require a subsequent procedure to remove loose material and microcracked.
    3. At locations indicated on the Drawings where the existing reinforcing is to be preserved, remove concrete using methods that do not damage the reinforcing. Use one of the following techniques:
        a. Hydrodemolition techniques as outlined in ICRI Guideline No. 310.3R.
        b. Chipping hammer, as defined herein, followed by heavy abrasive blast to remove all loose material and microcracking at remaining surfaces impacted by the chipping hammer.
        c. Alternate methods may be used, only when accepted in advance by the Engineer.
        d. For all methods, provide a small completed area for Engineer's review and acceptance. If the proposed method, in the opinion of the Engineer, damages the reinforcing, revise the removal method to remove the concrete with a less aggressive technique to protect the reinforcing.

C. Sizing of openings in existing concrete or masonry:
    1. Make openings large enough to permit final alignment of pipe and fittings without deflections, but without oversizing.
    2. Allow adequate space for packing around pipes and conduit to ensure watertightness.
    3. If the Engineer deems the opening to be insufficient in size to accomplish this criteria, remove additional material using the procedures outlined in this Section.

D. Cutting openings in existing concrete or masonry:
    1. Do not allow saw cuts to extend beyond limits of openings.
    2. Create openings by the following method or other means acceptable to the Engineer that prevents over-cutting of member at corners:
        a. Core-drill through slab or wall at corners, being careful not to damage materials beyond the area to be removed.
        b. Saw cut completely through the member, between the core holes at the corners.
        c. As an alternate to sawcutting through the member, score the edges of the opening with a saw to a 1-inch depth.
            1) Provide score on both surfaces (when accessible).
            2) Remove concrete or masonry to within 6 inches of material to remain with a concrete breaker.
            3) Remove the remaining material with a chipping hammer.
        d. Remove the remaining material at the corners left by the core-drilling with a chipping hammer.
    2. Prevent debris from falling into adjacent tanks or channels in service or from damaging existing equipment and other facilities.

E. In-place Abandonment of Pipe:
    1. Abandoned pipe in-place as indicated on the Drawings.
    2. Clean buried or exposed solids service piping to a condition free of residual.
        a. Solids service piping includes: raw wastewater (RAW WW), primary sludge or scum (PS), mixed liquor (ML), return activated sludge (RAS), waste active sludge (WAS), surface waste activated sludge (SWAS), thickened waste activated sludge (TWAS), digested sludge (DS), centrate, or other similar solids service subject to biological degradation, etc.
    3. Provide closure of abandoned pipe cut ends as indicated on the Drawings using one of the following methods:
        a. Leave one end open.
        b. Install cap.
        c. Install plug.
        d. Install drain valves, pressure relief valves, vents, etc.
        e. Fill abandoned pipe as specified in Section 02312 - Controlled Low Strength Material (CLSM).

F. Buried structures:
        a. Pump out buried tanks.

G. Immediately upon discovery, remove and dispose of contaminated, vermin-infested, or dangerous materials using safe means that will not endanger health of workers and public.

H. Remove trees and shrubs within marked areas, and clear undergrowth and dead plant material as specified in Section 02300 - Earthwork.

I. Backfill open pits and holes caused by demolition as specified in Section 02300 - Earthwork.

J. Rough grade areas affected by demolition.

K. Remove demolished materials, tools, and equipment upon completion of demolition.

3.04 RESTORATION

A. General:
   1. Repair damage caused by demolition to conditions equal to those that existed prior to beginning of demolition.
      a. Patch and replace portions of existing finished surfaces that are damaged, lifted, and discolored. Refinish patched portion surfaces in a manner which produces uniform color and texture to entire surface, and that matches color and texture of adjacent surfaces.
      b. When existing finish cannot be matched, refinish entire surface to nearest change of plane where angle of change exceeds 45 degrees.
   2. The cost of repairs shall be at the Contractor's expense at no increase in the Contract Price.
   3. When new construction abuts or finishes flush with existing construction, make smooth transitions. Match finish of existing construction.
   4. Where partitions are removed, patch floors, walls, and ceilings with finish materials that match existing materials.
   5. Where removal of partitions results in adjacent spaces becoming one, rework floors, walls, and ceilings to provide smooth planes without breaks, steps, or bulkheads.
      a. Where change of plane between adjacent surfaces exceeds 2 inches, request and obtain instructions for making transition from Engineer.
         1) Refinish door surfaces and edges as necessary.
   6. Trim existing doors as necessary to clear new floors.
   7. Match patched construction with adjacent construction in texture and appearance so that patch or transition is invisible at 5-foot distance.
   8. When finished surfaces are cut so that smooth transition is impossible, terminate existing surface in neat manner along straight line at natural line of division and provide appropriate trim.

B. Restore existing concrete reinforcement as follows:
   1. Where existing reinforcement is to be incorporated into the new Work, protect, clean, and extend into new concrete.
   2. Where existing reinforcement is not to be retained, cut off as follows:
      a. Where new concrete joins existing concrete at the removal line, cut reinforcement flush with concrete surface at the removal line.
      b. Where concrete surface at the removal line will become the finished surface, cut reinforcement 2 inches below the surface, paint ends with epoxy, and patch holes with dry pack mortar.

C. Restore areas affected by removal of existing equipment, equipment pads and bases, piping, supports, electrical panels, electric devices, conduits, and fasteners so little or no evidence of the previous installation remains:
   1. After removal of piping, conduit, fasteners, and other construction, fill areas in existing concrete and masonry floors, walls, and ceilings with non-shrink grout and finish smooth.

2. Remove concrete bases for equipment and supports by:
    a. Saw cutting clean, straight lines with a depth equal to the concrete cover over reinforcement minus 1/2 inch below finished surface.
        1) Do not cut existing reinforcement in slab.
    b. Chip concrete within scored lines.
    c. Cut exposed reinforcing steel and anchor bolts that will project above the repaired surface.
    d. Patch with non-shrink grout to match adjacent grade and finish.
3. Terminate abandoned piping and conduits with blind flanges, caps, or plugs.
4. Where existing fasteners are not to be retained, cut off as follows:
    a. Where new concrete joins existing concrete at the removal line, cut fasteners flush with concrete surface at the removal line.
    b. Where concrete surface at the removal line will become the finished surface, cut fasteners 1 inch below the surface, paint ends with epoxy, and patch holes with epoxy grout.

3.05 FIELD QUALITY CONTROL

A. Do not proceed with demolition without Engineer's inspection of lay out.

B. Do not deviate from the submitted demolition plan without notifying the Engineer prior to Work.

END OF SECTION

SECTION 01756

COMMISSIONING

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PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Commissioning.

1.02 DEFINITIONS

A. Commissioning: The process of planning for, testing of, and start-up of systems, subsystems, equipment, components, and devices of the Work to demonstrate, through documented verification, that the Work has successfully met the Contract Documents. It includes training the Owner's staff on operation and maintenance of the installed Work.

B. Commissioning Phases: The activities of commissioning are grouped into the phases defined in the following table.
   1. Table 1 - Commissioning Phases.

TABLE 1 - COMMISSIONING PHASES		
Planning Phase	**Testing and Training Phase**	**Start-Up Phase**
Draft Test Plans	Source Testing • Documentation	Start-Up • Documentation • Owner Training
	Installation Verification • Documentation • Owner Training	
	Functional Testing • Documentation • Owner Training	
Subsystem Testing Plan	Installation Testing	PCIS Optimization and Fine-Tuning

   2. Attachment A provides Commissioning Flowcharts.

C. Component: A part of a system that does not have an electrical connection or internal electronics. Examples: Piping and pressure gauges.

D. Device: A part of a system that has electrical connections or internal electronics. Examples: level transmitter or pressure transmitter.

E. Electrical Energization Plan: A plan to manage how and when power is applied to electrical equipment.

F. Equipment: A factory or field assembled apparatus that performs an identifiable function. Examples: pumps, motors, VFDs, MCCs.

G. Functional Testing: Testing performed on a completed subsystem or system to demonstrate that the system meets the specified requirements. Example systems: backwash system, dewatering system.

H. Installation Verification: Testing to demonstrate that equipment or system and associated components or devices have been properly installed. Example equipment: pumps, meters, and blowers with associated piping.

I. Manufacturer's Certificate of Functional Compliance: The form completed by the manufacturer to confirm that testing of the installed equipment or system has been performed and the results conform to the specified performance. The form is provided in Attachment D provided at the end of this Section.

J. Manufacturer's Certificate of Installation Verification: The form completed by the manufacturer to confirm that the equipment or system is installed in conformance with the Contract. The form is provided in Attachment C at the end of this Section.

K. Manufacturer's Certificate of Source Testing: The form completed by the manufacturer to confirm that the specified source tests have been performed and the results conform to the specified requirements. The form is provided in Attachment B at the end of this Section.

L. Owner Training: The Owner's staff is trained by the Contractor, with assistance from manufacturer, to operate and maintain the completed Work. This is sometimes referred to as Vendor Specific Training.

M. Process Stream: A series of liquid or solids flow processes that are designed to improve the water quality to meet regulatory permit requirements.

N. Source Testing: Test equipment or products for performance at point of manufacture or assembly for the requirements specified in the Contract Documents. Also referred to as factory testing and factory acceptance testing (FAT).

O. Start-Up Phase: The phase when Start-Up occurs.

P. Start-Up: Operating the Work with process water to verify the Work meets the Contract Documents.

Q. Subsystem: A grouping of equipment, components, and devices that is a part of a larger system and that perform a single definable function. Examples: sand filters, filter backwash.

R. System: A grouping of equipment, components, and devices that perform a single definable function. If a system is a part of a larger system, it is referred to as a subsystem Examples: Flocculation and sedimentation, filtration.

S. System Testing: Testing of a completed system for an extended time period. Examples: Headworks, filtration.

T. Water Management Plan: A plan to manage the test water used for commissioning from source to disposal. The test water may be clean water, potable water,

non-potable water, or process water (e.g., raw water, plant water, sludge). The plan demonstrates how water will be produced, conveyed, treated, disposed of as directed by the plant manager, and/or recycled.

1.03 SUBMITTALS

A. Project commissioning:
   1. Commissioning Coordinator's qualifications.
      a. Submit to Engineer no later than 30 days after Notice to Proceed.
      b. Describe previous similar experience on similar projects with a list of references including phone numbers.
      c. Provide names and qualifications of commissioning assistants, if applicable.
   2. Schedules:
      a. Commissioning Schedule containing all commissioning activities.
      b. Owner Training Schedule.
   3. Test Plans:
      a. Submit draft Test Plan outlined in the Planning Phase, unless specified otherwise.
         1) Engineer approval of draft Test Plans required for successful completion of Planning Phase.
      b. Submit final Test Plan a minimum of 120 calendar days prior to testing.
      c. Engineer approval of final Test Plan required prior to start of testing.
   4. Test Reports:
      a. Submit draft Test Reports outline in the Planning Phase, unless specified otherwise.
         1) Engineer approval of draft Test Reports outline required for successful completion of Planning Phase.
      b. Submit final Test Report a minimum of 30 calendar days after testing.

B. Technical Sections commissioning:
   1. Manufacturer's representative's qualifications.
      a. Submit to Engineer no later than 30 days in advance of required services.
      b. Representative's name, phone, and e-mail address:
         1) May use 2 representatives: 1 for field testing and 1 for Owner Training.
         2) Provide resume stating instructor's technical expertise and instructional technology skills and experience.
   2. Test Plans:
      a. Submit draft Test Plan outlined in the Planning Phase, unless specified otherwise.
         1) Engineer approval of draft Test Plans required for successful completion of Planning Phase.
      b. Submit final Test Plan a minimum of 120 calendar days prior to testing.
      c. Engineer approval of final Test Plan required prior to start of testing.
   3. Test Reports:
      a. Submit draft Test Reports outline in the Planning Phase, unless specified otherwise.
         1) Engineer approval of draft Test Reports outline required for successful completion of Planning Phase.
      b. Submit final Test Report a minimum of 30 calendar days after testing.

4. Manufacturer's representatives field notes and data.
5. Owner Training:
    a. Prior to the training session:
        1) Training instructor qualifications.
        2) Training course materials: Due 30 calendar days prior to initial training session.
            a) If Owner requires, Continuing Education Units (CEUs), submit training materials to state regulatory agency in sufficient time to obtain approval for training prior to the training.
            b) Drafts of training agenda, lesson plan, presentation, handouts, and list of audio-visual aids.
            c) Format: 1 electronic copy in format specified by Owner and 3 hard copies organized in notebooks.
    b. Post training session:
        1) Training course materials: Due 14 calendar days after class completion.
            a) Recordings.
            b) Class attendance sheet.
            c) Final version of training agenda, final lesson plan, presentation, handouts, and audio-visual aids.
            d) Format: 1 electronic copy in format specified by Owner and 3 hard copies organized in notebooks.
        2) Provide materials for all sessions of the class in a single transmittal.
        3) If the Owner requires training CEUs, issue training CEU certificates approved by the state regulatory agency to Owner’s staff who successfully completed the training.

1.04 COMMISSIONING COORDINATOR (CC)

A. Responsibilities include the following:
    1. Part-time person.
    2. Become thoroughly familiar with Contract commissioning requirements.
    3. Provide the primary interface with Engineer and Owner for Commissioning efforts.
    4. Lead Commissioning efforts - all phases and tasks.
    5. Coordinate training efforts.
    6. Meetings:
        a. CC is responsible for setting commissioning coordination meeting dates and times, as well as preparing the agendas and meeting minutes.
        b. CC shall conduct commissioning progress meetings throughout construction, to plan, scope, coordinate, and schedule future activities, resolve problems, etc.
        c. Frequency: Monthly minimum. Increase frequency as needed based on complexity and quantity of commissioning activities.

B. Designate and provide CC assistants, as needed.

1.05 MANUFACTURER'S REPRESENTATIVES

A. Qualifications: as specified below and in the Technical Sections:
   1. For Installation and Functional Testing:
      a. Factory trained and experienced in the technical applications, installation, operation, and maintenance of respective equipment/system with full authority by the equipment/system manufacturer to issue the certifications required of the manufacturer.
   2. Training instructor qualifications:
      a. Provide resume stating instructor's technical preparation and instructional technology skills and experience.
      b. If CEUs are required, the operator training instructors must comply with state regulatory.
      c. Knowledgeable in the equipment/system for which they are training.
      d. Experienced in conducting classes.
      e. Sales representatives are not qualified instructors unless they possess the detailed operating and maintenance knowledge required for proper class instruction.
   3. Representatives to be approved by Owner and Engineer.
   4. No substitute representatives without written approval by Owner and Engineer.

B. Duties:
   1. Determine if additional time and/or trips (beyond those specified in the Technical Sections) is required to perform the specified services.
   2. Coordinate services in accordance with the Contractor's project schedule up to and including making multiple trips to project site when there are separate milestones associated with installation of each occurrence of manufacturer's equipment.
   3. Perform on-site services as specified in the Technical Sections:
   4. Provide daily copies of manufacturer's representatives field notes and data to Contractor.

1.06 PLANNING PHASE

A. Overview of Planning Phase:
   1. Define approach and timing for commissioning.
   2. Obtain Engineer approval of draft Test Plans.

B. Test Plans.
   1. Define approach and timing for:
      a. Testing and Training Phases.
         1) Major systems, with separate plans for each system.
      b. Start-Up Phase.
   2. Centralized commissioning database:
      a. Provide system to manage information.
         1) Detailed steps.
         2) Dependencies and other relationships of steps.
      b. Update the database within 24 hours of task completion.
   3. Source Test (Factory Acceptance Test) and Functional Test Plans:
      a. As specified in this Section and other Technical Sections.
      b. Based on approved shop drawings.

c. Prepared by Contractor.
d. Include the following items for each test:
    1) Purpose of the test.
    2) Identification of each item of equipment/system to be tested, including system designation, location, tag number, control loop identifier, etc.
    3) Description of the pass/fail criteria that will be used.
    4) Listing of pertinent reference documents (Contract and industry standards or sections applicable to the testing).
        a) Credentials of test personnel.
    5) Test equipment:
        a) Include Product Data for the test equipment.
        b) Appropriate calibration records.
            (1) Drawings or photographs of test stands and/or test apparatus.
    6) Duration: Determine test durations with Owner's input.
    7) Detailed step-by-step test procedures.
        a) The level of detail shall be sufficient for the witness to follow the steps.
e. Define for Functional Testing:
    1) Required temporary systems (pumps, piping, etc.).
    2) Shutdown requirements for existing systems.
f. Furnish labor, power, tools, equipment, instruments, and services required for and incidental to testing activities.

4. Test forms minimum requirements:
    a. Name of product to be tested.
    b. Test date.
    c. Names of persons conducting the test.
    d. Names of persons witnessing the test, where applicable.
    e. Test data.
    f. Applicable project requirements as specified in the Technical Sections.
    g. Check offs for each completed test or test step.
    h. Place for signature of person conducting tests and for the witnessing person, as applicable.
5. Owner responsibilities:
    a. Schedule Owner's staff within the constraints of their workloads.
        1) Those who will participate in this test have existing full-time work assignments, and testing is an additional assigned work task, therefore, scheduling is imperative.
        2) Owner staff work schedules regularly shift, as treatment facilities are typically operated on an around-the-clock basis.
        3) Maximum hours per week: 4.
        4) Days available: Monday to Thursday.
        5) Scheduling coordination:
        6) CC is responsible for the following:
            a) Coordinate schedule with the Owner's personnel and manufacturer's representatives (instructors).

C. Test Reports:
    1. Minimum requirements:
        a. Title.
        b. Abstract.
        c. Equipment.
        d. Procedures.
        e. Results.
            1) Complete disclosure of the calculation methodologies.
        f. Conclusions.
        g. Signature by an authorized party.
        h. Appendices.
            1) Completed test forms signed by witnesses.
    2. Water Management Plan:
        a. Requirements:
            1) Demonstrate how water will be produced, conveyed, treated, recycled, and or disposed until testing verifies specified requirements.
    3. Commissioning Schedule:
        a. Content:
            1) Comply with Attachment G - Functional Testing Requirements and provide activities organized by system and subsystem.
            2) Include:
                a) Source testing when required.
                b) Functional testing.
                c) Owner Training.
            3) Comply with Attachment F - Commissioning Roles and Responsibilities Matrix.
        b. Procedures:
            1) Submit commissioning schedule as specified in Section 01321 - Schedules and Reports.

1.07 TESTING AND TRAINING PHASE

A. Overview of Testing and Training Phase:
    1. General:
        a. Contractor tests the Work to verify it meets the Contract requirements.
        b. Contractor trains the Owner to operate and maintain the Work.
    2. Contractor responsibilities:
        a. Furnish labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing commissioning activities in accordance with the approved Commissioning Plans.
    3. Owner responsibilities:
        a. Furnish labor, power, chemicals, and services required for and incidental to completing commissioning activities in accordance with the approved Commissioning Plans.
        b. Owner provided services, equipment, and/or materials to be as specified in Section 01110 - Summary of Work.

B. Source Testing:
   1. As specified in the Technical Section.
   2. Source Test Plan:
      a. Engineer approval of Source Test Plan required prior to testing.
   3. Witnessed in person:
      a. As specified in the Technical Section.
      b. Contractor is responsible for trip costs associated with Owner's and Engineer's representatives.
         1) Transportation:
            a) Commercial airline costs to and from Charles M. Schulz-Sonoma County Airport (STS) including related fees.
            b) Rental car to and from arrival airport, hotel, and test site including related fees.
         2) Hotel/Meals:
            a) Hotel with an American Automobile Association 3 Diamond rating or higher equivalent for single occupancy room per person per day.
            b) Meal allowance based on state government per diem guidelines per test site location.
   4. Virtual witness testing:
      a. As specified in the Technical Sections.
      b. Contractor is responsible for costs associated with virtual witness.
      c. Provide the following:
         1) An agenda detailing start time of each major phase in the procedure defined in the approved Test Plan.
         2) A dedicated operator (separate from the test technician) to operate the camera, provide commentary throughout test, and inspect devices at the request of the attendees.
      d. Online meeting platform: Microsoft Teams.
      e. Share video through a high-definition camera.
      f. Establish methods to communicate, convey, and record information clearly even in environments with loud background noise.
         1) Electronic feed for screen sharing of the control panel, HMI, or other screens used throughout testing.
         2) Provide recording of virtual sharing within 1 day after testing.
      g. Test run of virtual sharing a minimum of 1 week prior to the test:
         1) Use current record documents in PDF format.
         2) Provide recording of virtual sharing within 1 day after the test run.
         3) Engineer approval of test run virtual sharing is required before source testing.
   5. If the Source Test is not ready on the scheduled date or if the Source Test fails:
      a. Contractor is responsible for associated costs:
         1) First test costs that are non-refundable, if applicable.
         2) Repeat test costs:
            a) Trip costs, if applicable.
         3) Virtual witness costs, if applicable.
            a) Witness labor costs:
               (1) Travel time and witness time are included, if applicable.
               (2) The greater of $200 per hour or $1,600 per day.

6. Source testing is complete after successful testing, submittal of test report, and Manufacturer's Certificate of Source Testing.
7. Engineer approval of Source Testing Report is required.

C. Installation Verification:
   1. Overview:
      a. Verifying the installation of equipment to be in accordance with Manufacturer's Instructions.
   2. Prerequisite:
      a. Engineer approval of Source Testing Report.
   3. Perform checks:
      a. Structural anchorage check.
      b. Electrical energization check.
         1) As specified in the flowchart shown in Attachment A.
      c. Health and safety check.
   4. Submit Manufacturer's Certificate of Installation Verification.
   5. Engineer approval of Manufacturer's Certificate of Installation Verification is required.

D. Functional Testing:
   1. Overview:
      a. Testing the function of a system or subsystem.
   2. Prerequisites:
      a. Engineer approval of Manufacturer's Certificate of Installation Verification .
      b. Engineer approval of Functional Test Plan required prior to testing.
      c. Draft Operations and Maintenance Manual as specified in Section 01782 - Operations and Maintenance Manual.
      d. Completed pipe, valve, and gate labeling of system or subsystem.
         1) As specified in Section 15076 - Pipe Identification prior to the start of Functional Testing.
   3. Witnessed.
   4. Discipline checks:
      a. Verify support systems function properly, such as seal water, pipes, valves, etc.
      b. As specified in the individual Technical Sections.
   5. Consecutive Day Test:
      a. Operate the Work as specified in Attachment G - Functional Testing Requirements and as specified in the individual Technical Sections.
         1) Successful completion of subsystem testing required prior to system testing.
      b. Failure response time:
         1) Be equipped and ready to provide emergency repairs, adjustments, and corrections to comply with the "Significant Interruption Duration" requirements as specified in Attachment G - Functional Testing Requirements.

c. Duration:
    1) As specified in Attachment G - Functional Testing Requirements.
    2) Restart the consecutive day test when the system performance failures exceed the "Significant Interruption Duration" time period specified in Attachment G - Functional Testing Requirements.
        a) Individual equipment/system failures that are corrected within the "Significant Interruption Duration" time specified in Attachment G - Functional Testing Requirements shall not require the consecutive day test to be restarted unless the failure recurs.
        b) Engineer has the authority to reject the consecutive day test if individual equipment/system failures are repetitive.

6. Instrumentation and controls tests.
    a. Loop Validation Tests.
    b. Complete End-to-End Testing (CEET):
        1) Signal are tested from the field device through the PLC program, the network, and all the way to the operator’s HMI graphic screens.
7. Restore to condition prior to testing:
    a. Dewater and clean sumps.
    b. Dewater process units, where required by test plan.
8. Submit Manufacturer’s Certificate of Functional Compliance.
9. Engineer approval of Manufacturer’s Certificate of Functional Compliance is required.

E. Documentation:
1. Provide records generated during Commissioning Phase of Project including but not limited to:
    a. Training documentation.
    b. Manufacturer’s Certificate of Source Testing.
    c. Manufacturer’s Certificate of Installation Verification.
    d. Manufacturer’s Certificate of Functionality Compliance.
    e. Daily logs of equipment/system testing identifying tests conducted and outcome.
    f. Test forms and documentation.
    g. Functional Testing results.
    h. Logs of time spent by manufacturer's representatives performing services on the job site.
    i. Equipment lubrication records.
    j. Electrical phase, voltage, and amperage measurements.
    k. Insulation resistance measurements.
    l. Bearing temperature measurements.
    m. Data sheets of control loop testing including testing and calibration of instrumentation devices and setpoints.
    n. Provide: 1 electronic copy in format specified by Owner and 3 hard copies organized in notebooks.
    o. Store the data within 24 hours of the test or document creation in the project file system.
    p. Due date: Within 14 calendar days of Substantial Completion.
2. Engineer approval of documentation is required.

F. Owner Training:
   1. Train Owner's staff on the operation and maintenance of the equipment/system.
      a. Provide Owner staff with state regulatory agency approved training CEUs.
   2. Train on each topic of the approved Operation and Maintenance Manual.
      a. Include classroom instruction and field demonstration with all necessary tools and test equipment.
   3. Training tailored to the skills and job classifications of the staff attending the classes (e.g., plant superintendent, treatment plant operator, maintenance technician, electrician, etc.).
   4. Training outcomes:
      a. Owner's staff can safely operate, maintain, and repair the equipment/systems provided as recommended by the manufacturer.
   5. Training plan:
      a. CC shall meet with Engineer and Owner's designated training coordinator to develop list of personnel to be trained and to establish expected training outcomes and objectives at least 60 calendar days prior to commissioning of equipment/system.
      b. Coordinate and arrange for manufacturer's representatives to provide both classroom-based learning and field (hands-on) training, based on training module content and stated learning objectives.
      c. Conduct classroom training at location designated by Owner.
      d. Scope and sequence:
         1) Plan and schedule training in the correct sequence to provide prerequisite knowledge and skills to trainees.
            a) Describe recommended procedures to check/test equipment/system following a corrective maintenance repair.
         2) If multiple classes are needed to meet the training objectives, they shall be included in the training plan.
   6. Owner Training Schedule:
      a. Schedule Owner's staff training within the constraints of their workloads.
         1) Those who will participate in this training have existing full-time work assignments, and training is an additional assigned work task, therefore, scheduling is imperative.
         2) Owner staff work schedules regularly shift, as treatment facilities are typically operated on an around-the-clock basis.
         3) Maximum training hours per week: 16.
         4) Days available for training:
            a) Monday to Thursday**.**
      b. Training scheduling coordination:
         1) CC is responsible for the following:
            a) Coordinate schedule for training periods with the Owner's personnel and manufacturer's representatives (instructors).
         2) Complete Owner Training no sooner than 15 calendar days prior to Functional Testing of each system.
      c. Class logistics:
         1) Delivery time minimum: 2 hours.
         2) Delivery time maximum: 4 hours.

3) Class agenda:
    a) Refreshment break: One 10-minute break.
    b) Meal break: One 45-minute break, unless otherwise specified.
    c) Schedule refreshment breaks and meal breaks to meet the class needs and Owner work rules.
4) Schedule specific sessions:
    a) Minimum of 30 days in advance to allow Owner staffing arrangements to take place.
    b) At the times requested by the Owner, within the period 7 a.m. to 7 p.m. Monday through Friday.
        (1) Times scheduled will be at Owner's discretion.
    c) Owner approval and confirmation required for session schedules.
    d) Provide minimum of 2 sessions for each class unless otherwise noted.
        (1) The purpose of having multiple sessions on each class is to accommodate the attendance of as many Owner personnel working different shifts as possible.
    e) A maximum of 1 session per day for each class.

d. Number of students:
1) Estimated class size maximum: 5 staff.
2) Engineer will confirm the headcount 1 week prior to the class, so that the instructor can provide the correct number of training aids for students.

7. Submittals:
a. Submit Training Plan Schedule 30 calendar days before the first scheduled training session, including but not limited to lesson plans, participant materials, instructor's resumes, and training delivery schedules.
b. Submit training documentation including the following:
1) Training plan:
    a) Training modules.
    b) Scope and sequence statement.
    c) Contact information for manufacturer's instructors including name, phone, and e-mail address.
    d) Instructor qualifications.
2) Training program schedule:
    a) Format: Bar chart:
        (1) Include in the Project Progress Schedule.
    b) Contents:
        (1) Training modules and classes.

8. Lesson plans:
a. Divide training into discrete modules appropriate for the equipment and trades.
b. State performance-based learning objectives in terms of what the trainees will be able to do at the end of the lesson.
c. Define student conditions of performance and criteria for evaluating instructional success.
d. Minimum requirements:
1) Hands-on demonstrations planned for the instructions.
2) Cross-reference training aids.

3) Planned training strategies such as whiteboard work, instructor questions, and discussion points or other planned classroom or field strategies.
4) Attach handouts cross-referenced by section or topic in the lesson plan.
5) Indicate duration of outlined training segments.

e. Provide instruction lesson plans for each trade:
1) Detailed component description:
a) Identify each component function and describe in detail.
b) Identify equipment's mechanical, electrical, and electronic components and features.
c) Where applicable, group relative components into subsystems.
d) Identify and describe in detail equipment safety features, permissive and controls interlocks.
2) Equipment operation:
a) Describe equipment's operating (process) function and system theory.
b) Describe equipment's fundamental operating principles and dynamics.
c) Identify support equipment associated with the operation of subject equipment.
d) Detail the relationship of each piece of equipment or component to the subsystems, systems, and process.
e) Cite hazards associated with the operations, exposure to chemicals associated with the component, or the waste stream handled by the component.
f) Specify appropriate safety precautions, equipment, and procedures to eliminate, reduce, or overcome hazards.
3) Define Preventative Maintenance (PM) inspection procedures required on equipment in operation, spot potential trouble symptoms (anticipate breakdowns), and forecast maintenance requirements (predictive maintenance).
a) Review preventive maintenance frequency and task analysis table.
4) Define equipment Corrective Maintenance (CM) troubleshooting:
a) Describe recommended equipment preparation requirements as they relate to specific craft problems.
b) Identify and describe the use of any special tools required for maintenance of the equipment as they relate to specific craft problems.
c) Provide component specific troubleshooting checklists as they relate to specific craft problems.
d) Describe component removal/installation and disassembly/assembly procedures for specific craft repairs.
e) Perform at least 2 hands-on demonstrations of common corrective maintenance repairs.
5) Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.

9. Training instruction format:
    a. The training for operations and maintenance personnel shall be provided as 1 entity.
    b. Instructors shall apply adult education best practices, emphasizing learner participation and activity.
    c. Lecturing should be less than 30 percent of class time.
    d. Training delivery may include problem solving, question/answer, hands-on instruction, practice, evaluation/feedback tools, and lecture to support training objectives.
    e. Conduct hands-on instruction according to the following descriptions:
        1) Present hands-on demonstrations of at least the following tasks:
            a) Proper start-up, shutdown, and normal and alternative operating strategies.
            b) Common corrective maintenance repairs for each group.
            c) Recommended procedures to check/test equipment/system following a corrective maintenance repair.
            d) Preventative maintenance points.
            e) Calibration, if applicable.
        2) Use tools and equipment provided by manufacturer to conduct the demonstrations.
            a) Submit requests for supplemental assistance and facilities with the Contractor's proposed lesson plans.
        3) Contractor remains responsible for equipment disassembly or assembly during hands-on training situations involving equipment disassembly or assembly by Owner's personnel.
    f. Training aids:
        1) Instructors shall provide needed audio-visual devices such equipment (televisions, video recorder/player, computer, projectors, screens, easels, etc.), models, charts, etc. for each class.
        2) Instructor to confirm with Engineer in advance of each class that the classroom will be appropriate for the types of audiovisual equipment to be employed.
10. Training sessions:
    a. Provide training sessions for equipment/system as specified in the individual equipment/system section.
    b. Include the following information in the agenda:
        1) Instructor name.
        2) Listing of subjects to be discussed.
        3) Time estimated for each subject.
        4) Allocation of time for Owner staff to ask questions and discuss the subject matter.
        5) List of documentation to be used or provided to support training.
    c. Owner may request that particular subjects be emphasized, and the agenda be adjusted to accommodate these requests.
    d. Digitally record audio and video of each training session.
        1) Include classroom and field instruction with question and answering periods.
        2) Engineer approval required for producer of video materials from one of the following options:
            a) Qualified, professional video production company or individual.

3) Record in digital format and recording shall become property of the Owner with exclusive rights.
    a) No video recording agreements will be entered into by the Owner.
4) Media:
    a) Video quality shall be 720p HD or greater in MPG, AVCHD, AVI, or MP4 format.
    b) Digital color video format.
    c) Provide audio portion of the composite CD sufficiently free from electrical interference and background noise to provide complete intelligibility of oral report.
    d) Identification: On each copy provide a label with the following information:
        (1) Name of training.
        (2) Date video was recorded.
    e) Display continuous running time.
    f) At start of each video recording, record training class name, date, instructor's name.
    g) Provide audio quality that is not degraded during the recording of the field sessions due to background noise, space, distance or other factors.
5) The Contractor shall provide a written release from all claims to the recorded training material produced, if required.

e. Distribute copies of the agenda to each student at the beginning of each training class.
f. Trainees will keep training materials and documentation after the session.
g. Distribute Training Evaluation Form following each training session.
    1) Training Evaluation Form is included in this Section.
    2) Return completed Training Evaluation Forms to Owner's designated training coordinator immediately after session is completed.
    3) Revise training sessions judged "Unsatisfactory" by a majority of attendees.
        a) Conduct training sessions again until a satisfactory rating is achieved.

11. Engineer approval of Owner Training is required.

1.08 START-UP PHASE

A. Overview of Start-Up Phase:
    1. General:
        a. Confirm reliability requirements.
        b. Confirm regulatory compliance.

B. Start-Up Period:
    1. Contractor responsibilities:
        a. Support Owner to operate the Work.
    2. Owner responsibilities:
        a. Owner to operate the Work.

b. Owner-provided services, equipment, and/or materials to be as specified in Section 01110 - Summary of Work.
c. Furnish labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing commissioning activities in accordance with the approved Commissioning Plans.

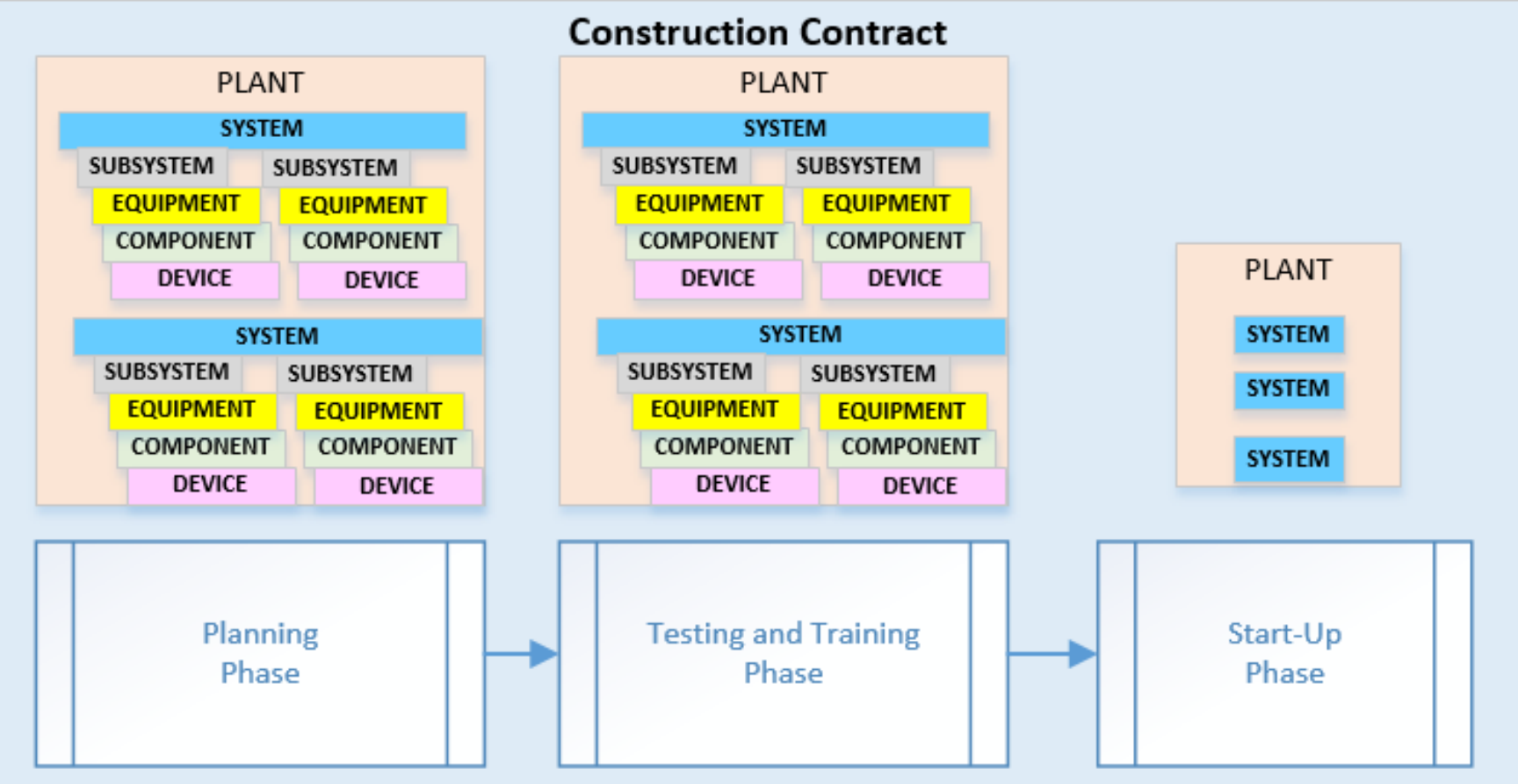
3. Prerequisites:
   a. Engineer approval of Testing and Training Phase.
4. Witnessed.
5. Duration: 30 days.
6. Engineer approval of Start-Up Period is required to achieve substantial completion.

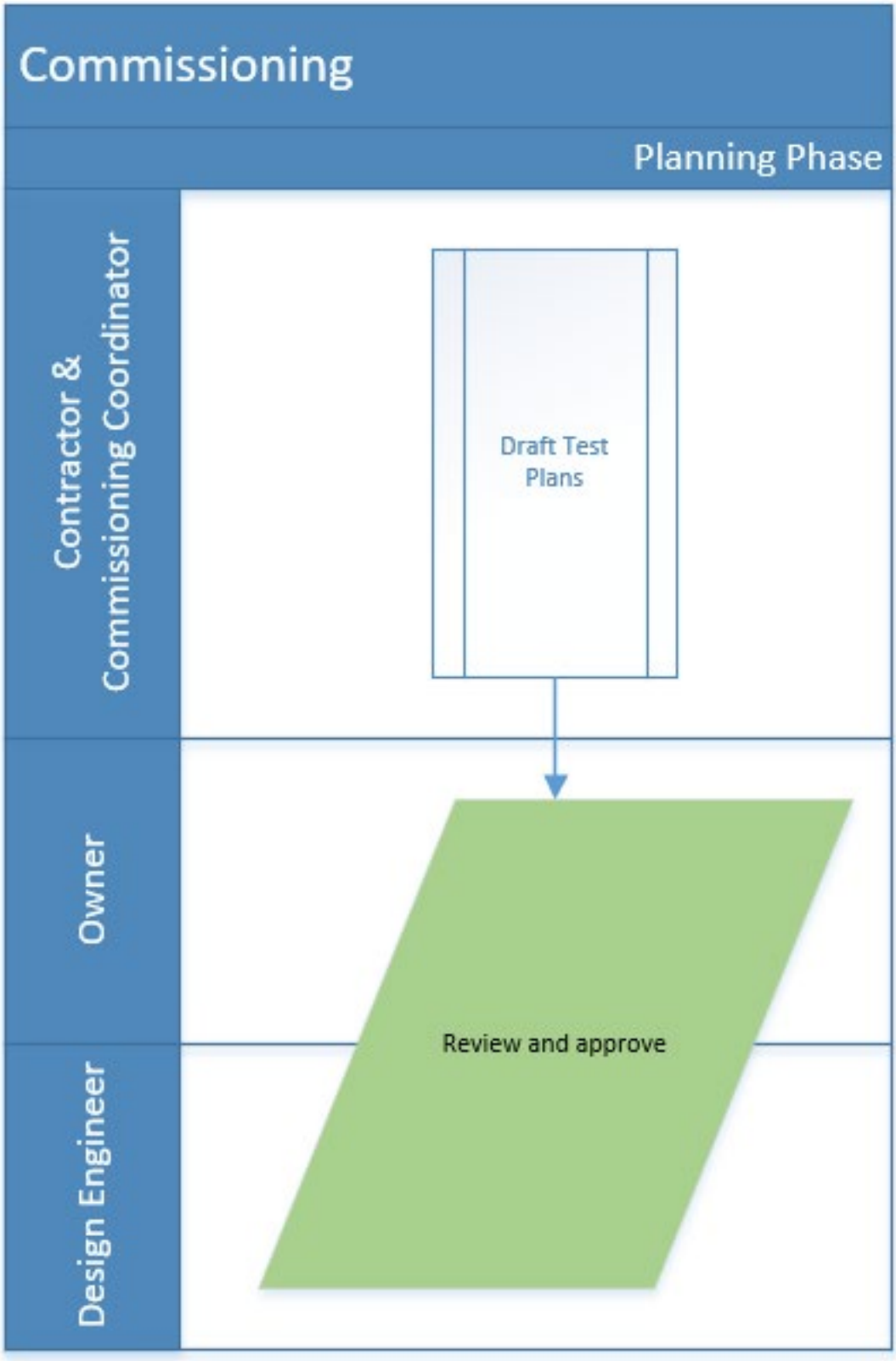
PART 2 PRODUCTS (NOT USED)

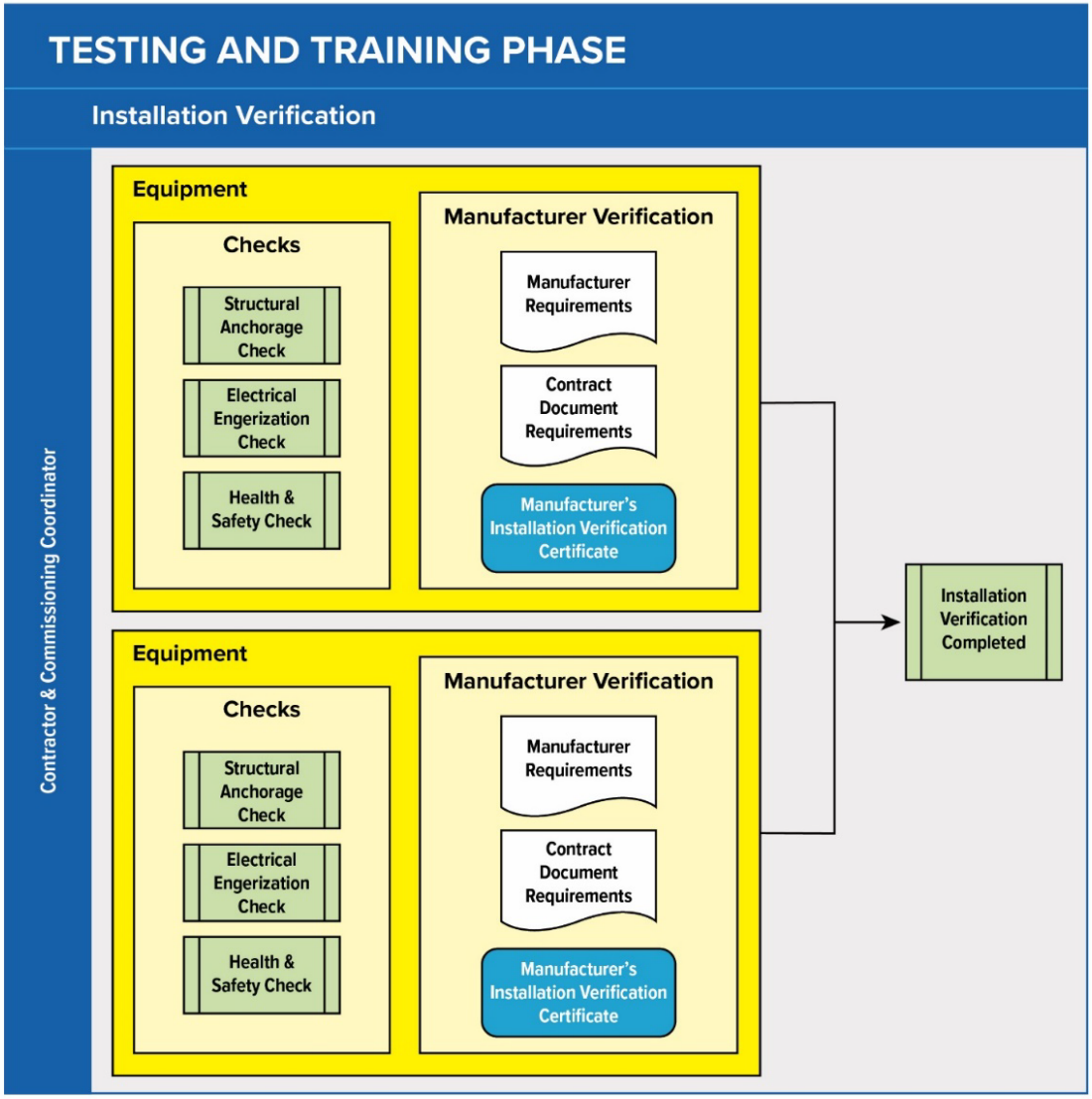
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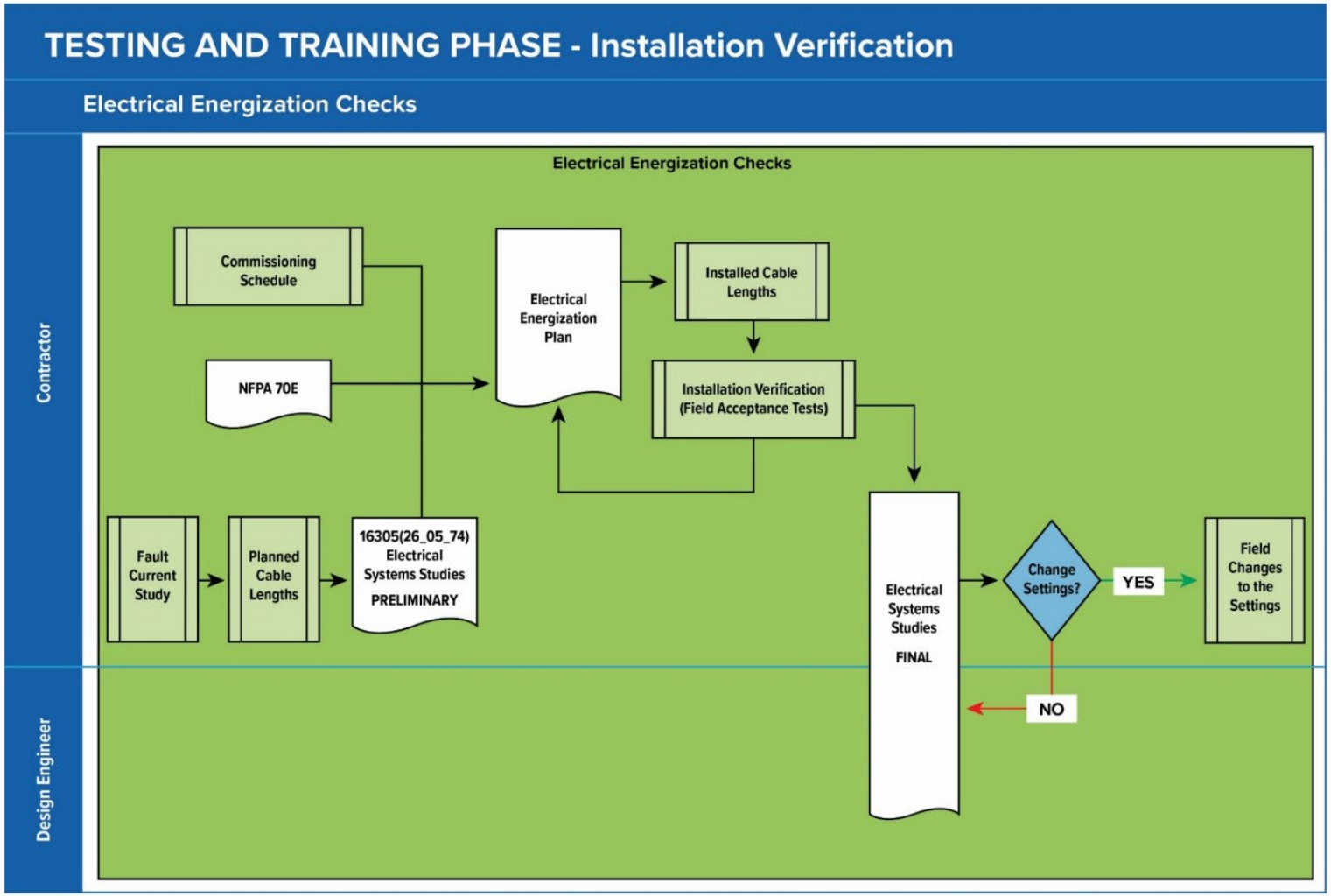
END OF SECTION

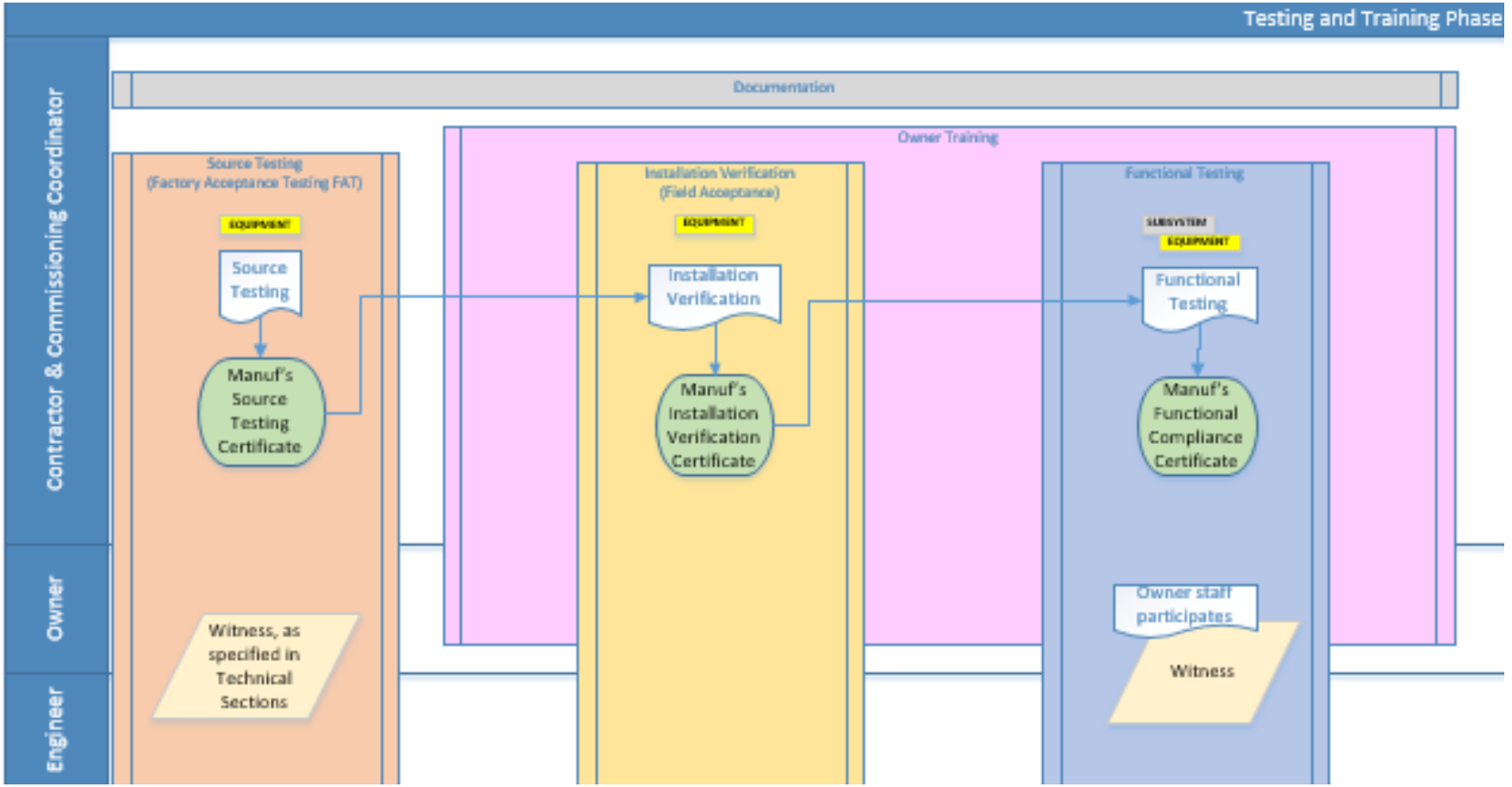
ATTACHMENT A - COMMISSIONING FLOWCHARTS

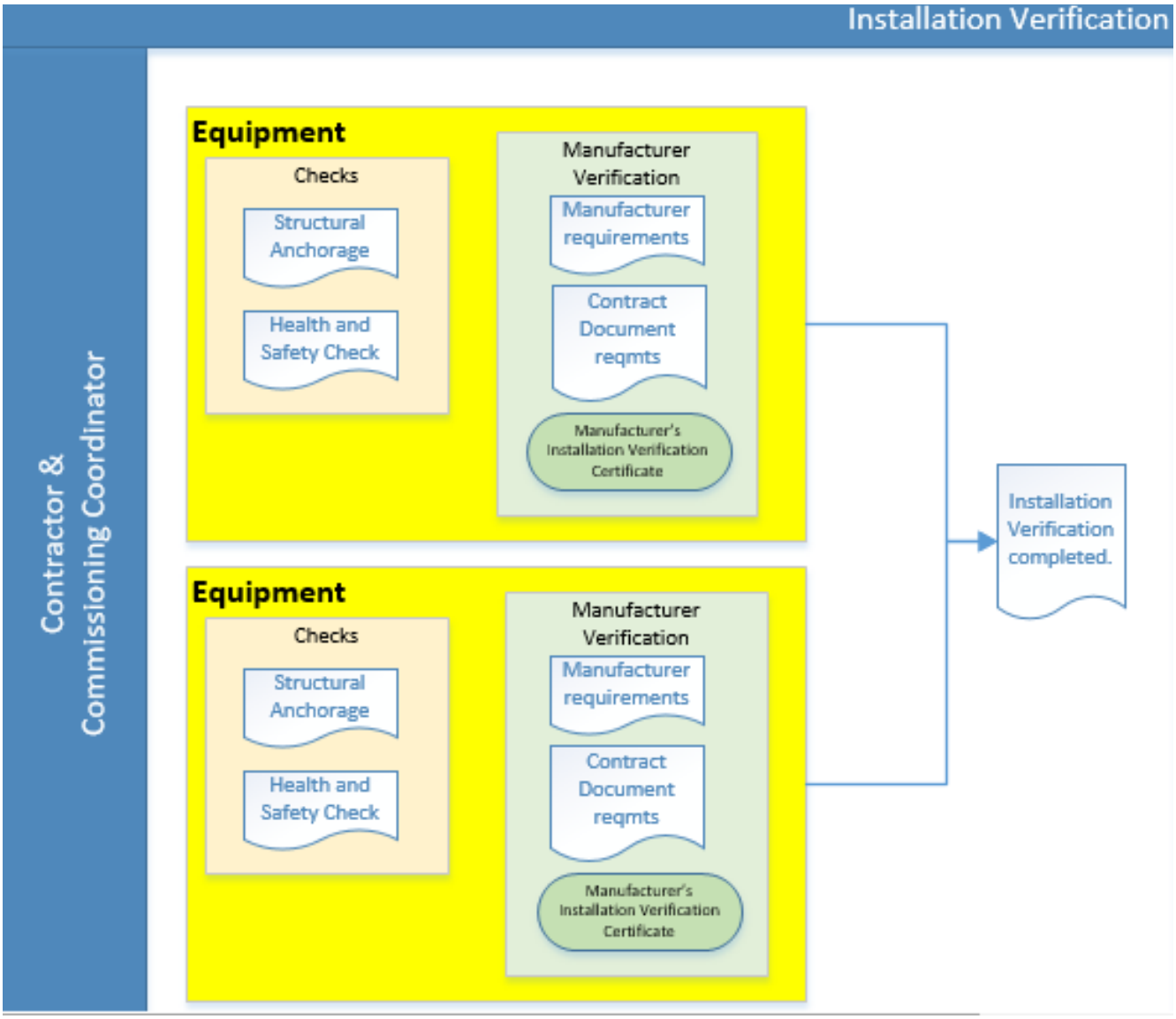

Construction Contract
PLANT
SYSTEM
SUBSYSTEM
SUBSYSTEM
EQUIPMENT
EQUIPMENT
COMPONENT
COMPONENT
DEVICE
DEVICE
SYSTEM
SUBSYSTEM
SUBSYSTEM
EQUIPMENT
EQUIPMENT
COMPONENT
COMPONENT
DEVICE
DEVICE
PLANT
SYSTEM
SUBSYSTEM
SUBSYSTEM
EQUIPMENT
EQUIPMENT
COMPONENT
COMPONENT
DEVICE
DEVICE
SYSTEM
SUBSYSTEM
SUBSYSTEM
EQUIPMENT
EQUIPMENT
COMPONENT
COMPONENT
DEVICE
DEVICE
PLANT
SYSTEM
SYSTEM
SYSTEM
Planning Phase
Testing and Training Phase
Start-Up Phase

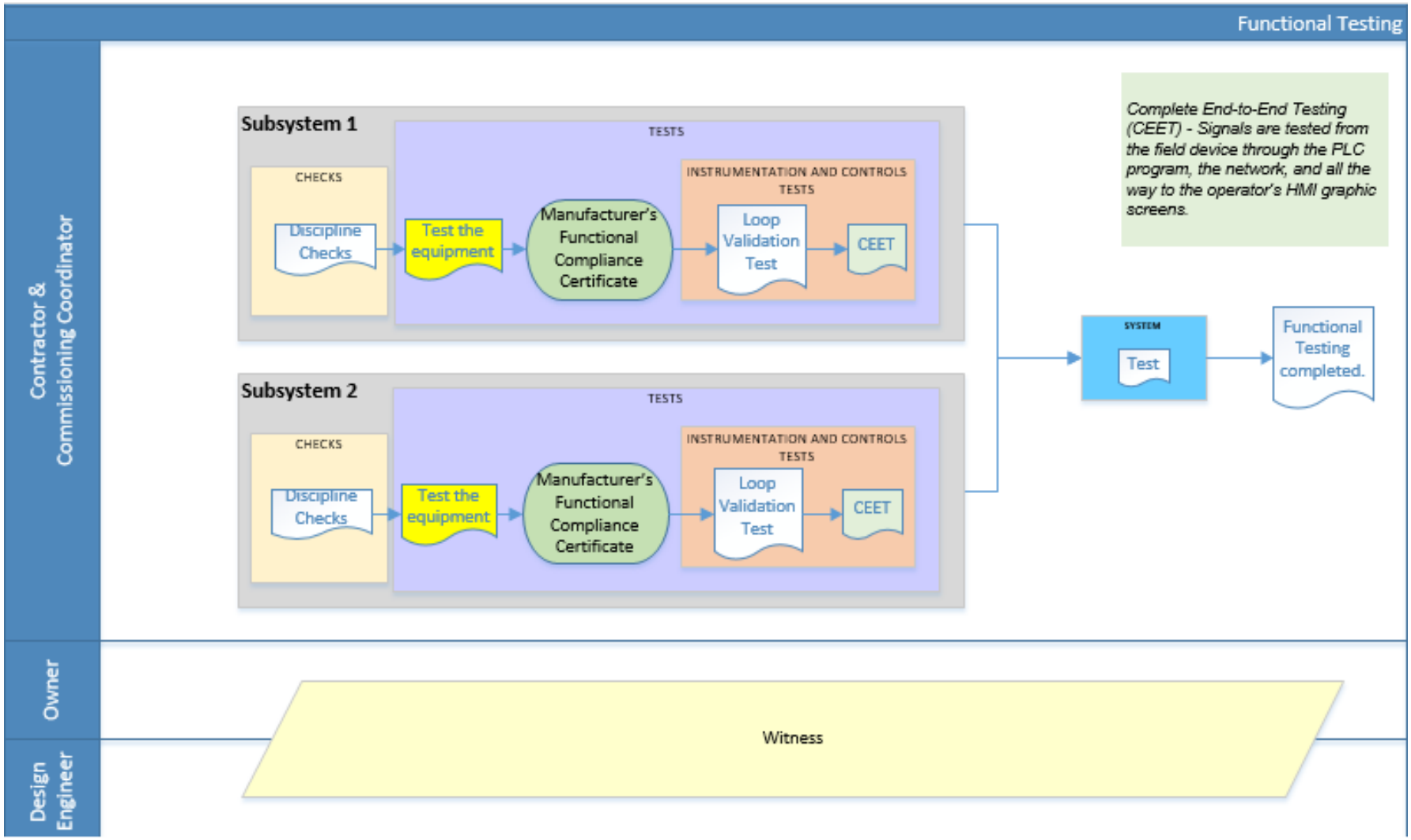

Commissioning
Planning Phase
Contractor & Commissioning Coordinator
Draft Test Plans
Owner
Review and approve
Design Engineer

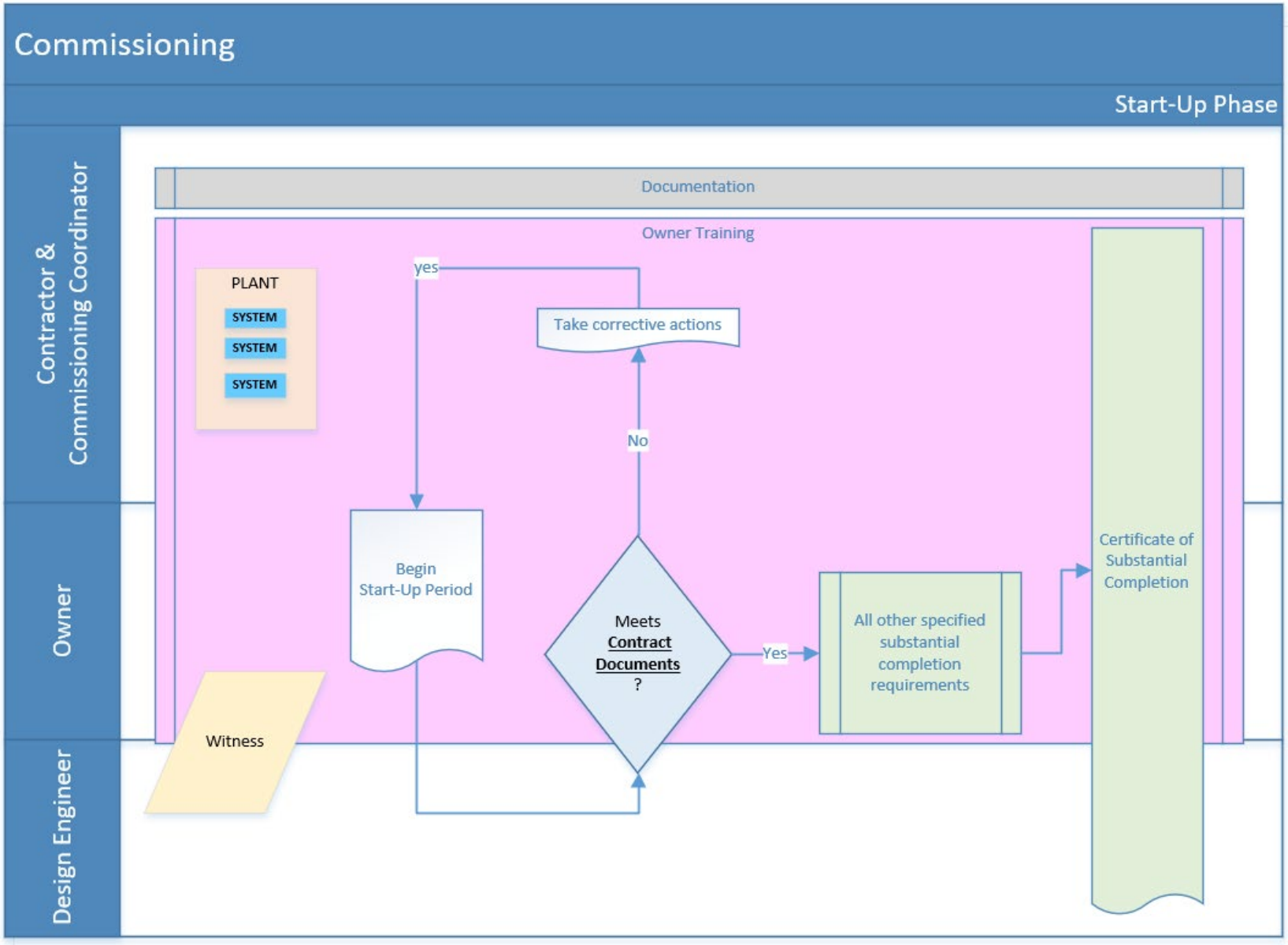

TESTING AND TRAINING PHASE
Installation Verification
Contractor & Commissioning Coordinator
Equipment
Checks
Structural Anchorage Check
Electrical Engerization Check
Health & Safety Check
Manufacturer Verification
Manufacturer Requirements
Contract Document Requirements
Manufacturer's Installation Verification Certificate
Equipment
Checks
Structural Anchorage Check
Electrical Engerization Check
Health & Safety Check
Manufacturer Verification
Manufacturer Requirements
Contract Document Requirements
Manufacturer's Installation Verification Certificate
Installation Verification Completed


TESTING AND TRAINING PHASE - Installation Verification
Electrical Energization Checks
Contractor
Design Engineer
Electrical Energization Checks
Commissioning Schedule
NFPA 70E
Electrical Energization Plan
Installed Cable Lengths
Installation Verification (Field Acceptance Tests)
Fault Current Study
Planned Cable Lengths
16305(26_05_74) Electrical Systems Studies PRELIMINARY
Electrical Systems Studies FINAL
Change Settings?
YES
NO
Field Changes to the Settings


Testing and Training Phase
Contractor & Commissioning Coordinator
Owner
Engineer
Documentation
Owner Training
Source Testing
(Factory Acceptance Testing FAT)
EQUIPMENT
Source Testing
Manuf's Source Testing Certificate
Witness, as specified in Technical Sections
Installation Verification
(Field Acceptance)
EQUIPMENT
Installation Verification
Manuf's Installation Verification Certificate
Functional Testing
SUBSYSTEM
EQUIPMENT
Functional Testing
Manuf's Functional Compliance Certificate
Owner staff participates
Witness


Installation Verification
Contractor & Commissioning Coordinator
Equipment
Checks
Structural Anchorage
Health and Safety Check
Manufacturer Verification
Manufacturer requirements
Contract Document reqmts
Manufacturer's Installation Verification Certificate
Equipment
Checks
Structural Anchorage
Health and Safety Check
Manufacturer Verification
Manufacturer requirements
Contract Document reqmts
Manufacturer's Installation Verification Certificate
Installation Verification completed.


Functional Testing
Contractor & Commissioning Coordinator
Owner
Design Engineer
Subsystem 1
TESTS
CHECKS
Discipline Checks
Test the equipment
Manufacturer's Functional Compliance Certificate
INSTRUMENTATION AND CONTROLS TESTS
Loop Validation Test
CEET
Subsystem 2
TESTS
CHECKS
Discipline Checks
Test the equipment
Manufacturer's Functional Compliance Certificate
INSTRUMENTATION AND CONTROLS TESTS
Loop Validation Test
CEET
Complete End-to-End Testing (CEET) - Signals are tested from the field device through the PLC program, the network, and all the way to the operator's HMI graphic screens.
SYSTEM
Test
Functional Testing completed.
Witness


Commissioning
Start-Up Phase
Contractor & Commissioning Coordinator
Owner
Design Engineer
Documentation
Owner Training
PLANT
SYSTEM
SYSTEM
SYSTEM
yes
Take corrective actions
No
Begin Start-Up Period
Meets Contract Documents ?
Yes
All other specified substantial completion requirements
Certificate of Substantial Completion
Witness

ATTACHMENT B - MANUFACTURER'S CERTIFICATE OF SOURCE TESTING

MANUFACTURER'S CERTIFICATE OF SOURCE TESTING

OWNER _____ EQPT/SYSTEM _____

PROJECT NAME _____ EQPT TAG NO. _____

PROJECT NO. _____ EQPT SERIAL NO. _____

SPECIFICATION NO. _____

SPECIFICATION TITLE _____

Comments: _____

_____

_____

_____

_____

I hereby certify Source Testing has been performed on the above-referenced equipment/system as defined in the Contract, and results conform to the Contract Document requirements. Testing data is attached.

Date of Execution: _____, 20____

Manufacturer: _____

Manufacturer's Authorized Representative Name *(print)*: _____

_____

(Authorized Signature)

If applicable, Witness Name *(print)*: _____

_____

(Witness Signature)

ATTACHMENT C - MANUFACTURER'S CERTIFICATE OF INSTALLATION VERIFICATION

MANUFACTURER'S CERTIFICATE OF INSTALLATION VERIFICATION

OWNER _____ EQPT/SYSTEM _____

PROJECT NAME _____ EQPT TAG NO. _____

PROJECT NO. _____ EQPT SERIAL NO. _____

SPECIFICATION NO. _____

SPECIFICATION TITLE _____

I hereby certify the installation of the above-referenced equipment/system as defined in the Contract Documents.

NOTES:
Attach written certification report prepared by and signed by the electrical and/or instrumentation subcontractor.

Comments: _____

_____

I, the undersigned manufacturer's representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate this equipment/system, and (iii) authorized to make recommendations required to ensure that the equipment/system furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____

Manufacturer: _____

Manufacturer's Authorized Representative Name *(print)*: _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

ATTACHMENT D - MANUFACTURER'S CERTIFICATE OF FUNCTIONAL COMPLIANCE

MANUFACTURER'S CERTIFICATE OF FUNCTIONAL COMPLIANCE

OWNER _____ EQPT/SYSTEM _____
PROJECT NAME _____ EQPT TAG NO. _____
PROJECT NO. _____ EQPT SERIAL NO. _____
SPECIFICATION NO. _____
SPECIFICATION TITLE _____

I hereby certify the Functional Testing of the above-referenced equipment/system as defined in the Contract Documents.

NOTES:
Attach test results with collected data and test report.

Attach written certification report prepared by and signed by the electrical and/or instrumentation subcontractor.

Comments: _____

_____

I, the undersigned manufacturer's representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate this equipment/system, and (iii) authorized to make recommendations required to ensure that the equipment/system furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____

Manufacturer: _____

Manufacturer's Authorized Representative Name *(print)*: _____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

WITNESSES

By Owner's Authorized Representative: _____
(Authorized Signature)

By Engineer's Authorized Representative: _____
(Authorized Signature)

ATTACHMENT E - TRAINING EVALUATION FORM

TRAINING EVALUATION FORM

EQUIPMENT/SYSTEM ITEM: _____

VENDOR/MANUFACTURER: _____

DATE: _____ NAME OF REPRESENTATIVE: _____

1.	Was representative prepared?	Acceptable	Unacceptable	or	N/A
2.	Was an overview description presented?	Acceptable	Unacceptable	or	N/A
3.	Were specific details presented for system components?	Acceptable	Unacceptable	or	N/A
4.	Were alarm and shutdown conditions clearly presented?	Acceptable	Unacceptable	or	N/A
5.	Were step-by-step procedures for starting, stopping, and troubleshooting presented?	Acceptable	Unacceptable	or	N/A
6.	Were routine/preventative maintenance items clearly identified?	Acceptable	Unacceptable	or	N/A
7.	Was the lubrication schedule (if any) discussed?	Acceptable	Unacceptable	or	N/A
8.	Was the representative able to answer all questions?	Acceptable	Unacceptable	or	N/A
9.	Did the representative agree to research and answer unanswered questions?	Acceptable	Unacceptable	or	N/A
10.	Comments: _____				
11.	Overall Rating:	Satisfactory	Unsatisfactory		

Note:

Sessions judged "Unsatisfactory" by a majority of attendees shall be revised and conducted again until a satisfactory rating is achieved.

ATTACHMENT F - COMMISSIONING ROLES AND RESPONSIBILITIES MATRIX

COMMISSIONING ROLES AND RESPONSIBILITIES MATRIX

NO.	TASK	OWNER	CONTRACTOR	ENGINEER
Testing and Training Phase				
Source Testing				
	Source Testing	Witness	Lead	Witness Review
	Manufacturer's Certificate of Source Testing	No Action	Lead	Review
Installation Verification				
	Structural Anchorage Check	Witness	Lead	Review
	Health and Safety Check	Witness	Lead	Review
	Manufacturer Requirements Verification	No Action	Lead	Review
	Contract Documents Verification	No Action	Lead	Review
	Manufacturer's Certificate of Installation Verification	No Action	Lead	Review
Functional Testing				
	Checks	Witness	Lead	Witness, Review
	Tests	Witness	Lead	Witness, Review
	Manufacturer's Certificate of Functional Compliance	No Action	Lead	Witness, Review
System Testing				
	System Testing	Witness	Lead	Witness, Review
Start-Up Phase				
	Start-Up	Lead	Support	Witness, Review

Legend:
Lead: Primarily responsible for organization, coordination, and execution of task work product or result.
Support: Assist the lead with organization, coordination, and execution of task work product or result.
Witness: Observe and document completion of task work product or result.
No Action: Limited or no involvement.
Review: Approve for compliance with Contract Documents or reject.

ATTACHMENT G - FUNCTIONAL TESTING REQUIREMENTS

FUNCTIONAL TESTING REQUIREMENTS

System	Subsystem	Consecutive Day Test Duration (Days)	Significant Interruption Duration (Hours)	Test Liquid	System Operated By
Dechlorination Structure		1	2	Test Water	Contractor
	Control Valves				
	Sample Pumps				
	Chlorine Sampler				
	3-way Valve				
Advanced Water Treatment (AWT) Clarifier/Filter System[1]		5	8	Test Water	Manufacturer
	Blowers				
	Coagulant Feed Pumps				
	Rapid Mix Pump				
	Waste Gate Actuator				
Backwash Pump Station		3	4	Test Water	Contractor
	Sample Pump				
	Chlorine Sampler				
	Flow Control Valves				
Carousel Pump Station		3	4	Test Water	Contractor
	Pumps				
Production Augmentation Unit (PAU)		7	8	Test Water	Owner
	PAU				
	PAU Pump Station				

System	Subsystem	Consecutive Day Test Duration (Days)	Significant Interruption Duration (Hours)	Test Liquid	System Operated By
Recycled Water Distribution System		7	8	Test Water	
	Recycled Water Pumps				
	Recycled Water Storage Tank				
	Recycled Water Pipeline				
	Tank Fill Valve				
	Tank Level				

Notes:
1. Additional testing requirements specified in Section 11802 - Packaged Water Treatment System Rehabilitation.

A. Schedule delays:
   1. Changes in the dates for source testing less than 30 days of the date provided in the latest approved Commissioning Schedule are considered delays.
   2. Contractor is responsible for associated costs resulting from delays:
      a. In person and/or virtual witnessing.
      b. Travel costs and witness labor costs.
         1) Witness labor costs at $250 per hour.

B. Repeat test costs:
   1. Contractor is responsible for associated costs for repeat testing:
      a. In person and/or virtual witnessing.
      b. Travel costs and witness labor costs.
         1) Witness labor costs at $250 per hour.

SECTION 01759

WATER LEAKAGE TEST FOR CONCRETE STRUCTURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Hydrostatic leakage test for concrete water-holding structures.

1.02 REFERENCES

A. Abbreviations and acronyms.

B. Definitions.
   1. Containment Structure Lined: Liquid-containing structure with barrier coating or membrane applied to the inside surfaces to prevent leaking of contents to the outside.
   2. Containment Structure, unlined: Liquid containing structure where only the concrete structure itself is used to prevent leaking of contents to the outside.
   3. Damp spots: Surfaces where visible moisture can be picked up by a dry hand.

C. Reference standards.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination.

B. Pre-installation meetings.

C. Sequencing.

D. Scheduling.

1.04 SUBMITTALS

A. Product data.

B. Shop drawings:
   1. Description and details of each evaporation/precipitation-measuring device anticipated for use during the test.

C. Samples.

D. Certificates.

E. Delegated design submittals.

F. Tests and evaluation reports:
    1. Results of water leakage test for each structure and for each portion of a structure designated for testing.

G. Manufacturer instructions.

H. Source quality control submittals.

I. Field/site quality control submittals.

J. Manufacturer reports.

K. Sustainable design submittals.

L. Special procedure submittals:
    1. Testing plan for each structure, or portion thereof, required to be tested.
        a. Describe methods of obtaining water for testing and of releasing water for disposal, including provisions for dechlorination if required.
        b. Include plans showing locations where measurements will be made and locations of evaporation/precipitation-measuring device.
        c. Indicate plans for filling and draining structure(s).
        d. Include schedule showing duration of test for each structure or cell to be tested, date and time for start of each test, dates and times of observations and measurements during the test, dates and times for closeout of testing procedures, and date for submittal of final results.
    2. Proposed procedures and products for repair of leaks.

M. Qualifications statements.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Test structures and portions of structures listed in the following paragraphs for water leakage.
    1. Unless otherwise specified, the Contractor shall:
        a. Obtain all required permits for discharging testing water.
        b. Provide dechlorination of such water if required by the permits.
        c. Prepare and fill the structures.
        d. Provide access and equipment required for testing and for recording test results.
        e. Take measurements and make observations required for testing.
    2. At all times during testing, the Engineer shall have access to observe measurements by others or to make independent measurements.

B. Test the following concrete structures for water leakage:
    1. Recycled Water Storage Tank.

C. Required preparation for testing is designated in this Section. Waiver of, or failure to complete preparations shall not change the testing criteria or approval criteria for the areas tested.

D. Retest structures and portions of structures until the evaluation criteria are satisfied.

3.02 TEST WATER SOURCE AND DISPOSAL

A. Water used for the first filling of the tank will be furnished by Owner.

B. In the event that retesting is required, Contractor shall bear the cost of refilling the tank for subsequent tests.

3.03 PREPARATION

A. For each structure to be tested, prepare and submit a plan showing schedule and sequence of activities, method of filling, and methods of disposing of test water.

B. Sequencing requirements:
   1. Complete construction of concrete structure and cure concrete to obtain minimum specified 28-day compressive strength as specified in Section 03300 - Cast-in-Place Concrete.
      a. Do not begin tests until all portions of structure are complete and have reached their minimum specified 28-day compressive strength.
      b. Do not begin tests until at least 14 days have passed since completion of the last concrete placement.
   2. Complete tests before:
      a. Covering any surface of the structure with materials that might mask the location of leaks or obscure damp concrete surfaces. Such coverings include, but are not limited to basin bottom grout, masonry veneer, stucco, plaster, and other coatings.
      b. Installation of equipment, unless otherwise approved by the Engineer.
      c. Backfilling structures to elevations above the limits indicated in the following paragraphs.
   3. Liners and coatings:
      a. Install liners that are mechanically locked to the concrete surface during placement of plastic concrete and before leakage testing.
         1) Examine liners for pinholes, tears, and partially fused splices, complete all required liner integrity testing, and make required repairs before commencing leakage testing.
      b. Unless otherwise specified, do not install surface-applied protective or decorative coatings and linings until leakage tests have been completed.

C. Weather requirements:
   1. Tests on structures with tops open to the atmosphere shall not be scheduled for periods when the 10-day weather forecast indicates a substantial change in weather patterns.
   2. Measurements of water surface levels in the structure shall not be scheduled for periods when the weather forecast indicates a difference of more than

35 degrees Fahrenheit between the ambient temperature readings at the times of initial and final measurements.

3. Tests shall not be scheduled for periods when the 10-day weather forecast indicates that the water surface may freeze before the test is complete.

D. Groundwater requirements:
   1. Bring groundwater to a level below the top of the floor slab and maintain at that level for the duration of the test.

E. Clean interior of structure:
   1. Remove dirt, contaminants, and construction debris.
   2. Flush floors and sumps to provide clean surfaces.
   3. Remove standing water that would interfere with examination of surfaces, cracks, or joints.

F. Observe the structure, or portions of the structure being tested, for potential leak locations:
   1. Give particular attention to cracks, open joints, voids, and honeycombed and repaired surfaces.
   2. Visually observe openings, fitting, and pipe penetrations in the structure at both faces, if possible.
   3. Repair potential leak locations in accordance with these Specifications and as approved by the Engineer.
   4. Backfill excavations to the top of the structure foundation. Do not place backfill against water-bearing walls or over footings unless approved in advance by the Engineer.
      a. If requesting backfilling of walls before testing, include a description of methods that will be used to detect leakage in the backfilled areas.
      b. Engineer's approval of backfilling before testing shall not relieve Contractor of the responsibility to conduct leakage tests, to satisfy the leakage acceptance criteria for the structure, or to repair leaking portions of the structure, including those portions below or behind the backfill.
   5. See Drawings and Section 02300 - Earthwork for requirements to provide wall stability before backfilling.

G. Inlets to/outlets from the structure:
   1. Make inlets to and outlets from the structure watertight.
      a. Include valves; stop, sluice, and slide gates; and temporary bulkheads as required.
      b. Inlets and outlets not required to be operable may be temporarily sealed before testing of the compartments to which they open.
      c. Secure inlets used to fill the structure for testing to ensure that no water is entering or leaving the structure once it has been filled to the test level.
   2. Adjustments to measured leakage at inlets and outlets based on manufacturer's or Contractor's estimates will not be allowed.
      a. Adjustments to measured leakage may be permitted by the Engineer, and, at his/her discretion, only when the Contractor makes specific measurements of leakage at each individual inlet and outlet using methods approved by the Engineer.

3.04 HYDROSTATIC LEAKAGE TEST FOR OPEN OR COVERED CONTAINMENT STRUCTURES ("HST-100")

A. Isolate sections of water-holding structures that can be isolated in actual operation. Fill and test sections for leakage separately.
   1. Fill structures and sections of structures scheduled for testing to 3 inches below the overflow level of open structures.

B. Initial rate for filling of structures shall not exceed 8 feet in 8 hours.

C. HST-100 testing includes 2 parts, "Qualitative Testing," and "Quantitative Testing," as described in the following paragraphs:
   1. HST-100, Part 1 - Qualitative Testing:
      a. During the first 24 hours after structures are filled, examine exposed concrete surfaces for damp spots or flowing water.
         1) Make observations in early morning, at midday, and in late afternoon.
         2) Continue observations through the duration of the Quantitative Testing period.
         3) Pay particular attention to conditions at joints, honeycombed areas, cracks, and repaired portions of the structure.
      b. Evaluation criteria:
         1) The structure shall be considered to have failed these Qualitative Testing requirements if any of the following conditions are observed.
            a) Water droplets or moist areas on an outside surface that could only have originated inside the structure.
            b) Water is flowing or seeping from joints, cracks, or surfaces.
               (1) Exception: Dampness or wetness on top of a footing, in the absence of flowing water, shall not be considered as failure to meet this criterion.
            c) Moisture can be transferred to a dry hand from the outside surfaces of the filled area.
      c. Repairs and retesting:
         1) Where damp spots or flowing water as described in the preceding paragraphs are observed, mark locations, provide repairs, and retest the structure as specified in subsequent paragraphs.
   2. HST-100 - Part 2: Quantitative Testing:
      a. If approved by the Engineer, Quantitative Testing may begin before repairs are made to areas failing Part 1 of this test; however:
         1) Adjustments to volume loss calculations of Quantitative Testing based on observed leakage will not be permitted.
         2) All defects identified for repair during Qualitative Testing shall be repaired to the satisfaction of the Engineer before approval of the structure.
      b. Report the results of quantitative testing.
         1) Submit completed Attachment A - Leakage Test Report or at a minimum, include the information specified in Attachment A - Leakage Test Report.

c. Unlined concrete structures:
    1) Fill to the designated water surface elevation. Maintain that level for at least 72 hours before recording initial water levels for leakage test.
    2) Duration of test:
        a) Recycled Water Tank Structure: 24 hours.

d. Lined concrete structures and secondary containment areas:
    1) Fill to the designated water surface elevation. Recording of water levels for leakage tests may begin as soon as the designated water surface level is reached and the water surface is calm.
    2) Duration of test: 72 hours (3 days).

e. Measurements: Water level:
    1) Record water levels at 24-hour intervals for the full duration of the test period.
    2) Measure water levels at not less than 2 locations on opposite ends of the structure, and preferably at 4 locations spaced equally around the structure. Mark locations on the structure and take measurements at the same locations throughout the duration of the test.
    3) Measure, to an accuracy of 1/16 inch, the vertical distance to the water surface from a fixed point on the structure above.

f. Measurements: Temperatures:
    1) As part of the first and last sets of level measurements, record water temperature at a depth of 18 inches below the water surface. Measure temperature at the same locations where level measurements are taken.
    2) Record ambient temperature at the time of each water level measurement.

g. Measurements: Evaporation and precipitation:
    1) Measure evaporation and precipitation by floating pans inside the structures during testing.
        a) For uncovered structures, measure both evaporation and precipitation.
        b) For covered structures that are well ventilated, measure evaporation.
    2) Measure using specially constructed clear containers:
        a) Provide clear plastic, calibrated, open-top containers not less than 18 inches in diameter and 18-inches deep.
        b) Partially fill containers with water and float inside the structure. Make provisions to hold containers in place at each measurement location, but away from structure walls and items passing overhead, such as beams or pipes.
        c) Measure initial depth of water in each device. Measure changes in water level in each device at the same time measurements of the water level inside the structure are taken.

h. Restart of test:
    1) The Engineer may order a restart of the test when, in the Engineer's opinion, measurements have become unreliable due to unusual precipitation or other factors.
    2) If measurements or observed leakage during the testing period indicate that the allowable leakage requirements will be exceeded, the test may be terminated before completion of the full test period.

Take appropriate actions to correct problems before restarting the test.

i. Calculations of leakage test results:
   1) For each section of the structure tested, use water surface level records to calculate average loss of volume per 24-hour interval.
      a) For each 24-hour interval during the test, calculate the average of all measured drops in water level around the structure.
      b) Use the average drop thus determined to calculate an average loss of volume for each 24-hour interval.
   2) Adjustments to leakage calculations:
      a) For uncovered basins, calculations shall be corrected for precipitation added to the structure.
      b) Calculations may be corrected for evaporation and water temperature.

j. Evaluation criteria:
   1) Unless otherwise specified, the average loss of volume during any 24-hour interval shall not exceed the limits shown in Table A.

Table - Loss of Volume Criteria for Leakage Tests

Structure Type	Maximum Loss of Water Volume
• Structure fully lined prior to leakage test. • Secondary containment areas.	No measurable loss over 72-hour test period.
• Structure with monolithically placed membrane floor slab.	0.0125 percent of volume per 24-hour period.
• Concrete paved canals, drying beds, lagoons, and similar structures.	0.100 percent of volume per 24-hour period.
• Other containment structures.	0.050 percent of volume per 24-hour period.

k. Repairs and retesting:
   1) Structures and portions of structures that have satisfied the qualitative requirements of HST-100, but have failed to satisfy the quantitative requirements of HST-100 may be immediately retested for volume loss.
      a) If the structure fails the second test for volume loss, the structure shall be drained, and the Contractor shall observe the interior for probable areas of leakage.
      b) The structure shall not be retested until repairs to the probable areas of leakage are complete.

3.05 REPAIRS FOR RETESTING

A. Locations showing damp spots or flowing water:
   1. Mark locations of visible leaks and damp spots.
   2. Drain structures for repair.
   3. Repair defects causing damp spots and flowing water using methods specified in Section 03300 - Cast-in-Place Concrete and approved by the Engineer.
      a. Repair both interior and exterior surfaces and make structures watertight.

b. Submit proposed repair products and procedures for Engineer's review.
c. Refill structures for retesting.

4. Repeat filling, observations, and repairs until no leaks or damp spots appear.

B. Structures for which water volume loss exceeds the limits specified after adjustments for evaporation, and precipitation:
1. Determine cause of volume loss.
2. Drain structures of water.
3. Repair defects causing loss of water volume using methods specified in Section 03300 - Cast-in-Place Concrete and approved by the Engineer.
a. Submit proposed repair products and procedures for Engineer's review.
4. Refill water-holding structures.
5. Repeat testing and repairs until volume loss does not exceed specified limits.

END OF SECTION

ATTACHMENT A - LEAKAGE TEST REPORT

LEAKAGE TEST REPORT

PROJECT:		SUBMITTED BY:	
STRUCTURE:		WITNESSED BY:	
AREA:		TEST DATES:	
TEST DURATION:		TEST DURATION:	

Surface area of structure tested:		(square feet)
Volume of structure tested:		(cubic feet)
Volume of structure tested:		(gallons)
Measured loss through gates, etc.:		(gallons / day)
Allowable loss of water volume:		(per day)
Allowable loss of water volume:		(% in 24 hours)
Allowable measured loss over test duration (inches):		
Measured loss of water:		(gallons / day - From E below)
Measured loss of water volume (%):		(in 24 hours - From E below)

Water Temperature: Start of test: °F End of test: °F

			Water Surface Elevation (top of structure to top of water)				
			Location #1	Location #2	Location #3	Location #4	Initials**
Day	Date	Time	(inches)	(inches)	(inches)	(inches)	
1							
2							
3							
4							
5							
Changes in Level:							

A. Average change in level (feet): _____ (Average of total charges for all locations)

B. Correction for precipitation: _____ (Measured from pan)

C. Correction for evaporation: _____ (Measured from pan)

D. Corrected change in level (CL): _____

E. Total days tested: _____

F. Average measured % water loss in 24 hours: _____ = $\frac{\text{(CL) x (surface area) x 100}}{\text{(initial water volume) x (number of test days)}}$

Notes and field observations**

** Place date and initials at the beginning of each entry

SECTION 01770

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Contract closeout requirements.

1.02 REFERENCES

A. American Water Works Association (AWWA).

1.03 FINAL CLEANING

A. Perform final cleaning prior to inspections for Substantial Completion.

B. Employ skilled workers who are experienced in cleaning operations.

C. Use cleaning materials which are recommended by manufacturers of surfaces to be cleaned.

D. Prevent scratching, discoloring, and otherwise damaging surfaces being cleaned.

E. Clean roofs, gutters, downspouts, and drainage systems.

F. Broom clean exterior paved surfaces and rake clean other surfaces of site work:
   1. Police yards and grounds to keep clean.

G. Remove dust, cobwebs, and traces of insects and dirt.

H. Clean grease, mastic, adhesives, dust, dirt, stains, fingerprints, paint, blemishes, sealants, plaster, concrete, and other foreign materials from sight-exposed surfaces, and fixtures and equipment.

I. Remove non-permanent protection and labels.

J. Polish waxed woodwork and finish hardware.

K. Wash tile.

L. Wax and buff hard floors, as applicable.

M. Wash and polish glass, inside and outside.

N. Wash and shine mirrors.

O. Polish glossy surfaces to clear shine.

P. Vacuum carpeted and soft surfaces.

Q. Clean permanent filters and replace disposable filters when heating, ventilation, and air conditioning units were operated during construction.

R. Clean ducts, blowers, and coils when units were operated without filters during construction.

S. Clean light fixtures and replace burned-out or dim lamps.

T. Probes, elements, sample lines, transmitters, tubing, and enclosures have been cleaned and are in like-new condition.

1.04 WASTE DISPOSAL

A. Arrange for and dispose of surplus materials, waste products, and debris off-site:
   1. Prior to making disposal on private property, obtain written permission from Owner of such property.

B. Do not fill ditches, washes, or drainage ways which may create drainage problems.

C. Do not create unsightly or unsanitary nuisances during disposal operations.

D. Maintain disposal site in safe condition and good appearance.

E. Complete leveling and cleanup prior to Final Completion of the Work.

1.05 TOUCH-UP AND REPAIR

A. Touch-up or repair finished surfaces on structures, equipment, fixtures, and installations that have been damaged prior to inspection for Substantial Completion.

B. Refinish or replace entire surfaces which cannot be touched-up or repaired satisfactorily.

1.06 FINAL CLEANING AND DISINFECTION OF SYSTEMS OF PLANT FACILITIES

A. Clean channels, pipe, basins, reservoirs, and tanks before running of 7-day test, or before facility goes on stream when 7-day test is not required. Membranes are to be installed after the sub-system function testing and before the membrane system functional testing.

B. Wash, wherever practicable, or broom sweep channels, pipe, basins, reservoirs, and tanks.

C. Disinfect filter basins, reservoirs, clear wells, tanks, channels, and piping intended to carry potable water as follows or in accordance with AWWA Standards.

D. Provide ample sampling outlets in pipe for testing.

E. Fill pipe and other plant facilities with chlorine solution of sufficient strength to retain residual of not less than 10 parts per million at end of 24 hours.

F. When reservoirs and basins are too large to be economically disinfected by filling with chlorine solution, spray reservoirs and basins with solution containing 100 parts per million of chlorine.

G. After disinfection, rinse entire potable water system with potable water sufficient to reduce chlorine residual to not more than 0.6 parts per million throughout system before system is put into service.

1.07 FINAL CLEANING AND DISINFECTION OF SYSTEMS OF POTABLE WATER MAINS

A. Clean interior of pipe and fittings.

B. When pipe contains dirt that cannot be removed by flushing, swab pipe interiors with solution containing not less than 500 parts per million of chlorine until clean.

C. Flush 12-inch in diameter and smaller pipe as thoroughly as available water sources will permit.

D. Fill pipe with chlorine solution of sufficient strength to provide 10 parts per million chlorine residual at end of 24 hours.

E. Flush pipes with potable water until chlorine residual is less than 0.6 parts per million before pipe are put into service.

1.08 CLOSEOUT DOCUMENTS

A. Submit the following Closeout Submittals before Substantial Completion:
   1. Punch list of items to be completed or corrected with the request for issuance of Substantial Completion.
   2. Evidence of Compliance with Requirements of Governing Authorities.
   3. Project Record Documents.
   4. Approved Operation and Maintenance Manuals.
   5. Approved Warranties and Bonds.
   6. Keys and Keying Schedule.
   7. Completed contract requirements for commissioning and process start-up.

B. Submit the following Closeout Submittals before final completion of the Work and at least 7 days prior to submitting Application for Final Payment:
   1. Punch list of items have been completed and Engineer and Owner are satisfied that all deficiencies are corrected.
   2. Evidence of Payment and Release of Liens or Stop Payment Notices as outlined in Conditions of the Contract.
   3. Release of claims as outlined in Conditions of the Contract.
   4. Submit certification of insurance for products and completed operations, as specified in the General Conditions.
   5. Final statement of accounting.
   6. Submit Final (As-Built) Schedule as specified in Section 01321 - Schedules and Reports.

1.09 EVIDENCE OF COMPLIANCE WITH REQUIREMENTS OF GOVERNING AUTHORITIES

A. Submit the following:
   1. Certificate of Occupancy.
   2. Certificates of Inspection.

1.10 PROJECT RECORD DOCUMENTS

A. Maintain at Project site, available to Owner and Engineer, 1 copy of the Contract Documents, shop drawings, and other submittals in good order:
   1. Mark and record field changes and detailed information contained in submittals and change orders.
   2. Record actual depths, horizontal and vertical location of underground pipes, duct banks, and other buried utilities. Reference dimensions to permanent surface features.
   3. Identify specific details of pipe connections, location of existing buried features located during excavation, and the final locations of piping, equipment, electrical conduits, manholes, and pull boxes.
   4. Identify location of spare conduits including beginning, ending, and routing through pull boxes and manholes. Record spare conductors, including number and size, within spare conduits and filled conduits.
   5. Provide schedules, lists, layout drawings, and wiring diagrams.
   6. Make annotations in electronic format or hard copy format with erasable colored pencil conforming to the following color code:

Additions:	Red
Deletions:	Green
Comments	Blue
Dimensions:	Graphite

B. Maintain documents separate from those used for construction:
   1. Label documents "RECORD DOCUMENTS."

C. Keep documents current:
   1. Record required information at the time the material and equipment is installed and before permanently concealing.
   2. Engineer will review Record Documents weekly to ascertain that changes have been recorded.

D. Affix civil engineer's or professional land surveyor's signature and registration number to Record Drawings to certify accuracy of information shown.

E. Deliver Record Documents with transmittal letter containing date, Project title, Contractor's name and address, list of documents, and signature of Contractor.

F. Record Documents will be reviewed monthly to determine the percent complete for the monthly pay application.

G. Updated Record Documents are a condition for Engineer's recommendation for progress payment.

H. Final Schedule Submittal as specified in Section 01321 - Schedules and Reports.

1.11 MAINTENANCE SERVICE

A. Maintenance service as specified in technical specifications.

1.12 SUBSTANTIAL COMPLETION

A. Obtain Certificate of Substantial Completion.

1.13 FINAL COMPLETION

A. When Contractor considers the Work is complete, submit written certification that:
   1. Work has been completed in accordance with the Contract Documents:
   2. Punch list items have been completed or corrected.
   3. Work is ready for final inspection.

B. Engineer will make an inspection to verify the status of completion with reasonable promptness.

C. Should the Engineer consider that the Work is incomplete or defective:
   1. Engineer will promptly notify the Contractor in writing, listing the incomplete or defective work.
   2. Contractor shall take immediate steps to remedy the stated deficiencies and send a second written certification to the Engineer that the Work is complete.
   3. Engineer shall re-inspect the Work.

1.14 FINAL ADJUSTMENT OF ACCOUNTS

A. Submit a final statement of accounting to the Engineer at least 7 days prior to final Application for Payment.

B. Statement shall reflect all adjustments to the Contract amount.
   1. The original Contract amount.
   2. Additions and deductions resulting from:
      a. Change Orders.
      b. Units installed and unit prices.
      c. Set-offs for uncorrected or incomplete Work.
      d. Set-offs for liquidated damages.
      e. Set-offs for reinspection payments.
      f. Extended engineering and/or inspection services and inspection overtime.
      g. Excessive shop drawings review cost by the Engineer.
      h. Other adjustments.
   3. Total Contract amount, as adjusted.
   4. Previous payments.
   5. Remaining payment due.

C. Engineer will prepare a final Change Order reflecting approved adjustments to the Contract amount which were not previously made by Change Orders.

1.15 FINAL APPLICATION FOR PAYMENT

A. Contractor shall submit the final Application for Payment reflecting the agreed upon information provided in the final statement of accounting.

PART 2 PRODUCTS

2.01 SPARE PARTS

A. Owner may request advanced delivery of spare parts, maintenance products, and special tools.
   1. Deduct the delivered items from the inventory list and provide transmittal documentation.

B. Prior to Substantial Completion, arrange to deliver spare parts, maintenance products, and special tools to Owner at a location on site chosen by the Owner.
   1. Provide itemized list of spare parts and special tools that matches the identification tag attached to each item.
   2. Owner and Engineer will review the inventory and the itemized list to confirm it is complete and in good condition prior to signing for acceptance.

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01782

OPERATION AND MAINTENANCE MANUALS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Preparation and submittal of manual with requirements to operate and maintain the equipment.

1.02 PREPARATION

A. General requirements:
   1. Provide dimensions in English units.
   2. Assemble material, where possible, in the same order within each volume.
   3. Reduce drawings and diagrams to 8 1/2 by 11-inch size, if possible unless otherwise specified.
   4. Complete forms on computer, handwriting not acceptable.
   5. Delete items or options not provided in the supplied equipment or system.
   6. Provide package control system annotated ladder logic for PLC, if applicable.

B. Hard copy requirements:
   1. Binders: 3-ring with rigid covers.
      a. Break into separate binders as needed to accommodate large size.
   2. Utilize numbered tab sheets to organize information.
   3. Provide original and clear text on reproducible non-colored paper, 8 1/2 by 11-inch size, 24 pound paper.
   4. Drawings larger than 8 1/2 by 11 inch:
      a. Fold drawings separately and place in envelope bound into the manual.
      b. Label each drawing envelope on the outside regarding contents.

C. Electronic requirements:
   1. File format:
      a. Entire manual in PDF format.
         1) Include text and drawing information.
         2) Provide a single PDF file even if the hard copy version is broken into separate binders due to being large.
         3) Create PDF from the native format of the document (Microsoft Word, graphics programs, drawing programs, etc.).
            a) If material is not available in native format and only available in paper format, remove smudges, fingerprints, and other extraneous marks before scanning to PDF format.
            b) Hard copy record drawing requirements:
               (1) Provide a single multipage PDF file of each set of the scanned drawings.
               (2) Page 1 shall be the cover of the drawing set.

c) At file opening, display the entire cover.
(1) Scan drawings at 200 to 300 dots per inch (DPI), black and white, Group IV Compression, unless otherwise specified.
(2) Scan drawings with photos in the background at 400 dots per inch (DPI), black and white, Group IV Compression.
4) Pagination and appearance to match hard copy.
5) Searchable.
6) Scanned images are not acceptable.
7) Bookmarks:
a) Bookmarks shall match the table of contents.
b) Bookmark each section (tab) and heading.
c) Drawings: Bookmark at a minimum, each discipline, area designation, or appropriate division.
d) At file opening, display all levels of bookmarks as expanded.
8) Thumbnails optimized for fast web viewing.
b. Drawing requirements:
1) Provide additional copy of drawings in most current version of AutoCAD format.
2) Drawings shall have a white background.
3) Drawing shapes shall not degrade when closely zoomed.
4) Screening effects intended to de-emphasize detail in a drawing must be preserved.
5) Delete items or options not provided in the supplied equipment or system.
2. Media:
a. USB flash drive.
b. Secure File Transfer Protocol (SFTP).
3. Label media with the following information:
a. Operation and Maintenance Manual.
b. Equipment name.
c. Specification Section Number
d. Equipment tag number.
e. Owner's name.
f. Project number and name.
g. Date.
4. If multiple submittals are made together, each submittal must have its own subdirectory that is named and numbered based on the submittal number.

1.03 CONTENTS

A. Table of Contents: General description of information provided within each tab section.

B. Complete Attachment A - Equipment Summary Form.

C. Description of system and components.

D. Description of equipment function, normal operating characteristics, and limiting conditions.

E. On-line resources.

F. Telephone resources.

G. Approved submittals.
   1. Markup with any field changes.
   2. Final programming.

H. Start-up procedures: Recommendations for installation, adjustment, calibration, and troubleshooting.

I. Operating procedures:
   1. Step-by-step instructions including but not limited to the following:
      a. Safety precautions and applicable Safety Data Sheets.
      b. Guidelines.
      c. Other information as needed for safe system operation and maintenance.

J. Preventative maintenance procedures:
   1. Recommended steps and schedules for maintaining equipment.
   2. Troubleshooting.

K. Lubrication information: Required lubricants and lubrication schedules.

L. Overhaul instructions: Directions for disassembly, inspection, repair and reassembly of the equipment; safety precautions; and recommended tolerances, critical bolt torques, and special tools that are required.

M. Manufacturer's technical reference manuals.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

ATTACHMENT A - EQUIPMENT SUMMARY FORM

EQUIPMENT SUMMARY FORM

1. EQUIPMENT ITEM_____

2. MANUFACTURER_____

3. EQUIPMENT TAG NUMBER(S)_____

4. LOCATION OF EQUIPMENT_____

5. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS)_____

_____

_____

_____

6. NAMEPLATE DATA -
   - Horsepower_____
   - Amperage_____
   - Voltage_____
   - Service Factor (S.F.)_____
   - Speed_____
   - ENC Type_____
   - Capacity_____
   - Other_____

7. MANUFACTURER'S LOCAL REPRESENTATIVE

   Name_____

   Address_____

   Telephone Number_____

8. MAINTENANCE REQUIREMENTS:

Maintenance Operation	Frequency	Lubricant (if applicable)	Comments
(List each operation required. Refer to specific information in Manufacturer's Manual, if applicable)	(List required frequency of each maintenance operation)	(Refer by symbol to lubricant list as required)	

9. LUBRICANT LIST:

Reference Symbol	Conoco Phillips	Exxon/Mobil	BP/Amoco	Other (List)
(Symbols used in Item 7 above)	(List equivalent lubricants, as distributed by each manufacturer for the specific use recommended)			

10. SPARE PARTS (recommendations)_____

_____

11. COMMENTS_____

12. GENERAL INFORMATION:

Date Accepted*: _____

Expected Life*: _____

Project Name & Number: _____

Design Engineer: _____

13. WARRANTY:

Start Date: _____

Expiration Date: _____

Prorated: _____

SECTION 01783

WARRANTIES AND BONDS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Warranty and bonds requirements.

1.02 SUBMITTALS

A. For each item of material or equipment furnished under the Contract:
   1. Submit manufacturer's warranty prior to fabrication and shipment of the item from the manufacturer's facility.
   2. Submit manufacturer's special warranty when specified.

B. Provide consolidated warranties and bonds within 15 calendar days of Substantial Completion.
   1. Contents:
      a. Organize warranty and bond documents:
         1) Include Table of Contents organized by specification section number and the name of the product or work item.
      b. Include each required warranty and bond in proper form, with full information, certified by manufacturer as required, and properly executed by Contractor, or subcontractor, supplier, or manufacturer.
      c. Provide name, address, phone number, and point of contact of manufacturer, supplier, and installer, as applicable.
   2. Hardcopy format:
      a. Submit 2 copies.
      b. Assemble in 3 D-side ring binders with durable cover.
      c. Identify each binder on the front and spine with typed or printed title "Warranties and Bonds"; Project Name or Title, and the Name Address and Telephone Number of the Contractor.
   3. Electronic copy in PDF format:
      a. Submit 1 copy.

1.03 OWNER'S RIGHTS

A. Owner reserves the right to reject warranties.

B. Owner reserves the right to refuse to accept Work for the project if the required warranties have not been provided.

1.04 RELATIONSHIP TO GENERAL WARRANTY AND CORRECTION PERIOD

A. Warranties specified for materials and equipment shall be in addition to, and run concurrent with, both Contractor's general warranty and the correction period requirements.

B. Disclaimers and limitations in specific materials and equipment warranties do not limit Contractor's general warranty, nor does such affect or limit Contractor's performance obligations under the correction period.

1.05 MANUFACTURER'S 1 YEAR WARRANTY MINIMUM REQUIREMENTS

A. Written warranty issued by item's manufacturer.

B. Project-specific information, properly executed by product manufacturer, and expressly states that its provisions are for the benefit of the Contactor.

C. Covers all costs associated with the correction of the defect, including but not limited to removal of defective parts, new parts, labor, and shipping.

D. Provides a timely response to correct the defect.
   1. Manufacturer shall provide, in a timely fashion, temporary equipment as necessary to replace warranted items requiring repair or replacement, when warranted items are in use and are critical to the treatment process, as defined by Owner.

E. Warranty commence running on the date of substantial completion.
   1. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit warranty within 10 calendar days after acceptance, listing date of acceptance as beginning of warranty period.

F. Duration of Warranty: 1 year.

1.06 MANUFACTURER'S SPECIAL WARRANTY

A. Manufacturer's special warranty is a written warranty published by the manufacturer which includes the requirements as specified in the Technical Section.
   1. Project-specific information and requirements.
   2. Properly executed by product manufacturer.
   3. Expressly states that its provisions are for the benefit of the Contractor or Owner.
   4. Manufacturer's special warranties commence on the date that the associated item is certified by Engineer as substantially complete.

1.07 WARRANTY WORK

A. Contractor's responsibilities:
   1. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the work that incorporates the product, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with Contractor.

B. Replacement cost:
   1. Upon determination that work covered by warranty has failed, replace or rebuild the work to an acceptable condition complying with requirement of the Contract Documents.
      a. Contractor is responsible for the cost of replacing or rebuilding defective work regardless of whether Owner has benefited from the use of the work through a portion of its anticipated useful service life.

C. Related damages and losses:
   1. When correcting warranted work that has failed, remove and replace other work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted work.

D. Owner's recourse:
   1. Written warranties are in addition to implied warranties, and shall not limit the duties, obligations, rights, and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitation on time in which Owner can enforce such other duties, obligations, rights, or remedies.

E. Reinstatement of warranty:
   1. When work covered by a warranty has failed and has been corrected by replacement or rebuilding, reinstate the warranty by written endorsement.
      a. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

1.08 IMPLIED WARRANTIES

A. Warranty of title and intellectual rights:
   1. Except as may be otherwise indicated in the Contract Documents, implied warranty of title required by Laws and Regulations is applicable to the Work and to materials and equipment incorporated therein.
   2. Provisions on intellectual rights, including patent fees and royalties, are in the General Conditions, as may be modified by the Supplementary Conditions.

B. Implied warranties: Duration in accordance with Laws and Regulations.

1.09 BONDS

A. Equipment bond and other bond requirements as specified in the Technical Sections.

B. Bonds commence running on the date of substantial completion.
   1. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit warranty within 10 calendar days after acceptance, listing date of acceptance as beginning of bond period.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01850

DESIGN CRITERIA

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Design criteria for use in the selection of equipment and appurtenances specified in Technical Sections of these Specifications and indicated on the Drawings.
   2. Criteria for design of systems, components and equipment fabricated off site and shipped to the Work for installation.
   3. Criteria for design of anchors to connect equipment and appurtenances to supports and structures.

B. The criteria in this Section apply throughout the Work, unless additional criteria, or more restrictive criteria, are indicated.
   1. Additional criteria and requirements relevant to specific locations, specific materials, and specific equipment are indicated on the Drawings, and in the Technical Sections.

1.02 REFERENCES

A. American Society of Civil Engineers (ASCE):
   1. 7-16 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE 7).

B. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):
   1. ASHRAE Fundamentals Handbook.

C. International Code Council (ICC):
   1. International Energy Conservation Code (IECC).
   2. International Plumbing Code (IPC).

D. Sheet Metal and Air Conditioning Contractor’s National Association (SMACNA):
   1. Seismic Restraint Manual: Guidelines for Mechanical Systems, 3rd edition - 2008.

PART 2 PRODUCTS

2.01 DESIGN CRITERIA - SITE INFORMATION

A. The Work located at and adjacent to the Ukiah Wastewater Treatment Plant, Ukiah, California, and in surrounding areas in the City of Ukiah and Mendocino County, California.
   1. Street Address: As specified in Section 01110 - Summary of Work.

2. Site elevation (approximate):
    a. 600 feet above mean sea level**.**
3. Groundwater elevation:
    a. See project geotechnical reports, included as Appendices to the Specifications, for information.
    b. For design of buried and partially buried construction.

2.02 DESIGN CRITERIA - REGULATORY REQUIREMENTS

A. Requirements of authorities having jurisdiction over the project are included in Section 01410 - Regulatory Requirements.

2.03 DESIGN CRITERIA - OPERATING ENVIRONMENT

A. The Drawings and Technical Sections include additional criteria and requirements relevant to specific locations, materials, and equipment.

B. Outdoor conditions:
1. International Energy Conservation Code (IECC): Climate Zone 3C.
2. Site climatic data location: Sacramento Executive Airport (approximately 154 miles from site), WMO 72483.
3. Temperature criteria: As specified in the following Table: Design Temperatures - Outdoor Criteria in Accordance with ASHRAE Fundamentals Handbook.

Table: Design Temperatures - Outdoor Criteria in Accordance with ASHRAE Fundamentals Handbook

Reference Location:	Ukiah Municipal Airport, CA
Condition	Criteria
Daily mean range:	60.2 degrees Fahrenheit.
Winter:	At or above this temperature 99.6 percent of the time: 29.6 degrees Fahrenheit dry-bulb.
Summer:	At or above this temperature 0.4 percent of the time: 99.9 degrees Fahrenheit dry-bulb.

4. Rainfall intensity:
    a. Reference: International Plumbing Code (IPC):
        1) 1.5 inches per hour (City of Ukiah Building Design Value).

C. Indoor Conditions:
1. HVAC schedules as indicated on the Drawings.
2. Humidity:
    a. Moisture/humidity conditions: As specified, and as defined in individual equipment sections.

2.04 DESIGN CRITERIA - STRUCTURAL

A. General:
1. Criteria for structural design of:
    a. Equipment at locations subject to seismic events.

b. Equipment exposed to outdoor environments.
c. Equipment supports and bracing, and anchorage of such items to building and non-building structures.
d. Structures provided for the Work through Delegated Design.
e. Manufactured and prefabricated structures, and anchorage of such structures to foundations or other supporting elements.

2. Structural design criteria used by the engineer of record and required by the building code to be indicated on the Drawings, are included in "Design Criteria" notes on the Drawings for each structure.

B. Delegated Design:
1. As specified in Section 01357 - Delegated Design Procedures.
2. Structural engineering design shall be performed by a Civil or Structural Engineer licensed in the State of California.

C. Structure risk category:
1. Develop design loads and provide detailing in accordance with the provisions of ASCE 7 and the building code specified in Section 01410 - Regulatory Requirements, based on the Structure Risk Category indicated in Table: Project Structures - Risk Category and Seismic Design Information.

D. Seismic loads:
1. Seismic design parameters: Design spectral response acceleration:
a. Site Specific Response Spectra (per Geotechnical Report) obtain maximum spectral acceleration, for any period within the range from 0.2 to 5 seconds, Sa.
b. Short period spectral response parameter, S_{DS}: Design using the greater of the following:
1) 90 percent of the maximum spectral acceleration, Sa, determined as described in the preceding paragraph.
2) 80 percent of the value of S_{DS} determined in accordance with Chapter 11 of ASCE 7.
3) 1.004 g.
c. One-second spectral response parameter, S_{D1}: Design using the greater of the following:
1) The maximum value of the product of the structure period, T and Sa, determined as described in the preceding paragraph.
2) 80 percent of the value of S_{D1} determined in accordance with Chapter 11 of ASCE 7.
3) 0.959 g.

2. Structures - General:
    a. Seismic Design Category (SDC): As indicated in the following Table: Project Structures - Risk Category and Seismic Design Information.

Table: Project Structures - Risk Category and Seismic Design Information						
Description: Water Treatment Facility						
Area	**Description**	**Risk Category**	**Site Class**	**S_{DS}**	**S_{D1}**	**Seismic Design Category(1)**
	All structures unless noted otherwise	III	D	1.004	0.959	D
	Pedestrian Bridge	IV	F	1.48	1.58	F

Notes:

(1) Seismic Design Category for Delegated Design, and for seismic certification of electrical and mechanical equipment as required by ASCE 7.

    b. Structure response modification coefficient, R:
        1) In accordance with ASCE 7, and the requirements of the Technical Sections.
3. Structures - Tanks and vessels.
    a. Includes: Tank structures, tank supports, and anchorage to structures or foundations:
    b. Liquid storage structures (e.g.: basins and tanks).
        1) Include impulsive and convective (“sloshing”) effects.
        2) Component response modification factor - impulsive effects, Ri: In accordance with ASCE 7, Table 15.4-2.
        3) Component response modification factor - convective effects, Rc = 1.0.
    c. Dry material storage structures (e.g.: silos, hoppers):
        1) Include effects of stored materials.
        2) Component response modification factor - impulsive effects, Ri: In accordance with ASCE 7, Table 15.4-2.
4. Non-structural components - General:
    a. Includes:
        1) Mechanical and electrical equipment; anchorage of equipment to structures or supports; design of supports; and anchorage of supports to structures or foundations.
        2) Distribution systems associated with mechanical and electrical equipment such as piping, ductwork, conduits, cable trays, raceways, bus ducts, and similar items; anchorage of such systems to supports and structures; and bracing or such systems.
    b. Seismic design requirements for non-structural components are based on the Seismic Design Category (SDC) of the structure or facility where the equipment is installed.
    c. Design components, component anchorage, and component connections to piping and utilities in accordance with the requirements of ASCE 7, Table 13.2-1

d. Component amplification factor (ap), response factor (Rp), and overstrength factor for anchorage to concrete (Ωo):
   1) Mechanical and electrical components and systems: In accordance with ASCE 7, Table 13.6-1, unless otherwise indicated in the Technical Sections for these items.
   2) Architectural components and systems: In accordance with ASCE 7, Table 13.6-1, unless otherwise indicated in the Technical Sections for these items.
e. Component importance factor, Ip:
   1) In accordance with the following Table: Component Importance Factor for seismic design, I_p.
   2) For items not listed in Table: Component Importance Factor for seismic design, I_p, designate importance factor in accordance with the provisions of ASCE 7, Chapter 13 and submit to Engineer for review prior to developing calculations and details related to that component.

Table: Component Importance Factor for seismic design, I_p

Structure Seismic Design Category	Components	Ip
All	Electrical: Items and distribution system components specified in Division 16 - Electrical.	1.5
All	Process Control and Instrumentation Systems: Components and distribution systems specified in Division 17 - Instrumentation and Controls.	1.5
All	Equipment and components specified in Divisions 11 through 15, ***except*** HVAC and plumbing components listed below.	1.5
All	Plumbing equipment specified in the following Sections: 15400 - Plumbing Systems	1.0
All	HVAC equipment specified in the following Sections: 15732 - Air Conditioning Units	1.0
All	Other equipment not listed above.	1.0

5. Non-structural components: HVAC ductwork.
   a. Component importance factor, Ip: Determine in accordance with ASCE 7, Section 15.4.1.1.
   b. Seismic design category:
      1) See Table: Component Importance Factor for seismic design, I_p (preceding).
   c. SMACNA seismic hazard level.
      1) Seismic hazard level for design of heating, ventilating, and air conditioning ductwork, supports and equipment in accordance with SMACNA Seismic Restraint Manual:
         a) SMACNA Seismic hazard level = A.

E. Wind loads:
    1. Design structures and non-structural components that are exposed to wind to withstand design wind loads.
        a. Reduction of wind loads based on shielding effects of surrounding structures or components is not allowed.
        b. Design for wind loading is not required for non-structural components and for non-building structures located inside enclosed buildings.
    2. Design parameters:
        a. Basic wind speed:
            1) 110 miles per hour (33 feet, 3 second gust).
        b. Exposure category: D.
        c. Topographic factor, Kzt: 1.0.
        d. Wind pressure for design of "components and cladding".
            1) "Components and cladding" includes doors, windows, siding panels, skylights, parapets and similar architectural elements.
            2) Minimum wind pressure for components and cladding, strength level:
                a) Wall elements: Minimum 50.8 pounds per square foot, pressure or vacuum.
                b) Roof elements: Minimum 48.8 pounds per square foot, pressure or vacuum.
                c) For "allowable stress level" pressures, multiply strength level pressures by 0.625.

F. Rainfall loads:
    1. Determine rainfall loads using rainfall intensity specified herein, and including effects of exposed surface slope, height above surface to discharge elevation, and deflection of ponded surfaces.

G. Operational loads:
    1. Loads may include equipment vibration, torque, thermal effects, effects of internal contents (weight and sloshing), surge or "water hammer," and other load conditions.
    2. Design for loads indicated by equipment manufacturer.
    3. Design for loads indicated in the Technical Sections for equipment and appurtenances.

H. Serviceability considerations: ASCE 7-16
    1. Deflection, unless otherwise indicated on the Drawings, or specified:
        a. Beam deflection as fraction of span:
            1) Walkways and platforms: total load = L/240; live load = L/360.
            2) Equipment supports: L/450.

PART 3 EXECUTION

3.01 GENERAL

A. Design approach and criteria in accordance with:
    1. Regulatory requirements, including but not limited to the building code specified in Section 01410 - Regulatory Requirements.

2. Reference standards and project-specific design criteria listed in this Section.
3. Specific requirements for individual elements and components of the Work as specified in subsequent Technical Sections.

B. In the event of conflicts between design criteria, contact Engineer for interpretation.

C. Where Owner-Delegated Design is required by the Specifications, prepare and submit designs as specified in Section 01357 - Delegated Design Procedures.

3.02 DELEGATED DESIGN:

A. Where Delegated Design is required by the Technical Sections, prepare and submit designs as specified in Section 01357 - Delegated Design Procedures.

B. Calculations:
1. Where submittal of calculations is required:
   a. Provide complete calculations, including sketches to illustrate the design concepts being evaluated, and details to fully describe proposed construction.
2. Requirements for seismic design calculations will be waived for the following:
   a. Furniture and storage racks 6 feet in height or less.
   b. Moveable equipment.
   c. Mechanical and electrical equipment and components located in structures designated as Seismic Design Category A or B.
   d. Mechanical and electrical equipment and components located in structures designated as Seismic Design Category C and where the component importance factor, Ip, is equal to 1.0.
3. Requirements for wind design calculations will be waived for the following:
   a. Equipment and components located inside structures, and away from the effects of wind loads.

C. Shop drawings:
1. Shop drawings describing components and manufacturer's requirements for connections.
   a. Include details for connections of components to structures and supports.
   b. Include details for anchoring bracing to structures where required.

3.03 DESIGN - ANCHORS FOR EQUIPMENT, COMPONENTS, AND BRACING

A. General:
1. Engineer's approval of anchor designs is required before placement of construction that supports or provides bracing for anchored equipment and components.
   a. Prepare anchor designs after Engineer's approval of the products and layout, and before placement of concrete or masonry that supports them.
2. Adjust equipment pad sizes and add additional anchor confinement reinforcing to provide required strength at anchorage points between equipment and pad, and between pad and structure.

3. Supports and bracing:
    a. Design and install braces and anchors to transfer forces from equipment and components to the lateral force resisting system of the surrounding structure.
    b. Anchor and brace piping, ductwork, and electrical distribution components so that lateral or vertical displacement does not result in damage to or failure of essential architectural, mechanical, or electrical equipment.
        1) Provide supplementary framing where required to transfer forces.
        2) Detail and locate braces and anchors to minimize differential movements between components and structure.

B. Preparation:
1. Obtain manufacturer's information:
    a. Weight and dimensions of components.
    b. Layout and location of anchors that connect to equipment base plates, sole plates, skids, or pads.
    c. Sizes of holes for anchors that will be provided in equipment bases or support frames.

C. Analysis and design:
1. Perform and submit calculations to determine anchor designs at locations where equipment and equipment supports are connected to the supporting structure.
    a. Indicate number, size, type, and material for anchors.
2. In determining forces at locations where equipment is anchored to structures, include effects of:
    a. Equipment self-weight and operating weight.
    b. Location of equipment center of mass.
    c. Forces from equipment operation including, but not limited to:
        1) Effects of internal contents including weight and sloshing.
        2) Effects of thrust, surge, and water hammer where specified.
        3) Equipment reactions and operating torque.
        4) Equipment vibration.
        5) Thermal effects from equipment and from distribution systems connected to the equipment (piping, ducts, and electrical).
        6) Other load or displacement inducing conditions.
    d. Forces on equipment from loads specified in this Section.
        1) Include effects of wind, snow, and icing loads where applicable.
        2) Design for load combinations indicated in ASCE 7, unless otherwise specified or indicated on the Drawings.
        3) Seismic and wind loads: For equipment and tanks with weight that varies based on the volume of contained material, determine anchor forces to accommodate the full range of filled, partially filled, and empty conditions.
3. Determine forces and overturning moments at equipment supports and at locations where supports are anchored to structures.
    a. Indicate shear force and associated axial force at each anchor.
4. Do not use friction to resist sliding resulting from seismic or wind forces.
    a. Resist sliding only by direct application of sliding loads to fasteners as bearing, shear, tension, or compression forces.

5. Using combined shears and axial forces at each anchor, design anchors and anchor groups for ductile failure.
    a. Ductile failure: Anchor yield before failure of base material, typically concrete or masonry, at the anchor.
6. Anchor selection:
    a. Provide anchors type indicated on the Drawings.
    b. Where anchors are not specifically indicated on the Drawings, select in accordance with the following:
        1) Anchors that resist seismic and wind forces:
            a) Cast-in-place forged hex-head anchor bolt.
        2) Anchors loaded in sustained tension:
            a) Cast-in-place forged hex-head anchor bolt.
        3) Anchors for reciprocating, vibrating, and rotating equipment:
            a) Cast-in-place forged hex-head anchor bolt.
    c. Do not use post-installed anchors, mechanical or adhesive, unless:
        1) Post-installed anchors are indicated on the Drawings; or
        2) Post-installed are approved by Engineer prior to placement of the surrounding concrete or masonry.
    d. Anchor diameter:
        1) Select diameter so that hole in base plate is not greater than 125 percent of the nominal diameter of the anchor, nor greater than the diameter of the anchor plus 1/4 inch.
7. Determine number, size, layout, and minimum effective embedment for anchors.
    a. Layout includes anchor spacing and required distance(s) from anchor to edge(s) of supporting concrete or masonry.
    b. Anchors in concrete: Design based on minimum specified 28-day compressive strength, f'c, as follows, unless otherwise indicated on the Drawings for the Work area:
        1) Concrete placed for this Work: f'c = 4000 pounds per square inch.
    c. Anchors in masonry: Design based on minimum specified compressive strength, f'm, as follows, unless otherwise indicated on the Drawings for the Work area:
        1) Concrete masonry placed for this Work: f'm = 1500 pounds per square inch.
8. Prepare drawings showing construction details of anchor designs.
9. Submit design calculations and drawings prior to placement of anchors, and of the structural elements to which they will connect.

END OF SECTION

SECTION 02001

COMMON WORK RESULTS FOR GENERAL PIPING - LINEAR INFRASTRUCTURE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Basic materials and methods for metallic and plastic piping systems.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through 24.
   2. B16.47 - Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard.

B. American Water Work Association (AWWA):
   1. C11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe.
   2. C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
   3. C151 - Ductile-Iron Pipe, Centrifugally Cast.
   4. C207 - Standard for Steel Pipe Flanges for Waterworks Services-Size 4 In. Through 144 In.
   5. C230 – Stainless-Steel Full-Encirclement Repair and Service Connection Clamps for 2 IN. Through 12 IN. Pipe.

C. ASTM International (ASTM):
   1. A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
   2. A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
   3. A194 - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   4. A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
   5. A536 - Standard Specification for Ductile Iron Castings.
   6. A563 - Standard Specification for Carbon and Alloy Steel Nuts.
   7. B88 - Standard Specification for Seamless Copper Water Tube.
   8. D2000 - Standard Classification System for Rubber Products in Automotive Applications.
   9. D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing and Fittings.
   10. F37 - Standard Test Methods for Sealability of Gasket Materials.
   11. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

12. F594 – Standard Specification for Stainless Steel Nuts.
13. F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements of Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

D. NSF International (NSF):
1. 61 – Drinking Water System Components – Health. Effects.

1.03 DEFINITIONS

A. Buried Pipes: Pipes that are buried in the soil with or without a concrete pipe encasement.

B. Exposed Pipe: Pipes that are located above ground, or located inside a structure, supported by a structure, or cast into a concrete structure.

C. Pipes Adjacent to a Wet Wall: Pipe centerline within 10 inches of the wet wall.

D. Underground PIPES: Buried pipes - see A. above.

E. Underwater Pipes: Pipes below the top of walls in basins or tanks containing water.

F. Wet Wall: A wall with water on at least 1 side.

PART 2 PRODUCTS

2.01 GENERAL

A. Materials as specified in Section 01601 - Product Requirements including special requirements for materials in contact with drinking water.

2.02 LINK TYPE SEALS

A. Characteristics:
1. Modular mechanical type, consisting of interlocking neoprene or synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening.
2. Links to form a continuous rubber belt around the pipe.
3. Provide a nylon polymer pressure plate with Type 316 stainless steel hardware. Isolate pressure plate from contact with wall sleeve.
4. Hardware to be Type 316 stainless steel.
   a. Provide anti-galling lubricant for threads.

B. One of the following or equal:
1. Link-Seal.
2. Pipe Linx.

2.03 FLANGE BOLTS AND NUTS

A. General:
   1. Washer:
      a. Provide a washer for each nut.
      b. Washer shall be of the same material as the nut.
   2. Nuts: Heavy hex-head.
   3. Cut and finish flange bolts to project a maximum of 1/4-inch beyond outside face of nut after assembly.
   4. Tap holes for cap screws or stud bolts when used.
   5. Lubricant for stainless steel bolts and nuts:
      a. Chloride-free.
      b. Manufacturers: One of the following or equal:
         1) Huskey FG-1800 Anti-Seize.
         2) Weicon Anti-Seize High-Tech.

B. For ductile iron pipe:
   1. On exposed pipes with pressures equal to or less than 150 pounds per square inch gauge (psig):
      a. Bolts: ASTM A307, Grade B.
      b. Nuts: ASTM A563, Grade A.
      c. Bolts and Nuts: Hot-dip galvanized in accordance with ASTM F2329.
   2. On exposed pipes with pressures greater than 150 psig:
      a. Bolts: ASTM A193, Grade B.
      b. Nuts: ASTM A194, Grade 2H.
      c. Bolts and nuts: Hot-dip galvanized in accordance with ASTM F2329.
   3. On underwater pipes and pipes adjacent to wet walls:
      a. Bolts: ASTM A193, Grade B8M.
      b. Nuts: ASTM A194, Grade 8M.
   4. On buried pipes:
      a. Bolts: ASTM A193, Grade B8M.
      b. Nuts: ASTM A194, Grade 8M for nuts.

2.04 MECHANICAL JOINTS BOLTS AND NUTS

A. Bolts including T-Bolts:
   1. High strength low alloy steel in accordance with AWWA C111.
      a. Fluoropolymer coated.
   2. Type 304 stainless steel in accordance with ASTM F593.
   3. Type 316 stainless steel in accordance with ASTM F593.

B. Heavy Hex Nuts:
   1. High strength low alloy steel in accordance with AWWA C111.
      a. Fluoropolymer coated.
   2. Type 304 stainless steel in accordance with ASTM F594.
   3. Type 316 stainless steel in accordance with ASTM F594.

2.05 GASKETS

A. General.
   1. Gaskets shall be suitable for the specific fluids, pressure, and temperature conditions.
   2. Capable of being applied on surface of piping with cavities to provide for an improved seal with the internal piping pressure.

B. Gaskets for flanged joints in ductile iron and steel piping for sewage service:
   1. Suitable for pressures equal and less than 150 pounds per square inch gauge, temperatures equal and less than 160 degrees Fahrenheit, and raw sewage service.
   2. Gasket material:
      a. SBR or neoprene elastomer with minimum Shore A hardness value of 70.
      b. Reinforcement: Cloth or synthetic fiber.
      c. Thickness: Minimum 3/32-inch thick for less than 10-inch pipe; minimum 1/8 inch thick for 10-inch and larger pipe.
   3. Manufacturers: One of the following or equal:
      a. Pipe less than 48 inches in diameter:
         1) Garlock, Style 7797.
         2) John Crane, similar product.
      b. Pipe 48 inches in diameter and larger:
         1) Garlock, Style 3760.
         2) John Crane, similar product.

C. Gaskets for flanged joints in ductile iron or steel water piping:
   1. Suitable for hot or cold water, pressures equal to and less than 150 pounds per square inch gauge, and temperatures equal to and less than 160 degrees Fahrenheit.
   2. Material:
      a. SBR or neoprene elastomer, compressed, with non-asbestos fiber reinforcement.
   3. Manufacturers: One of the following or equal:
      a. Garlock, Bluegard 3300.
      b. John Crane, similar product.

D. Gaskets for mechanical joints in ductile iron:
   1. Certified to NSF-61 when used for potable water service.
   2. SBR or NBR.

E. Gaskets for push-on rubber gasket joints in ductile iron:
   1. Certified to NSF-61 when used for potable water service.
   2. SBR or NBR.

2.06 REPAIR BANDS

A. Design requirements:
   1. In accordance with AWWA C230.

B. Materials:
   1. Shells: Type 304 stainless steel.
   2. Lugs: Removable epoxy coated ductile iron in accordance with ASTM A536.
   3. Bolts and nuts: 304 Stainless Steel with fluorpolymer coated nuts.
   4. Gaskets: Compounded for water and sewer service.

C. Manufacturers: One of the following or equal:
   1. Romac Industries, Inc.
   2. Smith-Blair Inc.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
   1. Piping drawings:
      a. Except in details, piping is indicated diagrammatically. Not every offset and fitting, or structural difficulty that may be encountered has been indicated on the Drawings. Sizes and locations are indicated on the Drawings.
      b. Perform minor modifications to piping alignment where necessary to avoid structural, mechanical, or other type of obstructions that cannot be removed or changed.
         1) Modifications are intended to be of minor scope, not involving a change to the design concept or a change to the Contract Price or Contract Times.
   2. Piping alternatives:
      a. Provide piping as specified in this Section, unless indicated on the Drawings or specified otherwise.
      b. Alternative pipe ratings:
         1) Piping with greater pressure rating than specified may be substituted in lieu of specified piping without changes to the Contract Price.
         2) Piping of different material may not be substituted in lieu of specified piping.
      c. Valves in piping sections: Capable of withstanding specified test pressures for piping sections and fabricated with ends to fit piping.
      d. Flanged joints: where 1 of the joining flanges is raised face type, provide a matching raised face type flange for the other joining flange.
   3. Unless otherwise indicated on the Drawings, piping at pipe joints, fittings, couplings, and equipment shall be installed without rotation, angular deflection, vertical offset, or horizontal offset.

B. Wall and slab penetrations:
   1. Provide sleeves for piping penetrations through aboveground masonry and concrete walls, floors, ceilings, roofs, unless specified or otherwise indicated on the Drawings.
   2. For piping 1 inch in nominal diameter and larger, provide sleeves with minimum inside diameters of 1 inch plus outside diameter of piping. For piping

smaller than 1 inch in nominal diameter, provide sleeve of minimum twice the outside diameter of piping.
    a. Arrange sleeves and adjacent joints so piping can be pulled out of sleeves and replaced without disturbing the structure.
    b. Cut ends of sleeves flush with surfaces of concrete, masonry, or plaster.
    c. Conceal ends of sleeves with escutcheons where piping runs through floors, walls, or ceilings of finished spaces within buildings.
    d. Seal spaces between pipes and sleeves with link-type seals when not otherwise specified or indicated on the Drawings.
3. Provide flexibility in piping connecting to structures to accommodate movement due to soil settlement and earthquakes. Provide flexibility using details indicated on the Drawings.
4. Core drilled openings:
    a. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without acceptance by Engineer.
    b. Determine location of reinforcing bars or other obstructions with a non-destructive indicator device.
    c. Remove dust and debris from hole using compressed air.

C. Exposed piping:
1. Install exposed piping in straight runs parallel to the axes of structures, unless otherwise indicated on the Drawings:
    a. Install piping runs plumb and level, unless otherwise indicated on the Drawings.
        1) Slope plumbing drain piping with a minimum of 1/4-inch per foot downward in the direction of flow.
2. Install exposed piping after installing equipment and after piping and fitting locations have been determined.
3. Support piping: As specified in Sections 15061 - Pipe Supports, 15062 - Preformed Channel Pipe Support System, and 15063 - Non-Metallic Pipe Support System:
    a. Do not transfer pipe loads and strain to equipment.
4. In addition to the joints indicated on the Drawings, provide unions, flexible couplings, flanged joints, flanged coupling adapters, and other types of joints or means which are compatible with and suitable for the piping system, and necessary to allow ready assembly and disassembly of the piping.
5. Assemble piping without distortion or stresses caused by misalignment:
    a. Match and properly orient flanges, unions, flexible couplings, and other connections.
    b. Do not subject piping to bending or other undue stresses when fitting piping.
    c. Do not correct defective orientation or alignment by distorting flanged joints or subjecting flange bolts to bending or other undue stresses.
    d. Flange bolts, union halves, flexible connectors, and other connection elements shall slip freely into place.
    e. Alter piping assembly to fit, when proper fit is not obtained.
    f. Install eccentric reducers or increasers with the top horizontal for pump suction piping.

D. Buried piping:
   1. Bury piping with minimum 3-foot cover without air traps, unless otherwise indicated on the Drawings.
   2. Where 2 similar services run parallel to each other, piping for such services may be laid in the same trench.
      a. Lay piping with sufficient room for assembly and disassembly of joints, for thrust blocks, for other structures, and to meet separation requirements of public health authorities having jurisdiction.
   3. Laying piping:
      a. Lay piping in finished trenches free from water or debris. Begin at the lowest point with bell ends up slope.
      b. Place piping with top or bottom markings with markings in proper position.
      c. Lay piping on an unyielding foundation with uniform bearing under the full length of barrels.
      d. Where joints require external grouting, banding, or pointing, provide space under and immediately in front of the bell end of each section laid with sufficient shape and size for grouting, banding, or pointing of joints.
      e. At the end of each day's construction, plug open ends of piping temporarily to prevent entrance of debris or animals.

E. Venting piping under pressure:
   1. Lay piping under pressure flat or at a continuous slope without air traps, unless otherwise indicated on the Drawings.
   2. Install plug valves as air bleeder cocks at high points in piping.
      a. Provide 1-inch plug valves for water lines, and 2-inch plug valves for sewage and sludge lines, unless otherwise indicated on the Drawings.
   3. Provide additional pipe taps with plug cocks and riser pipes along piping as required for venting during initial filling, disinfecting, and sampling.
   4. Before piping is placed into service, close plug valves and install plugs. Protect plugs and plug valves from corrosion in as specified in Section 09960 - High-Performance Coatings.

F. Restraining buried piping:
   1. Restrain piping at valves and at fittings where piping changes direction, changes sizes, and at ends:
      a. When piping is underground, use concrete thrust blocks, mechanical restraints, or push-on restraints.
      b. Determine thrust forces by multiplying the nominal cross-sectional area of the piping by design test pressure of the piping.
   2. Provide restraints with ample size to withstand thrust forces resulting from test pressures:
      a. During testing, provide suitable temporary restraints where piping does not require permanent restraints.
   3. Place concrete thrust blocks against undisturbed soil.
   4. Place concrete so piping joints, fittings, and other appurtenances are accessible for assembly and disassembly.
   5. Provide underground mechanical restraints where specified in the Piping Schedule.

G. Restraining above ground piping:
    1. Restrain piping at valves and at fittings where piping changes direction, changes sizes, and at ends:
        a. When piping is aboveground or underwater, use mechanical or structural restraints.
        b. Determine thrust forces by multiplying the nominal cross-sectional area of the piping by design test pressure of the piping.
    2. Provide restraints with ample size to withstand thrust forces resulting from test pressures:
        a. During testing, provide suitable temporary restraints where piping does not require permanent restraints.

H. Connections to existing piping:
    1. Expose existing piping to which connections are to be made with sufficient time to permit, where necessary, field adjustments in line, grade, or fittings:
        a. Protect domestic water/potable water supplies from contamination:
            1) Make connections between domestic water supply and other water systems in accordance with requirements of public health authorities.
            2) Provide devices approved by Owner of domestic water supply system to prevent flow from other sources into the domestic supply system.
    2. Make connections to existing piping and valves after sections of new piping to be connected have been tested and found satisfactory.
    3. Provide sleeves, flanges, nipples, couplings, adapters, and other fittings needed to install or attach new fittings to existing piping and to make connections to existing piping.
    4. For flanged connections, provide stainless steel bolts with isolation bushings and washers, and full-face flange gaskets.

I. Connections between ferrous and nonferrous metals:
    1. Connect ferrous and nonferrous metal piping, tubing, and fittings with dielectric couplings especially designed for the prevention of chemical reactions between dissimilar metals.
    2. Nonferrous metals include aluminum, copper, and copper alloys.

J. Flanged connections between dissimilar metals such as ductile iron pipe and steel pipe:
    1. Provide stainless steel bolts with isolation bushings and washers, and full-face flange gaskets.

3.02 CLEANING

A. Piping cleaning:
    1. Upon completion of installation, clean piping interior of foreign matter and debris.
    2. Perform special cleaning when required by the Contract Documents.

B. Conduct pressure and leak test, as specified.

3.03 PIPE SCHEDULE

A. As specified in Attachment A - Pipe Schedule.

END OF SECTION

ATTACHMENT A - PIPE SCHEDULE

PIPING SCHEDULE

PROCESS ABBREV.	SERVICE	EXPOSED, BURIED, ETC	NOMINAL DIAMETER (INCHES)	MATERIAL	WORKING PRESSURE	PIPE SPEC. SECTION	JOINTS/ FITTINGS[3]	TEST PRESSURE/ METHOD (SEE NOTES FOR SPECIAL CONDITIONS)	LINING	COATING	SERVICE CONDITIONS	COMMENTS
RW	Recycled Water	Burried	16-18	PVC C900	DR-18	02706	Push on / Mech Rest.	225 psi / HH	None	None		Tranmission Main, Purple Finish
RW	Recycled Water	Burried	16-18	FPVC C900	DR-18	02706	Fusion Welded	225 psi / HH	None	None		Tranmission Main, Purple Finish
RW	Recycled Water	Burried	4-12	PVC C905	DR-18	02706	Push on / Mech Rest.	225 psi / HH	None	None		Tranmission Main, Purple Finish
RW	Recycled Water	Burried	4-12	FPVC C905	DR-18	02706	Fusion Welded	225 psi / HH	None	None		Tranmission Main, Purple Finish
RW	Recycled Water	Burried	2-8	PVC	SCH 80	02710	SW	225 psi / HH	None	None		Property Connection Purple Finish
RW	Recycled Water	Burried	4-12	DIP	Class 350	02693	Restrained	225 psi / HH	CM	PEE		Tranmission Main, Purple Finish
RW	Recycled Water	Burried	16-18	DIP	Class 250	02693	Restrained	225 psi / HH	CM	PEE		Tranmission Main, Purple Finish
RW	Recycled Water	Exposed	16-18	DIP	Class 250	02693	FL	225 psi / HH	CM	EPP		Pump Station, Purple Finish
RW	Sanitary Sewer	Burried	21	PVC C900	DR 21	02705	Push on	GR / 15 feet	None	None		Sanitary Sewer, Green Finish

GR GRAVITY METHOD
HH HIGH HEAD METHOD
LH LOW HEAD METHOD
SC SPECIAL CASE

2. ABBREVIATIONS TO DESIGNATE PIPING INCLUDE THE FOLLOWING:

B&SP BELL AND SPIGOT
CCP BAR-WRAPPED AWWA 303 CONCRETE CYLINDER PIPE
CI CAST IRON
CISP CAST IRON SOIL PIPE
CL CLASS, FOLLOWED BY THE DESIGNATION
CM CEMENT MORTAR
CTP COAL TAR PITCH
DIP DUCTILE IRON PIPING
EPP EPOXY POLYURETHANE COATING AND/OR LINING
FL FLANGE
GA GAUGE, PRECEDED BY THE DESIGNATION
GE GROOVED END JOINT
GSP GALVANIZED STEEL PIPE
MJ MECHANICAL JOINT
NPS NOMINAL PIPE SIZE, FOLLOWED BY THE NUMBER IN INCHES
PSI POUNDS PER SQUARE INCH
PSIG POUNDS PER SQUARE INCH GAUGE
PE POLYETHYLENE
PEE POLYETHYLENE ENCASEMENT
PO PUSH-ON JOINT
RPO RESTRAINED PUSH-ON
PTW POLYETHYLENE TAPE WRAP
PVC POLYVINYL CHLORIDE
SCH SCHEDULE, FOLLOWED BY THE DESIGNATION
SCRD SCREWED-ON
SST STAINLESS STEEL
SW SOLVENT WELDED

PIPING SCHEDULE												
PROCESS ABBREV.	SERVICE	EXPOSED, BURIED, ETC	NOMINAL DIAMETER (INCHES)	MATERIAL	WORKING PRESSURE	PIPE SPEC. SECTION	JOINTS/ FITTINGS[3]	TEST PRESSURE/ METHOD (SEE NOTES FOR SPECIAL CONDITIONS)	LINING	COATING	SERVICE CONDITIONS	COMMENTS
	WLD WELD											
NOTE 1. RESTRAINED LENGTHS FOR RESPECTIVE PIPE MATERIALS AND PRESSURES ARE TO BE DESIGNED BY THE PIPING MANUFACTURER PER THE SPECIFICATIONS.												
NOTE 2. ALL PIPING WITHIN ZONE 3 SHALL BE OF THE SAME PIPE MATERIAL, EXCEPT AT ISOLATION VALVES.												
NOTE 3. RESTRAINED JOINTS PER PIPELINE SPECIFICATIONS.												
NOTE 4. WORKING PRESSURE AND TEST PRESSURE SHALL BE THE SAME AS ADJACENT RAW WATER PIPELINE.												

SECTION 02003

PIPE IDENTIFICATION - LINEAR INFRASTRUCTURE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Pipe identification including the following:
   1. Pipe identification markers, flow direction arrows, tags, and bands.
   2. Underground warning tape.
   3. Tracer wire.
   4. Witness markers.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. A13.1 - Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Submit following:
   1. Product data.
   2. Samples.
   3. Manufacturer's installation instructions.
   4. Submit following as specified in Section 01770 - Closeout Procedures:
      a. Operation and Maintenance Data.
      b. Warranty.

PART 2 PRODUCTS

2.01 EXPOSED AND IN-CHASE PIPE IDENTIFICATION

A. For piping with outer diameter greater than or equal to 3/4-inch, provide lettered pipe markers and flow direction arrows:
   1. General requirements:
      a. Pipe markers shall include the following, minimum:
         1) Printed text identifying the pipe fluid.
            a) The text shall be all capital letters matching the text listed in the "Service" column of the Piping Schedule for the corresponding piping system.
         2) An arrow identifying the direction of fluid flow.
            a) The arrow can either be integral to the text marker or provided separately. If provided separately, the arrow must be placed immediately adjacent to each text marker, with the arrow aligned

with the text such that the text and arrow are both visible from the same viewpoint.

b) The arrow color shall match the text color, and the arrow background color shall match the text background color.

b. Suitable for outdoor application from -40 degrees to 180 degrees Fahrenheit; in accordance with ASME A13.1 requirements.

c. Lettering:

Outside Pipe Diameter Including Covering	Lettering Height
Less than 0.75 inches	N/A
0.75 to 1.5 inches	1/2-inch
1.5 inches to 2 inches	3/4-inch
2.5 inches to 6 inches	1-1/4 inches
8 inches to 10 inches	2-1/2 inches
Over 10 inches	3-1/2 inches

d. Marker colors:

Marker Color System ID(1)	Fluid service	Text/arrow color	Background color
1	Flammable and oxidizing fluids	Black	Yellow
2	Potable, cooling, boiler feed, and other waters	White	Green
3	Compressed air	White	Blue
4	Fire quenching fluids	White	Red
5	Toxic and corrosive fluids	Black	Orange
6	Combustible fluids	White	Brown
7	Defined by User	White	Purple
8	Defined by User	Black	White
9	Defined by User	White	Gray
10	Defined by User	White	Black
Notes: (1) See Piping Schedule.			

2. Self-adhesive type markers:
   a. Manufacturers: One of the following or equal:
      1) Seton, (of Brady Corporation), Opti Code Pipe Markers.
      2) Marking Services, Inc.
   b. Materials:
      1) Self-adhesive vinyl.
3. Snap-on markers:
   a. Manufacturers: One of following or equal:
      1) Brady Snap-On.
      2) Seton (of Brady Corporation) Setmark.

B. For piping with outer diameter less than 3/4-inch, provide identification tags and flow direction arrows:
   1. Manufacturer: One of the following or equal:
      a. Seton (of Brady Corporation).
   2. Tag and chain materials:
      a. Copper piping: Brass.
      b. Ferrous piping: Type 316 stainless steel.
      c. Plastic piping: PVC.
   3. Flow direction arrow colors shall adhere to the same requirements as for piping with outer diameter greater than or equal to 3/4 -inch, as specified in this Section.

C. Pipe bands:
   1. When bands are required by the Piping Schedule for a specific piping system, provide solid-colored 4-inch wide bands.
      a. Color as specified in the Piping Schedule.
   2. Self-adhesive type.
   3. Suitable for outdoor application from -40 degrees to 180 degrees Fahrenheit.

2.02 BURIED PIPELINE IDENTIFICATION

A. Underground warning tape:
   1. Manufacturer: One of the following or equal:
      a. Seton (of Brady Corporation).
      b. T. Christy Enterprises, Inc.
   2. Material:
      a. Polyethylene tape for prolonged underground use.
      b. Minimum tape thickness: 4 mils.
      c. Overall tape width: 4 inches.
      d. Message: “CAUTION” with the name of the service followed by “LINE BURIED BELOW.” in black lettering on colored background in accordance with approved APWA colors.

Service	Color
Potable water	Blue
Reclaimed water, irrigation, and slurry lines	Purple
Sewers and drain lines	Green
Gas, oil, steam, petroleum, chemicals, or other service	Yellow

      e. Aluminum backing or solid aluminum core.

B. Tracer wire:
   1. Manufacturers: One of the following or equal:
      a. Kris-Tech Wire.
      b. Aegion Corrpro.
   2. Materials: One of the following or equal:
      a. Solid copper conductor
      b. Thickness minimum: 10 gauge.

c. Insulation:
1) Match insulation color to the color of the pipe being installed.
2) UF type, direct bury.
3) 30 mil HMWPE.

3. Splicing kit:
a. Manufacturers: One of the following or equal:
1) 3M, Model 82 A1N.

4. Station box:
a. Lid and collar materials: Cast iron.
b. Lid type: Locking.
c. Able to withstand heavy traffic loading.
d. Manufacturers: One of the following or equal:
1) CP Test & Valve Products, Inc., Glenn Test Station.
2) Farwest Corrosion Control.

C. Witness markers:
1. Manufacturers: One of the following or equal:
a. Carsonite Composites, Utility Marker.
2. Materials:
a. Glass fiber and resin reinforced thermosetting composite material.
b. UV resistant.
3. Constructed as a single piece.
4. Pointed at the bottom end.
5. Information to be included on the marker:
a. “Caution” (type of service) “Pipeline”.
b. Phone number for Underground Service Alert.
c. Phone number for Owner in case of emergency.
d. Station number.
e. Offset:
1) Only provide offset if marker is not directly over the pipe.
f. Name of appurtenance or fitting (e.g. 45, BO, ARV, etc.)

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify satisfactory conditions of substrate for applying identification.

B. Verify that conditions are satisfactory for installation and application of products as specified in Section - Product Requirements.

3.02 PREPARATION

A. Prepare and coat piping with the coating systems defined in the Piping Schedule.

B. Prepare surface in accordance with identification product manufacturer's instructions.

3.03 EXPOSED AND IN-CHASE PIPING IDENTIFICATION

A. Identify exposed and in-chase piping with flow direction arrows and lettering (for piping with outer diameter greater than or equal to 3/4-inch) or tags (for piping with outer diameter less than 3/4-inch).

B. Provide lettering (or tags for pipes with outer diameter less than 3/4-inch) and flow direction arrows near equipment served, adjacent to valves, both sides of walls and floors where pipe passes through, at each branch or tee, and at intervals of not more than 50 feet in straight runs of pipe.
   1. Label all chemical tank fill pipelines at locations that are visible from chemical fill stations.
   2. Place markers on piping so they are visible from operator's position in walkway or working platform near piping. Locate markers along horizontal centerline of pipe, unless better visibility is achieved elsewhere.
   3. Do not apply markers, arrows, or tags to piping that is regularly submerged.

C. Where scheduled in the Piping Schedule, space solid-color bands along piping at 10-foot intervals.
   1. Do not apply bands to piping that is regularly submerged.

3.04 BURIED PIPING IDENTIFICATION

A. Underground warning tape:
   1. Non-detectable warning tape:
      a. Place continuous run of warning tape in pipe trench, 12 inches above the pipe.
   2. Detectable warning tape:
      a. Place continuous run of warning tape in pipe trench, 12 inches above the pipe or a greater height if necessary to limit the tape bury depth to 36 inches. Do not bury detectable warning tape deeper than 36 inches.

B. Tracer wire:
   1. Install on all non-metallic pipe.
   2. Install an electrically continuous run of tracer wire along the entire length of the pipe with wire terminations in valve boxes, vaults, or structures.
   3. Install tracer wire on top of the pipe and secure to pipe with tape a minimum of every 10 feet.
   4. Unless approved by the Engineer, splicing sections of wire together is not permitted.

C. Witness markers:
   1. Install over pipe in unpaved open-space areas at intervals not greater than 200 feet.
   2. Place markers at appurtenances located in unpaved areas.
   3. Embed markers at least 18 inches into the soil.

END OF SECTION

SECTION 02005

PIPING SPECIALTIES - LINEAR INFRASTRUCTURE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Piping specialties including:
   1. Transition fittings.
   2. Pipe saddles.
   3. Tapping sleeves.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24.

B. American Water Works Association (AWWA):
   1. C110 - Standard for Ductile-Iron and Gray-Iron Fittings.
   2. C151 - Standard for Ductile-Iron Pipe, Centrifugally Cast.

C. ASTM International (ASTM):
   1. A148 - Standard Specification for Steel Castings, High-Strength, for Structural Purposes.
   2. A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
   3. A194 – Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   4. A536 - Standard Specification for Ductile Iron Castings.

D. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects, Includes Errata.
   2. 372 - Drinking Water System Components - Lead Content.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. For each piping product in this Section as applicable:
      a. Design features.
      b. Load capacities.
      c. Material designations by UNS alloy number or ASTM Specification and Grade.
      d. Data needed to verify compliance with the Specifications.

e. Catalog data.
f. Clearly mark submittal information to show specific items, materials, and accessories or options being furnished.

C. Calculations:
1. Provide calculations in accordance with NSF 372 for materials in contact with drinking water.

D. Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning:
1. Provide as specified in this Section.

1.04 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

A. As specified in Section 01601 - Product Requirements.

B. Materials in contact with drinking waters: In accordance with NSF 61 and NSF 372.

2.02 TRANSITION FITTINGS

A. Manufacturers: One of the following or equal:
1. Spears.

B. Materials:
1. Slip socket: Schedule 80 PVC.
2. Collar: Type 316 stainless steel.
3. Threaded insert: Type 316 stainless steel.

2.03 PIPE SADDLES

A. For ductile iron pipe:
1. Double strap brass type.
2. Manufacturers: One of the following or equal:
a. A.Y. McDonald, Style 3825.
b. The Ford Meter Box Company, Style 202B.
c. Mueller Company, Style BR2B.
3. Materials:
a. Pipe saddle body, straps, and nuts: Brass or silicon bronze.
b. Gaskets: Rubber.

B. For PVC C900 or C905 pipe:
1. Manufacturers: One of the following or equal:
a. Smith-Blair, Inc., Style 317.
b. Romac Industries, Inc., Style 202S.

2. Materials:
    a. Pipe saddles: Ductile iron with fusion bonded epoxy finish.
    b. Straps, bolts, and nuts: Type 304 stainless steel with Teflon™ coating on nuts.
    c. Gaskets: Rubber.

2.04 TAPPING SLEEVES

A. Manufacturers: One of the following or equal:
    1. Smith-Blair, Inc., Style 622.
    2. Romac Industries, Inc., Style FTS 420.

B. Materials:
    1. Tapping sleeves: Steel construction.
    2. Bolts and nuts: Type 304 stainless steel.
    3. Nuts: Teflon™ coated.
    4. Gaskets: Rubber.
    5. Size of tapped boss: As indicated on the Drawings.

2.05 SHIPPING

A. As specified in Section 01601 - Product Requirements.

PART 3 EXECUTION

3.01 GENERAL

A. As specified in Section 01601 - Product Requirements.

B. Drawings supersede conflicts with this Section.

C. Bellows type expansion joints and vibration control joints:
    1. Protect joints against damage during pressure test.

3.02 INSTALLATION

A. Transition couplings:
    1. Application:
        a. Use transition couplings with function and design similar to flexible couplings and flanged coupling adapters for connecting piping having different outside diameters.
    2. Install transition-coupling products specifically designed and manufactured for that application.

B. Pipe saddles:
    1. Coat threads on bolts with anti-gall coating prior to installation.

C. Tapping sleeves:
   1. Verify existing pipe material and outer diameter prior to ordering materials.
   2. Coat threads on bolts with anti-gall coating prior to installation.

D. Surge cushions:
   1. Provide surge cushions to dampen shock pressure surges due to power loss, fast closing valves, or other events that produce water hammer.
   2. Install gate valve between surge cushion and piping.

E. Spray nozzles:
   1. Install spray nozzles so that elevation of the nozzles is 18 inches above the water surface.

3.03 COMMISSIONING

A. As specified in Section 01756 - Commissioning and this Section.

B. Manufacturer services:
   1. Required only for:
      a. Transition couplings.
      b. Tapping sleeves for large diameter pipe.
   2. Provide Manufacturer's Certificate of Installation and Functionality Compliance.
   3. Provide Manufacturer's Representative Onsite:
      a. Installation: 2 trip/1 day each:
         1) Installation consultation and advice.
         2) Installation inspection.

C. Field testing:
   1. As specified in Section 02001 - Common Work Results for General Piping.

END OF SECTION

SECTION 02007

PIPE COUPLINGS - LINEAR INFRASTRUCTURE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Pipe couplings for ductile iron piping.
   2. Pipe couplings for carbon steel piping.
   3. Pipe couplings for stainless steel piping.

1.02 REFERENCES

A. American National Standards Institute (ANSI).

B. American Society of Mechanical Engineers (ASME):
   1. B31.1 - Power Piping.
   2. B31.9 - Building Services Piping.

C. American Water Works Association (AWWA):
   1. C111 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   2. C207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In.
   3. C213 - Standard for Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings.
   4. C606 - Standard for Grooved and Shouldered Joints.

D. ASTM International (ASTM):
   1. A36 - Standard Specification for Carbon Structural Steel.
   2. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   3. A193 - Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
   4. A351 - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
   5. A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/9 ksi Minimum Tensile Strength, General Use.
   6. A536 - Standard Specification for Ductile Iron Castings.
   7. A563 - Standard Specification for Carbon and Alloy Steel Nuts.
   8. A576 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
   9. C425 - Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
   10. C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

11. C564 - Standard Specification for Rubber Gasket for Cast Iron Pipe and Fittings.
12. C1173 - Standard Specification for Flexible Transition Couplings for Underground Piping Systems.
13. D1869 - Standard Specification for Rubber Rings for Asbestos-Cement Pipe.
14. D2000 - Standard Classification System for Rubber Products in Automotive Applications.
15. D5926 - Standard Specification for Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems.
16. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
17. F594 - Standard Specification for Stainless Steel Nuts.

E. NSF International (NSF):
1. 61 - Drinking Water System Components - Health Effects.
2. 372 - Drinking Water System Components - Lead Content.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data:
1. For each product in this Section as applicable:
   a. Design features.
   b. Load capacities.
   c. Material designations by UNS alloy number or ASTM Specification and Grade.
   d. Data needed to verify compliance with the Specifications.
   e. Catalog data.
   f. Clearly mark submittal information to show specific items, materials, and accessories or options being furnished.

C. Calculations:
1. Provide calculations in accordance with NSF 372 for materials in contact with drinking water.

1.04 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

A. As specified in Section 01601 - Product Requirements:
1. Materials in contact with drinking waters: In accordance with NSF 61 and NSF 372.

B. Known acceptable manufacturers are listed by specific products.

C. Provide references as specified in this Section by specific product.

D. Manufacturer's representatives requirements as specified in Section 01756 - Commissioning and this Section by specific product.

E. Gaskets for flexible couplings and flanged coupling adapters:
   1. Provide gasket materials for piping applications as follows:
      a. Low-pressure and high-pressure air, steam, hot water: EPDM.
      b. All other piping applications: Neoprene rubber or Buna-N.

F. Exterior coatings for underground and submerged applications:
   1. Manufacturers: One of the following or equal:
      a. Tapecoat Co., Inc., T.C. Mastic.
      b. Kop-Coat Co., Inc., Bitumastic Number 50.
   2. Thickness: Minimum 0.040 inch.

2.02 PIPE COUPLINGS FOR DUCTILE IRON PIPING

A. Dismantling joints:
   1. Manufacturers: One of the following or equal:
      a. Romac Ind., Inc., Style DJ400.
      b. Smith-Blair, Inc., Series 975.
   2. Materials:
      a. Flanged spool: AWWA C207 steel pipe:
         1) ASTM A53 for sizes 3 inches to 12 inches.
         2) ASTM A36 for sizes 14 inches to 72 inches.
      b. End ring and body:
         1) For sizes 3 inches to 12 inches, ductile iron in accordance with ASTM A536.
         2) For sizes 14 inches to 72 inches, steel in accordance with ASTM A36 or A53.
      c. Follower ring: Ductile iron in accordance with ASTM A536.
      d. Bolts and hex nuts:
         1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
         2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F593.
      e. Tie rods: High tensile steel in accordance with ASTM A193 Grade B7.
   3. Flange design: Class D steel ring flange in accordance with AWWA C207, compatible with ANSI Class 125 and 150 bolt circles.
   4. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.

B. Flanged coupling adapters: 12-inch size and smaller:
   1. Manufacturers: One of the following or equal:
      a. Dresser, Inc., Style 227.
      b. Romac Ind., Inc., Style FCA501.
      c. Smith-Blair, Inc., Series 912.
   2. Materials:
      a. Flanged body: Ductile iron in accordance with ASTM A536.
      b. Follower ring: Ductile iron in accordance with ASTM A536.

c. Bolts and hex nuts:
1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F593.

3. Flange design: Class D steel ring flange in accordance with AWWA C207 compatible with ANSI Class 125 and 150 bolt circles.
4. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.

C. Flanged coupling adapters: Greater than 12-inch size:
1. Manufacturers: One of the following or equal:
a. Dresser, Inc., Style 128-W.
b. Romac Ind., Inc., Style FC400.
c. Smith-Blair, Inc., Series 913.
2. Materials:
a. Flange and flanged body: Ductile iron or low carbon steel having a minimum yield strength of 30,000 pounds per square inch.
b. Follower ring: Low carbon steel having a minimum yield strength of 30,000 pounds per square inch.
c. Bolts and hex nuts:
1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F593.
3. Flange design: Class D steel ring flange in accordance with AWWA C207 compatible with ANSI Class 125 and 150 bolt circles.
4. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.

D. Flexible couplings:
1. Manufacturers: One of the following or equal:
a. Dresser, Inc., Style 253.
b. Romac Ind., Inc., Style 501.
c. Smith-Blair, Inc., Series 441.
2. Materials:
a. Center rings: Ductile iron in accordance with ASTM A536.
b. Follower rings: Ductile iron in accordance with ASTM A536.
c. Bolts and hex nuts:
1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
2) Buried and underwater: Type 316 stainless steel in accordance with ASTM F593.
3. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.

4. Center sleeve dimensions: Provide center sleeves with lengths in accordance with following table:

Nominal Pipe Size	Sleeve Length
3 inch and smaller	Manufacturer's standard
4 inch through 8 inch	7 inches
10 inch through 14 inch	12 inches
Greater than 16 inch	Use steel flexible coupling per Pipe Couplings for Steel Piping

E. Flexible couplings (Gravity Flow):
   1. Manufacturers: One of the following or equal:
      a. Fernco Flexible Coupling.
   2. Materials:
      a. In accordance with ASTM D5926, C1173 and applicable portions of ASTM C443, C425, C564, and D1869.
   3. Requirements:
      a. In underground and underwater installations, couplings shall be corrosion resistant or coated with a fusion applied epoxy coating in accordance with AWWA C213.
      b. Bolts and hardware shall be stainless steel 18-8 type 316 epoxy coated alloy hardware.

F. Restrained flange coupling adapter:
   1. Manufacturers: One of the following or equal:
      a. Romac Ind., Inc., Style RFCA.
      b. Star Pipe Products, 3200 StarFlange™.
   2. Materials:
      a. Flange and flanged body: Ductile iron in accordance with ASTM A536.
      b. Follower ring: Lug type restraint system.
         1) Follower ring: Ductile iron in accordance with ASTM A536.
         2) Restraining lugs: Ductile iron in accordance with ASTM A536.
            a) Designed to contact the pipe and apply forces evenly.
         3) Restraining bolts:
            a) Ductile iron in accordance with ASTM A536.
            b) Bolt heads shall be designed to twist off when the proper torque has been applied.
      c. Bolts and hex nuts:
         1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
         2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F593.
   3. Flange design: Class D steel ring flange in accordance with AWWA C207 compatible with ANSI Class 125 and 150 bolt circles.
   4. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.
   5. Angular deflection: Restrained flange coupling adapter must allow angular deflection after assembly.

G. Grooved joint couplings:
    1. Manufacturers: The following or equal:
        a. Victaulic Co., Series 31 or equal.
    2. Materials:
        a. Housings: Ductile iron in accordance with ASTM A536.
        b. Gasket:
            1) FlushSeal® type, or equal. Elastomer in accordance with ASTM D2000.
            2) Neoprene or BUNA-N.
        c. Bolts and nuts: Electroplated steel in accordance with ASTM A449.
        d. Coating: As specified in Section 09960 - High-Performance Coatings.
    3. For use with rigid or flexible radius grooved components in accordance with AWWA C606.
    4. For connection to IPS steel pipe sizes, Victaulic Style 307.

2.03 PIPE COUPLINGS FOR CARBON STEEL PIPING

A. Dismantling joints:
    1. Manufacturers: One of the following or equal:
        a. Romac Ind., Inc., Style DJ400.
        b. Smith-Blair, Inc., Series 975.
    2. Materials:
        a. Flanged spool:
            1) C207 Schedule 40 pipe in accordance with ASTM A53 for sizes 3 inches to 12 inches.
            2) Steel for pipe in accordance with ASTM A36 or A53 for sizes 14 inches to 72 inches.
        b. End ring and body:
            1) For sizes 3 inches to 12 inches, ductile iron in accordance with ASTM A536.
            2) For sizes 14 inches to 72 inches, steel in accordance with ASTM A36.
        c. Follower ring: Ductile iron in accordance with ASTM A536 or steel in accordance with ASTM A36 or A576.
        d. Bolts and hex nuts:
            1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
            2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F593.
        e. Tie rods: High tensile steel in accordance with ASTM A193 grade B7.
    3. Flange design: Class D steel ring flange in accordance with AWWA C207 compatible with ANSI Class 125 and 150 bolt circles.
    4. Coating and lining: Fusion bonded epoxy certified in accordance with NSF 61.

B. Flanged coupling adapters:
    1. Manufacturers: One of the following or equal:
        a. Dresser, Inc., Style 128-W.
        b. Romac Ind., Inc., Style FCA501 (10 inch and smaller) or Style FC400 (12 inch and larger).
        c. Smith-Blair, Inc., Series 913.

2. Materials:
    a. Flange and flanged body: Ductile iron or low carbon steel having a minimum yield strength of 30,000 pounds per square inch.
    b. Follower ring: Low carbon steel having a minimum yield strength of 30,000 pounds per square inch.
    c. Bolts and hex nuts:
        1) Aboveground: High-strength, low-alloy steel in accordance with AWWA C111.
        2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F593.
3. Flange design: Class D steel ring flange in accordance with AWWA C207 compatible with ANSI Class 125 and 150 bolt circles.
4. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.

C. Flexible couplings:
1. Manufacturers: One of the following or equal:
    a. Dresser, Inc., Style 38.
    b. Smith-Blair, Inc., Series 411.
    c. Romac Ind., Inc., Style 511 or Style 400.
2. Materials:
    a. Center sleeve and follower flanges: Ductile iron or low carbon steel having a minimum yield strength of 30,000 pounds per square inch.
    b. Bolts and hex nuts:
        1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
        2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F593.
3. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.
4. Center sleeve dimensions: Provide center sleeves with lengths in accordance with following table:

Nominal Pipe Diameter	Sleeve Length
2-1/2 inch and smaller	Manufacturer's standard
3 inch through 6 inch	7 inch
8 inch through 14 inch	7 inch
Greater than 14 inches	10 inch

D. Restrained flange coupling adapters:
1. Manufacturers: One of the following or equal:
    a. Romac Ind., Inc., Style RFCA.
    b. Star Pipe Products, 3200 StarFlange™.
2. Materials:
    a. Flange and flanged body: Ductile iron in accordance with ASTM A536.
    b. Follower ring: Lug type restraint system.
        1) Follower ring: Ductile iron in accordance with ASTM A536.

2) Restraining lugs: Ductile iron in accordance with ASTM A536.
a) Designed to contact the pipe an apply forces evenly.
3) Restraining bolts: Ductile iron in accordance with ASTM A536. Bolt heads shall be designed to twist off when the proper torque has been applied.

c. Bolts and hex nuts:
1) Aboveground: High-strength, low-alloy steel in accordance with AWWA C111.
2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F593.

3. Flange design: Class D steel ring flange in accordance with AWWA C207 compatible with ANSI Class 125 and 150 bolt circles.
4. Coating and lining: Manufacturer's standard fusion bonded epoxy certified in accordance with NSF 61.

E. Grooved joint couplings:
1. Model numbers from one manufacturer are shown to indicate type only. Equivalent products of other manufacturers may be submitted for approval.
2. Coating: As specified in Section 09960 - High-Performance Coatings.
3. Sizes through 12 inch:
a. Rigid type:
1) Housings shall be cast with offsetting angle-pattern bolt pads to provide rigidity and system support and hanging in accordance with ASME B31.1 and B31.9.
2) 2 inch through 6 inch: Installation-ready, for direct stab installation without field disassembly, with grade EHP gasket rated to plus 250 degrees Fahrenheit.
3) Manufacturers: One of the following or equal:
a) Victaulic Style 107.
b) Victaulic Zero-Flex Style 07.

b. Flexible type:
1) For use in locations where vibration attenuation and stress relief are required.
2) Three flexible couplings may be used in lieu of a flexible connector.
3) The couplings shall be placed in close proximity to the source of the vibration.
4) Manufacturers: The following or equal:
a) Victaulic Style 77.

c. Flange adapter:
1) Flat face, ductile iron housings with elastomer pressure responsive gasket, for direct connection to ANSI Class 125 or 150 flanged components.
2) Manufacturers: The following or equal:
a) Victaulic Style 741.

4. Sizes 14 inch through 24 inch:
a. Victaulic AGS series with lead-in chamfer on housing key and wide width FlushSeal® gasket.
b. Rigid type:
1) Housing key shall fill the wedge shaped AGS groove and provide rigidity and system support and hanging in accordance with ASME B31.1 and B31.9.

2) Manufacturers: The following or equal:
a) Victaulic Style W07.

c. Flexible type:
1) Housing key shall fit into the wedge shaped AGS groove and allow for linear and angular pipe movement.
2) Manufacturers: The following or equal:
a) Victaulic Style W77.

d. Flange adapter:
1) Flat face, ductile iron housings with elastomer pressure responsive gasket, for direct connection to ANSI Class 125 or 150 flanged components.
2) Manufacturers: The following or equal:
a) Victaulic Style W741.

5. For sizes 30 inch and larger:
a. Manufacturers: The following or equal:
1) Victaulic Style AGS multiple-segment housing may be used.

PART 3 EXECUTION

3.01 INSTALLATION

A. In underground and underwater installations, coat the exterior of coupling with a protective coating in accordance with manufacturer's instructions.

B. Joints and flexible connections shall be installed centered with no angular deflection unless otherwise indicated on the Drawings.

C. Flexible couplings and flange coupling adapters: Install with gap between pipe ends in accordance with the following table unless a greater gap is indicated on the Drawings. Maximum gap tolerance shall be within 1/8 inch.
1. Install flexible coupling with pipe gap located in middle of center sleeve.
2. Install flanged coupling adapter with end of plain end pipe in middle of flanged coupling body.

Center Ring Length	Gap Dimension and Tolerance
4 inch through 6 inch	3/8 inch
7 inch	5/8 inch
10 inch and greater	7/8 inch

D. Provide harnesses (tie-downs) for flexible couplings unless otherwise indicated on the Drawings with a written note.
1. Design harnesses (tie-downs) for the test pressures as specified in the Piping Schedule in Section 02001 - Common Work Results for General Piping.

E. Grooved joint couplings:
1. Grooved ends: Clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
2. Gaskets: Elastomer grade suitable for the intended service, and molded and produced by the coupling manufacturer.

F. Bolted, split-sleeve couplings:
   1. Inspect each coupling to insure that there are no damaged portions of the coupling.
      a. Pay particular attention to the sealing pad/sealing plate area.
      b. Before installation, thoroughly clean each coupling of any foreign substance which may have collected thereon and shall be kept clean at all time.
   2. Wrenches:
      a. Conform to manufacturer instructions.
      b. Bolts and studs shall be tightened so as to secure a uniform gasket compression between the coupling and the body of the pipe with all bolts or studs tightened approximately the same amount.
      c. Final tightening shall be done by hand (no air impact wrenches) and is complete when the coupling is in uniform contact with the outside surface of the pipe all around the circumference of the pipe.
   3. No joint shall be misfit in any plane.
   4. On the fixed ends of bolted, split-sleeve couplings, the shoulders shall bear on the restraint rings all around with no visible gap.
   5. Ends of piping where coupler are installed shall be smooth and free of defects.
      a. Remove weld splatter and grind smooth.
      b. Grind pipe seam welds flush with pipe wall and smooth.

END OF SECTION

SECTION 02009

PIPING SYSTEMS TESTING - LINEAR INFRASTRUCTURE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Test requirements for piping systems.

1.02 REFERENCES

A. National Fuel Gas Code (NFGC).

B. American Society of Mechanical Engineers (ASME):
   1. B31.1 - Power Piping.
   2. B31.3 - Process Piping.
   3. B31.8 - Gas Transmission and Distribution Piping Systems.

C. Underwriters Laboratories Inc. (UL).

1.03 TESTING REQUIREMENTS

A. General requirements:
   1. Testing requirements are stipulated in Laws and Regulations; are included in the Piping Schedule in Section 15052 - Common Work Results for General Piping; are specified in the specifications covering the various types of piping; and are specified in this Section.
   2. Requirements in Laws and Regulations supersede other requirements of Contract Documents, except where requirements of Contract Documents are more stringent, including higher test pressures, longer test times, and lower leakage allowances.
   3. Test plumbing piping in accordance with Laws and Regulations, the plumbing code, as specified in Section 01410 - Regulatory Requirements, and UL requirements.
   4. Test natural gas or digester gas piping:
      a. For less than 125 pounds per square inch gauge working pressure, test in accordance with mechanical code, as specified in Section 01410 - Regulatory Requirements, or the National Fuel Gas Code, whichever is more stringent.
      b. For 125 pounds per square inch gauge or greater working pressure, test per ASME B31.3 or ASME B31.8, whichever is more stringent.
   5. When testing with water, the specified test pressure is considered to be the pressure at the lowest point of the piping section under test.
      a. Lower test pressure as necessary (based on elevation) if testing is performed at higher point of the pipe section.

B. Furnish necessary personnel, materials, and equipment, including bulkheads, restraints, anchors, temporary connections, pumps, water, pressure gauges, and other means and facilities required to perform tests.

C. Water for testing, cleaning, and disinfecting:
   1. Water for testing, cleaning, and disinfecting will be provided as specified in Section 01500 - Temporary Facilities and Controls.

D. Pipes to be tested: Test only those portions of pipes that have been installed as part of this Contract. Test new pipe sections prior to making final connections to existing piping. Furnish and install test plugs, bulkheads, and restraints required to isolate new pipe sections. Do not use existing valves as test plug or bulkhead.

E. Unsuccessful tests:
   1. Where tests are not successful, correct defects or remove defective piping and appurtenances and install piping and appurtenances that comply with the specified requirements.
   2. Repeat testing until tests are successful.

F. Test completion: Drain and leave piping clean after successful testing.

G. Test water disposal: Dispose of testing water at sanitary sewer manholes in accordance with requirements of federal, state, county, and city regulations governing disposal of wastes in the location of the Project and disposal site. All requirements and costs associated with notifications and obtaining any discharge permit or approvals shall be responsibility of Contractor.

1.04 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Schedule and notification of tests:
   1. Submit a list of scheduled piping tests by noon of the working day preceding the date of the scheduled tests.
   2. Notification of readiness to test: Immediately before testing, notify Engineer in writing of readiness, not just intention, to test piping.
   3. Have personnel, materials, and equipment specified in place before submitting notification of readiness.

1.05 SEQUENCE

A. Clean piping before pressure or leak tests.

B. Test gravity piping underground, including sanitary sewers, for visible leaks before backfilling and compacting.

C. Underground pressure piping may be tested before or after backfilling when not indicated or specified otherwise.

D. Backfill and compact trench, or provide blocking that prevents pipe movement before testing underground piping with a maximum leakage allowance.

E. Test underground piping before encasing piping in concrete or covering piping with slab, structure, or permanent improvement.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 TESTING ALIGNMENT, GRADE, AND DEFLECTION

A. Alignment and grade:
   1. Visually inspect the interior of gravity piping with artificial light, reflected light, or laser beam.
   2. Consider inspection complete when no broken or collapsed piping, no open or poorly made joints, no grade changes that affect the piping capacity, or no other defects are observed.

B. Deflection test:
   1. Pull a mandrel through the clean piping section under test.
   2. Perform the test not sooner than 30 days after installation and not later than 60 days after installation.
   3. Use a 9-rod mandrel with a contact length of not less than the nominal diameter of the pipe within 1 percent plus or minus.
   4. Consider test complete when the mandrel can be pulled through the piping with reasonable effort by 1 person, without the aid of mechanical equipment.

3.02 AIR TESTING METHOD FOR PRESSURE PIPING

A. Air test piping, indicated with "AM" in the Piping Schedule, with air or another nonflammable or inert gas.

B. Test gas, air, liquefied petroleum gas, liquid chlorine, and chlorine gas piping by the air test method:
   1. Test chlorine piping with dry air or nitrogen having a dew point of minus 40 degrees Fahrenheit or less. Supply temporary air dryers as necessary.

C. Test at pressure as specified in Piping Schedule in Section 15052 - Common Work Results for General Piping:
   1. Provide temporary pressure relief valve for piping under test:
      a. Set at the lesser of 110 percent of the test pressure or 50 pounds per square inch gauge over the test pressure.
   2. Air method test pressures shall not exceed 110 percent of the piping maximum allowable working pressure calculated in accordance with the most stringent of ASME B31.1, ASME B31.3, ASME B31.8, or the pipe manufacturer's stated maximum working pressure.
   3. Gradually increase test pressure to an initial test pressure equal to the lesser of 1/2 the test pressure or 25 pounds per square inch gauge.

4. Perform initial check of joints and fittings for leakage.
5. Gradually increase test pressure in steps no larger than the initial pressure. Check for leakage; at each step increase until test pressure reached.
6. At each step in the pressure, examine and test piping being air tested for leaks with soap solution.
7. Consider examination complete when piping section under test holds the test pressure for 15 minutes without losses.

3.03 TESTING GRAVITY FLOW PIPING

A. Test gravity flow piping indicated with "GR" in the Piping Schedule, as follows:
   1. Unless specified otherwise, subject gravity flow piping to the following tests:
      a. Alignment and grade.
      b. For plastic piping test for deflection.
      c. Visible leaks and pressure with maximum leakage allowance, except for storm drains and culverts.
   2. Inspect piping for visible leaks before backfilling.
   3. Provide temporary restraints when needed to prevent movement of piping.
   4. Pressure test piping with maximum leakage allowance after backfilling.
   5. With the lower end plugged, fill piping slowly with water while allowing air to escape from high points. Keep piping full under a slight head for the water at least 24 hours:
      a. Examine piping for visible leaks. Consider examination complete when no visible leaks are observed.
      b. Maintain piping with water or allow a new water absorption period of 24 hours for the performance of the pressure test with maximum leakage allowance.
      c. After successful completion of the test for visible leaks and after the piping has been restrained and backfilled, subject piping to the test pressure for minimum of 4 hours while accurately measuring the volume of water added to maintain the test pressure:
         1) Consider the test complete when leakage is equal to or less than the following maximum leakage allowances:
            a) For concrete piping with rubber gasket joints: 80 gallons per day per inch of diameter per mile of piping under test:
               (1) Advise manufacturer of concrete piping with rubber gasket joints of more stringent than normal maximum leakage allowance.
            b) For vitrified clay piping: 500 gallons per day per inch of diameter per mile of piping under test.
            c) For other piping: 80 gallons per day per inch diameter per mile of piping under test.

3.04 TESTING HIGH-HEAD PRESSURE PIPING

A. Test piping for which the specified test pressure in the Piping Schedule is 20 pounds per square inch gauge or greater, by the high head pressure test method, indicated "HH" in the Piping Schedule.

B. General:
   1. Test connections, hydrants, valves, blowoffs, and closure pieces with the piping.
   2. Do not use installed valves for shutoff when the specified test pressure exceeds the valve's maximum allowable seat differential pressure. Provide blinds or other means to isolate test sections.
   3. Do not include valves, equipment, or piping specialties in test sections if test pressure exceeds the valve, equipment, or piping specialty safe test pressure allowed by the item's manufacturer.
   4. During the performance of the tests, test pressure shall not vary more than plus or minus 5 pounds per square inch gauge with respect to the specified test pressure.
   5. Select the limits of testing to sections of piping. Select sections that have the same piping material and test pressure.
   6. When test results indicate failure of selected sections, limit tests to piping:
      a. Between valves.
      b. Between a valve and the end of the piping.
      c. Less than 500 feet long.
   7. Test piping for minimum 2 hours for visible leaks test and minimum 2 hours for the pressure test with maximum leakage allowance.

C. Testing procedures:
   1. Fill piping section under test slowly with water while venting air:
      a. Use potable water for all potable waterlines and where noted on the Piping Schedule.
   2. Before pressurizing for the tests, retain water in piping under slight pressure for a water absorption period of minimum 24 hours.
   3. Raise pressure to the specified test pressure and inspect piping visually for leaks:
      a. Consider visible leakage testing complete when no visible leaks are observed.

D. Pressure test with maximum leakage allowance:
   1. Leakage allowance is zero for piping systems using flanged, National Pipe Thread threaded and welded joints.
   2. Pressure test piping after completion of visible leaks test.
   3. For piping systems using joint designs other than flanged, threaded, or welded joints, accurately measure the makeup water necessary to maintain the pressure in the piping section under test during the pressure test period:
      a. Consider the pressure test to be complete when makeup water added is less than the allowable leakage and no damage to piping and appurtenances has occurred.
      b. Successful completion of the pressure test with maximum leakage allowance shall be achieved when the observed leakage during the test

period is equal or less than the allowable leakage and no damage to piping and appurtenances has occurred.

c. When leakage is allowed, calculate the allowable leakage by the following formula:

$L = S \times D \times P^{1/2} \times 148{,}000^{-1}$

wherein the terms shall mean:

L = Allowable leakage in gallons per hour.

S = Length of the test section in feet.

D = Nominal diameter of the piping in inches.

P = Average observed test pressure in pounds per square inches gauge, at the lowest point of the test section, corrected for elevation of the pressure gauge.

x = The multiplication symbol.

3.05 TESTING LOW-HEAD PRESSURE PIPING

A. Test piping for which the specified test pressure is less than 20 pounds per square inch gauge, by the low head pressure test method, indicated "LH" in the Piping Schedule.

B. General:
   1. Test pressures shall be as scheduled in Section 15052 - Common Work Results for General Piping.
   2. During the performance of the tests, test pressure shall not vary more than plus or minus 2 pounds per square inch gauge with respect to the specified test pressure.
   3. Test connections, blowoffs, vents, closure pieces, and joints into structures, including existing bell rings and other appurtenances, with the piping.
   4. Test piping for minimum 2 hours for visible leaks test and minimum 2 hours for the pressure test with maximum leakage allowance.

C. Visible leaks test:
   1. Subject piping under test to specified pressure measured at the lowest end.
   2. Fill piping section under test slowly with water while venting air:
      a. Use potable water for all potable waterlines and where noted on the Piping Schedule.
   3. Before pressurizing for the tests, retain water in piping under slight pressure for the water absorption period of minimum 24 hours.
   4. Raise pressure to the specified test pressure and inspect piping visually for leaks. Consider testing complete when no visible leaks are observed.

D. Pressure test with maximum leakage allowance:
   1. Pressure test piping after completion of visible leaks test.
   2. Accurately measure the makeup water necessary to maintain the pressure in the piping section under test during the pressure test period:
      a. Consider the pressure test to be complete when makeup water added is less than the allowable leakage of 80 gallons per inch of nominal diameter, per mile of piping section under test after 24 hours, and no damage to piping and appurtenances has occurred.
      b. Successful completion of the leakage test shall have been achieved when the observed leakage is equal or less than the allowable leakage and no damage to piping and appurtenances has occurred.

E. Optional joint test:
   1. When joint testing is allowed by note in the Piping Schedule, the procedure shall be as follows:
      a. Joint testing will be allowed only for low head pressure piping.
      b. Joint testing does not replace and is not in lieu of any testing of the piping system or trust restraints.
   2. Joint testing may be performed with water or air.
   3. Joint test piping after completion of backfill and compaction to the top of the trench.
   4. Joint testing with water:
      a. Measure test pressure at the invert of the pipe. Apply pressure of 4 feet plus the inside diameter of the pipe in water column within 0.20 feet in water column.
      b. Maintain test pressure for 1 minute.
      c. Base the allowable leakage per joint on 80 gallons per inch nominal diameter, per mile of piping, per 24 hours equally distributed to the actual number of joints per mile for the type of piping.
      d. Consider the pressure test to be complete when makeup water added is less than the allowable leakage.
      e. Successful completion of the joint test with water shall have been achieved when the observed leakage is equal or less than the allowable leakage.
   5. Joint testing with air:
      a. Apply test pressure of 3 pounds per square inch gauge with a maximum variation of plus 0.20 and minus 0.00 pounds per square inch.
      b. Maintain test pressure for 2 minutes.
      c. Consider the pressure test to be complete when the test pressure does not drop below 2.7 pounds per square inch for the duration of the test.

END OF SECTION

SECTION 02050

SOILS AND AGGREGATES FOR EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Material requirements for soils and aggregates.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C117 - Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.
   2. C131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
   3. C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   4. D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
   5. D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
   6. D4829 - Standard Test Method for Expansion Index of Soils.

B. California State Transportation Agency, Department of Transportation (CALTRANS):
   1. (Standard Specifications).
   2. California Test Methods (CTM):
      a. California Test 205 - Method of Test for Determining Crushed Particles.
      b. California Test 211 - Method of Test for Abrasion of Coarse Aggregate by Use of the Los Angeles Abrasion Testing Machine.
      c. California Test 217 - Method of Test for Sand Equivalent.
      d. California Test 229 - Method of Test for Durability Index.
      e. California Test 301 - Method of Test for Determining the Resistance "R" Value of Treated and Untreated Bases, Subbases, and Basement Soils by the Stabilometer.

1.03 SUBMITTALS

A. Product data:
   1. Material source.
   2. Gradation.
   3. Testing data.

B. Quality control for aggregate base course:
   1. Test reports: Reports for tests required by Sections of Standard Specifications.
   2. Certificates of Compliance: Certificates as required by Sections of Standard Specifications.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Storage and protection: Protect from segregation and excessive moisture during delivery, storage, and handling.

B. Comply with Standard Specifications storage requirements, if applicable.

PART 2 PRODUCTS

2.01 MATERIALS - GENERAL

A. Provide material having maximum particle size not exceeding 4 inches and that is free of trash, lumber, debris, leaves, grass, roots, stumps, and other organic matter.

B. Comply with soil and aggregate material requirements in the Standard Specifications; unless specified otherwise.

2.02 NATIVE MATERIAL

A. Native soil:
   1. Sound, earthen material.
   2. Expansion index less than 35 when tested in accordance with ASTM D4829.
   3. Conforms to size and grade within the following limits when tested in accordance with ASTM C117 and ASTM C136:

Sieve Sizes (Square Openings)	Percent by Weight Passing Sieve
1-inch	100
Number 200	30 maximum

B. Native soil-select:
   1. Sound earthen material.
   2. Sum of plasticity index when tested in accordance with ASTM D4318 and the percent of material by weight passing a Number 200 sieve shall not exceed 23 when tested in accordance with ASTM C136.
   3. Organic content not be greater than 3 percent by volume.
   4. Corrosion resistance requirements:
      a. Resistivity minimum (wet aggregates): 5,000 ohm-cm.
      b. pH: 5.0 to 12.0.
      c. Chlorides maximum: 100 parts per million.
      d. Sulfates maximum: 200 parts per million.

2.03 AGGREGATE BASE COURSE

A. Material requirements:
   1. Class 2, 3/4-inch maximum aggregate size, free from organic matter and other deleterious substances, and of such nature that aggregate can be compacted readily under watering and rolling to form a firm, stable base.

2. Recycled aggregate base course shall only be considered for use in pavement structural sections.
3. Aggregate base course for structures:
    a. Consist of crushed or fragmented particles.
    b. Coarse aggregate material retained in Number 4 sieve shall consist of material of which at least 25 percent by weight shall be crushed particles when tested in accordance with California Test 205.
4. Aggregate shall not be treated with lime, cement, or other chemical material.
5. Durability index: Not less than 35 when tested in accordance with California Test 229.
6. Aggregate grading and sand equivalent tests shall be performed to represent not more than 500 cubic yards or 1 day's production of material, whichever is smaller.
7. Sand equivalent: Not less than 25 when tested in accordance with California Test 217.
8. Resistance (R-value): Not less than 78 when tested in accordance with California Test 301.
9. Conforms to size and grade within the following limits when tested in accordance with ASTM C117 and ASTM C136:

Sieve Sizes (Square Openings)	**Percent by Weight Passing Sieve**
1 inch	100
3/4 inch	90 - 100
Number 4	35 - 60
Number 30	10 - 30
Number 200	2 - 9

2.04 GRAVEL

A. Material requirements:
    1. Consists of hard, durable particles of stone or gravel; or crushed to the specified sizes and gradations; and free from organic matter, lumps or balls of clay, and other deleterious matter.
    2. Crush or waste coarse material and add or waste fine material in order to meet the specified gradations.
    3. Fraction of material passing Number 40 sieve: Material having plasticity index not greater than 5 when tested in accordance with ASTM D4318.
    4. Durability: Percentage of wear not greater than 40 percent when tested in accordance with California Test 211.

5. Conform to sizes and grade within the following limits when tested in accordance with ASTM C117 and C136:

Sieve Size (Square Openings)	Percent by Weight Passing Sieve		
	Type A	Type B	Type C
2 inch	100	--	--
1-1/2 inch	95 - 100	100	--
3/4 inch	35 - 60	55 - 85	100
3/8 inch	15 - 40	35 - 65	50 - 100
Number 4	0 - 25	20 - 35	30 - 45
Number 30	--	5 - 15	10 - 20
Number 200	0 - 5	2 - 9	2 - 9

2.05 DRAIN ROCK

A. Material requirements:
   1. Durability index: Percentage of wear not greater than 40 when tested in accordance with California Test 229.
   2. Consists of hard, durable particles of stone or gravel; screened or crushed to specified size and gradation; and free from organic matter, lumps or balls of clay, or other deleterious matter.
   3. Crush or waste coarse material and waste fine material as required to meet gradation requirements.
   4. Conforms to size and grade within the following limits when tested in accordance with ASTM C117 and C136:

Sieve Size (Square Openings)	Percent By Weight Passing Sieve
2 inch	100
1-1/2 inch	95 - 100
3/4 inch	50 - 100
3/8 inch	15 - 55
Number 200	0 - 2

2.06 CLASS 2 PERMEABLE FILL

A. Material requirements:
   1. Durability index: Percentage of wear not greater 40 when tested in accordance with California Test 229.
   2. Consists of hard, durable particles or fragments of stone or gravel; crushed to required size and grading; and free from organic matter, lumps or balls of clay, alkali, adobe, or other deleterious matter.

3. Materials derived from processing demolished or removed asphalt concrete are not acceptable.
4. Aggregate base course for structures:
   a. Consist of crushed or fragmented particles.
5. When sampled and tested in accordance with specified test methods, material shall comply with following requirements: Sand equivalent: Not less than 75 when tested in accordance with ASTM D2419.
6. Conforms to size and grade within the following limits when tested in accordance with ASTM C117 and C136:

Sieve Size (Square Openings)	Percent by Weight Passing Sieve
1 inch	100
3/4 inch	90 - 100
3/8 inch	40 - 100
Number 4	25 - 40
Number 8	18 - 33
Number 30	5 - 15
Number 50	0 - 7
Number 200	0 - 3

2.07 IMPORTED FILL

A. Material requirements:
   1. Import fill shall be granular soil, free of organic material and debris and meet the following requirements:
      a. Plasticity Index less than 15.
      b. Organic Content less than 2 percent.
      c. Conforms to size and grade within the following limits:

Sieve Size (Square Openings)	Percent by Weight Passing Sieve
3-inch	100
No. 4	35-100
No. 30	20-100
No. 200	10-45

2.08 SAND

A. Clean, coarse, natural sand.

B. Non-plastic when tested in accordance with ASTM D4318.

C. Conforms to size and grade within the following limits when tested in accordance with ASTM C117 and C136:

Sieve Size (Square Openings)	Percent by Weight Passing Sieve
1/2 inch	100
Number 200	0 - 20

2.09 STABILIZATION MATERIAL

A. Durability percentage of wear not greater than 40 percent when tested in accordance with California Test 211.

B. Consists of clean, hard, durable particles of crushed rock or gravel; screened or crushed to the specified sizes and gradations; and free of any detrimental quantity of soft, friable, thin, elongated, or laminated pieces, disintegrated material, organic matter, oil, alkali, or other deleterious substance.

C. Shall be free of slaking or decomposition under the action of alternate wetting and drying.

D. The portion of material retained on the 3/8-inch sieve shall contain at least 50 percent of particles having 3 or more fractured faces. Not over 5 percent shall be pieces that show no such faces resulting from crushing. Of that portion which passes the 3/8-inch sieve but is retained on the Number 4 sieve, not more than 10 percent shall be pieces that show no faces resulting from crushing.

E. Conforms to size and grade when tested in accordance with ASTM C117 and ASTM C136.

Sieve Size (Square Openings)	Percent by Weight Passing Sieve
1 inch	100
3/4 inch	90 - 100
Number 4	0 - 10
Number 200	0 - 2

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 02200

SITE CLEARING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Clearing, grubbing, and stripping project site.

1.02 REFERENCES

A. United States Code of Federal Regulations (CFR):
   1. 40 - Protection of Environment:
      a. 503 - Standards for the Use or Disposal of Sewage Sludge.

1.03 DEFINITIONS

A. Clearing: Consists of removal of natural obstructions and existing foundations, buildings, fences, lumber, walls, stumps, brush, weeds, rubbish, trees, boulders, utility lines, and any other items which interferes with construction operations or are designated for removal.

B. Grubbing: Consists of the removal and disposal of wood or root matter below the ground surface remaining after clearing and includes stumps, trunks, roots, or root systems greater than 1 inch in diameter or thickness to a depth of 6 inches below the ground surface.

C. Stripping: Includes the removal and disposal of all organic sod, topsoil, grass and grass roots, and other objectionable material remaining after clearing and grubbing from the areas designated to be stripped. The depth of stripping is estimated to be 6 inches, but the required depth of stripping will be determined by the Engineer.

D. Sludge:
   1. Sludge contains both inert and organic material and is classified as a “Class B” product in accordance with 40 CFR 503.
   2. Dispose of sludge on a permitted land application site or in a permitted landfill.

E. Sludge-entrained soil:
   1. Sludge-entrained soil is all existing material within the top layer of soil within each existing sludge storage lagoon.
   2. Based on geotechnical investigations performed during the design phase of the project, the depth of the sludge-entrained soil layer extends 5.5 feet to 6.5 feet below the elevation of the existing sludge storage lagoon bottom.
   3. Sludge-entrained soil does exist on the faces of the existing embankments.
   4. Dispose of sludge-entrained soil classified as a “Class B” in accordance with 40 CFR 503 on a permitted land application site or in a permitted landfill.

1.04 QUALITY ASSURANCE

A. Regulatory requirements: Verify and comply with applicable regulations regarding those governing noise, dust, nuisance, drainage and runoff, fire protection, and disposal.

B. Pre-construction conference: Meet with Engineer to discuss order and method of work.

1.05 PROJECT CONDITIONS

A. Environmental requirements:
   1. For suspected hazardous materials found: As specified in Section 01354 - Hazardous Material Procedures.

1.06 SEQUENCING AND SCHEDULING

A. Clearing and grubbing: Perform clearing and grubbing in advance of grading operations.

B. Remove sludge-entrained soil from within each existing sludge storage lagoon bottom and dispose of this material in a location that is permitted to receive Class B biosolids in accordance with 40 CFR 503.

C. Following the removal of sludge-entrained soil, remove remainder of soil to depth as indicated on the Drawings. This material may be utilized to reconstruct sludge storage lagoon embankments, provided it meets specified requirements for screened native material as specified in Section 02050 - Soils and Aggregates for Earthwork.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Examine site and verify existing conditions for beginning work.

3.02 PREPARATION

A. Protect existing improvements from damage by site preparation work.

3.03 INSTALLATION

A. Clearing:
   1. Clear areas where construction is to be performed and other areas as indicated on the Drawings, or specified in this Section, of fences, lumber, walls, stumps, brush, roots, weeds, trees, shrubs, rubbish, and other objectionable material of any kind which, if left in place, would interfere with

proper performance or completion of the work, would impair its subsequent use, or form obstructions.

2. Do not incorporate organic material from clearing and grubbing operations in fills and backfills.
3. Contractor's temporary construction facilities: Fill or remove pits, fill, and other earthwork required for erection of facilities, upon completion of the work, and level to meet existing contours of adjacent ground.

B. Grubbing:
   1. From excavated areas: Grub stumps, roots, and other obstructions 3 inches or over in diameter to depth of not less than 18 inches below finish grade.
   2. In embankment areas or other areas to be cleared outside construction area: Do not leave stumps, roots, and other obstructions higher than the following requirements:

Height of Embankment Over Stump	Depth of Clearing and Grubbing
0 feet to 2 feet	Grub stumps or roots 3 inches or over in diameter to 18 inches below original grade. Cut others flush with ground.
2 feet to 3 feet	Grub stumps 1 foot and over in diameter to 18 inches below original grade. Cut others flush with ground.
Over 3 feet	Leave no stumps higher than stump top diameter, and in no case more than 18 inches.

   3. Backfill and compact cavities left below subgrade elevation by removal of stumps or roots to density of adjacent undisturbed soil.

C. Stripping:
   1. Remove soil material containing sod, grass, or other vegetation to depth of 6 inches from areas to receive fill or pavement and from area within 5 feet outside foundation walls.
   2. Deposit stripped material in accordance with following requirements:
      a. At locations acceptable to Engineer.
      b. Use accepted material in top 6 inches of areas to be used for future planting.

D. Preservation of Vegetation and Property:
   1. Every reasonable effort shall be made to preserve and protect trees, natural vegetation, landscaping, structures, fences, and natural barriers that are not in conflict with the completion of the Work. Existing trees not shown to be removed on the Drawings shall be protected in place. Such features that are damaged by the Contractor’s activities shall be replaced or otherwise repaired in a manner meeting the approval of the Construction Manager. Trees that are not designated to be removed, but are removed without the written consent of the Construction Manager shall be replaced in kind at the Contractor’s expense and the Contractor shall be subjected to Liquidated Damages per the General Conditions.
   2. Acceptance by the Construction Manager of the Contractor’s operations or methods of clearing, grubbing, demolition, or disposal shall not relieve the Contractor of the responsibility for protecting the Work and adjacent

properties. While performing Work under this Section, the Contractor shall comply with the terms and conditions concerning preservation of property as described in the General Conditions of this Contract and other Specification Sections.

E. Material reuse and recycling:
   1. 100 percent of trees, stumps, rocks and associated vegetation and soils resulting primarily from land clearing shall be reused or recycled. For a phased project, such material may be stockpiled on site until project completion.
   2. Contractor shall provide Engineer with list of local markets and salvage sites for reuse of clearing debris.

END OF SECTION

New Section

SECTION 02224[AD3]

AUGER BORING

PART 1 GENERAL

1.01 SUMMARY

A. This Section establishes the minimum requirements for installing pipe by auger boring at the locations indicated on the Drawings. The Contractor shall furnish all labor, equipment, power, and materials necessary for pipe installation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Section 02260 - Excavation Support and Protection.

B. Section 02471 - Geotechnical Instrumentation and Monitoring.

C. Section 02448 - Jacking Steel Pipe Casings.

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. The publications listed below form a part of this Specification to the extent referenced. Where conflicts between these Specifications and the referenced specification, code, or standard occur, the more restrictive specification shall govern. The latest edition available on the date of issue of Contract Documents shall be used.

B. Occupational Safety and Health Administration (OSHA) Regulations and Standards for Underground Construction, 29 CFR Part 1926, Subpart S, Underground Construction, and Subpart P, Excavations.

C. Geotechnical Reports:
   1. City of Ukiah Recycled Water Pipeline - Phase 4 Design (August 2021).

1.04 DEFINITIONS

A. Auger Boring: Auger boring is a trenchless construction method that uses a cutterhead rotated by a flight of cased augers to cut the soil in front of the casing pipe. A power unit consisting of a motor and transmission located in the jacking shaft are used to rotate the augers. Hydraulic jacks or a rail system located in the jacking shaft are used to propel the casing pipe sections and flight augers forward.

B. Carrier Pipe: Permanent pipe for operational use that is used to convey flows.

C. Casing: A pipe installed during tunneling that supports the ground and provides a stable underground support system for the installation of a carrier pipe.

D. Jacking Pipe: The jacking pipe may be the carrier pipe or casing pipe, and must be specifically designed to be installed by pipejacking using guided boring equipment.

1.05 DESIGN CRITERIA

A. Auger Boring Equipment
   1. Augers used for all auger boring work required for this project shall have a diameter of at least 85 percent of the casing I.D. Undersize augers shall not be used.
   2. Auger boring equipment selected for the project shall be suitable for and capable of efficiently advancing through the geologic conditions described in the Geotechnical Report and the geologic conditions anticipated by the Contractor. The machine shall be capable of excavating cobbles or boulders or other objects up to 30 percent of the outside diameter of the augers.
   3. The auger boring equipment shall be equipped with water level survey equipment. The auger boring machine shall be steerable in vertical direction to allow the operator to maintain grade within the specified tolerances.
   4. The boring machine shall be manufactured by a company that specializes in the design and fabrication of this type of equipment and has had at least 5 years of experience manufacturing and marketing guided boring systems.

B. A pipe lubrication injection system shall be provided to inject pipe lubricants as required to minimize jacking forces.

C. Where there is a potential for flammable or noxious gases to be encountered, the machine shall have an automatic shut-off switch and provisions for continuous gas monitoring.

D. The Contractor shall use manual data acquisition for collecting information for the jacking record. The Engineer and/or Owner's representative shall have reasonable access to all areas of the work, including the operations control area, and shafts, for inspection and collection of data, measurements, and observations.

E. The maximum allowable radial overcut shall be 0.5 inch. Radial overcut values shall be selected to minimize potential settlements of the ground and subsurface facilities. The radial overcut will be determined as the difference between the maximum diameter created by the cutting teeth or overcut band on the machine (whichever is greater) and the outer diameter of the casing pipe, divided by 2.

F. Methods and equipment shall control surface settlement and heave above the pipeline to prevent damage to existing utilities, facilities, and improvements. Ground movements (settlement/heave) shall be limited to values that do not cause damage or distress to surface features, utilities, or improvements. In no case shall settlements exceed the maximum allowable values listed in Section 02471 - Geotechnical Instrumentation and Monitoring. The Contractor shall be responsible for any damage to existing features, improvements, or utilities, and shall repair any damage to the satisfaction of the Engineer, at no additional cost to the Owner, and without schedule extension.

G. A thrust block or other means of providing reaction force shall be used to transfer jacking loads to the soil behind the jacking shaft. If a thrust block is used, it shall be installed perpendicular to the proposed pipe alignment, and shall be designed to withstand the maximum jacking pressure anticipated, with a factor of safety of at least 1.5 without excessive deflection or displacement.

H. Provide portal stabilization/ground improvement as necessary to prevent loss of ground and uncontrolled inflows at entry and exit locations.

1.06 QUALITY ASSURANCE

A. Failure to meet the qualification requirements is failure to fulfill the Contract and the Contractor will be required to obtain a subcontractor that meets the qualification requirements.

B. All boring work shall be performed by an experienced subcontractor or Contractor who has at least 3 years of experience in performing boring work and has completed a minimum of 5 projects of similar diameter in similar ground conditions. At least one of the projects shall have involved an individual drive equal to or greater in length than the longest drive on this project. The Contractor shall submit a description of referenced projects including owner's name and current contact information, project superintendent, and machine operators.

C. The project superintendent shall have at least 3 years of experience in supervising boring construction. The Contractor shall submit a description of referenced projects including owner's name and contact information, project superintendent, and machine operators.

D. The boring machine operator(s) shall have technical training and experience in the operation of the proposed boring equipment and shall have completed, as a primary operator, at least 5 similar boring projects involving at least 150 feet of boring on each project. At least one of the projects shall have an individual drive equal or greater in length than the longest drive on this project. The Contractor shall submit a description of referenced project including owner's name and contact information, project superintendent, and machine operators.

E. The site safety representative and personnel responsible for air quality monitoring shall be experienced in tunnel construction and shall be certified by OSHA.

F. The surveyor responsible for line-and-grade control shall be a Licensed Surveyor registered in the State of California who has prior experience setting control for pipejacking projects.

G. The Contractor shall provide at least 72 hours advance written notice to Engineer prior to beginning the bore.

H. All Work by the Contractor shall be done in the presence of the Engineer unless the Engineer grants prior written approval to perform such Work in Engineer's absence.

I. The Contractor shall immediately notify the Engineer, in writing, when any problems are encountered with equipment or materials, or if the Contractor believes the conditions encountered are materially and significantly different than those represented within the Contract Documents.

J. The Contractor shall allow access to the Engineer and shall furnish necessary assistance and cooperation to aid the Engineer in observations, measurements, data, and sample collection, including, but not limited to the following:
   1. The Owner and/or Engineer shall have access to the operator control panel prior to, during, and following all boring operations. This shall include, but not be limited to, providing visual access to real-time operator control screens, gauges, and indicators.
   2. The Owner and/or Engineer shall have access to the jacking and reception shafts prior to, during, and following all boring operations. The Contractor shall provide safe access in accordance with all safety regulations.
   3. The Owner and/or Engineer shall have access to spoils removed from the tunnel excavation during and following all boring operations. The Engineer shall be allowed to collect soil samples from the spoil piles a minimum of once per installed pipe section, or every 10 feet, whichever is more often, and at any time when changes in soil conditions or obstructions are apparent or suspected.

1.07 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of these Specifications, and shall provide sufficient detail to allow the Engineer to judge whether the proposed equipment, materials, and procedures will meet the Contract requirements. All drawings shall be legible with dimensions accurately shown and clearly marked in English. Review of submitted details and data will be based on consideration of requirements for the completed work, protection of existing utilities, and the possibility of unnecessary delays in the execution of the work to be constructed under this Contract. Review and acceptance of the Contractor's Submittals by the Engineer shall not be construed in any way as relieving the Contractor of its responsibilities under this Contract.

B. Qualifications: Submit the names of the project superintendent, machine operators, and site safety representative. Submit personnel qualifications in accordance with Paragraphs 1.6 B through F. Provide evidence of OSHA certification for site safety representative and personnel responsible for air quality monitoring.

C. Submit the following describing the boring equipment and construction methods to be employed:
   1. A detailed description of the boring equipment and procedures to be employed.
   2. Manufacturer's literature describing the boring system to be used including machine type, equipment dimensions, and spoil removal system. Provide descriptions of 3 projects on which this system has been successfully used including names, addresses, and telephone numbers of owner's representatives for these projects as well as length, diameter, and pipe material used.
   3. Capacity of jacking system or other system to provide thrust. Provide details of thrust ring, jacking controls, and pressure gages.
   4. Provide thrust block, if used, and jacking frame design and details, including dimensions.
   5. Provide details of pipe lubrication injection system and pipe lubricants to be used as required during construction. Include a description of proposed

lubrication procedures during jacking, including estimated volumes of lubricant that will be pumped.

6. Describe spoil handling, transport, and disposal equipment and procedures, and spoil disposal sites. Provide written documentation from the disposal site(s) indicating that they will accept the spoil and are in compliance with prevailing (and applicable) regulations.

D. Submit the planned procedure for installation of the final product pipe using a 2- step process for auger boring.

E. Shaft Layout Drawings: The Contractor shall submit shaft layout drawings detailing dimensions and locations of all equipment, including overall work area boundaries. The Contractor's layout drawings shall show that all equipment and operations shall be completely contained within the allowable construction zones shown on the Drawings.

F. Schedule:
   1. Provide a schedule for boring work identifying all major construction activities as independent items. The schedule shall include as a minimum the following activities: mobilization; groundwater control at jacking and receiving shafts; shaft excavation and support; jacking equipment setup; casing installation, and product pipe installation; site restoration; cleanup; and demobilization.
   2. The schedule shall also include the work hours and workdays for each activity, and a written description of the construction activities.
   3. The schedule shall be reviewed by the Engineer and shall be updated and resubmitted by the Contractor every 2 weeks or more frequently, if requested by the Engineer.

G. Daily Records: The following daily records shall be submitted to the onsite Engineer by noon on the day following the shift for which the data or records were taken.
   1. Jacking Records: The Contractor shall provide complete jacking records to the Engineer. These records shall include, at a minimum: date, time, name of operator, drive identification, installed casing pipe number and corresponding bore length, rate of advance, jacking forces, volume of soil removed, line and grade offsets, any movement of the guidance system, problems encountered with the jacking frame or other components or equipment, and durations and reasons for delays.
   2. Manually recorded observations should be made at intervals of not less than once every twenty feet during casing installation, whenever conditions change, and as directed by the Engineer.
   3. At least 7 days prior to beginning the bore, the Contractor shall submit samples of the manual jacking records. Samples shall include the manual logs or records to be used.
   4. Lubrications Records: The Contractor shall provide lubrication records to the Engineer. These records shall include the injection locations, lubrication type and additives, pressures, and amount, in gallons, of lubricant pumped throughout a drive. The record will also include the date, time, and drive distance when used.

H. Calculations: Calculations shall be submitted in a neat, legible format. Assumptions used in calculations shall be consistent with information provided in the Geotechnical Report.
   1. Provide an estimate of the maximum jacking force expected to complete each drive, accounting for both face pressures and frictional resistance along the pipe string.
   2. Provide calculations demonstrating that the soils behind the thrust block can transfer the maximum planned jacking forces exerted by the main jacks to the ground during pipe installation with a factor of safety of at least 1.5, without excessive deflection or displacement.
   3. Provide settlement calculations based on contractors means and methods and anticipated geotechnical conditions.

I. Submit a safety plan for the boring operations.

1.08 SAFETY

A. The Contractor is responsible for safety on the job site. Methods of construction shall ensure the safety of the work, Contractor's and other employees on site, and the public. Perform all work in accordance with the current applicable regulations of the Federal, State, and local agencies. Comply with all applicable provisions of Tunnel Safety Orders of the State of California and 29 CFR Part 1926, Subpart S, Underground Construction and Subpart P, Excavations, by OSHA. In the event of conflict, comply with the more restrictive applicable requirement.

B. No gasoline powered equipment shall be permitted in jacking and receiving shafts. Diesel, electrical, hydraulic, and air powered equipment are acceptable, subject to applicable local, State, and Federal regulations.

C. Furnish and operate a temporary ventilation system in accordance with applicable safety requirements when personnel are in the shaft or in the pipe. Perform all required air and gas monitoring. Ventilation system shall provide a sufficient supply of fresh air and maintains an atmosphere free of toxic or flammable gasses in all underground work areas.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Casing Pipe: Steel casing pipe to be installed by direct pipejacking shall conform to Section 02448 - Jacking Steel Pipe Casings.

B. Final product pipe to be installed, shall conform to the requirements on the Drawings. Typical Details labeled for microtunneling shall be used for auger boring.

PART 3 EXECUTION

3.01 GENERAL

A. Boring shall not begin until the following have been completed:
   1. All required submittals have been provided, reviewed, and accepted.
   2. Jacking shaft and receiving shaft excavations and support systems have been completed in accordance with reviewed and accepted submittals.
   3. Soil and groundwater control and portal stabilization for breaking out of jacking shafts and into receiving shafts has been established.
   4. All settlement monitoring instruments have been installed, surveyed, and accepted by the Engineer.
   5. The location, orientation, and grade of the jacking frame or guide rails have been surveyed to ensure they are on the proper line and grade and to verify that they are properly supported. Special care shall be taken when setting the guide rails or jacking frame in the jacking shaft to ensure stability and accuracy of the alignment and grade.
   6. Site safety representative has prepared a code of safe practices and an emergency plan in accordance with Cal/OSHA and other applicable requirements. Provide the Engineer with a copy of each prior to starting guided boring. Hold safety meetings and provide safety instruction for new employees as required by Cal/OSHA.
   7. Utility locate requests have been made through the California Underground Service Alert (USA) One-Call system and to all known and suspected utility owners who do not participate in the One-Call system. The Contractor shall confirm that all requested locates are made prior to commencing tunneling operations. Contractor shall review as-builts and conduct walkover site inspection for evidence of unmarked and mismarked utilities. Contractor shall confirm locations of all crossing and adjacent utilities within the tolerance zone defined in California One-Call law using accepted good practices as described in One-Call law and Common Ground Alliance Best Practices. Contractor shall implement good practices necessary to protect all utilities.

B. Furnish all necessary equipment, power, water, and utilities for equipment, pipe lubricant mixing and pumping, removal and disposal of spoil, and other associated work required for the Contractor's methods of construction.

C. Conduct all operations such that trucks and other vehicles do not create a dust or noise nuisance in the streets and adjacent properties. Promptly clean up, remove, and dispose of any spoil spillage.

D. All work shall be done so as not to disturb roadways, adjacent structures, landscaped areas, or utilities. Any damage shall be immediately repaired to the satisfaction of the Engineer at no additional cost to the Owner.

E. Notify the Engineer at least 15 days before beginning boring excavation.

F. Size and locate shafts to minimize interference with vehicular and pedestrian traffic. All equipment and operations must be contained within the allowable construction zones shown on the Drawings. All Work shall be in accordance with the applicable permits.

3.02 BORING

A. Pipe installation by boring shall be completed in accordance with the shop drawings, reviewed and accepted submittals, and permit conditions.

B. Boring machine shall meet the specified requirements of this section.

C. Provide a suitable jacking frame and thrust block or other means of providing thrust resistance to carry out the work.

D. The axial forces from the jacking frame shall be distributed to the pipe uniformly through a properly designed thrust adaptor to prevent damage to the ends of the pipe. The jacking system shall be capable of continuously monitoring the jacking pressure.

E. Pipes shall be jacked into position following the design line and grade of the pipeline without damaging the pipe. In the event a section of pipe is damaged during the jacking operation, the damaged section of pipe shall be removed. Methods of repairing the damaged pipe may be proposed, subject to approval by the Engineer.

F. Provide a lubrication system, and inject pipe lubricants through injection ports at the rear of the reaming head, as necessary, to minimize pipe friction.

G. Boring operations shall control surface settlement and heave above the pipeline to prevent damage to existing utilities, facilities, and improvements. The Contractor shall repair any damage resulting from construction activities, at no additional cost to the Owner and without extension of schedule for completion. The Contractor shall modify equipment and procedures as required to avoid recurrence of excessive settlements, heave, or damage.

H. The boring machine shall be operated to restrict the excavation of the materials to a volume equal to the boring head and pipe jacked, to prevent loss of ground and settlement or possible damage to overlying structures. Control the advance rate and monitor the volume of material excavated and adjust advance rate, as required, to avoid loss of ground, over-excavation, and surface heave.

I. Transport and dispose of all excavated materials properly away from the construction site. Solids shall be disposed of at acceptable facilities in accordance with current state regulations for disposal of these materials. Only use the disposal sites identified in the submittals for muck disposal.

3.03 CONTROL OF LINE AND GRADE

A. The benchmarks and control points indicated on the Drawings have been established in the field by the Owner. The Contractor shall verify these benchmarks by survey prior to the start of construction, and shall confirm positions or report any errors or discrepancies in writing to the Engineer.

B. After confirming all established survey control points, the Contractor shall use these control points to furnish and maintain all reference lines and grades for boring. The Contractor shall use these lines and grades to establish the location of the pipe

using a guidance system. Submit to the Engineer copies of field notes used to establish all lines and grades and allow the Engineer to check guidance set up prior to beginning boring. The Contractor remains fully responsible for the accuracy of the work and the correction of it, as required.

C. The jacking pipe shall be installed in accordance with the following tolerances:
   1. Variations from design line or grade: +/- 3 inches maximum.

D. If the pipe installation exceeds the specified tolerances, the Contractor shall correct the installation, including any necessary redesign of the pipeline or structures and acquisition of necessary easements. All corrective work shall be performed by the Contractor at no additional cost to the Owner and without schedule extension, and is subject to the written approval of the Engineer.

3.04 CLEANUP AND RESTORATION

A. After completion of the boring and pipe installation, all construction debris, slurry, oil, grease, and other materials shall be removed from the installed pipe, jacking and receiving shafts, and all Contractor work areas. Cleaning shall be incidental to the construction.

B. Restoration shall follow construction as the work progresses and shall be completed as soon as possible. Restore and repair any damage resulting from surface settlement or heave caused by shaft excavation or boring. Any property damaged or destroyed shall be restored to a condition equal to or better than existing prior to construction. Restoration shall be completed no later than 30 days after the pipe is in place along any boring segment.

END OF SECTION

[AD3] Addendum No. 3

SECTION 02240

DEWATERING - PLANT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Installation and maintenance of dewatering systems.
   2. Disposal of water entering excavation or other parts of the Work.

1.02 REFERENCES

A. National Electrical Manufacturers Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

1.03 SUBMITTALS

A. Dewatering plan:
   1. Dewatering design analysis.
   2. Required permits.
   3. Arrangement, location, and depths of dewatering system components.
   4. Type and sizes of filters.
   5. Identify proposed alignment, support, and protection for discharge pipe. Identify location of discharge and provide details for that location. For pipes discharging to manholes, provide details of pipe entry at manhole.

B. Well construction logs, including:
   1. Descriptions of actual materials encountered, categorized in accordance with Unified Soil Classification System.
   2. Construction details.
   3. Well development procedures and results.
   4. Deviations from original design.

C. Flowmeter:
   1. Product information on flowmeter and chart recorder.
   2. Recent flowmeter calibration documentation.
   3. Chart(s) from flowmeter chart recorder.

D. Qualifications:
   1. Dewatering contractor.
   2. Dewatering design engineer.
   3. Testing laboratory.

E. Control points and schedule of measurements:
   1. Location and details of control points and method and schedule of measurements.

2. All structures or facilities located within the radius of influence of the dewatering operation shall have control points established to detect any settlement which may develop.
3. Within 24 hours of constructing control points, survey and submit measurements at each control point. Submit copy of field notes with measurements.
4. Survey and submit measurements of control points every 7 days. Submit measurements within 24 hours. For each control point:
    a. Show current measurement and the change in measurement from first measurement taken.
    b. Show graphical plot of movements.

1.04 QUALITY ASSURANCE

A. Dewatering plan and dewatering system analysis:
1. Prepared by a qualified Civil Engineer, licensed in the state where the Project is located.
    a. The dewatering design engineer shall have at least 8 years of experience in designing similar systems.

B. Dewatering Contractor shall have at least 8 years of experience in installing similar systems.

C. Testing laboratory shall meet discharge permit testing laboratory qualifications.

D. Regulatory requirements:
1. Obtain required water discharge permits.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Flowmeter and chart recorder: The following or equal:
1. Badger Turbo Series Meter with totalizer.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Design requirements:
1. Keep excavations reasonably free from water. Draw down static groundwater level to minimum of 3 feet below anticipated bottom of excavations before the excavation reaches bottom elevation.
2. Dewatering design analysis. Include the following:
    a. Evaluation of anticipated subsurface conditions.
    b. Required well spacing.
    c. Diameter of wells.
    d. Depth to screen, screen height, and mesh size.
    e. Backfill and filter pack.
    f. Pump size.
    g. Drawdown duration.
    h. Drawdown and steady state flow rates.

i. Plans for de-silting of groundwater before discharge.
j. Anticipated area influenced by dewatering system and potential impacts to adjacent structures, existing and proposed. Mitigation measures needed to prevent any expected settlements. Contingency plan for restoring nearby structures if settlement is observed as result of dewatering operations.
k. Expected settlements.

3. Include water drawdown curves in dewatering calculations.
4. Coordinate dewatering design with excavation and shoring design. Excavation and shoring design shall consider changes in groundwater conditions and associated earth pressures.
5. Do not place concrete or masonry foundations or concrete slabs in water. Do not allow water to rise over these elements until concrete or mortar has set for at least 24 hours.
6. Maintain operation of dewatering system until complete structure -- including walls, slabs, beams, struts, and other structural elements -- has been constructed; concrete has attained its specified compressive strength; and backfill has been completed to finished grade.
7. Provide standby power to ensure continuous dewatering in case of power failure.

B. Dewatering shored excavations:
1. Dewater from within shoring.
2. Use impermeable shoring system to minimize lowering of groundwater outside shoring.
3. Extend impermeable shoring below bottom of excavation sufficient amount to:
a. Minimize lowering of groundwater outside shoring.
b. Prevent unstable excavation due to piping and heave.
4. To minimize settlement outside shoring due to dewatering, do not lower groundwater outside shoring more than 1 foot. Provide groundwater recharge if required to maintain this groundwater elevation outside of shoring.
5. Provide monitoring wells located outside shoring for monitoring groundwater elevation.

C. Obtain written permission from Engineer before locating wells, well points, or drain lines for dewatering within the limits of a structure’s foundation.

D. Locate dewatering facilities where they will not interfere with utilities and construction work to be performed by others.

E. Discharge:
1. Discharge water to the City of Ukiah Wastewater Treatment Plant (WWTP) influent channel in accordance with permits.

PART 3 EXECUTION

3.01 INSTALLATION

A. The responsibility for conducting the dewatering operation in a manner which will protect adjacent structures and facilities rests solely with Contractor.

B. During construction, provide and maintain ample means and devices to promptly remove and properly dispose of water entering excavation or other parts of the work, whether water is surface water or underground water.

C. Keep excavations reasonably free of water.

D. Make provisions to maintain continuous dewatering:
   1. Provide standby power to maintain dewatering during power outages and interruptions.
   2. Provide 24-hour monitoring by personnel skilled in operation and maintenance of the system, and capable of providing or obtaining work required to maintain system operation.

E. Monitoring wells:
   1. Provide at least 1 groundwater level monitoring well. If more than 4 dewatering wells or well points are installed, provide 1 additional monitoring well for every 4 dewatering wells or well points.
   2. Locate monitoring wells within 6 feet of excavation and mid-way between dewatering wells or well points.
   3. Provide temporary threaded cap, not less than 2 inches in diameter at the top of wells.
   4. Protect dewatering wells in place during excavation.

F. Intercept and divert precipitation and surface water away from excavations. Use dikes, curb walls, ditches, pipes, sumps, or other means acceptable to Engineer.

G. Disposal of water:
   1. Dispose of water from the work in suitable manner without damage to adjacent property.
   2. Do not drain water into work built or under construction.
   3. Properly dispose of discharge water in accordance with Federal, State, and local requirements and permits and in such manner that it will not be a menace to public health or safety.
   4. For discharge of water into holding tanks or infiltration ponds, include a means of overflow protection that is acceptable to Engineer.

H. Wells, well points, and drain lines for dewatering:
   1. Provide after receiving Engineer's written acceptance.
   2. Fill dewatering wells, pipes, and french drains to be left in place within structure foundation limits with Class “C” concrete as specified in Section 03300 - Cast-in-Place Concrete or grout as specified in Section 03600 - Grouting.

3.02 CONSTRUCTION

A. Prior to release of groundwater to its static level: Confirm that:
   1. All groundwater pressure relief devices for structure are fully operational.
   2. Construction of structure is complete and concrete has reached its specified compressive strength.
   3. Backfill of structure is complete.

B. Control release of groundwater to its static level to prevent disturbance of natural foundation soils or compacted backfills and fills and to prevent flotation or movement of structures, pipelines, or other facilities.

3.03 FIELD QUALITY CONTROL

A. Flowmeter and chart recorder:
   1. Provide flowmeter and continuous 24-hour chart recorder for recording dewatering flow.
   2. Maintain meter recorder and provide continuous reading charts with minimum capacity of 24 hours each.
   3. Calibrate flowmeter and recorder device to provide accuracy within 5 percent.
   4. Submit written evidence of calibration of meter and recorder signed by a Professional Engineer registered in the state where Project is located.
   5. Portable recorder (bench mount), dual scale, and mounted in NEMA Type 4X enclosure with transparent plastic door and latch. Operate unit off 115-volts, 60-Hertz power supply.
   6. Submit readings to the Engineer on a weekly basis.

B. Monitoring wells:
   1. Record groundwater levels at least once a week. Submit readings to Engineer within 1 week.

END OF SECTION

SECTION 02241

DEWATERING - LINEAR INFRASTRUCTURE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Requirements to dewater trench excavations.

1.02 REFERENCES

A. National Electrical Manufacturers Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1,000 V Maximum).

1.03 COORDINATION REQUIREMENTS

A. Coordinate the dewatering system design with excavation and shoring design.

B. Excavation and shoring design shall consider changes in groundwater conditions and associated earth pressures in compliance with project geotechnical report requirements.

C. Do not place concrete or masonry foundations or concrete slabs in water. Do not allow water to rise over these elements until concrete or mortar has set for at least 24 hours.
   1. Maintain operation of dewatering system:
      a. Until complete structure has been constructed, including walls, slabs, beams, struts, and other structural elements.
      b. Concrete has attained its specified compressive strength.
      c. Backfill has been completed to 3 feet above normal static groundwater level at the site.

1.04 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures and Section 01600 - Product Requirements.

B. Dewatering Plan.

C. Copies of correspondence with the authorities having jurisdiction, regarding dewatering operations, including but not limited to the authorization to drill, well driller's license, well driller’s permits, and completion report.

D. Well construction logs: Include the following at a minimum:
   1. Descriptions of actual materials encountered, categorized in accordance with the Unified Soil Classification System.
   2. Construction details.

3. Well development procedures and results.
4. Deviations from original design.

E. Submit a drainage encroachment permit.

F. Submit a Settlement Monitoring Plan.

G. Qualifications:
1. Dewatering Contractor.
2. Dewatering design Engineer.
a. Civil Engineer, licensed in state where the project is located.
b. Minimum experience: 8 years of experience in designing similar systems of equal type, size, and complexity to that required for the Work.
3. Testing laboratory.

H. Flowmeter:
1. Product information on flowmeter and chart recorder.
2. Recent flowmeter calibration documentation.
3. Flowmeter chart recorder.

1.05 CONTROLS

A. Dewatering shall be performed at the discretion of Contractor as approved by the Engineer.

B. Contractor shall demonstrate the system proposed and verify that adequate equipment, personnel, and materials are provided to dewater the excavations.

C. Contractor shall discharge water without damaging adjacent property, and in conformance with discharge permit and regulations, including meeting discharge limitation parameters.
1. Any penalties and fees due to Non-Conformance with permit shall be the responsibility of the Contractor.

D. Contractor shall control the rate and effect of the dewatering in such a manner as to avoid objectionable settlement and subsidence, defined shows settlement or damage that resulted from the dewatering.
1. Engineer has determined 1 inch as the maximum amount of settlement moving upward or downward at any monitoring point in comparison to the elevations taken during the baseline survey.
2. Operating wells for active dewatering shall not exceed a distance of 2,000 linear feet at a single trenching run and the discharge water volume must be within the terms of the discharge Permit.
a. Simultaneous dewatering at different trenching runs will be performed under the same discharge Permit and the cumulative discharge water volume is subject to the terms of the Permit.
3. Operating wells for active dewatering shall not exceed 90 days of continuous operation at a single trenching run.
a. At a time not longer than 80 days after the beginning of dewatering operations at a trenching run, if the Contractor believes that construction

cannot be completed within the specified 90-day limit, the Contractor shall notify the Engineer immediately.
    b. At that time, a meeting between the Contractor and the Engineer shall be scheduled to review settlement monitoring surveys and to discuss options in order to prevent damage to existing structures.
4. If survey monitoring during dewatering activities reveals settlement upward or downward of any monitoring point has reached 90 percent of this maximum settlement value the Contractor shall notify the Engineer immediately.
    a. At that time, a meeting between the Contractor and the Engineer shall be scheduled to review settlement monitoring surveys and to discuss options in order to prevent damage to existing structures.

E. Contractor shall be responsible for ensuring dewatering operations shall be adequate to ensure the integrity of the finished project.

1.06 SETTLEMENT

A. Establish reference points by a Professional Land Surveyor where critical structures or facilities exist immediately adjacent to areas of proposed dewatering.

B. Observe reference points at daily intervals by a Professional Land Surveyor to detect settlement.

C. Contractor shall implement a Settlement Monitoring Plan. The plan shall include, but not be limited to the following:
1. Contractor shall be responsible to install settlement monitoring points along those existing structures within the influence zone of the dewatering wells. The location and number of monitoring points including the method of establishing the points shall be approved by the Engineer prior to their installation.
2. Contractor shall utilize a land surveyor licensed in the State of California, to perform settlement monitoring surveys. The surveyor shall select a benchmark or control point to perform settlement surveys suitable to the Engineer that is outside of the influence zone of the dewatering system.
3. Contractor shall establish settlement monitoring points at maximum 200-foot intervals along the existing right-of-way on both sides of the construction areas for open cut pipelines.
4. Contractor shall establish settlement monitoring points at maximum 50-foot intervals along the existing right-of-way on both sides of the construction areas for tunneled pipelines; and 6 monitoring points by each launching or receiving shaft, 2 points on either side of shaft, 2 points on curb each side of roadway at the prescribed intervals for tunneling.
    a. Additional monitoring points to be identified by the Engineer, may be required at locations of critical structures.
    b. The settlement monitoring plan and the monitoring points shall be approved by the Engineer and installed prior to the initial start-up of the dewatering system.
5. Contractor/Owner shall perform a baseline survey of monitoring points prior to the start-up of the dewatering system and then perform a survey once weekly within the areas of active dewatering. A final survey shall also be performed at least 60 days after the decommissioning of the dewatering system.

6. Contractor shall furnish a report of the settlement monitoring elevations with cumulative elevation differences to the Engineer within 24 hours of the survey being performed.
    a. Contractor shall also furnish a final report including the results of all surveys at the end of the settlement monitoring period.
    b. Contractor shall notify the Engineer of the settlement monitoring schedule at least 7 days prior to the final settlement monitoring survey performed.

D. Contractor shall install monitoring wells to monitor the groundwater level:
1. Provide at least 1 groundwater level monitoring well. If more than 4 dewatering wells or well points are installed, provide 1 additional monitoring well for every 4 dewatering wells or well points.
2. Locate monitoring wells within 6 feet of excavation and mid-way between dewatering wells or well points.
3. Provide temporary threaded cap, not less than 2 inches in diameter at the top of wells.
4. Protect dewatering wells in place during excavation.

1.07 DEWATERING WELLS

A. Contractor shall design the well casing, screen slot size, and gravel filter pack according to applicable laws and regulations.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Contractor shall design the dewatering system to keep excavations reasonably free from water. Draw down static groundwater level to minimum of 3 feet below anticipated bottom of excavations before the excavation reaches bottom elevation.

B. Dewatering design and analysis. Include the following:
1. Evaluation of anticipated subsurface conditions.
2. Required well spacing.
3. Diameter of wells.
4. Drilling method and development technique.
5. Depth to screen, screen height, and mesh size.
6. Backfill and filter pack.
7. Pump size.
8. Drawdown curves.
9. Drawdown duration.
10. Drawdown and steady state flow rates.
11. Plans for treatment of groundwater treatment.
12. Plans for de-silting of groundwater before discharge.
13. Anticipated area influenced by dewatering system and potential impacts to adjacent structures, existing and proposed.
    a. Mitigation measures needed to prevent any expected settlements.
    b. Contingency plan for restoring nearby structures if settlement is observed as result of dewatering operations.
14. Expected settlement calculations.

C. Contractor shall include water drawdown curves in dewatering calculations.

D. Provide dewatering design sealed by a registered Professional Engineer, licensed in the project location.

2.02 DESIGN CRITERIA

A. Prior to excavation, submit a detailed Dewatering Plan and operation schedule for dewatering of excavations.

B. Create a Settlement Monitoring Plan and submitted to the Engineer for approval.

C. Design the dewatering system to keep excavations reasonably free from water.
   1. Select appropriate method to dewater, subject to Engineer's review and concurrence.
   2. Shored excavation dewatering as specified in Section 02318 - Trenching.
   3. Draw down static groundwater level to minimum of 3 feet below anticipated bottom of excavations before the excavation reaches bottom elevation.
   4. Dewatering analysis shall determine the following:
      a. Evaluation of anticipated subsurface conditions.
      b. Required well spacing.
      c. Diameter of wells.
      d. Depth to screen, screen height, and mesh size.
      e. Backfill and filter pack.
      f. Pump size.
      g. Drawdown curves.
      h. Drawdown duration.
      i. Drawdown and steady state flow rates.
      j. Plans for treatment of groundwater treatment.
      k. Settlement calculations.
   5. Prevent unstable excavation due to pumping and heave.
   6. Dewatering plan prepared by a professional Engineer licensed in the state where the project is located.
   7. Dewatering plan shall include, but not be limited to the following:
      a. Dewatering design analysis and supporting calculations.
      b. Required permits.
      c. Arrangement, location, and depths of dewatering system components including monitoring wells.
      d. Type of proposed pumps to be used and their locations.
      e. Header piping size, material, and piping alignments.
      f. Meter type and locations.
      g. Valve type and locations.
      h. Piezometer locations.
      i. Well casing and well screen materials.
      j. Gravel filter pack materials.
      k. Proposed discharge locations, as identified in this Section.
      l. Settling tanks and filters.
      m. Pipeline material, alignment, and connection details.
      n. Materials added to borehole during drilling and construction of wells.
      o. Sample and sieve analysis of well materials.

p. Settlement Monitoring Plan for existing above and underground structures adjacent to the dewatering system.
q. Standby pumping equipment.
r. Required power supply equipment.
s. Design of any needed water treatment facilities shall comply with the NPDES Discharge Permit.

D. Locate dewatering facilities where they will not interfere with utilities and construction work.

E. Contractor shall design and install a water treatment system if necessary to comply with discharge limitation parameters.

F. Decommissioning:
1. Contractor shall obtain Engineer's approval to begin decommissioning activities.
2. Contractor shall decommission and remove dewatering system.
3. Contractor shall abandon existing monitoring wells located along the alignment.

2.03 EQUIPMENT

A. Provide and maintain equipment necessary for dewatering.

B. Keep standby equipment available at all times to ensure efficient dewatering and maintenance of dewatering operation during power failure.

2.04 DEWATERING PUMPS

A. The preliminary well type and location are as indicated on the Drawings.

B. Pumps shall be specifically designed for dewatering applications where pumping sand may be encountered.
1. The impeller and rotor shaft shall be hardened, heat-treated stainless steel. The mechanical seal material shall be silicon carbide.
2. Pump motor shall have thermal overload protection.

2.05 FLOWMETER AND CHART RECORDER

A. Flowmeter and chart recorder: One of the following or equal:
1. Badger Turbo Series Meter with totalizer.

PART 3 EXECUTION

3.01 DEWATERING PROCEDURES

A. The designer of the dewatering system shall oversee dewatering operations.

B. Site grading shall promote drainage. Surface runoff shall be diverted away from excavations.

C. Complete dewatering prior to excavation.
   1. Ensure that the subsurface soil is not being removed by the dewatering operation.

D. Continue dewatering operations throughout construction to achieve the following:
   1. Maintain the groundwater level a minimum of 3 feet below bottom of excavation.
   2. Preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.

E. Contractor shall make provisions to maintain continuous dewatering.
   1. Provide standby power to maintain dewatering during power outages and interruptions.
   2. Provide 24-hour monitoring by personnel skilled in operation and maintenance of the system, and capable of providing or obtaining work required to maintain system operation.

F. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, excavate the affected areas and replaced with drain rock at no additional cost to Owner.

G. Maintain a trench bottom free from standing water.

H. Prevent flotation by maintaining a positive and continuous removal of water.

I. Contractor shall be fully responsible and liable for damages that may result from failure to adequately keep excavations dewatered.

J. Do not place concrete or masonry foundations or concrete slabs in water.
   1. Do not allow water to rise over these elements until concrete or mortar has set for at least 24 hours.

K. Maintain operation of dewatering system until the pipeline has been installed and backfill has been completed to finished grade 3 feet above normal static groundwater level at the site.

L. Wells, well points, and drain lines for dewatering:
   1. Obtain Engineer's written acceptance prior to commencing operations.
   2. Fill dewatering wells, pipes, and French drains to be left in place within structure foundation limits with Class “C” concrete as specified in Section 03300 - Cast-In-Place Concrete, or grout as specified in Section 03600 - Grouting.

3.02 SETTLEMENT AND GROUNDWATER LEVEL MONITORING

A. Conduct dewatering operation in a manner that will protect adjacent structures and facilities.

B. Repair damage to adjacent structures and restore facilities at no expense to Owner.

3.03 WATER DISPOSAL

A. Discharge water to nearest sanitary sewer manhole in accordance with the permits.

B. Dispose of water from the work in suitable manner:
   1. Without damage to adjacent property.
   2. That will not be a menace to public health or safety.

C. Do not drain dewatering water or associated debris into the Work built or under construction.

D. For discharge of water into holding tanks or infiltration ponds, include a means of overflow protection that is acceptable to the Engineer.

3.04 FIELD QUALITY CONTROL

A. Monitoring wells:
   1. Record groundwater levels at least once a week. Submit readings to Engineer within 1 week.

B. Flowmeter and chart recorder:
   1. Provide flowmeter and continuous 24-hour chart recorder for recording dewatering flow.
   2. Maintain meter recorder and provide continuous reading charts with minimum capacity of 24 hours each.
   3. Calibrate flowmeter and recorder device to provide accuracy within 5 percent.
   4. Submit written evidence of calibration of meter and recorder signed by a Professional Engineer registered in the state where Project is located.
   5. Portable recorder (bench mount), dual scale, and mounted in NEMA Type 4X enclosure with transparent plastic door and latch. Operate unit off 115-volts, 60-hertz power supply.
   6. Submit readings to the Engineer on a weekly basis.

END OF SECTION

SECTION 02260

EXCAVATION SUPPORT AND PROTECTION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for designing, providing, maintaining, and removing excavation support and protection.

1.02 REFERENCES

A. American Society of Civil Engineers (ASCE):
   1. Guidelines of Engineering Practice for Braced and Tied-Back Excavations.

B. California Code of Regulations (CCR):
   1. Title 8 - Industrial Relations:
      a. Division 1. Department of Industrial Relations:
         1) Chapter 4. Division of Industrial Safety:
            a) Subchapter 4. Construction Safety Orders:
               (1) Article 6. Excavations.

C. Department of the Navy Naval Facilities Engineering Command (NAVFAC):
   1. Design Manual 7.2 - Foundations and Earth Structures.
   2. Design Manual 7.3 - Soil Dynamics and Special Design Aspects.

D. State of California Department of Transportation (Caltrans):
   1. Caltrans California Trenching and Shoring Manual.

E. United States Steel Corporation (USS):
   1. Steel Sheet Piling Design Manual.

1.03 DEFINITIONS

A. General Engineering Design Practice: General engineering design practice in area of the Project, performed in accordance with recent engineering literature on subject of shoring and stability of excavations.

B. Shoring: A temporary structural system designed to support vertical faces, or nearly vertical faces, of soil or rock for purposes of excavation. Shoring includes cantilevered sheet piling, internally braced sheet piling, slurry walls, and other similar shoring systems. Sloping of the soil is not shoring.

C. Support levels: Level of tiebacks, wales, rakers, bottom of excavation, and other types of support.

1.04 SUBMITTALS

A. Shop drawings and calculations:
   1. Calculations for different load, support, and other conditions that occur during the sequence of installation of shoring, construction of facilities protected by shoring, and sequence of removal of shoring.
   2. Sketches showing the condition at various stages of installation and removal of shoring.
   3. Show on plan shoring, structures, pipelines, and other improvements located near shoring.
   4. When utilities penetrate shoring, show location of penetrations on elevation of sides of shoring.
   5. Show details for ground support and sealing around utility penetrations.
   6. Indicate method used for installing driven shoring.

B. Control points and schedule of measurements:
   1. Submit location and details of control points and method and schedule of measurements.
   2. Survey data.

C. Detailed sequence of installation and removal of shoring:
   1. Consider effects of ground settlement in sequence of installation and removal of shoring.
   2. Provide sketches showing conditions at various stages in sequence of installation and removal of shoring.

D. Submit submittals for excavation support and protection as complete package and include items required in this Section:
   1. Incomplete submittals will not be reviewed and will be returned for resubmittal as complete package.

E. Submit dewatering submittals as specified in Section 02240 - Dewatering with submittals for excavation support and protection.

1.05 SEQUENCING

A. Do not begin construction of any shoring or excavation operations until:
   1. Submittals for shoring and dewatering have been accepted.
   2. Control points as specified in this Section and on existing structures and other improvements as indicated on the Drawings have been established and surveyed to document initial elevations and locations.
   3. Materials necessary for installation are on site.

B. Submit submittals minimum of 60 days prior to scheduled date to begin excavation work.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Where general engineering design practice is specified, provide drawings and calculations that are performed and signed by civil or structural engineer registered in State where Project is located:
   1. Clearly disclose assumptions made, criteria followed, and stress values used for materials being used in design calculations.
   2. Submit list of references acceptable to Engineer that substantiating appropriateness of design assumptions, criteria, and stress values.

B. Design requirements:
   1. General:
      a. In accordance with requirements in CCR, Title 8, Chapter 4, Subchapter 4, Article 6 for trench excavations 5 feet or more in depth and for trenches less than 5 feet in depth when there is potential for cave-in.
         1) Where such designs vary from excavation support standards set forth in CCR, Title 8, Chapter 4, Subchapter 4, Article 6, submit design calculations pursuant to general engineering design practice.
         2) Provide means for safe and stable excavations that are not less effective than required in CCR, Title 8, Chapter 4, Subchapter 4, Article 6.
         3) The preceding requirements do not apply to trench excavation support conforming to standards set forth CCR, Title 8, Chapter 4, Subchapter 4, Article 6.
      b. Dewatering:
         1) Dewater soil inside shoring as specified in Section 02240 - Dewatering (Plant) and Section 02241 - Dewatering (Linear Infrastructure).
         2) Do not lower groundwater outside of shoring more than 1 foot.
         3) Recharge groundwater outside shoring to limit groundwater draw down outside of shoring to amount specified above.
      c. When electing to design with material stresses for temporary construction higher than allowable stresses prescribed in building code as specified in Section 01410 - Regulatory Requirements, increase in such stresses shall not exceed 10 percent of value of prescribed stresses.
      d. Minimum safety factor used for design shall not be less than 1.5.
      e. The calculated minimum depth of penetration of shoring below bottom of excavation shall be increased not less than 30 percent if full value of allowable passive pressure is used in design.
      f. Maximum height of cantilever shoring above bottom of excavation shall not exceed 15 feet. Use braced shoring when height of shoring above bottom of excavation exceeds 15 feet.
      g. The location of point of fixity for shoring shall not be less than half calculated minimum embedment depth below bottom of excavation.
      h. Generally acceptable references for design of shoring and excavations are as follows:
         1) ASCE Guidelines of Engineering Practice for Braced and Tied-Back Excavations.
         2) Caltrans California Trenching and Shoring Manual.

3) NAVFAC Design Manual 7.2.
4) NAVFAC Design Manual 7.3.
5) USS Steel Sheet Piling Design Manual.

i. Maximum total deflection of shoring at any point on shoring shall not be more than 1/4 inch.

2. Soldier piles and lagging:
   a. Provide lagging over full face of excavation. Joints between pieces of lagging shall be tight to prevent loss of soil.
   b. Provide full face lagging all around penetrations through lagging.
   c. If the soldier piles are installed in predrilled holes and are not concrete encased, fill predrilled holes with controlled low strength material as specified in Section 02312 - Controlled Low Strength Material (CLSM) after soldiers piles are installed.
   d. Assumed effective width for passive soil resistance:
      1) Effective width of driven soldier piles shall not exceed 2 times width of pile.
      2) Effective width of CLSM encased soldier piles in drilled holes shall not exceed 2 times width of pile.
      3) Effective width of concrete encased soldier piles shall not exceed 2 times width of concrete encasement.
   e. Fill voids behind lagging with gravel or other material acceptable to Engineer.
   f. Apply loads from tie back soil, rock, or deadman anchors concentrically to soldier piles or wales spanning between soldier piles:
      1) Wales shall be back-to-back double channels or other members acceptable to Engineer.
      2) Do not eccentrically load structural section of soldier piles or wales.
   g. Design soldier piles for downward loads including vertical loads from tieback anchors.
3. Set inside face of shoring back from structure not less than greater of following:
   a. 5 feet from face of wall.
   b. 2 foot 6 inches from edge of foundation.
   c. Depth of excavation below bottom of foundation.

C. Performance requirements:
   1. General:
      a. Support faces of excavations and protect structures and improvements in vicinity of excavations from damage and loss of function due to settlement or movement of soils, alterations in ground water level caused by such excavations, and related operations.
      b. Specified provisions:
         1) Complement, but do not substitute or diminish, obligations of Contractor for furnishing of safe place of work pursuant to provisions of the Occupational Safety and Health Act of 1970 and its subsequent amendments and regulations and for protection of Work, structures, and other improvements.
         2) Represent minimum requirement for:
            a) Number and types of means needed to maintain soil stability.

b) Strength of such required means.
c) Methods and frequency of maintenance and observation of means used for maintaining soil stability.

2. Provide safe and stable excavations by means of sheeting, shoring, bracing, sloping, and other means and procedures, such as draining and recharging groundwater and routing and disposing of surface runoff, required to maintain stability of soils and rock.
3. Provide support for trench excavations for protection of workers from hazard of caving ground.
4. Provide shoring:
   a. Where, as result of excavation work and analysis performed pursuant to general engineering design practice, as defined in this Section:
      1) Excavated face or surrounding soil mass may be subject to slides, caving, or other types of failures.
      2) Stability and integrity of structures and other improvements may be compromised by settlement or movement of soils, or changes in soil load on structures and other improvements.
   b. For trenches 5 feet and deeper.
   c. For trenches less than 5 feet in depth, when there is potential for cave-in.
   d. Where indicated on the Drawings.
5. For safe and stable excavations, use appropriate design, construction, and maintenance procedures to minimize settlement of supported ground and to prevent damage to structures and other improvements, including:
   a. Using stiff shoring systems.
   b. Following appropriate construction sequence.
   c. Using shoring system that is tight enough to prevent soil loss through the shoring.
   d. Using shoring system that extends far enough below bottom of excavation to prevent piping, heave, or flow of soil under shoring.
   e. Design for safety factor of not less than 1.50.
   f. Providing surface runoff routing and discharge away from excavations.
   g. Where dewatering inside shoring is necessary, recharge groundwater outside shoring as necessary to prevent settlement in area surrounding shored excavation.
   h. Where sheet piling is used, use interlocking type sheets:
      1) Sheet piles shall be continuous and driven in interlock.
      2) If bottom of the excavation is located below the water table, use “ball and socket” or "thumb and finger" type interlock.
   i. Not applying shoring loads to existing structures and other improvements.
   j. Not changing existing soil loading on existing structures and other improvements.
   k. Provide welded steel packing between soil retaining members such as sheet piles and wales and similar members when gap exceeds 1/4 inch before wales are loaded.

PART 3 EXECUTION

3.01 CONSTRUCTION

A. Installation of shoring:
   1. Install means for providing safe and stable excavations as indicated in submittals.

B. Removal of shoring:
   1. Except for slurry walls, and similar shoring systems, remove shoring by completion of Work.
   2. Select shoring system and method of removal, which will minimize soil that sticks to shoring from creating voids and causing settlement.
   3. To prevent settlement caused by pulling shoring, fill voids with pressure injected grout:
      a. Inject grout starting at bottom of void and progressively fill void to grade.
      b. Minimize length of shoring removed ahead of grouting operation and limit time void is left ungrouted to prevent void from closing up before being grouted.
   4. Pressure preservative treated wood lagging may be left in place if acceptable to Engineer.

C. Control points:
   1. Establish control points on shoring and on structures and other improvements in vicinity of excavation for measurement of horizontal and vertical movement:
      a. Set control points on shoring support system:
         1) Set points at distances not exceeding 25 feet at each support level.
   2. Promptly upon completion of construction of control points survey control points. Submit copy of field notes with measurement.
   3. Perform horizontal and vertical survey and measurement of control points at least once every week.
      a. Field notes shall show current measurement and change in measurement from first measurement taken.
   4. Set control points on corners of existing structures and on curbs, manholes, and other improvements at the locations indicated on the Drawings.
   5. Provide plumb bobs with horizontal targets indicating original position of plumb bobs in relation to shoring at control points.

D. Maintenance:
   1. Where loss of soil occurs, plug gap in shoring and replace lost soil with fill material acceptable to Engineer.
   2. Where measurements and observations indicate possibility of failure or excessive movement of excavation support, determined in accordance with general engineering design practice, take appropriate action immediately.

END OF SECTION

SECTION 02280

SUBSURFACE UTILITY ENGINEERING

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Requirements for subsurface utility engineering (SUE) as part of the Work for new pipelines.

1.02 REFERENCES

A. American Society of Civil Engineers (ASCE):
   1. 38-02 Standard Guideline for the Collection and Depiction of Existing and Subsurface Utility Data.

1.03 DEFINITIONS

A. General: Definitions used in this Section are in accordance with ASCE 38-02.

1.04 REQUIREMENTS

A. Existing utilities indicated on the Drawings are approximate only and are provided based on the best information available by use of record documents provided by the Owner and the geotechnical reports included as Appendices to the Specifications.

B. Existing utilities are shown for the convenience of Contractor only.
   1. It is the Contractor's responsibility to field verify the vertical and horizontal location of all utilities including those not indicated or incorrectly indicated on the Drawings.

C. Contractor is responsible to review all geotechnical reports, record drawings, and Contract Documents.

D. Coordinate with utility locator, such as CALL BEFORE YOU DIG, and other affected entities when they have jurisdiction over the project site.

E. Contractor is responsible for protecting all utilities encountered.
   1. Before any excavation, follow requirements of Section 01140 - Work Restrictions.
   2. If a conflict exists between what is indicated on the Drawings and what exists in the field, Contractor shall notify Engineer immediately.

F. Where scheduled, provide subsurface utility engineering services by a Civil Engineer registered in California in accordance with ASCE 38-02.

G. Requirements: The SUE shall entail the following at a minimum:
    1. Review of existing record drawings.
    2. Geophysical methods such as ground-penetrating radar.
    3. Soft excavation to locate known utilities along the proposed pipeline alignment.
    4. Open trench excavation to locate unknown utilities along the proposed pipeline alignment.
    5. Utilization of field survey by a Professional Land Survey licensed in California for determination of vertical and horizontal locations.

1.05 QUALIFICATIONS

A. General: Contractor shall utilize the services of a qualified subconsultant for SUE services with minimum qualifications that include but are not limited to:
    1. Minimum of 5 years of SUE experience in California where providing vertical and horizontal locations of utilities in accordance with ASCE 38-02 utility quality level A was required.
    2. Completion of 5 SUE projects of equal or greater magnitude within the past 5 years.

1.06 SUBMITTALS

A. Shop drawings:
    1. Contractor shall submit all SUE information as follows:
        a. Plan drawings that clearly illustrate vertical and horizontal location of known and unknown utilities.
            1) Horizontal location shall include northing and easting coordinates.
            2) Vertical locations shall include top of pipe elevations and top and bottom of duct bank elevations.
        b. Identifies size and material and service for known utilities.
        c. Identify size and material for unknown utilities.
    2. Review of shop drawings and calculations by Engineer and Owner are for record only.
    3. Drawings shall be performed, stamped, and endorsed by a Civil Engineer registered in California.
    4. Field survey information shall be performed, stamped, and endorsed by a Surveyor registered in California.

B. Detailed sequence of SUE:
    1. Submit a schedule for all SUE events that shows start, end, and intermediate milestones.
    2. Provide sketches showing the conditions at various stages in the sequence of SUE.

C. Submit submittals for stability of excavations as a complete package and include all items required in this Section.
    1. Incomplete submittals will not be reviewed and will be returned for resubmittal as a complete package.

1.07 SEQUENCING AND SCHEDULING

A. Coordinate all Work with restrictions provided in Section 01140 - Work Restrictions.

B. Do not begin Work until submittals have been accepted by Engineer and until equipment and materials necessary for installation are on site.

C. Submit submittals a minimum of 30 days prior to the scheduled date to begin excavation work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SUE SCHEDULE

A. Provide SUE services for the following pipelines and utilities located within the City of Ukiah Wastewater Treatment Plant (WWTP) or the City of Ukiah Water Treatment Plant (WTP).

Description	Facility	Reference Drawings
Existing Sludge Lines	WWTP	91C01
16-inch Recycled Water	WWTP	91C01, 91C07
30-inch Recycled Water	WWTP	91C01, 91C07
Duct Bank (Size Unknown)	WWTP	91C01, 91C06, 91C07, 91C08
City of Ukiah Electric Utility	WWTP	91C01, 91C06, 91C07
36-inch Final Effluent	WWTP	91C08
12-inch Existing Utility	WWTP	91C08
6-inch Drain	WWTP	91C08
2-inch Existing Utility	WWTP	91C08
4-inch Force Main	WWTP	91C08
14-inch Back Wash	WWTP	91C08
24-inch Final Effluent	WWTP	91C08
24-inch Wash Water	WWTP	91C08
18-inch CLCS Distribution	WTP	98C01
24-inch Transfer Pipe	WTP	98C01
24-inch Overflow	WTP	98C01
1.5-inch Non-Potable water	WTP	98C01

Description	Facility	Reference Drawings
6-inch Sanitary Sewer	WTP	98C01
21-inch Sanitary Sewer	WTP	98C01
16-inch Recycled Water	WTP	98C01

B. Provide SUE services for the following pipelines and utilities located adjacent to the Recycled Water Distribution System alignment. See Attachment A for this section.

END OF SECTION

ATTACHMENT A - SUBSURFACE UTILITY ENGINEERING - SCHEDULE

STREET LOCATION	APPROX. STATION	DWG #	UTILITY TYPE	SIZE	NOTES
Brush Street	A13+86	99C01	SS	21"	
Brush Street	A13+90	99C01	W	16"	
Brush Street	A16+88	99C01	W	Lat.	
Brush Street	A18+28	99C01	SS	6"	
Brush Street	A18+40	99C01	SS	15"	Parallel
Brush Street	A20+00	99C02	SS	15"	Parallel
Brush Street	A22+53	99C02	SS	6"	
Brush Street	A22+96	99C02	W	Lat.	
Brush Street	A24+49	99C02	SD	15"	
Brush Street	A24+95	99C02	W	Lat.	
Brush Street	A25+02	99C02	W	Lat.	
Brush Street	A26+72	99C02	G	Lat.	
Brush Street	A27+29	99C02	G	Lat.	
Brush Street	A27+20	99C02	SS	6"	
Brush Street	A27+46	99C02	W	Lat.	
Brush Street	A30+00	99C03	SS	15"	
Brush Street	A31+00	99C03	W	12"	Parallel
Brush Street	A32+00	99C03	SS	6"	
Brush Street	A32+12	99C03	SD	18"	
Brush Street	A32+44	99C03	W	Lat.	
Brush Street	A32+85	99C03	T	-	
Brush Street	A33+55	99C03	SS	15"	
Brush Street	A33+77	99C03	G	Lat.	
Brush Street	A35+62	99C03	W	Lat.	
Brush Street	A35+65	99C03	T	-	
Low Gap Road	A44+18	99C04	SS	12"	
Low Gap Road	A44+23	99C04	SS	6"	
Low Gap Road	A44+40	99C04	E	-	Parallel
Low Gap Road	A44+80	99C04	W	Lat.	
Low Gap Road	A45+23	99C04	W	Lat.	
Low Gap Road	A45+28	99C04	E	-	
Low Gap Road	A45+50	99C04	W	Lat.	
Low Gap Road	A45+63	99C04	G	Lat.	
Low Gap Road	A45+99	99C04	W	Lat.	
Low Gap Road	A46+00	99C04	SS	8"	Parallel
Low Gap Road	A46+50	99C04	W	Lat.	
Low Gap Road	A47+11	99C04	W	Lat.	
Low Gap Road	A47+72	99C04	W	Lat.	
Low Gap Road	A48+64	99C04	G	Lat.	
Low Gap Road	A49+49	99C05	W	Lat.	
Low Gap Road	A49+57	99C05	G	Lat.	
Low Gap Road	A49+65	99C05	T	-	
Low Gap Road	A49+73	99C05	E	-	
Low Gap Road	A50+06	99C05	SS	8"	
Low Gap Road	A50+11	99C05	SS	12"	

Low Gap Road	A50+17	99C05	G	Unk.	
Low Gap Road	A50+20	99C05	E	-	
Low Gap Road	A50+54	99C05	W	Lat.	
Low Gap Road	A51+31	99C05	W	Lat.	
Low Gap Road	A51+82	99C05	W	Lat.	
Low Gap Road	A52+09	99C05	G	2"	
Low Gap Road	A52+46	99C05	W	6"	
Low Gap Road	A53+12	99C05	G	Lat.	
Low Gap Road	A54+35	99C05	W	6"	
Low Gap Road	A54+38	99C05	SS	6"	
Low Gap Road	A54+46	99C05	G	2"	
Low Gap Road	A55+51	99C05	G	2"	
Low Gap Road	A56+22	99C05	W	Lat.	
Low Gap Road	A56+28	99C05	G	Lat.	
Low Gap Road	A57+53	99C05	Comm.	-	
Low Gap Road	A58+00	99C05	W	12"	Parallel
Low Gap Road	A58+20	99C05	SD	18"	
Low Gap Road	A58+30	99C05	E	-	
Low Gap Road	A58+47	99C05	W	8"	
Low Gap Road	A58+55	99C05	SS	8"	
Low Gap Road	A58+69	99C05	W	10"	
Low Gap Road	A58+71	99C05	E	-	
Low Gap Road	A58+76	99C05	G	Unk.	
Low Gap Road	A59+65	99C06	W	Lat.	
Low Gap Road	A59+68	99C06	W	Lat.	
Low Gap Road	A59+69	99C06	W	Lat.	
Low Gap Road	A59+72	99C06	W	Unk.	
Low Gap Road	A60+27	99C06	W	Unk.	
Low Gap Road	A60+77	99C06	W	Lat.	
Low Gap Road	A61+10	99C06	W	6"	
Low Gap Road	A61+40	99C06	W	Lat.	
Low Gap Road	A61+70	99C06	G	Lat.	
Low Gap Road	A62+14	99C06	G	Lat.	
Low Gap Road	A62+55	99C06	W	Lat.	
Low Gap Road	A62+91	99C06	SD	18"	
Low Gap Road	A64+38	99C06	E	-	
Low Gap Road	A64+46	99C06	W	Lat.	
Low Gap Road	A66+82	99C06	W	Unk.	
Low Gap Road	A67+62	99C06	E	-	
Low Gap Road	A67+86	99C06	Comm.	-	
Low Gap Road	A70+68	99C07	W	Lat.	
Low Gap Road	A77+07	99C07	Comm.	-	
Low Gap Road	A77+50	99C07	Comm.	-	
Low Gap Road	A77+55	99C07	SD	18"	
Low Gap Road	A79+90	99C08	G	Unk.	
Low Gap Road	A79+95	99C08	Comm.	-	
Low Gap Road	A79+98	99C08	E	-	

Despina Drive	A80+22	99C08	Comm.	-	
N Bush Street	B10+15	99C09	E	-	
N Bush Street	B10+96	99C09	SD	12"	
N Bush Street	B11+55	99C09	W	6"	
N Bush Street	B13+52	99C09	CATV	-	
N Bush Street	B13+67	99C09	Comm.	-	
N Bush Street	B13+79	99C09	E	-	
N Bush Street	B14+13	99C09	E	-	
N Bush Street	B17+00	99C09	G	Unk.	
N Bush Street	B18+13	99C09	E	-	
N Bush Street	B19+06	99C10	Comm.	-	
Arlington Drive	B19+92	99C10	G	Unk.	
Arlington Drive	B20+18	99C10	W	Lat.	
Arlington Drive	B20+79	99C10	W	Lat.	
Arlington Drive	B21+18	99C10	W	Lat.	
Arlington Drive	B21+80	99C10	W	Lat.	
Arlington Drive	B22+19	99C10	W	Lat.	
Arlington Drive	B22+50	99C10	G	Unk.	
Low Gap Road	C10+12	99C12	SS	8"	
Low Gap Road	C10+23	99C12	W	12"	
N Bush Street	C10+30	99C12	E	-	
N Bush Street	C10+31	99C12	G	Unk.	
N Bush Street	C10+39	99C12	Comm.	-	
N Bush Street	C11+38	99C12	W	Hyd.	
N Bush Street	C11+52	99C12	Comm.	-	
N Bush Street	C11+78	99C12	G	Unk.	
N Bush Street	C12+85	99C12	W	Hyd.	
N Bush Street	C15+46	99C12	W	Hyd.	
N Bush Street	C15+77	99C12	W	Lat.	
N Bush Street	C15+82	99C12	G	Unk.	
N Bush Street	C15+91	99C12	SS	6"	
N Bush Street	C16+27	99C12	SD	18"	
N Bush Street	C15+33	99C12	SD	12"	
-	C28+40	99C13	SD	18"	
-	C42+10	99C15	Utility	6"	
-	C46+40	99C15	SS	8"	
Maple Ave	C48+76	99C15	SS	6"	
Maple Ave	C48+85	99C15	G	Unk.	
Maple Ave	C48+87	99C15	G	Unk.	
Live Oak Ave	C53+08	99C16	SS	6"	MH Adjacent
Live Oak Ave	C53+19	99C16	W	8"	
Live Oak Ave	C53+24	99C16	W	8"	
Clubhouse Drive	C55+80	99C16	W	8"	
Clubhouse Drive	C56+80	99C16	W	Lat.	
Clubhouse Drive	C59+80	99C17	W	Hyd.	
Clubhouse Drive	C59+95	99C17	E	-	
Clubhouse Drive	C60+25	99C17	W	8"	

Clubhouse Drive	C60+95	99C17	W	Hyd.	
Park Boulevard	C63+95	99C17	SS	6"	
Park Boulevard	C64+00	99C17	W	6"	
Park Boulevard	C68+43	99C17	SS	8"	

SECTION 02300

EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Loosening, excavating, filling, grading, borrow, hauling, preparing subgrade, compacting in final location, wetting and drying, and operations pertaining to site grading for buildings, basins, reservoirs, boxes, roads, and other facilities.
   2. Backfilling and compacting under and around structures.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. Standard Specifications for Highway Bridges.

B. ASTM International (ASTM):
   1. D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method.
   2. D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3).
   3. D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.03 DEFINITIONS

A. Backfill adjacent to structure: Backfill within volume bounded by the exterior surfaces of structure, the surface of undisturbed soil in the excavation around structure, and finish grade around structure.

B. Embankments: Dikes, levees, berms, and similar facilities.

C. Excavation: Consists of loosening, removing, loading, transporting, depositing, and compacting in final location, wet and dry materials, necessary to be removed for purposes of construction of structures, ditches, grading, roads, and such other purposes as are indicated on the Drawings.

1.04 SUBMITTALS

A. Copy of Property Owner’s Agreement allowing placement of surplus soil material on their property.

B. Excavation plan:
   1. Describe/show planned conformance with excavation limits, dimensions, depths, and other constraints put forth in the Contract documents and Geotechnical report.
   2. Describe/show proposed shoring and excavation methods.

3. Describe/show how excavation process will be sequenced and coordinated.
4. If confined site, describe/show how access will be maintained to necessary areas during excavation process.
5. Describe/show proposed equipment and location of equipment placement, if critical to excavation stability.

C. Testing lab: Submit Contractor's proposed testing laboratory capabilities and equipment.

D. Test reports:
1. Submit certified test reports of tests specified to be performed by the Contractor.
2. Sign and seal test reports by a registered Geotechnical Engineer.

1.05 QUALITY ASSURANCE.

A. Initial compaction demonstration:
1. Adequacy of compaction equipment and procedures: Demonstrate adequacy of compaction equipment and procedures before exceeding any of following amounts of earthwork quantities:
a. 50 cubic yards of backfill adjacent to structures.
b. 100 cubic yards of embankment work.
c. 100 cubic yards of fill.
d. 50 cubic yards of roadway base material.
e. 100 cubic yards of road fill.
2. Compaction sequence requirements: Until specified degree of compaction on previously specified amounts of earthwork is achieved, do not perform additional earthwork of the same kind.
3. After satisfactory conclusion of initial compaction demonstration and at any time during construction, provide confirmation tests as specified under "FIELD QUALITY CONTROL."

B. Contractor shall perform work related to this Section in accordance with the approved Stormwater Pollution Prevention Plan (SWPPP).

1.06 SEQUENCING AND SCHEDULING

A. Schedule earthwork operations to meet requirements specified in this Section for excavation and uses of excavated material.

B. If necessary, stockpile excavated material in order to use it at specified locations.

C. Excavation, backfilling, and filling: Perform excavation, backfilling, and filling during construction in manner and sequence that provides drainage at all times.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Performance requirements:
   1. Where mud or other soft or unstable material is encountered, remove such material and refill space with stabilization material. Wrap stabilization material with stabilization fabric.
   2. Obtain acceptable import material from other sources if surplus obtained within Project site does not conform to specified requirements or are not sufficient in quantity.
   3. No extra compensation will be made for hauling of fill materials nor for water required for compaction.

2.02 MATERIALS

A. Water for compacting: Use water from source acceptable to Engineer.

B. Soil and rock materials:
   1. General:
      a. Provide aggregate base course, Class 2 permeable, controlled low-strength material, drain rock, gravel, native material, sand, select material, and stabilization material where specified or indicated on the Drawings.
      b. If suitable surplus materials are available, obtain native material and select material from cut sections or excavations or imported materials.
   2. Aggregate base course materials: As specified in Section 02050 - Soils and Aggregates for Earthwork.
   3. Class 2 permeable: As specified in Section 02050 - Soils and Aggregates for Earthwork.
   4. Drain rock: As specified in Section 02050 - Soils and Aggregates for Earthwork.
   5. Gravel: As specified in Section 02050 - Soils and Aggregates for Earthwork.
   6. Native material: As specified in Section 02050 - Soils and Aggregates for Earthwork.
   7. Sand: As specified in Section 02050 - Soils and Aggregates for Earthwork.
   8. Select material: As specified in Section 02050 - Soils and Aggregates for Earthwork.
   9. Stabilization material: As specified in Section 02050 - Soils and Aggregates for Earthwork.

C. Controlled low-strength material: As specified in Section 02312 - Controlled Low Strength Materials (CLSM).

D. Geotextile fabrics:
   1. Filter fabric: As specified in Section 02620 - Filter Fabric.
   2. Stabilization fabric: As specified in Section 02621 - Stabilization Fabric.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
   1. Character and quantity of material:
      a. Verify character and quantity of rock, gravel, sand, silt, water, and other inorganic or organic materials to be encountered in work to be performed.
      b. Determine gradation, shrinkage, and swelling of soil, and suitability of material for use intended in work to be performed.
      c. Determine quantity of material, and cost thereof, required for construction of backfills, cuts, embankments, excavations, fills, and roadway fills, whether from onsite excavations or imported materials. Include in cost of work to be performed.
      d. Include wasting of excess material, if required, in cost of work to be performed.

3.02 PREPARATION

A. Backfills:
   1. After clearing and excavation are completed, scarify entire areas that underlie backfills or structures to a depth of 6 inches and until surface is free of ruts, hummocks, and other features that would prevent uniform compaction by equipment to be used.
   2. Recompact scarified areas to density specified before placing backfill material or concrete.
   3. If foundation areas have cemented rock, cobbles, or boulders, do not scarify the top 6 inches prior to compaction. Moisten the native soil and compact the coarse fill as specified in this Section.
   4. Do not place backfill against walls until:
      a. Walls have been cast full height of structure and concrete has reached the specified strength.
      b. Connecting slabs and beams have been cast, and concrete has reached the specified strength.
   5. Prior to backfilling:
      a. Remove forms.
      b. Clean trash and debris from the excavation site.
   6. After inspection of foundation, walls, and pipes, place backfill symmetrically around structures to prevent eccentric loading of structures.

B. Embankments:
   1. After clearing is completed, scarify entire areas that underlie embankments to a depth of 6 inches and until surface is free of ruts, hummocks, and other features that would prevent uniform compaction by equipment to be used.
   2. Recompact scarified areas to density specified for embankments before placing of embankment material.

C. Fills:
   1. After clearing is completed, scarify entire areas that underlie fill sections or structures to a depth of 6 inches and until surface is free of ruts, hummocks,

and other features that would prevent uniform compaction by equipment to be used.
2. Recompact scarified areas to density specified for compacted fills before placing of fill material or concrete.

D. Roadway fills:
1. After clearing is completed, scarify entire areas that underlie roadway fills to a depth of 6 inches and until surface is free of ruts, hummocks, and other features that would prevent uniform compaction by equipment to be used.
2. Recompact scarified areas to density specified for roadway fills before placing of roadway fill material.

E. Sloped surfaces for fill or foundations:
1. Foundations for fill having slopes in excess of 1 vertical to 4 horizontal:
a. Bench or terrace to adequately key existing ground and fill built thereon.
2. Slopes of original hillsides and old fills: Bench minimum of 10 feet horizontally as fill is placed.
3. Provision of new benches:
a. Start new bench wherever vertical cut of next lower bench intersects existing grade.
b. Recompact material thus cut out along with new embankment material at no additional cost to the Owner.

3.03 INSTALLATION

A. General:
1. Dispose of excavated materials that are not required or are unsuitable for fill and backfill in lawful manner.
2. Dispose of surplus material on private property only when written permission agreement is furnished by owner of property. Submit copies of such agreements.
3. Rocks, broken concrete, or other solid materials larger than 4 inches in greatest dimension: Remove from project site at no additional cost to the Owner.
4. Stabilization of subgrade: Provide materials used, or perform work required, to stabilize subgrade so it can withstand loads that may be placed upon it by Contractor's equipment.
5. There will be no additional cost to the Owner for use of imported material.

B. Compaction:
1. Provide specified compaction for backfills, cuts, embankments, fills, roadway fills, and other earthwork.
2. Perform confirmation tests to verify and confirm that work has complied, and is complying at all times, with compaction requirements specified in this Section for initial compaction demonstration and field quality control testing.
3. In-place density of compacted backfills, cuts, embankments, fills, and roadway fills determined in accordance with ASTM D1556, or with ASTM D6938.
4. Maximum density, laboratory compaction: Soil maximum density and optimum water content when tested in accordance with ASTM D1557.
5. To prevent damage to structures due to backfilling operations, place backfill with equipment that does not exceed AASHTO Standard Specifications for

Highway Bridges, H-20 vehicle loading, within a distance from the face of the structure of not less than 1/2 the depth of backfill. The depth of backfill is the distance between the level being compacted and the bottom of the excavation. Outside this distance, heavier compaction equipment may be used.

6. Compact to percentage of maximum density as follows:
    a. Backfill adjacent to structures: 95 percent.
    b. Backfilling voids: 95 percent.
    c. Embankments: 95 percent.
    d. Demolition areas: As indicated on the Drawings.
    e. Other areas: 85 percent.
    f. Under present and future structures: 95 percent.
    g. Under roadways, parking and storage areas, curbs, and sidewalks: 95 percent.
    h. Upper 6 inches of cuts: 95 percent.
    i. Fills: 95 percent.

C. Dewatering: As specified in Section 02240 - Dewatering.

D. Excavation:
    1. Blasting: Not permitted.
    2. Excavations for trenching: As specified in Section 02318 - Trenching.
    3. Excavations for structures:
        a. Provide excavations conforming to dimensions and elevations indicated on the Drawings for each structure.
        b. After clearing is complete, excavate for the structure, down to the elevation indicated on the Drawings. Unless directed by Engineer, do not carry excavations below elevation indicated on the Drawings.
        c. Where soil is encountered having unsuitable bearing value, Engineer may direct in writing that excavation be carried to elevations below those indicated on the Drawings.
        d. Where excavations are made below elevations indicated on the Drawings, adjust elevations of excavations in accordance with the following requirements:
            1) Under slabs: Restore to proper elevation in accordance with procedure specified for backfill in this Section.
            2) Under footings: Restore to the proper elevation using one of the following:
                a) Aggregate base course.
                b) Controlled low-strength material.
        e. Excavation width:
            1) Extend excavations at least 2 feet clear from walls and foundations of structures to allow for placing and removal of forms, installation of services, and inspection.
            2) Do not undercut slopes.
        f. Difficulty of excavation: No extra compensation will be made for removal of rock or any other material due to difficulty of excavation.

4. Excavation of lined channels:
    a. Excavations in open cut for lined channels may be made so as to place concrete directly against excavated surfaces providing faces of excavations are:
        1) Firm and unyielding.
        2) Will stand or can be made to stand without sloughing.
    b. Excavations to provide subgrade for lined channel or subdrainage material: Excavate to lines and grades indicated on the Drawings.
5. Excavation of unlined channels and basins:
    a. Excavate to lines and grades indicated on the Drawings.
    b. Perform excavation and grading so that finish surfaces are in uniform planes with no abrupt breaks in surface.
6. Excavation of ditches and gutters:
    a. Cut ditches and gutters accurately to cross sections and grades indicated on the Drawings.
    b. Take care not to excavate ditches and gutters below grades indicated on the Drawings.
    c. Backfill excessive ditch and gutter excavations to grade with suitable material acceptable to the Engineer.
    d. Do not deposit any material within 3 feet of edge of ditch unless otherwise indicated on the Drawings.
7. Necessary over excavation:
    a. Where it becomes necessary to excavate beyond normal lines of excavation in order to remove boulders or other interfering objects, backfill voids remaining after removal as specified in backfilling of voids below, or as acceptable to the Engineer.
    b. Backfill voids with material acceptable to the Engineer:
        1) With acceptance of the Engineer, backfill with one of the following:
            a) Aggregate base course.
            b) Controlled low-strength material.

E. Materials for backfills, embankments, fills, and roadway fills:
1. General:
    a. Obtain import material from other sources if surplus materials from cuts and excavations obtained from within Project site do not conform to specified requirements or are not sufficient in quantity for construction of Project.
2. Backfills:
    a. Backfill adjacent to structures, slabs, or walls: Native material or imported material meeting the requirements of native material, unless otherwise specified or indicated on the Drawings.
    b. Backfill material under concrete structures: Aggregate base course material, except in areas where controlled low-strength material or concrete encasement are indicated on the Drawings.
    c. Extend backfill in any area under concrete structures from undisturbed soil or rock to the bottom aggregate base course material layer.
3. Embankments:
    a. Native material or imported material meeting the requirements of native material, unless otherwise specified or indicated on the Drawings.

4. Fills:
    a. Native material or imported material meeting the requirements of native material, unless otherwise specified or indicated on the Drawings.
    b. Extend fill in any area under concrete structures from undisturbed soil or rock to the bottom aggregate base course material layer.
5. Roadway fills: One of the following, unless otherwise specified or indicated on the Drawings:
    a. Aggregate base course material.

F. Placement:
1. General:
    a. Lines and grades:
        1) Construct backfills, embankments, fills, and road fills, at locations and to lines and grades indicated on the Drawings.
        2) Overbuild permanent fill slopes by at least 1 foot and then cut to final grade to provide adequate compaction of the remaining fill.
2. Backfills:
    a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
    b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
    c. Defective compacted backfills: Remove and recompact.
3. Fills:
    a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
    b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
    c. Defective compacted fills: Remove and recompact.
4. Embankments:
    a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
    b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
    c. Defective compacted embankments: Remove and recompact.
5. Roadway fills:
    a. Place loose material in successive layers that do not exceed 8 inches in depth after compaction.
    b. Bring each layer to a moisture content between optimum moisture content and 3 percent above optimum moisture content before compacting.
    c. Defective compacted roadway fills: Remove and recompact.
6. Loose fill:
    a. In disposal areas: In disposal areas as indicated on the Drawings, bring fill up in an essentially level layer over entire spoil area indicated:
        1) Continue filling spoil area until disposal of surplus excavated material is completed.
        2) Slope edges of fill area at between 1 and 2 horizontal to 1 vertical to the intersection with existing grade.
        3) Provide slopes that are smooth and uniform.
        4) Level finished surface of disposal area to within 4 inches of elevation indicated on the Drawings.

b. Clods or hard lumps of earth of 6 inches in greatest dimension: Break up before compacting material in embankments, except as provided as follows:
    1) When fill material includes large rocky material or hard lumps, such as hardpan or cemented gravel which cannot be broken readily, distribute such material throughout fill.
    2) Place sufficient earth or other fine material around larger material as it is deposited so as to fill interstices and produce dense, compact fill. Do not place such material within 2 feet of finish grade of fill.

3.04 FIELD QUALITY CONTROL

A. Confirmation tests:
    1. Contractor's responsibilities:
        a. Adequacy of compaction equipment and procedures:
            1) Demonstrate adequacy of compaction equipment and procedures.
            2) At each test location include tests for each type or class of backfill from bedding to finish grade.
        b. Compaction sequence requirements:
            1) Do not perform additional earthwork of the same kind until specified degree of compaction has been demonstrated.
        c. Cost of confirmation tests: Paid for by the Contractor.
        d. Qualifications of Contractor's testing laboratory: Acceptable to Engineer.
        e. Copies of confirmation test reports: Submit promptly to the Engineer.
    2. Frequency of confirmation testing:
        a. Frequency of confirmation testing:
            1) Perform testing not less than the following:
                a) In-place density:
                    (1) Backfill: 50 cubic yards (CY).
                    (2) Embankment: 100 CY.
                    (3) Roadway fills: 50 CY.
        b. Maximum dry density versus moisture:
            1) Backfill: 200 CY.
            2) Cuts: 200 CY.
            3) Embankments: 200 CY.
            4) Fills: 200 CY.
            5) Roadway fills: 200 CY.
        c. Cost of confirmation tests:
            1) Paid for by the Contractor.
        d. Qualifications of Contractor's testing laboratory:
            1) Perform confirmation testing by soils testing laboratory acceptable to the Engineer. Copies of confirmation test reports: Submit promptly to the Engineer.

B. Tolerances:
    1. Finish grading of backfills, cuts, embankments, fills, and roadway fills:
        a. Perform fine grading under concrete structures such that finish surfaces are never above the grade or cross section indicated on the Drawings and are never more than 0.10 feet below.
        b. Provide finish surface for areas outside of structures that are within 0.10 feet of grade or cross section indicated on the Drawings.

2. Unlined channels and basins:
    a. In both cut and fill, and levee and access road side slopes in cut: Vertical tolerance of none above and 3 inches below grade indicated on the Drawings on bottom and side slopes.
    b. On top surface of levee and access road in both cut and fill, and levee and access road side slopes in fill: Vertical tolerance of none below and 3 inches above grade indicated on the Drawings.
3. Areas which are not under structures, concrete, asphalt, roads, pavements, sidewalks, dikes, and similar facilities:
    a. Provide finish graded surfaces of either undisturbed soil, or cohesive material not less than 6 inches deep.
    b. Intent of proceeding is to avoid sandy or gravelly areas.
4. Finish grading of surfaces:
    a. Reasonably smooth, compacted, and free from irregular surface changes.
    b. Provide degree of finish that is ordinarily obtainable from blade grader operations, except as otherwise specified.
    c. Uniformly grade areas that are not under concrete.
    d. Finish ditches and gutters so that they drain readily.

C. Compliance tests:
1. Frequency of testing: Periodic compliance tests will be made by the Engineer to verify that compaction is meeting requirements previously specified.

3.05 ADJUSTING

A. Finish grades of excavations, backfills, and fills:
1. Repair and reestablish grades to required elevations and slopes due to any settlement or erosion that may occur from action of the elements or any other cause prior to final acceptance.

3.06 PROTECTION

A. Finish grades of backfills, cuts, excavations, and fills:
1. Protect newly graded areas from erosion and deterioration by action of the elements.

B. Ditches and gutters:
1. Maintain ditches and gutters free from detrimental quantities of debris that might inhibit drainage until final acceptance.

END OF SECTION

SECTION 02301

LINED POND EARTHWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Loosening, excavating, filling, grading, borrow, hauling, preparing subgrade, compacting in final location, wetting and drying, and operations pertaining to lined recovery pond earthwork.
   2. The compacted pond liner shall be a minimum of 18 inches.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soils Using Standard Effort (12,400 ft-lbf/ft3).
   2. D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m).
   3. D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth).

1.03 DEFINITIONS

A. Excavation: Consists of satisfactory loosening, removing, loading, transporting, depositing, and compacting in final location, wet and dry materials, necessary to be removed for purposes of construction, or as required for the pond liners at the Recovery Ponds, and such other purposes as are indicated on the Drawings.

B. In-place density of compacted backfill and pond liner: Density determined in accordance with ASTM D698, ASTM D1557, or with ASTM D6938.

C. Maximum Density: Is density obtained in laboratory when tested in accordance with ASTM D698.

1.04 SUBMITTALS

A. General: Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: Submit material source, gradation, and testing data for materials, including imported and on-site materials.

C. Excavation plan: Submit proposed excavation plan.

D. Testing lab: Submit Contractor's proposed testing laboratory capabilities and equipment.

E. Test reports:
   1. Submit certified test reports of tests specified to be performed by Contractor.
   2. Test reports shall be signed and sealed by a registered geotechnical engineer in the state of California.

1.05 QUALITY ASSURANCE

A. Initial compaction demonstration:
   1. Adequacy of compaction equipment and procedures: Demonstrate adequacy of compaction equipment and procedures before exceeding any of following amounts of earthwork quantities:
      a. 100 cubic yards of pond work.
      b. 50 cubic yards of roadway base material.
   2. Compaction sequence requirements: Until specified degree of compaction on previously specified amounts of earthwork is achieved, do not perform additional earthwork of the same kind.
   3. After satisfactory conclusion of initial compaction demonstration and at any time during construction, provide confirmation tests as specified under "FIELD QUALITY CONTROL."

1.06 SEQUENCING AND SCHEDULING

A. Schedule earthwork operations to meet requirements as provided in this Section for excavation and uses of excavated material.

B. If necessary, stockpile excavated material in order to use it in specified locations.

C. Excavation and filling: Perform excavation and filling, during construction, in manner and sequence that provides drainage at all times.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Performance requirements:
   1. Where mud or other soft or unstable material is encountered, remove such material and refill space with select material or gravel which can be compacted with no perceptible movement under roller.
   2. No extra compensation will be made for hauling of excavated or fill materials nor for water required to compact fills.
   3. Pond and roadway fills:
      a. Unless otherwise specified, material shall be as follows:
         1) Roadways Associated with Recovery Ponds: Caltrans Standard Specification for Type B flexible base as specified in Section 02050 - Soil and Aggregates for Earthwork and as indicated on the Drawings.

2) Pond liner:
a) May be acceptable surplus material from excavation for structures or other.
b) Compacted depth of the pond liner shall be minimum of 18 inches.
3) Other fill: Fills other than roadway fill associated with the pond or pond fill shall be as specified in Section 02300 - Earthwork.

b. Whatever source is used, provide fill material conforming with specified requirements.
c. Obtain acceptable material from other sources if surplus or borrow materials obtained within Project site do not conform to specified requirements or are not sufficient in quantity for construction of embankments.

4. Compacted fills:
a. Provide specified compaction for backfill, fill, and other earthwork.
b. Perform confirmation tests to verify and confirm that work has complied, and is complying at all times, with requirements specified in this Section concerning initial compaction demonstration, and field quality control testing.

2.02 MATERIALS

A. Water for compacting fills: Use water from source acceptable to Engineer.

B. Fill materials:
1. General:
a. Provide impermeable select material, and native material, where required for fill and backfill.
b. Obtain material for fills from cut sections or from borrow source.
c. Provide material having maximum particle size not exceeding 3 inches and that is free of trash, lumber, debris, leaves, grass, roots, stumps, and other vegetable matter.
2. Impermeable pond liner:
a. Excavated clay and silty clay materials free of roots, organic matter, trash, debris, rocks larger than 3 inches, or other deleterious materials and having a liquid limit greater than 30 and a plasticity index greater than 15 with more than 40 percent passing a No. 200 sieve.
b. Provide imported material of equivalent quality, if required to accomplish the work.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
1. Character and quantity of material:
a. Verify character and quantity of water, and other inorganic or organic materials to be encountered in work to be performed.
b. Determine gradation and shrinkage of excavation and fill material, and suitability of material for use intended in work to be performed.

c. Determine quantity of material, and cost thereof, required for construction of excavations and fills, whether from on-site excavations, borrow areas, or imported materials. Include in cost of work to be performed.
d. Include wasting of excess material, if required, in cost of work to be performed.

3.02 PREPARATION

A. Surface preparation:
1. Preparing sloped surfaces for fill or foundations:
a. Foundations for fill having slopes in excess of 1 vertical to 4 horizontal:
1) Bench or terrace to adequately key existing ground and fill built thereon.
b. Slopes of original hillsides and old fills: Bench minimum of 4 feet horizontally as fill is placed.
c. Provision of new benches:
1) Start new bench wherever vertical cut of next lower bench intersects existing ground.
2) Recompact material thus cut out along with new embankment material at no additional cost to the Contract.

B. Dewatering: Dewatering of pond excavation area shall be as specified in Section 02240 - Dewatering.

3.03 APPLICATION

A. General:
1. Dispose of excavated materials which are not required or unsuitable for fill and backfill in disposal sites indicated on the Drawings.
2. Obtain material required for fills in excess of that produced by excavation from borrow areas subject to the fill material requirements specified in this Section.
3. Rocks, broken concrete, or other solid materials larger than 3 inches in greatest dimension shall not be placed in fill areas, but removed from project site at no additional cost to the Contract.
4. Stabilization of subgrade: Provide materials used or perform work to stabilize subgrade so it can withstand loads which may be placed upon it by Contractor's equipment.

B. Excavation:
1. Excavation of lined ponds:
a. Excavated areas shall be firm and unyielding.
b. Excavated areas shall stand or can be made to stand without sloughing.
2. Necessary over-excavation:
a. General:
1) Where it becomes necessary to excavate beyond normal lines of excavation in order to remove boulders or other interfering objects, backfill voids remaining after removal as specified in Backfilling of Voids, or as acceptable to Engineer.
2) Perform necessary excavation beyond normal lines as specified above and backfill such voids.

b. Backfilling of voids:
1) Fill voids with suitable material acceptable to Engineer, placed in manner and to same uniform density as surrounding material.

C. Compaction:
1. General:
a. Lines and grades:
1) Construct fills, embankments, and backfills, designated in this Section as fills, at locations and to lines and grades indicated on the Drawings.
2) The clay liner shall extend up the slope to a minimum of the road edge around the pond or the top of the slope, whichever is greater.
b. If borrow sources are not available within project (plant) site, Contractor shall provide necessary imported fill material from outside sources.
c. Compacted fill shape and sections: Provide completed fill that corresponds to shape indicated on the Drawings or that meets requirements for particular case.
d. Preparation of areas designated to receive fill material: Scarify to minimum depth of 6 inches, unless otherwise indicated on the Drawings, and recompact to density of fill material as specified in following Article.
e. Moisture content: Bring each layer to optimum moisture content for maximum density before compaction.
f. Placing compacted fills and pond liner:
1) Placement:
a) Place loose material in successive lifts that do not exceed 8 inches in depth after compaction.
b) Each lift shall be compacted to not less than 95 percent relative compaction based on ASTM D698.
c) Surfaces between lifts shall be lightly scarified to promote bonding.
d) Liner material shall begin on the pond bottom and shall be progressively placed working up the slope and into benched areas.
e) Embankments: Each 8-inch lift shall be keyed into the existing cut slope or previously constructed embankment by excavating shallow benches, full 8-inch lift height, into the existing slope to expose a firm, moist surface for bonding with the new embankment just prior to placing the next layer of clay liner.
f) The compacted pond liner shall be constructed beyond the proposed line and grade a sufficient distance to allow the slope to be trimmed to a compacted surface at the proposed line and grade.
2. Defective compacted fills: Remove and recompact.

3.04 FIELD QUALITY CONTROL

A. Tests:
1. Confirmation tests:
a. Contractor's responsibilities:
1) Accomplish specified compaction for backfill, fill, and other earthwork.

2) Control operations by confirmation tests to verify that compaction work complies, and is complying at all times, with requirements specified in this Section concerning compaction, control, and testing.
3) Cost of confirmation tests: Paid for by Contractor.
4) Qualifications of Contractor's testing laboratory: Perform confirmation testing by soils testing laboratory acceptable to Engineer.
5) Copies of Confirmation Test Reports: Submit promptly to Engineer.

b. Frequency of confirmation testing:
1) Perform testing not less than as follows:
a) 1 in-place soil density test every 10,000 square feet (approx. every 250 cubic yards) of placed material per lift.
b) Minimum of 3 soil density tests per lift.
c) 1 PI test and 1 No. 200 sieve analysis every 20,000 square feet (approx. every 500 cubic yards) of placed material per lift.
d) Minimum of 2 PI tests per lift.

2. Compliance tests:
a. Frequency of testing: Periodic compliance tests will be made by Engineer to verify that compaction is meeting requirements previously specified.
1) Coordination with Engineer's testing: Remove overburden above level at which the Engineer wishes to test and backfill and recompact excavation after testing is completed.
2) If compaction fails to meet specified requirements, perform remedial work by one of the following methods:
a) Remove and replace backfill at proper density.
b) Bring density up to specified level by other means acceptable to Engineer.
c) Retesting: Costs of retesting: Costs of retesting required to confirm and verify that remedial work has brought compaction within specified requirements shall be borne by Contractor.

B. Tolerances:
1. Excavation of ponds:
a. In both cut and fill: Vertical tolerance of none above and 3 inches below specified grade will be allowed on bottom and side slopes.

3.05 ADJUSTING

A. Finish grades of excavations, backfilling and fill:
1. Repair and reestablish grades to required elevations and slopes due to any settlement or washing way that may occur from action of the elements or any other cause prior to final acceptance.

3.06 PROTECTION

A. Finish grades of excavations, backfilling and fill:
1. Protect newly graded areas from action of the elements.

END OF SECTION

SECTION 02312

CONTROLLED LOW STRENGTH MATERIAL (CLSM)

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Controlled low strength material (CLSM), also known as "flowable fill."

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 229R - Report on Controlled Low-Strength Materials.
   2. 301 - Specifications for Structural Concrete.

B. ASTM International (ASTM):
   1. C33 - Standard Specification for Concrete Aggregates.
   2. C94 - Standard Specification for Ready Mix Concrete.
   3. C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
   4. C150 - Standard Specification for Portland Cement.
   5. C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
   6. C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
   7. D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3(600 kN-m/m^3).
   8. D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN-m/m^3)).
   9. D4832 - Standard Test Method of Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
   10. D5971 - Standard Practice for Sampling Freshly Mixed Controlled Low Strength Material.
   11. D6023 - Standard Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material.

1.03 SUBMITTALS

A. Product data: Submit data completely describing materials in the mix and demonstrating compliance with the requirements of this Section:
   1. Cement: Mill tests. Indicate alkali content representative of each shipment.
   2. Fly ash: Identify source and type of fly ash.
   3. Water: Identify source and quality if not from a municipal treatment source.
   4. Admixtures: Manufacturer’s product data indicating suitability for use in CLSM mixes and recommended dosage rates.
   5. Aggregate:
      a. Submit source, type, and sieve analyses. Include testing to demonstrate that materials in accordance with ASTM C33 requirements.
      b. Resubmit at any time there is a significant change in grading of materials.

B. Mix design:
   1. Submit full details, including mix design calculations for mix proposed for use.
   2. Trial batch test data:
      a. Submit data for each test cylinder.
      b. Submit data that identifies mix and slump for each test cylinder.

1.04 DELIVERY, STORAGE AND HANDLING

A. Store or stockpile cement, fly ash, and aggregate in accordance with ACI 301.

B. Store admixtures in accordance with the manufacturer's recommendations.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Mixture of portland cement, water, pozzolan, fine aggregate and admixtures, proportioned in accordance with the recommendations of ACI 229 to produce a homogeneous mixture that is flowable, that will readily work into corners and angles; that will not segregate in the plastic state; and that is self-compacting at the time of placement without the use of mechanical vibration.

B. Performance requirements:
   1. Air content, total calculated in accordance with ASTM D6023: Not less than 8.0 percent, nor greater than 12.0 percent.
   2. Compressive strength, measured in accordance with ASTM D4832 at 28 days: Not less than 50 pounds per square inch, nor greater than 150 pounds per square inch.
   3. Wet density: Not greater than 132 pounds per cubic foot.
   4. Slump, measured in accordance with ASTM C143 at the point of placement: Greater than 9 inches and that allows CLSM to flow freely and to be self-compacting during placement.

2.02 MATERIALS

A. Cement:
   1. Portland cement in accordance with ASTM C150, Type II.
   2. Having total alkali content not more than 0.60 percent.

B. Fly ash: Class C or Class F fly ash in accordance with ASTM C618.

C. Water:
   1. Potable water: Clean and free from oil and deleterious amounts of alkali, acid, organic matter, or other substances.

D. Admixtures: Products of a single manufacturer, specifically manufactured or recommended by that manufacturer for use in CLSM.
   1. Air entraining admixture: In accordance with ASTM C260.

E. Aggregate:
   1. Non-expansive, non-reactive, inert natural sand in accordance with ASTM C33 for fine aggregate.

2.03 MIXES

A. See Design and Performance Criteria for performance requirements of the plastic and hardened mix.

2.04 SOURCE QUALITY CONTROL

A. Trial batch:
   1. After mix design has been accepted by Engineer, have trial batch of the accepted mix design prepared by testing laboratory acceptable to Engineer.
   2. Prepare trial batches using the specific cement, fly ash, admixtures, aggregates, and water proposed for the Work.
   3. Prepare trial batch with quantity sufficient to determine slump, workability, and consistency; and to provide test cylinders as indicated in this Section.

B. Trial batch testing:
   1. Determine slump in accordance with ASTM C143, with the following modifications:
      a. Do not rod the concrete material.
      b. Place material in slump cone in one semi-continuous filling operation, slightly overfill, tap lightly, strike off, and then measure and record slump.
   2. Prepare and test trial batch specimens in accordance with ASTM D4832, with the following modifications:
      a. Provide cylindrical test specimens, each 6-inches in diameter by 12-inch high.
      b. Provide a minimum of 8 cylinders for testing of each trial batch.
      c. Fill the molds to overflowing and tap sides lightly to settle the mix.
      d. Do not rod the mix for consolidation in the cylinder.
      e. Strike off the excess material.
   3. Place test cylinders in a moist curing room. Exercise caution in moving and transporting the cylinders since they are fragile and will withstand only minimal bumping, banging, or jolting without damage.
   4. Do not remove the test cylinder from mold until that cylinder is to be capped and tested.
      a. Perform the capping carefully to prevent premature fractures.
      b. Do not perform initial compression test until the cylinders reach a minimum age of 3 days.
   5. Provide compressive strength tests:
      a. Test 4 test cylinders at 7 days after casting, and another 4 cylinders at 28 days after casting.
      b. The compression strength of the 4 test cylinders tested at 28 days shall be equal to or greater than the minimum required compression strength, but shall not exceed maximum compression strength.

C. If the trial batch tests do not meet the Specifications for strength or density, revise and re-submit the mix design, prepare additional trial batch(es), and complete

additional trial batch tests. Repeat until an acceptable trial batch is that conforms to the Specifications is produced.

1. All the trial batches and acceptability of materials shall be paid by the Contractor.
2. After acceptance, do not change the mix design without submitting a new mix design, trail batches, and test information.

PART 3 EXECUTION

3.01 PREPARATION

A. Do not place CLSM until preparation and condition of surfaces receiving the fill have been observed and accepted by the Engineer.

B. Remove debris foreign matter, and standing or running water from excavations and areas receiving CLSM before placement.

3.02 INSTALLATION

A. Pipes and trenches:
   1. Install cellular concrete as indicated on the Drawings and specified.
   2. Where CLSM is placed around and over pipes, secure pipes in place, or place CLSM in lifts to prevent pipe flotation.
   3. Where CLSM is placed in long, open trenches, confine material using bulkheads of sandbags, earth dams, or stiffer concrete at open ends of placement.
   4. Place CLSM at specified access points in the abandoned in-place pipe.

B. Soil preparation:
   1. Prior to placement of CLSM, prepare underlying soils as follows:
      a. Scarify surface to a depth of 8 inches.
      b. Adjust moisture content to or slightly above the optimum in accordance with ASTM D1557.
      c. Re-compact scarified surface to a minimum of 95 percent relative density in accordance with ASTM D1557.

3.03 MEASURING, BATCHING, MIXING AND TRANSPORTING

A. Measure, batch, mix and transport CLSM in accordance with the requirements of ASTM C94 and this Section.

B. Mix until there is uniform distribution of materials.

C. Discharge mixer completely prior to recharging.

D. After trial batch testing and mix acceptance, maintain slump during construction within plus or minus 1 inch of the design slump.

3.04 PLACING

A. Place controlled low strength material by method that preserves the quality of the material in terms of compressive strength and density.

B. Maintain fluid properties of the mix during placement:
   1. At point of placement, provide material that flows easily around, beneath, or through walls, pipes, conduits, or other structures.
   2. Do not place CLSM that has partially hardened or that has been contaminated by foreign materials.
   3. Handle and place CLSM using methods that minimize segregation of the mix.
   4. Deposit mix as near its final position as possible to avoid segregation due to rehandling or flowing.
   5. Contain and confine mix while it is fluid. Design containment structures and bracing at walls and forms to withstand lateral pressures of wet mix.

C. Lifts:
   1. Limit lift heights of CLSM placed against structures and other facilities that could be damaged due to the pressure from the CLSM, to the lesser of 3 feet or the lift height indicated on the Drawings.
   2. Do not place another lift of CLSM until the last lift of CLSM has set and gained sufficient strength to prevent additional lateral load against the forms or structure due to the weight of the next lift of CLSM.

D. Water conditions:
   1. Do not place CLSM in standing or flowing water.
   2. Do not permit water to flow over the surface of freshly placed or un-hardened CLSM.
   3. Do not submerge CLSM in water within 24 hours after placement.

E. Manage CLSM bleed water.
   1. Grade top surface of CLSM to drain away from the fill.
   2. Provide side containment that permits bleed water to drain to a contained management area away from the fill.

3.05 CURING AND PROTECTION

A. Curing:
   1. Prior to and during curing, install barriers to prevent equipment or personnel from falling into or becoming entrapped in CLSM.

B. Protect CLSM from:
   1. Damage from the elements.
   2. Damage of any nature during surrounding construction operations.

3.06 FIELD QUALITY CONTROL

A. Provide quality control over the Work of this Section as specified in Section 01450 - Quality Control and Section 01460 - Contractor Quality Control Plan and as specified in this Section.

B. General:
   1. Engineer inspection and acceptance required prior to placement.
   2. Make provisions for and furnish all material for the test specimens, and provide manual assistance to assist the Engineer in preparing said specimens.

3.07 FIELD QUALITY ASSURANCE

A. Provide quality control over the work of this Section as specified in Section 01450 - Quality Control and Section 01460 - Contractor Quality Control Plan.

B. Field inspections:
   1. Engineer shall provide on-site inspection for the Work of this Section.
   2. Advise Engineer of readiness to proceed at least 24 hours prior to each placement of CLSM.
   3. Required inspections:
      a. Engineer will observe the prepared areas. Do not place CLSM until Engineer has observed and accepted preparations.
   4. Record of inspections.

C. Field sampling and testing:
   1. During construction, Contractor shall provide sampling and testing to determine whether the CLSM, as produced and placed, complies with the requirements specified.
   2. Sample CLSM for testing in accordance with ASTM D5971.
   3. Required tests:
      a. Air content: Prepare sample and test in accordance with ASTM D6023.
      b. Compressive strength: Prepare and test cylinder specimens in accordance with ASTM D4832.
         1) Prepare 6-inch diameter by 12-inch high specimens for testing.
            a) Provide one set of specimens for each 150 cubic yards of CLSM placed, but not less than 1 set for each half day's placement.
            b) Prepare and test not less than 3 cylinders for each set.
            c) Place CLSM in the molds in accordance with ASTM D4832. Do not rod or otherwise consolidate the material in the mold.
            d) In accordance with ASTM D4832 recommendations for displacing bleed water at the top of the molds and refilling the molds before covering with a lid. Do not use air-tight lids.
         2) Place the cylinders in a safe location away from construction activities.
            a) Protect cylinders from bumping and impact.
            b) Maintain temperature surrounding cylinders between 60 and 80 degrees Fahrenheit until delivery to the laboratory for testing.
            c) After the first day, surround molds with a high humidity environment by covering with wet burlap, or equivalent highly absorptive material. Maintain saturation of the cover. Do not sprinkle water directly on the cylinders.

3) After 4 days, place the cylinders in a protective container for transport to the laboratory for testing.
    a) Exercise caution in moving and transporting the cylinders since they are fragile and will withstand only minimal bumping, banging, or jolting without damage.
    b) Transport container may be a box with a Styrofoam or similar lining that will limit jarring and bumping of the cylinders.
4) Upon receipt at the testing laboratory, place test cylinders in a moist curing room until dates for testing.
5) Do not remove test cylinders from molds until the day that cylinders is to be capped and tested.
6) Cap and test for compressive strength in accordance with ASTM D4832.
    a) Do not perform initial compression test until the cylinders reach an age of at least 4 days.
    b) Test 1 cylinder at 7 days and 2 at 28 days.
7) Compressive strength of the cylinders tested at 28 days shall be equal to or greater than the minimum required compression strength, but shall not exceed maximum compression strength specified.

3.08 NON-CONFORMING WORK

A. When testing or observation indicates CLSM with properties outside the specified and accepted range, Engineer will issue instructions regarding disposition of nonconforming materials.

B. Engineer may:
    1. Reject CLSM represented by those test specimens and require its removal and replacement.
    2. Require modification of the mix design to provide CLSM with the properties specified.

C. Make such modifications at no additional expense to the Owner and with no adjustment to the schedule.

END OF SECTION

SECTION 02318

TRENCHING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Trench excavation and trench backfill for pipelines, manholes, vaults, and appurtenances.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method.
   2. D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3).
   3. D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.03 SUBMITTALS

A. As specified in Section 01330 - Submittal Procedures.

B. Product data on soils and aggregates:
   1. Material source.
   2. Gradation.
   3. Test data to demonstrate compliance with requirements as specified in this Section.

C. Samples:
   1. Provide 50-pound sample of materials when requested by the Engineer.

D. Confirmation testing:
   1. Certification of Contractor's testing laboratory.
   2. Record copy report for tests performed by Contractor's testing laboratory.

1.04 DEFINITIONS

A. Backfill: Material placed in trench above the pipe embedment zone.

B. Bedding: Material placed under, around, and over pipes or ducts in trenches.

C. Fine grading: bedding material placed directly below pipes or ducts to provide support at the bottom of the trench and to bring those elements to required grades and elevations.

D. Pipe foundation: Stabilization material placed at the bottom of trench to provide support when the trench bottom is not firm, dry or uniform.

E. Pipe embedment zone: Includes bedding, fine grading, and haunch zone.

F. Haunch zone: Material placed below and beside the pipe up to the pipe springline.

G. Pipe springline: A horizontal reference line located at mid-height, or halfway point, of a circular conduit, pipe, or tunnel. It is the maximum horizontal dimension or diameter of a circular conduit, pipe, or tunnel.

H. Rigid pipe: Includes reinforced non-cylinder concrete, reinforced concrete cylinder, prestressed concrete cylinder, vitrified clay, polymer concrete, cast iron, asbestos cement and cast-in-place pipes.

I. Flexible pipe: Includes steel, ductile iron, thermoplastics such as polyvinyl chloride (PVC) and high-density polyethylene (HDPE), thermosetting plastics such as fiberglass-reinforced polymer (FRP), bar-wrapped concrete cylinder pipe, and corrugated steel pipes.

J. Haunch zone: Material placed below and beside the pipe up to the pipe springline.

K. Lift: A layer of soil or aggregate material, measured before compaction.

L. Maximum density, laboratory compaction: Soil maximum density and optimum water content when tested in accordance with ASTM D1557.

M. Maximum density, field compaction: Soil density and water content when tested in accordance with ASTM D1556 and ASTM D6938.

N. Pavement section: Includes pavement plus underlying courses such as base course and subgrade.

O. Pipe embedment zone: Includes bedding, fine grading, and haunch zone.

P. Pipe foundation: Material placed at the bottom of trench to provide support.

PART 2 PRODUCTS

2.01 MATERIALS

A. As specified in Section 02050 - Soils and Aggregates for Earthwork.

B. Class C concrete: As specified in Section 03300 - Cast-in-Place Concrete.

C. Controlled low-strength material: As specified in Section 02312 - Controlled Low Strength Material (CLSM).

PART 3 EXECUTION

3.01 PREPARATION

A. Stabilize excavations as specified in Section 02260 - Excavation Support and Protection.

B. Perform subsurface utility engineering (SUE) for utility locating and verification prior to any excavation work and as specified in Section 02280 - Subsurface Utility Engineering.

3.02 DEWATERING

A. As specified in Section 02240 - Dewatering (Plant) and 02241 - Dewatering (Infrastructure).

3.03 TRENCH EXCAVATION

A. Excavate bottom of trench to depth indicated on the Drawings.

B. Areas of new fill or embankment:
   1. Prior to laying pipes or electrical service, place fill and compact as specified to not less than 2 feet above top of pipe, conduit, or duct bank.
   2. Excavate through fill for pipe trench.

C. Trench widths as specified in the following table:

Buried Pipe Or Accessory	Minimum Trench Width	Maximum Trench Width
Nominal Pipe Diameter: 4 inch to 24 inch	OD + 18 inches	OD + 24 inches
Nominal Pipe Diameter: Greater than 24 inch	OD + 24 inches	OD + 36 inches
Manholes, vaults, valves, or other accessories	12 inches between outer surface and trench side or shoring	Not applicable

D. At road crossings or existing driveways:
   1. Provide notification, vehicular access, and traffic control as required by permits and special conditions.
   2. Provide temporary asphalt or plating for traffic or access at the end of each work day unless approved in writing by Engineer.
   3. If unexpected utility conflicts or changed site conditions require trenchless technologies or temporary bridges, immediately notify the Engineer in writing. Approval is required before proceeding with construction.
   4. When trench width at top of pipe is increased beyond width specified in this Section because of soil conditions, safety requirements, or other reasons, Engineer approval for remedy is required without additional cost to Owner.
      a. Remedy may include upgrade laying conditions or install stronger pipe designed in accordance with Specifications.

3.04 TRENCH BACKFILL - GENERAL

A. Trench area terminology and locations as indicated on the Drawings.

B. Place material, except CLSM and concrete, in maximum 6-inch lifts, measured before compaction.

C. Backfilling of manhole excavation: Conform to backfilling requirements for trenches as specified in this Section.

3.05 PIPE FOUNDATION

A. Provide trench bottom with firm, dry, uniform bearing surface at the grade indicated on the Drawings.

B. Excess excavation below elevation indicated on the Drawings will require installation of pipe foundation material to bring the trench bottom back to the elevation indicated on the Drawings at no additional cost to Owner.
   1. Materials and placement:
      a. Stabilization material:
         1) Wrap stabilization material as specified in Section 02621 - Stabilization Fabric.

C. If bottom of trench excavation consists of soil:
   1. Scarify bottom of trench to a depth of 6 inches below the grade indicated on the Drawings.
   2. Materials and placement:
      a. Recompact scarified material to 95 percent of maximum density.

D. If bottom of trench excavation consists of rock or any material that, by reason of its hardness, cannot be excavated to provide uniform bearing surface:
   1. Remove such rock or other material to a depth of not less than 4 inches below pipe embedment zone.
   2. Materials:
      a. CLSM.
      b. Class C concrete.

E. If bottom of trench excavation consists of mud or other soft unstable material:
   1. Remove such unacceptable material to a depth of not less than 18 inches below pipe embedment zone.
   2. Material and placement:
      a. Stabilization material:
         1) Wrap stabilization material as specified in Section 02621 - Stabilization Fabric.

3.06 PIPE EMBEDMENT ZONE

A. Pipe displacement:
   1. Take necessary precautions in placement and compaction of bedding material to prevent displacement of piping.
   2. In event there is movement or floating of the piping, re-excavate, re-lay, and backfill the pipe.

B. Fine grading:
   1. Place 6-inches of approved haunch zone bedding material from the trench bottom to the bottom of the pipe or duct to provide support at the bottom of the trench and to bring those elements to required line and grade.

C. Depressions for joints or couplings:
   1. Excavate holes in the fine grading material at the bottom of the trench.
   2. Provide holes of sufficient width to provide ample room for grouting, banding, or welding as necessary for making joints and to ensure that pipe rests upon prepared trench bottom and not supported by any portion of the joint.

D. Flexible pipe:
   1. Pipe embedment zone:
      a. Compacted to a depth above pipe: 12-inch minimum.
      b. Materials and placement:
         1) Aggregate base course compacted to 95 percent maximum dry density.
         2) CLSM. Place gravel bags to support and set pipe to line and grade prior to CLSM placement. Place CLSM in lifts as necessary to prevent floatation.

3.07 BACKFILL

A. Trenches:
   1. Materials and placement:
      a. Native soil compacted to 95 percent maximum dry density.
      b. Imported fill compacted to 95 percent maximum dry density.
      c. Aggregate base course compacted to 95 percent maximum dry density.
      d. CLSM.

B. Trenches in rock:
   1. Backfill to top of rock.
      a. Materials and placement:
         1) CLSM.
         2) Class C concrete.
   2. Backfill from top of rock to grade, if applicable:
      a. Materials and placement:
         1) Aggregate base course compacted to 95 percent of maximum density.

C. Trenches below or within 10 feet of the outside perimeter of structures:
   1. Backfill to underside of structural fill below structure, as specified in Section 02300 - Earthwork.

2. Materials and placement:
    a. Aggregate base course compacted to 95 percent of maximum density.
    b. CLSM.

D. Trenches in roadways and paved areas:
1. Backfill trench to underside of pavement.
2. Materials and placement:
    a. Aggregate base course compacted to 95 percent of maximum density.
    b. CLSM.

E. Trenches in areas outside the improved section of roadways or in open country:
1. Backfill to underside of topsoil layer.
2. Materials and placement:
    a. Native soil, native soil - select, imported material, or aggregate base course compacted to 90 percent of maximum density.

F. Trenches under existing intersecting pipes, duct banks, or conduits larger than 3 inches in diameter:
1. Backfill from above top of new pipe embedment zone to springline of intersecting pipe or conduit.
    a. Extend backfill at least 2 feet on either side of intersecting pipe or conduit to ensure backfill material remains in place while other backfill is being placed.
    b. Materials and placement:
        1) CLSM, unless otherwise indicated on the Drawings.
2. Backfill remainder of trench:
    a. Materials and placement:
        1) CLSM.
        2) Class C concrete.

3.08 EXCESS MATERIAL

A. Remove excess excavated material from the Project site as specified in Section 02300 - Earthwork.

3.09 FIELD QUALITY CONTROL

A. Provide field quality control for the Work as specified in Section 01450 - Quality Control.

B. Confirmation tests: As specified in Section 02300 - Earthwork.
1. Minimum frequency of confirmation testing:
    a. At each test location include tests for each type or class of backfill from bedding to finished grade.
    b. For trenches: At each test location include test for each type or class of backfill from bedding to finished grade.
    c. In open fields: 2 locations every 1,000 linear feet or 1 location every 200 cubic yards.
    d. Along dirt or gravel road or off traveled right-of-way: 1 location at every 500 linear feet.

e. Crossing paved roads: 2 locations at each crossing.
f. Under pavement cuts or within 2 feet of pavement edges: 1 location every 400 linear feet.

C. Compliance tests:
1. Make periodic compliance tests to verify that compaction is meeting requirements as specified in this Section will be made by the Engineer.
2. Perform remedial work if compaction test fails to meet specified requirements using one of the following methods:
a. Remove and replace backfill at the proper density.
b. Other means acceptable to the Engineer.
3. Retesting:
a. Costs of retesting: Contractor is responsible for the costs of retesting required to confirm and verify that remedial work has brought compaction within specified requirements.
b. Contractor's confirmation tests during performance of remedial work:
1) Performance: Perform tests in manner acceptable to the Engineer.
2) Frequency: Double amount specified for initial confirmation tests.

D. Piping system testing:
1. As specified in Section 15956 - Piping Systems Testing (Plant) and 02009 - Piping Systems Testing (Infrastructure).

END OF SECTION

SECTION 02370

RIPRAP AND GABIONS EROSION AND SEDIMENTATION CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Plain riprap.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. A90 - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
   2. C150 - Standard Specification for Portland Cement.

1.03 SUBMITTALS

A. Product data.

B. Installation instructions.

PART 2 PRODUCTS

2.01 PLAIN RIPRAP

A. Material: Rock, broken concrete from site preparations, or wasted concrete from project pours.

B. Size and weight: 1/8 cubic to 1 cubic foot and 20 to 150 pounds, except small stones and spalls used to chink interstices shall weigh not less than 10 pounds and at least 50 percent of pieces shall weigh not less than 100 pounds.

C. Material shapes:
   1. Capable of forming stable protection structure of required depth.
   2. Rounded boulders or cobbles on 2:1 slopes and less.
   3. Angular.
   4. Flat or needle shapes with thickness more than 1/3 length.

PART 3 EXECUTION

3.01 PREPARATION

A. Shape and trim bed for riprap as required to provide even surface which at no point is higher than design surface.

B. Grade slopes on which sacked concrete riprap or gabions are to be placed to tolerance of 0.00 to minus 0.20 foot.

C. Excavate footing trench along toe and cutoff trench at top of slope, as indicated on the Drawings.

3.02 PLACING PLAIN RIPRAP

A. When required riprap is less than 20 inches in depth, place material by hand.

B. When riprap is 20 inches or more in depth, place material by dumping and spreading in layers by bulldozers or other suitable equipment.

C. Place material to provide minimum of voids.

D. Place larger pieces in toe of trench, foundation course, and on outer surface of riprap.

E. Place pieces with their longitudinal axis normal to face of embankment and so arranged that each piece above the foundation course has minimum 3-point bearing on underlying stones.
   1. Bearing on smaller pieces used to fill voids will not be acceptable.

F. Fill interstices between pieces with small pieces and spalls.

3.03 TOLERANCES

A. Finished surfaces of riprap for plain riprap: Within 3 inches per foot of depth.

B. Finished surface of for sacked concrete riprap: Within 3 inches.

C. Finished surfaces of gabions: Within 3 inches.

END OF SECTION

SECTION 02441

MICROTUNNELING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Requirements for trenchless installation of pipe by microtunneling.

B. Measurement and payment:
   1. Payment for obstruction removal shafts shall be paid for under the following bid items:
      a. Obstruction removal shaft.
      b. (Depth up to 25 feet) (Revocable): Per each.
      c. Obstruction removal shaft depth adjustment (revocable): Per foot of depth exceeding 25 feet.
   2. Obstruction removal shaft:
      a. The pay items for obstruction removal shafts shall be applied as in the following example:
         1) If an obstruction removal shaft is authorized and the depth is less than or equal to 25 feet, then only the per each payment item for obstruction removal shaft shall apply.
         2) No reduction will be made for shafts with depths less than 25 feet.
   3. Payment under these bid items shall cover all labor, material, equipment, and incidentals required to construct the obstruction removal shafts, remove the obstruction, provide all information regarding the obstruction to the Engineer, and all other items required by the special provisions and no additional compensation will be allowed therefor.
   4. Payment for the 2 access shafts at the endpoints of the tunnel at approximate "S" Line stations A10+60 and A13+00 shall be deemed included in the price paid for the pipeline and no additional compensation will be allowed.
   5. Payment for the 2 access shafts at the endpoints of the tunnel at approximate "S" Line stations A32+25 and A34+90 shall be deemed included in the price paid for the pipeline and no additional compensation will be allowed.

1.02 REFERENCES

A. Occupational Safety and Health Administration (OSHA).

B. United States Code of Federal Regulation (CFR):
   1. 29 - Labor.
      a. 1926 Occupational Safety and Health Administration (OSHA).

C. Geotechnical Reports:
   1. As specified in Appendix C to the Specifications:
      a. “City of Ukiah Recycled Water Pipeline – Phase 4 Design Project DRAFT Geotechnical Report, Crawford & Associates, Inc., August 2021”

1.03 DEFINITIONS

A. Jacking Record: A computer-generated report that contains information on all pertinent microtunneling operations, including rate of advance, slurry flow rates and pressures, jacking forces, face pressure, cutter-head torque, steering corrections, machine inclination, roll, machine position, installed tunnel length, intermediate jacking station pressures, date, time, name of Operator, problems with the tunneling machine, and reasons for delays.

B. Intermediate Jacking Station (IJS): A fabricated steel cylinder fitted with hydraulic jacks that is incorporated into a pipeline between 2 interjack pipe sections. The function of an intermediate jacking station is to distribute the jacking load along the pipe string during pipe installation. The hydraulic jacks are removed at the completion of a drive and the gap between adjacent pipe sections is fully closed by pushing the pipes together with the main shaft jacks.

C. Launch Seal: A mechanical seal usually comprised of a rubber flange attached to a steel housing that is mounted to the wall of the drive shaft. The microtunneling machine distends the flange seal as it passes through, creating a seal to prevent water, slurry, or lubrication inflows into the shaft during tunneling operations.

D. Lubrication Port: A port located in a jacking pipe segment, fitted with a one-way valve, for injection of lubrication material or grout into the annular space between the pipe and the ground.

E. Microtunneling: A remotely controlled, guided, pipe jacking process that provides continuous support to the excavation face. The guidance system usually consists of a laser, mounted in the jacking pit as a reference, with a target mounted inside the microtunneling machine's articulated steering head. The microtunneling process does not require personnel entry into the tunnel. A key element of microtunneling is the ability to control the stability of the face by applying mechanical or fluid pressure to the face to balance the earth and groundwater pressures.

F. Obstruction: Objects or portions of objects located wholly or partially within the cross-sectional area excavated by the microtunneling machine that are larger than 1/3 the outer diameter of the shield or cutter-head, and that prevent the forward motion of the microtunneling machine.

G. Surface Settlement Point: A point with elevation and spatial location established by survey prior to construction. The point is re-surveyed periodically to monitor ground movements. The point may be a nail, pin, or other device that can be readily located and surveyed.

1.04 SUBMITTALS

A. Submit the following as specified in Section 01330 - Submittal Procedures: Provide sufficient detail to allow the Engineer to judge whether or not the proposed equipment, materials, and procedures will meet the Contract requirements.

B. Calculations: Submit all calculations in a legible, comprehensible format:
   1. Submit calculations for anticipated jacking forces for each drive. The anticipated jacking forces shall be based on anticipated face pressures and frictional forces along the pipeline.
   2. Submit calculations demonstrating that the soils behind the thrust block are capable of sustaining the maximum anticipated forces required to complete the drive or the maximum capacity of the jacking frame, whichever is less, with an appropriate safety factor.

C. Shop drawings/microtunneling-excavation plan:
   1. All drawings shall be legible with dimensions accurately shown and clearly marked in English.
   2. Drawings transmitted by a facsimile will not be accepted.
   3. The Engineer’s review of submitted details and data will be based on consideration of requirements for the completed work, utilities, and the possibility of unnecessary delays in the execution of the work to be constructed under this Contract.
   4. Equipment product data and details: Submit the following:
      a. Provide manufacturer's literature describing the microtunneling equipment in detail, including detailed description of the microtunneling equipment and procedures to be employed.
      b. Describe method and capabilities for providing stabilizing pressure at the tunnel heading.
         1) Indicate the range of face pressures anticipated to be required to stabilize the heading and the methods and equipment to be used to monitor and control the face pressure.
         2) Indicate the torque required to rotate the cutterhead under no face pressure.
      c. Alignment control and steering system:
         1) Description of the alignment control and steering system.
         2) Confirm that these systems can achieve the required tolerances for pipeline line and grade.
         3) Include a description of the equipment and procedure for checking the position of the laser.
         4) Provide documentation that the laser has been calibrated for the longest drive length.
      d. Provide details for the following:
         1) Lubrication injection system used for lubrication of the pipeline during microtunneling operations.
         2) Planned lubrication port locations along the pipeline and the injection scheme that will be used.
         3) Provide details of the calculated volume of the annular space (the minimum volume that will be continuously pumped throughout installation procedures).
         4) Provide a description of the lubrication materials that will be used.
      e. Details on the muck/slurry handling, transport, recovery, and disposal equipment and procedures:
         1) Include details on the slurry separation and recirculation systems. Details shall be provided on the planned slurry composition and any slurry additives that are planned for use during the microtunneling operations.

2) Include diagrams showing the location of all slurry delivery and return pumps.
3) Provide written documentation signed by the site Owner or manager of the disposal site(s) indicating that they will accept the muck or slurry and are in compliance with all applicable local, state, and federal regulations.
4) Provide detailed description of the slurry separation plant, including dimensions, specifications, noise ratings, and sound proofing.

f. Provide details on the jacking frame, including a diagram of the main jacks, thrust ring, jacking controls, and pressure gauges:
1) Provide details on the maximum jacking capacity of the jacking frame and the hydraulic pressure required to develop the maximum pressure.
2) Provide the conversion factor from gauge pressure for the hydraulic jacks to thrust, in tons.

g. Provide details on the entry and exit shaft seals and the mounting procedures.

h. Provide details on the intermediate jacking stations, including detailed drawings of the alignment of the jacks, the capacity of each hydraulic jack, and the instrumentation for recording jacking pressures at the IJS location.

i. Provide details on the generator, including dimensions, noise ratings at 100 feet, and soundproofing.

D. Quality assurance submittals:
1. Qualifications. Submit written documentation, including Owner's representatives' names, addresses, and telephone numbers, summarizing the experience of the microtunneling project superintendent, the microtunneling operator(s), and the site safety representative.
a. The superintendent and operator(s) must be as listed in the prequalification document.
b. The site personnel shall meet or exceed the minimum qualifications of the personnel submitted in the Contractor's prequalification.
c. Submit evidence of Cal/OSHA certification for the site safety representative and personnel responsible for gas testing.

E. Schedule:
1. Provide a schedule for all microtunneling work, identifying all major construction activities as independent items.
2. The Schedule shall include, as a minimum, the following activities:
a. Mobilization.
b. Groundwater control at jacking and receiving shafts.
c. Shaft excavation and support.
d. Thrust wall construction.
e. Jacking equipment set-up.
f. Ground stabilization for launch of machine.
g. Microtunneling for each drive.
h. Moving equipment between drives.
i. Shaft abandonment.
j. Site restoration.

k. Cleanup.
l. Demobilization.
1) The schedule shall also include the working hours for each activity, and a written description of the construction activities.
2) The schedule shall be reviewed by the Engineer and will be updated and resubmitted by the Contractor every 2 weeks or more frequently if requested by the Engineer.

3. Ground stabilization during launch: Submit details on the method of controlling groundwater inflows and loss of ground into the shafts at all times, including the periods during launch and retrieval of the microtunneling machine, i.e., when exiting the launch shaft and entering the reception shaft.

F. Daily records: The following daily records shall be submitted to the Engineer for review:
1. Jacking records: These records shall include, at a minimum, the following information:
a. The name of the operator.
b. Tunnel drive identification.
c. The date.
d. The installed length of tunnel.
e. Thrust force.
f. Slurry flow rates.
g. Face pressure.
h. Cutter head torque.
i. Progression rate.
j. Roll.
k. Inclination.
l. Steering adjustments.
m. Laser position.
n. Line and grade deviations.
o. Any movement of the laser.
p. Use of intermediate jacking stations.
q. Jacking force at the intermediate jacking stations.
r. Problems.
s. Reason for stopping operations.
t. And duration of any stops.
2. The operating system shall continuously provide performance data to the operator.
a. Recorded data shall be referenced to the length of installed tunnel and shall be recorded at length intervals of 1 foot or less.
b. Manually recorded observations shall be made at intervals of not less than once per shift, as conditions change, or as directed by the Engineer.
3. Lubrication records:
a. These records will include the amount of lubrication pumped throughout a drive, reported as pumped volume per pipe, and total for each shift.
4. Slurry additives:
a. These records will include all slurry additives, including any bentonite and polymers and will be submitted with the daily jacking record.

b. The time and volume of the addition to the slurry shall be noted.
c. Measurements of specific gravity and viscosity will be made at the beginning, middle, and end of each shift, and submitted with the daily logs.

5. Survey measurements:
   a. Survey measurements of settlement points will be submitted to Engineer by the end of the day after the measurements were taken. Contractor shall monitor settlement once a day from start to completion of crossing, and until no change is identified. Contractor shall then progress to once a week until no change identified~~Survey measurements of settlement points will be submitted to the Engineer by the end of the day after the measurements were taken~~.[AD3]
   b. Measurements will be made at least once per 100 feet of tunneling, or as directed by the Engineer.

G. Safety plan:
1. Protection of adjacent structures: Provide details on measures to be taken to monitor and protect adjacent utilities, structures, roadways, and provide details on monitoring equipment and provisions, including the layout of all surface settlement points and other monitoring points.
2. Safety plan: Submit a safety plan for personnel conducting the pipe jacking operations, including provisions for lighting, ventilation, and electrical system safeguards. Include in the safety plan a code of safe practices and an emergency plan in accordance with Cal/OSHA requirements.

H. Contingency plans: The following list includes problem scenarios that may be encountered during the microtunneling operations. The Contractor shall submit contingency plans for dealing with each problem scenario while satisfying the specifications. These plans shall include the observations and measurements required to clearly identify the cause of the problems:
1. Machine unable to advance, must be retrieved:
   a. Possible obstructions (including boulders, construction debris, or wood).
   b. Insufficient jacking capacity.
   c. Machine malfunction.
2. Slurry separation problems:
   a. Cuttings do not settle out using the Contractor's onsite slurry separation plant.
   b. Cuttings settle out in the slurry lines before reaching the sedimentation tanks.
3. Strong hydrocarbon smell is detected in the slurry returns or in the shaft.
4. Laser distorted by heat, humidity, or physical disturbance.
5. Jacking forces:
   a. Jacking forces increase dramatically or suddenly.
   b. Jacking forces reach design capacity of pipe, jacking frame, or thrust wall (treat these scenarios as separate incidents).
6. Settlement:
   a. Survey measurements indicate deformations exceed allowable limits.
   b. Excavated volumes exceed pipe volume installed.
   c. Slurry face pressures and/or torque on head decrease suddenly and significantly.
7. Slurry losses from tank or slurry returns to ground surface.

8. Groundwater inflows to shaft transport fines into shaft in measurable quantities.
9. Steering difficulties result in line and grade tolerances being exceeded.
10. Pipe damaged or found to be out of compliance with specifications:
    a. Before installation.
    b. During or after installation.
11. Thrust block deforms excessively under jacking loads, or provides insufficient capacity to advance pipe.
12. Severe storms or flooding predicted; shaft flooding possible.
13. Voids are created that may or may not be visible by ground surface settlements.

I. The Contractor shall submit shaft layout drawings detailing locations of all equipment, including crane, slurry separation equipment, jacking frame, pumps, control container, generator, lubrication plant, pipe storage area, sound baffles, and staging area.
    1. Shaft layout drawings will be required for each launch shaft location and shall be to scale.

J. Product data.

K. Shop drawings and calculations:
    1. Design data.
    2. Certificates.
    3. Test reports.
    4. Manufacturer's instructions.
    5. Manufacturer's field reports.

L. Closeout submittals.

1.05 QUALITY ASSURANCE

A. Failure to meet the qualification requirements is failure to fulfill the Contract and the Contractor will be required to obtain a subcontractor that meets the qualification requirements.

B. All microtunneling work shall be performed by an experienced Contractor who has at least five (5) years of experience in performing microtunneling work and has completed at least five (5) projects of similar diameter in similar ground conditions. At least one of the projects shall have an individual drive equal to or greater in length than the longest drive on this project. The Contractor shall submit a description of referenced projects including owner's name and contact information, project superintendent, and machine operators.

C. The project superintendent shall have at least five (5) years of experience supervising microtunneling construction. The Contractor shall submit a description of referenced projects including owner's name and contact information, project superintendent, and machine operators.

D. The microtunneling machine operator(s) shall have technical training in the operation of the proposed microtunneling equipment and shall have completed, as a

primary operator, at least five (5) similar microtunneling projects involving at least 250 feet of microtunneling on each project. At least one of the projects shall have an individual drive equal to or greater in length than the longest drive on this project. The Contractor shall submit a description of referenced projects including owner's name and contact information, project superintendent, and machine operators.

E. The site safety representative and personnel responsible for air quality monitoring shall be experienced in tunnel construction and shall have current certification by Cal/OSHA.

F. The surveyor responsible for line-and-grade control shall be a Licensed Surveyor registered in the State of California who has prior experience setting control for pipejacking projects.

G. The Contractor shall provide at least 72 hours advance written notice to Engineer of the planned launch of the MTBM.

H. All work by the Contractor shall be done in the presence of the Engineer unless the Engineer grants prior written approval to perform such work in Engineer's absence.

I. The Contractor shall immediately notify the Engineer, in writing, when any problems are encountered with equipment or materials, or if the Contractor believes the conditions encountered are materially and significantly different than those represented within the Contract Documents.

J. The Contractor shall allow access to the Engineer and shall furnish necessary assistance and cooperation to aid the Engineer in observations, measurements, data, and sample collection, including, but not limited to the following:
    1. The Engineer shall have reasonable access to the operator control container prior to, during, and following all microtunneling operations. This shall include, but not be limited to, providing visual access to real-time operator control screens, gauges, and indicators.
    2. The Engineer shall have access to the jacking and reception shafts prior to, during, and following all jacking operations. This shall include, but not be limited to, visual inspection of installed pipes, launch and retrieval seals, and verification of line and grade. The Contractor shall provide safe access in accordance with all safety regulations.
    3. The Engineer shall have reasonable access to the slurry separation plant prior to, during, and following all microtunneling operations. This shall include, but not be limited to, access to shaker screens, hydrocyclones, conveyor belts, centrifuge equipment, and slurry and spoil holding tanks. The Engineer shall be allowed to collect soil samples from the shaker screens and/or spoil holding tanks on the slurry separation plant a minimum of once per installed pipe section, or every ten (10) feet, whichever is more often, and at any time when soil conditions change or debris or foreign objects are apparent or suspected.
    4. The Engineer shall have reasonable access to the bentonite lubrication plant prior to, during, and following all jacking operations. This shall include, but not be limited to, access to visually inspect storage and mixing tanks, lubricant pressures and pumping rates, and amount and type of lubricants on site.

1.06 PROJECT CONDITIONS

A. Environmental requirements:
   1. As Specified in Section 01150 - Mitigation and Monitoring Requirements.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Microtunneling shall be used for the installation of 42-inch inner-diameter pipeline for gravity sewer. The location of the pipeline is indicated on the Drawings.

B. General:
   1. The work specified in this Section includes the construction of all pipelines using microtunneling methods, as indicated in the Contract Documents.
   2. Remote controlled, laser guided, pipe-jacking equipment with a slurry spoil removal system capable of maintaining positive face pressure will be required.
   3. Pipe jacking methods, using microtunneling equipment, shall be employed to directly install microtunneling jacking pipe at each of the locations indicated in the Drawings.

C. Design requirements:
   1. Equipment: ONLY slurry microtunneling equipment will be used for the pipe installation work described in this Section:
      a. Microtunneling equipment:
         1) Manufacturers: One of the following or equal:
            a) Akkerman.
            b) Herrenknecht.
            c) Iseki.
            d) Soltau.
   2. The machine shall be equipped with a computerized data acquisition system for collecting information for the jacking record. An on-site printer and disk drive will also be required for production of the printed daily jacking record and digital files.
   3. The machine shall be capable of fully supporting the face during both excavation and shutdown periods and shall have the capability of exerting a controllable, measurable, continuous, stabilizing pressure at the face required to prevent loss of ground and groundwater inflows.
   4. The machine shall be capable of controlling the volume of excavated material removed at the tunnel face, independent of machine advance.
   5. The machine shall have a slurry chamber capable of being pressurized. A pressure gauge shall be provided to monitor the pressure exerted by the slurry at the heading.
   6. The machine shall be remotely operated, laser-guided, and monitored continuously by the operator. A display showing the position of the machine in relation to the design line and grade shall be provided at the operation console to allow the operator and site inspector to monitor the face pressure, torque, roll, inclination, laser position, steering attitude, rate of advance, installed length, and jacking force.

7. The machine shall have an articulated shield that is steerable in both the vertical and horizontal directions to maintain line and grade within the specified tolerances. The cutter head shall have a reversible drive system so that it can rotate in either direction to minimize rotation or roll of the machine during installation.
8. The machine shall be capable of advancing through the geologic conditions to be encountered at the site, as described in the Geotechnical Report and as determined by the Contractor's own investigation.
9. The machine shall be able to excavate or advance past rocks or other objects with diameters up to 1/3 the outer diameter of the shield and with unconfined compressive strengths as high as 30,000 pounds per square inch.
10. The machine shall be equipped for continuous gas monitoring.
    a. The Contractor shall have a shutdown plan that includes activation of the slurry by pass in the event that a gassy environment is detected in the heading.
11. A lubrication injection system shall be provided to inject pipe lubricant to decrease required jacking forces. Lubrication materials may include a mixture of bentonite or polymers and water.
12. Radial overcut:
    a. The maximum will be 1.0 inch.
    b. The minimum will be 0.25 inch.
    c. The radial overcut will be determined as the difference between the maximum diameter created by the cutting teeth or overcut band on the machine and the outer diameter of the pipeline, divided by 2.
13. The connection between the tail of the machine and the first pipe section shall be fully gasketed and sealed to prevent material or water from flowing into the machine during tunneling operations.
14. The jacking system, including any intermediate jacking stations, shall be capable of continuously monitoring the jacking pressure, rate of advance, and jacking distance. The jacking system shall develop a uniform distribution of jacking forces on the ends of the pipe.
15. The outer shell or "can" of the intermediate jacking station shall be constructed of stainless steel. The intermediate jacking station shell shall be fully gasketed between the interjack shell and each interjack pipe, with 2 gaskets.

D. Design of the jacking pipe and determination of acceptable pipe fabrication tolerances is the responsibility of the Contractor.
    1. Minimum requirements are specified in Section 02620 - Filter Fabric.
    2. The pipe shall be designed to withstand all anticipated loads with appropriate safety factors.

E. The thrust block shall be perpendicular to the proposed pipe alignment and shall be designed to withstand the maximum jacking force provided by the jacking frame with an appropriate safety factor. The thrust block shall be designed to transmit the applied jacking forces to the earth behind the shaft wall and to minimize deflection and displacement.

F. Ground surface settlement or heave across California Highway 101 above the tunnel centerline shall be limited to 1/4 inch or less.

G. Ground surface settlement or heave across Brush Street above the tunnel centerline shall be limited to 1 inch or less.

H. Tolerances. The following tolerances apply to the pipelines installed by microtunneling:
   1. Line tolerance: 2 inches.
   2. Grade tolerance: 2 inches.

I. Water shall be free draining between any 2 points at the pipe invert.
   1. No reverse grades will be allowed.

J. Safety:
   1. All work must be performed in accordance with the current applicable regulations of federal, state, and local agencies.
   2. All applicable provisions of the Tunnel Safety Orders of the State of California and 29 CFR 1926, Subpart S, Underground Construction by OSHA must be met. In the event of conflict, the more restrictive applicable requirements must be met.
   3. No gasoline-powered equipment shall be permitted in jacking and receiving shafts.

2.02 MATERIALS AND EQUIPMENT

A. As specified in Section 02620 - Filter Fabric.

B. As specified in Section 02448 - Jacking Steel Pipe Casing.

~~B.~~C. As specified in Section 02471 - Geotechnical Instrumentation and Monitoring.[AD3]

PART 3 EXECUTION

3.01 EXAMINATION

A. Site verification of conditions: The Contractor shall not begin microtunneling until the following conditions have been met:
   1. All required submittals have been made and the Engineer has reviewed and accepted all submittals.
   2. Required pre-construction surveys have been completed.
   3. Shaft excavation and support has been completed as specified in Section 02260 - Excavation Support and Protection.
   4. Groundwater control and soil stabilization has been established for launch.
   5. A pre-construction safety conference has been conducted in accordance with Cal/OSHA requirements. This conference must be arranged and the Engineer notified of the date at least 7 days in advance of the conference.

3.02 PREPARATION

A. Protection:
   1. As Specified in Section 01140 - Work Restrictions.
   2. As Specified in Section 01500 - Temporary Facilities and Control.

3. As Specified in Section 01550 - Traffic Control.
4. As Specified in Section 01734 - Work Within Public Right-of-Way.
5. Work space needs to be secured from public access outside working hours.

B. Surface preparation:
1. As Specified in Section 02200 - Site Clearing.

3.03 INSTALLATION

A. Equipment: The Contractor shall furnish all necessary equipment, power, water, and utilities for microtunneling, shoring and shafts, excavation, bentonite mixing and pumping, removal and disposal of spoils, and other associated work consistent with the Contractor's methods of construction.

B. Preparation:
1. The Contractor shall survey the location and orientation of the pipe guide rails prior to starting jacking operations to ensure they are on the proper line and grade.

C. Tunnel excavation shall be between the limits indicated on the Contract Drawings to the specified line and grade and shall be accomplished using methods which include due regard for safety of workers, adjacent structures and improvements, utilities, and the public. Jacking and receiving pits shall be located as identified on the Contract Drawings, unless otherwise approved in writing by the Engineer.

D. The Contractor shall ensure that the axial forces from the main jacks shall be distributed to the pipe uniformly through cushion materials to prevent damage to the ends of the pipe.

E. The Contractor shall ensure that each pipe section shall be jacked as the excavation progresses in such a way that no length of tunnel is left exposed at any time.

F. The Contractor will ensure that steering corrections are gradual, with corrections made at a rate of no more than 1 inch over 25 feet of drive length.

G. The Contractor shall jack the pipes into place without damaging the pipe. In the event a section of pipe is damaged during the jacking operation, the pipe shall be jacked through to the next shaft and removed.

H. The Contractor shall control the advance rate of the machine and shall balance the rate of removal of excavated material with the rate of excavation and pipe installation to avoid over excavation that can lead to subsidence and under excavation that can lead to heave.

I. The Contractor shall mount the laser independently from the thrust block and jacking frame to maintain the alignment of the laser.
1. The Contractor will stop tunneling operations and reset the laser if the laser alignment shifts or is moved off design alignment and grade for any reason.
2. The Contractor shall immediately notify the Engineer if the laser has been disturbed and must be reset.

J. If the pipe installation does not meet the specified tolerance, the Contractor will correct the installation including, if necessary, redesign of the pipeline or structures and acquisition of necessary easements.
    1. All corrective work shall be performed by the Contractor at no additional cost to the City and is subject to the approval of the Engineer.

K. The Contractor will maintain and control face pressure exerted at the heading of the tunneling machine to balance soil and groundwater pressures and prevent loss of ground, groundwater inflows, and settlement or heave of the ground surface. Face pressures shall be measured at the face of the machine and slurry flow rates shall be measured at the shaft.

L. The Contractor's operations shall prevent excessive settlement or heave of the ground.
    1. The Contractor shall repair any damage resulting from surface settlement or heave caused by shaft excavation, shaft dewatering, or tunneling at no additional cost to the City, and will modify any practices that caused or contributed to the ground disturbance to avoid continued or recurring problems.

M. The Contractor shall take active measures to prevent loss of ground during launch and retrieval of the machine.
    1. Groundwater or slurry inflows into the shaft during launch and retrieval will not be permitted.
    2. A launch and retrieval seal will be required for each microtunneling drive.

N. The Contractor shall use an alignment control and steering system capable of maintaining the position of the machine to the specified line and grade. The laser shall be field calibrated to the longest drive length, to ensure that the position of the laser on the target can be distinguished and that the signal is sufficiently strong to provide accurate steering data to the operator.

O. The Contractor shall use a lubrication/bentonite injection system to provide continuous lubrication of the pipeline. Lubrication material will be pumped in sufficient volume to completely fill the annular space of the pipeline, or that area between the outer diameter of the pipe and the overcut diameter.
    1. A minimum of 1 bentonite port will be located in each pipe section.
    2. The pipes will be inserted into the string with the bentonite ports alternating between 10, 12, and 2 o'clock.

P. Slurry composition:
    1. The composition of the slurry will be monitored during the tunneling operations.
    2. Specific gravity and viscosity measurements shall be taken at the beginning, middle, and end of each shift and will be included in the daily record.
    3. The Contractor shall keep accurate records of all slurry additives, including volumes added to the slurry tanks.

Q. Intermediate jacking stations (IJS):
    1. At least 1 fully-assembled intermediate jacking station (IJS) will be required on-site prior to the launch of each drive.

2. The Contractor will install 1 IJS in each drive, within 150 feet of the tunneling machine.
3. Additional IJS will be inserted into the pipeline when the jacking force, recorded at the main jacks, reaches 80 percent of the jacking capacity of the jacking pipe or main jacking frame, whichever is less.
4. The equipment will be capable of continuously monitoring the jacking forces at the intermediate jacking station.
    a. This information will be recorded on the daily logs.
5. Upon completion of the microtunnel drive, the intermediate jacking station hydraulic jacks shall be fully removed and the interjack pipes shall be pushed together without any gaps.

R. The Contractor shall conduct all operations such that trucks and other vehicles do not create a dust or mud nuisance or traffic hazard in the streets and adjacent properties.
    1. Any muck spillage or slurry breakthroughs will be promptly cleaned up, removed and properly disposed.

S. The Contractor shall perform all work so as not to disturb roadways, adjacent structures, landscaped areas, or utilities.
    1. Any damage shall be immediately repaired by the Contractor to the satisfaction of the City, at no additional cost to the City.

T. If the microtunneling operations shall encounter an obstruction that prevents the forward progress of the machine, the Contractor shall notify the Engineer immediately.
    1. The Contractor shall remove, clear, or otherwise make it possible for the microtunneling machine and jacked pipe to advance past any and all objects or obstructions that halt forward progress of the machine.
    2. Upon written notification of the Engineer, the Contractor shall immediately proceed with removal of the obstruction by means of an obstruction removal shaft or by other approved means, as submitted by the Contractor in reviewed submittals.
        a. An obstruction removal shaft shall consist of a small excavation for the purpose of removing the obstruction.
        b. Obstruction removal shafts shall be built as specified in Section 02260 - Excavation Support and Protection.
    3. The Contractor will receive compensation for removal of obstructions, as defined as objects larger than 1/3 the outer diameter of the shield or cutting head, whichever is larger.
        a. Payment will be made in accordance with the provisions of this Section.
        b. However, any removal process that does not allow direct inspection of the nature and position of the obstruction will not be considered for payment.
    4. The Contractor will receive no additional compensation for removing, clearing, or otherwise making it possible for the microtunneling machine to advance past objects consisting of cobbles, boulders, wood, non-reinforced concrete, and other nonmetallic objects or debris with maximum lateral dimensions less than 1/3 the outer diameter of the shield or cutterhead, whichever is larger.
    5. The Contractor shall be aware that most of the pipeline alignment contains substantial rock that cannot be removed with a standard excavator. The cost

to excavate this rock shall be included in the prices for the applicable bid items and no additional compensation will be allowed.

U. Prior to the launch of the machine, the Contractor will conduct a start-up inspection of all mechanical and hydraulic systems associated with the microtunneling operations.
   1. The system will be tested on the surface to ensure that the microtunneling machine and supporting equipment is functioning properly.
   2. The Engineer will be notified prior to the start-up inspection and a site inspector representing the Owner will be present during the start-up inspection.
   3. Key machine performance data will be measured and recorded during this inspection, including cutterhead torque, correct functioning of steering jacks, laser target, and other components.

V. In the event that voids are created or encountered around the pipeline, the Contractor shall grout the voids using materials and procedures that have been submitted in the Contingency Plan and reviewed by the Engineer.

END OF SECTION

[AD3] Addendum No. 3

SECTION 02448

JACKING STEEL PIPE CASINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Steel Casing Pipe.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. A283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.

1.03 SUBMITTALS

A. Submittals shall be made in accordance with the requirements of these Specifications, and shall provide sufficient detail to allow the Engineer to judge whether the proposed equipment, materials, and procedures will meet the Contract requirements. All drawings shall be legible with dimensions accurately shown and clearly marked in English. Review of submitted details and data will be based on consideration of requirements for the completed work, protection of existing utilities, and the possibility of unnecessary delays in the execution of the work to be constructed under this Contract. Review and acceptance of the Contractor's Submittals by the Engineer shall not be construed in any way as relieving the Contractor of its responsibilities under this Contract.

B. Shop Drawings: The Contractor shall furnish shop drawings illustrating the details of the casing pipe, lubrication ports, joint details, and miscellaneous items to be furnished and fabricated for the pipe. Total quantity ordered, dimensions, tolerances, wall thickness, properties and strengths, and other pertinent information shall be shown. These items shall be submitted for review by the Engineer prior to fabrication.

C. Calculations: Calculations shall be submitted in a neat, legible format. Basis of calculations shall be consistent with information provided in the Geotechnical Report.
   1. Provide calculations confirming that pipe jacking capacity is adequate to resist anticipated jacking loads with a minimum factor of safety of two (2).
   2. Submit calculations confirming that pipe capacity is adequate to safely support all other anticipated loads, including earth and groundwater pressures, surcharge loads, and handling loads.
   3. Submit calculations confirming that jointing method will support all loading conditions.

1.04 QUALITY ASSURANCE

A. Installation qualifications: Successfully completed at least 3 projects of similar diameter, length, soil, and installation conditions.

1.05 SEQUENCING AND SCHEDULING

A. Prior to tunneling, submit written request and obtain the Engineer's acceptance of tunneling.

PART 2 PRODUCTS

2.01 MATERIALS

A. Casing pipe:
   1. Type: Steel in accordance with ASTM A283, Grade C or ASTM A 1097. Shop and field joints shall be butt welded.
      a. Press-fit interlocking connection system joints (Permalok or equal) are also acceptable in lieu of field welded butt joints. If used, submit joint details for approval.
   2. Internal diameter: As indicated on the Drawings and be within 1-1/2 percent of being true circle.
   3. Wall thickness: As indicated on the Drawings.

B. Material for filling of voids between casing and carrier pipe and annular space: As indicated on drawings.

C. Casing Spacers:
   1. Band: Minimum 14-gauge steel band:
      a. 8-inch minimum width.
   2. Finish:
      a. Rust inhibiting paint.
      b. Fusion Bonded PVC Coating:
         1) 10-16 mils.
         2) Durometer - shore A2 (10 sec, ASTM D1706-61T): 80.
   3. Runners:
      a. Painted 2-inch Wide Glass Reinforced Polymer:
         3) Tensile Strength (ASTM D638): 17,600 psi minimum.
         4) Flexural Strength (ASTM D790): 25,300 psi minimum.
   4. Liner: Polyvinyl Chloride:
      a. Thickness: 0.09-inch minimum.
      b. Hardness Durometer “A”: 85-90.
   5. Risers: 10 gauge steel MIG welded to band.
   6. Manufacturers: One of the following or approved equal:
      a. Pipeline Seal and Insulator, Inc.
      b. Advance Products & Systems.
      c. Cascade Waterworks Manufacturing Company.

D. Casing End Seals:
   1. Materials:
      a. Seal: 1/8 inch thick synthetic rubber.
      b. Bands and Clamps: Stainless steel.
   2. Manufacturers: One of the following or approved equal:
      a. Pipeline Seal and Insulator, Inc., Model S or C.
      b. Advance Products & Systems, Model AC.
      c. Maloney Technical Products, MULTIFLEX End Seal

PART 3 EXECUTION

3.01 INSTALLATION

A. Temporary steel casing pipe shall be installed in accordance with Section 02441 - Microtunneling.

B. Provide grout connections on steel casing with 36-inch larger inside diameter at maximum 10 feet on center:
   1. Upon completion of the jacking operation, grout voids around outside face of steel casings.
   2. Have grouting equipment and material on the jobsite before the jacking operations are completed so that grouting may be started immediately.
   3. Place grout by pumps capable of pressures up to 100 pounds per square inch unless otherwise accepted by the Engineer.
   4. Control grouting pressure to approximately 10 pounds per square inch to avoid movement of the ground around steel casing.
   5. After grouting has been completed, close the grouting connections with threaded steel plugs.

~~A.~~C. Steel casing smaller than 36 inches inside diameter will require outside grouting through grout ports installed on both ends within 3 feet of shaft wall and where caving or earth movement occurs.[AD3]

END OF SECTION

[AD3] Addendum No. 3

SECTION 02460

PILE LOAD TESTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Pile load tests.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D1143 - Standard Test Methods for Deep Foundations Under Static Axial Compressive Load
   2. D8169 - Standard Test Methods for Deep Foundations Under Bi-Directional Static Axial Compression Load.

1.03 SYSTEM DESCRIPTION

A. System Requirements:
   1. Pile axial load testing shall consist of one of the following test methods:
      a. Static Axial Load Test per ASTM D1143:
         1) Conventional load test comprised of a reaction beam with an anchorage system, and a hydraulic jack to apply the load.
      b. Bi-Directional Axial Load Test per ASTM D8169:
         1) Calibrated bi-directional embedded load device capable of applying loads upward and downward when embedded in a deep foundation.
   2. Dedicated test piles and reaction piles shall be installed in accordance with the Section 02466B - Augured Pressure Grouted Piles or Section 02467A - Drilled Concrete Piles. The Contractor shall use the same means and methods of construction that will be implemented on all production piles. All methods of pile construction shall be pile tested. Any alternative construction method proposed for production piles shall require additional pile testing as described in this Section.
   3. Piles shall maintain a minimum center to center spacing of 3 pile diameters including reaction pile placements.

1.04 SUBMITTALS

A. Statement of Qualifications (SOQ):
   1. The Specialty Contractor shall prepare and submit a statement of qualifications to the Engineer for review and acceptance.
   2. The SOQ shall include the following:
      a. 5 reference projects with the following information for each:
         1) Brief project description.
         2) Owner's name and current phone number.
         3) Load test reports.

B. Load Test Plan:
   1. The Contractor shall submit a load test plan developed for review and input from the Specialty Contractor and submitted for review and approval by the Engineer prior to test pile construction. The load test plan shall include, as applicable:
      a. Description and details on:
         1) Loading equipment.
         2) Calibration of:
            a) Hydraulic Jack and load cell.
            b) Bi-directional load cell type embedded jack and load transfer mechanism (bearing plates).
            c) Pressure gauges.
            d) Instrument to measure loaded pile movement.
            e) Other load and measuring equipment.
         3) Equipment for measuring load.
         4) Equipment for measuring movement of loaded pile.
         5) Method to obtain as-drilled dimensions of test shaft using borehole calibers (mechanical or sonic).
         6) Other details related to loading and testing.
      b. For the Static Axial Load Test include design and calculations performed by a civil or structural engineer licensed in the state of California for:
         1) Design of test pile to support test load.
         2) Pile test loading frame.
         3) Connections between test pile and load frame.
         4) Connection between reaction piles and load frame.
         5) Load and time increments and decrements.

C. Load Test Report:
   1. Analyzing test data as outlined in this Specification.

1.05 QUALITY ASSURANCE

A. Provide quality assurance as specified in Section 02466B - Augured Pressure Grouted Piles or Section 02467A - Drilled Concrete Piers.

B. Pile testing observations:
   1. The Geotechnical Engineer will be present to provide on-site observation of the pile drilling operation and pile testing. Pile testing shall not be conducted unless the Geotechnical Engineer (or their representative) is present.

1.06 SEQUENCING AND SCHEDULING

A. Equipment Calibration: No more than 1 month before start of pile load tests, have loading and measuring equipment calibrated by an independent testing laboratory.

B. Pile load tests: Perform tests to the satisfaction of the Engineer prior to ordering production piles:
   1. Allow 3 weeks for the analysis of the pile load tests by the Engineer, after the pile load tests have been completed.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Static Axial Load Test Design Requirements:
   1. Pile load tests:
      a. Design and calculations of pile loading frame, connections between test pile and reaction piles, loading, and unloading shall be performed by an engineer licensed in the state of California.

B. Bi-directional Load Cell Design Requirements:
   1. Design and calculations of load cell location, size, and instrumentation shall be performed by an engineer licensed in the state of California.

2.02 BI-DIRECTIONAL LOAD CELL

A. The Contractor shall supply all instrumentation and materials required to install the bi-directional load cell and related components, perform the axial load test and remove the load test instrumentation and apparatus as required:
   1. Manufacturer: The following or approved equal:
      a. Load test, Gainesville, FL.

B. Assembly and Installation Materials:
   1. Steel reinforcing cage or carrying frame used to support and convey bi-directional load cell assembly, instrumentation, and piping to appropriate levels within the test shaft.
   2. Two circular steel plates for bi-directional load cell assembly, which shall be 2 inches thick and approximately equivalent diameter as I.D. of steel reinforcing cage used on production shafts of same diameter. The plates are welded to the top and bottom of the bi-directional load cell for use as a mechanism of load transfer.
   3. Centralizers shall be provided or means shall be implemented to ensure centralizing of the load test apparatus, instrumentation and reinforcing steel.
   4. Steel pipes shall be 1/2-inch diameter used as conduit for telltales from above working level to the top of the bi-directional load cell assembly. Additional set of steel pipes serving dual purpose of venting the bi-directional load cell annulus during the test and as post-test grout placement tube, if production shaft is tested.
   5. Materials such as angle or channel steel or rebar needed to protect load bi-directional load cell assembly, hydraulic fittings, and instrumentation during installation and concreting procedures.
   6. Materials such as rebar used to construct an apparatus for funneling of the concrete slickline or tremie through the bi-directional load cell assembly for concrete placement.
   7. Use clean water from an approved source to mix with water-soluble oil contained within the bi-directional load cell to form the hydraulic fluid used to pressurize the bi-directional load cell.

2.03 INSTRUMENTATION AND MEASURING MATERIALS

A. Provide the following primary instrumentation packages to monitor movement and strain of the pile as needed to develop load monitoring:
   1. Linear Vibrating Wire Displacement Transducers (LVWDTs) having a range of at least 6 inches, with signed certificates of calibration. Transducers shall be capable of reading to within 0.001-inch of displacement.
   2. Three dial gages having at least 2 inches of travel, an adequate number of suitable blocks to increase travel to at least an additional 4 inches.
   3. Linear Variable Displacement Transducers (LVDTs) having a range of at least 6 inches, with signed certificates of calibration. Transducers shall be capable of reading to within 0.001-inch of displacement.
   4. Sister Bar Vibrating Wire Strain Gauges, with signed certificates of calibration.
   5. Telltale extensometer assemblies to measure in the pile to determine elastic shortening of the pile. Telltale extensometer assemblies shall have a range of at least 1 inch with signed certificates of calibration. Transducers shall be capable of measuring movement within 0.001-inch. Embedded compression telltale assemblies shall be used when typical surface measuring methods are impractical.

B. Additional equipment as required to operate test and data collection:
   1. Air compressor (minimum 185 cfm, 125 psi) with hose and Chicago-type fitting for pump operation during the load test.
   2. Air-driven hydraulic pump to be used as bi-directional load cell pressure source and accompanying pressure gage.
   3. Tripods, automated survey level and related equipment to measure upward top of shaft displacement.
   4. All necessary data acquisition equipment.
   5. A portable computer and electronic logging equipment shall be furnished to simultaneously monitor all instrumentation at time intervals required for the load testing.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install dedicated load test piles to verify the design of the pile system and proposed construction methods prior to installing any production piles. Installation shall be performed under the direction and supervision of the Specialty Contractor and the Engineer.

B. Obtain at least 4 concrete cylinders for compressive strength testing for the concrete used in each test pile. At least one cylinder shall be tested prior to the pile load test to establish the minimum concrete strength per Section 02466B - Augured Pressure Grouted Piles or Section 02467A - Drilled Concrete Piers. The remaining 2 cylinders shall be tested on the day of the load test.

C. Static Axial Load Test Installation:
   1. Loading frame, reaction piles and hydraulic jack, and instrumentation shall be installed in accordance with ASTM D1143.

2. Place LVDTs at the top of the test pile to measure displacement.
3. The vibrating wire strain gauges shall be placed in pairs on opposite sides of the reinforcing cage at the elevations shown on the test pile schematics in Appendix A. The geotechnical engineer may require modifications to location of the instrumentation after pile drilling if subsurface conditions are different than anticipated from available borings. The intent of the load test internal instrumentation including “sister bar” vibrating wire strain gauges is to measure the test load and its distribution along the shaft and near the tip.

D. Bi-directional Axial Load Test Installation:
1. Bi-directional load cell, hydraulic supply lines and other instruments shall be assembled and prepared for installation in a suitable area adjacent to the test shaft, provided by the Contractor.
2. The intent of the load test internal instrumentation including LVWDTs, and sister bar vibrating wire strain gauges is to measure the test load and its distribution (side friction) along the drilled pile. The bi-directional load cell assembly shall be located as indicated on the test pile schematics in Appendix A. The bi-directional load cell location and test load shall take into account downdrag forces on the pile and the weight of the pile itself. The vibrating wire strain gauges shall be placed in pairs on opposite sides of the reinforcing cage at the elevations shown on the test pile schematics. The geotechnical engineer may require modifications to location of the instrumentation after pile drilling if subsurface conditions are different than anticipated from available borings.
3. Two LVWDTs shall be attached to the top and bottom plates of the bidirectional load cell to monitor the expansion and contraction of the load cell. In addition, two LVDT gauges shall be mounted on an independent reference beam and set on opposite sides of the top of the test shaft to monitor axial shaft displacement.
4. A pair of sister bars shall be placed at a location below the bi-directional load cell to measure the test load and resistance in the lower portion of the drilled pile.
5. Two telltale rods shall be set on the top of the bi-directional load cell to monitor the displacement of the top of the load cell. The telltale shall consist of a 3/8-inch diameter stainless steel rod, greased for reducing friction and corrosion, and placed inside a constant 3/4-inch diameter pipe. Individual sections of telltales shall be joint coupled flush so that each rod is of uniform diameter throughout its length.
6. Bi-directional load cell assembly shall be welded to the reinforcing steel, with the plane of the bottom plate of the bi-directional load cell set at right angles to the long axis of the reinforcing cage.
7. Once the shaft excavation has been completed, tested, inspected, and accepted by the Engineer, the bi-directional load cell and reinforcing cage shall be lowered into the excavation.
8. The Contractor shall use the utmost care in handling the test assembly so as not to damage the instrumentation during installation. The Contractor shall limit the deflection of the reinforcing cage to 2 feet between pick points while lifting the cage from the horizontal to the vertical position. The maximum spacing between pick points shall be 25 feet. The Contractor shall provide support bracing, strong backs, etc. to maintain the deflection within the specified tolerance. The bi-directional load cell assembly must remain

perpendicular to the long axis of the reinforcing cage throughout the lifting and installation process.

3.02 PILE LOAD TEST

A. Requirements of this Section apply to Static Axial Load Test and Bi-directional Axial Load Test.

B. General Requirements:
   1. General:
      a. At locations selected by Engineer, install and load test piles.
      b. Load test the following number of piles:
         1) 2 piles under axial compression (1 pile on each side of the bridge).
         2) 2 additional piles for each unsuccessful test.
      c. The pile design loads are as follows:
         1) Compression: 100 kilopounds.
      d. Pile load test records will be used by Engineer to confirm or modify pile tip elevations or pile lengths as indicated on the Drawings.
      e. Install piles that will be load tested to a tip elevation of 45 feet below ground.
      f. Load test shall not begin until after a minimum of one week after completion of test pile construction and pile concrete attains a minimum compressive strength of not less than 85 percent design mix strength.
      g. Records: Contractor shall keep records of pile load tests, including as a minimum.
      h. Date.
      i. Pile identification.
      j. Loading, showing amount of each increment and decrement.
      k. Time of each increment and decrement in loading.
      l. Axial movement of test pile and time when measured.
   2. Test equipment:
      a. Load piles with hydraulic jacks.
      b. Measure load with a load cell and verify load cell measurements with pressure gauges measuring hydraulic pressure of jacks.
   3. Install load test piles using the equipment and method proposed for the production piles.
   4. Axial compression pile load test:
      a. Perform test in accordance with ASTM D1143 or D8169, as complemented and modified in this Section:
         1) Loading shall be applied in accordance with “Standard Loading Procedure” in ASTM D1143.
      b. Prevent lateral movement of top of piles by lateral restraints or other suitable measures.
         1) Pile load shall not be eccentric.
      c. At the option of Contractor, piles may be loaded from existing grade, before beginning of excavation, or from bottom of completed excavation:
         1) Where test piles project above design pile butt cutoff elevation, ensure piles are free to move in axial direction above design pile butt cutoff elevation.
         2) Where ground level at time of testing is above design pile butt cutoff elevation, encase such piles above butt cutoff elevation, in manner

such that there is no friction between pile and surrounding soil or between pile and casing.

d. Maximum load:
   1) Twice design load.
   2) Static axial load test frame and jack or bi-directional load cell shall be capable of applying a test load up to 2000 kilopounds.
   3) Maintained constant for 1 hour before load is removed:
      a) Remove load in decrements not exceeding 20 percent of maximum load.
      b) Where axial movement of pile is excessive, maximum applied load shall be removed in several decrements after movement of butt of pile reaches 2 inches.

5. Gamma-gamma logging:
   a. Provide access tubes for gamma-gamma logging.
   b. After placing the pile concrete and before beginning the gamma-gamma logging of the pile, inspect the access tubes. Each access tube that the test probe cannot pass through shall be replaced, at the Contractor's expense, with a 2-inch diameter hole cored through the concrete for the entire length of the pile. Unless directed otherwise by the Engineer, the cored holes shall be located approximately 3 inches inside the reinforcement and shall not damage the reinforcement. Descriptions of inclusions and voids in cored holes shall be logged, and a copy of the log shall be submitted to the Engineer. Finding from cored holes shall be preserved, identified as to location, and made available for inspection by the Engineer.

3.03 FIELD QUALITY CONTROL

A. Provide field quality control as specified in Section 02466B - Augured Pressure Grouted Piles or Section 02467A - Drilled Concrete Piers.

B. Provided and paid by Contractor:
   1. As specified in Section 02466B - Augured Pressure Grouted Piles or Section 02467A - Drilled Concrete Piers.
   2. Reporting:
      a. At each load increment (or decrement), telltale, survey level, LVDT, LVWDT and strain gauge data shall be reported at 1, 2, 4 and 8-minute intervals.
      b. Load Test Report: Provide an electronic version to the Engineer for evaluation. An initial data report containing the load-movement curves and data tables shall be provided to the Engineer within 5 working days of the completion of load testing. A final report on the load testing shall be submitted within 10 working days after acceptance of the load test results. At a minimum, the report shall include:
         1) Summary of load test procedures.
         2) Tabulated data of all embedded and surface instrument readings.
         3) Load vs. displacement plots of test shaft.
         4) Equivalent top-loaded load settlement plot, if bi-directional load cell used.
         5) Load distribution plot based on strain gauge data.

6) Net unit side shear curves, and unit end bearing vs. displacement curves (t-z and q-z curves).
7) Creep limit analysis.
8) Caliper tool shaft excavation profiling.
9) Calibration documentation for all instrumentation and bi-directional load cells used during the load test.
10) Boring logs and related site investigation results, if appropriate.
11) Summary of test shaft details and schematic as-built drawing of test shaft indicating locations of bi-directional load cell, instrumentation, and soil stratigraphy.

3.04 AFTER LOAD TEST COMPLETION

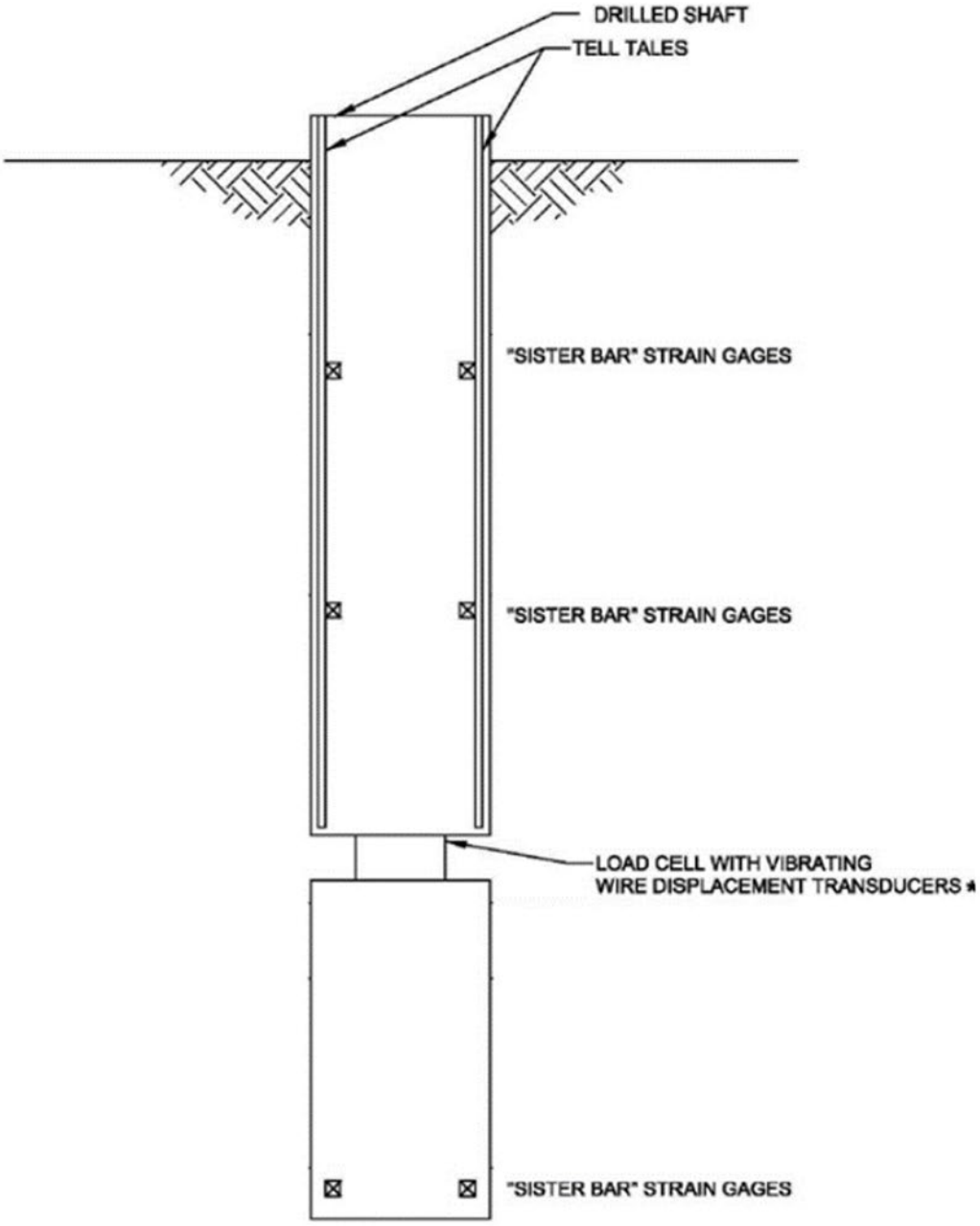
A. Leave test piles in the ground and do not use such piles for support of structures:
   1. Cut top off 2 foot below bottom of pile cap.
   2. Fill void with compacted aggregate base course material.

B. Static Load Test piles:
   1. At Contractor's option, reaction piles can be used for support of structures where all reaction piles meet the following conditions, as determined by the Engineer:
      a. Their design capacity is equal to or greater than that of the production piles.
      b. Their location is as indicated on the Drawings for piles for the structure.
      c. Their loading during performance of tests has not exceeded their allowable design load.
      d. They have not been damaged.
      e. Their pile butt axial deflection has not exceeded 0.5 inches.

C. Bi-directional Load Test piles:
   1. Flush all hydraulic fluid from the load cells and hydraulic lines, and replace with cement grout.
   2. At Contractor’s option, test piles can be used for support of structures where they meet the following conditions, as determined acceptable by the Engineer:
      a. Their design capacity is equal to or greater than that of the production piles.
      b. Their location is as indicated on the Drawings for piles for the structure.
      c. Their loading during performance of tests has not exceeded their allowable design load.
      d. They have not been damaged.
      e. Their pile butt axial deflection has not exceeded 0.5 inches.

D. Gamma-gamma logging: All access tubes and cored holes shall be dewatered and filled with grout after tests are completed. The access tubes and cored holes shall be filled used grout tubes that extend to the bottom of the tube or hole or into the grout already placed.

GAMMA-GAMMA LOGGING



* REPLACE WITH "SISTER BAR" STRAIN GAGES FOR STATIC LOAD TEST.

NOT TO SCALE

END OF SECTION

SECTION 02466A

BORED AND AUGERED PILES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Bored/augered piles.

B. Payment procedures:
   1. Payment for pile work:
      a. Base lump sum bid price for pile work on the number and lengths of piles indicated on the Drawings.
         1) This price shall include all costs in connection with the Work, including pile material, installation, reinforcing, concrete, and other related items for a complete installation.
      b. In addition, quote a unit price per foot for additional pile length and reduction in pile length for changes in pile length made before the manufacture of production piles:
         1) This change in length will be based on the results of Engineer's analysis of the pile tests.
      c. Payment will be made only for the length of pile established by the Engineer's analysis of the pile load tests:
         1) No payment will be made for any defective pile.
         2) Install piles to the elevations and lengths indicated on the Drawings, unless otherwise indicated in writing by the Engineer:
            a) No payment will be made for the length of pile greater than the length indicated on the Drawings.

1.02 SUBMITTALS

A. Product data: Description of equipment proposed for installing piles.

B. Shop drawings: Shop drawings of piles proposed for use on the Project showing details of piles, reinforcing, concrete mix design, calculations, and other information required to describe proposed materials and construction methods.

C. Pile location:
   1. Piling layout plan: Plan showing location of piles as indicated on the Drawings including:
      a. Assigned number for each pile as identification for use in pile installation record.
      b. Pile cutoff elevation.
      c. Pile tip elevation.
   2. Pile location survey.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Protect piles from damage during transportation, storage, and handling.

1.04 SEQUENCING AND SCHEDULING

A. Fabrication and installation of piles: Do not fabricate or install piles until submittals have been accepted by the Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONSTRUCTION

A. Site tolerances:
   1. Pile installation tolerances:
      a. Deviation of pile top centers: Do not deviate from locations indicated on the Drawings more than 6 inches in any direction.
      b. Elevation of pile tops: Not more than 1 inch higher nor more than 3 inches lower than elevation indicated on the Drawings.
      c. Deviation of vertical piles from vertical: Not more than 1/4 inch per foot of length.
      d. After installation, a line from center of butt to center of tip shall be wholly within body of pile.

3.02 FIELD QUALITY CONTROL

A. Field measurements:
   1. Pile location survey:
      a. After piles are installed and prior to placing reinforcing steel, formwork, or concrete for the structure, prepare pile location survey showing coordinates of final location of butt of piles and elevations of butt of piles to accuracy of plus or minus 0.01 feet.
      b. Pile location survey shall be performed by Surveyor registered in the state where the Project is located.
      c. Provide survey that includes as minimum following information:
         1) Location coordinates of:
            a) Pile butts as indicated on the Drawings.
            b) Pile butts as installed.
            c) Calculate distances between location coordinates of pile butts as indicated on the Drawings and actual location coordinates of pile butts as installed.
         2) Elevation of pile butts:
            a) As indicated on the Drawings.
            b) Elevation of pile butts as installed.
            c) Calculate difference between elevations of pile butts as indicated on the Drawings and actual elevation of pile butts as installed.

3) Highlight piles that are not within specified tolerances for location in plan and butt elevation.
4) Provide preceding information in tabular form and keyed to a pile plan by pile number:
a) Provide pile plan that shows each pile for each structure.

d. Engineer will utilize pile location survey information to evaluate acceptability of pile locations.

3.03 ADJUSTING

A. Correction of defective pile work:
1. Pile work not in accordance with the requirements indicated on the Drawings and specified in the Specifications is considered defective.
2. Take corrective measures acceptable to the Engineer, if piles are damaged, out of tolerance, mislocated, or otherwise defective:
a. Cost of redesign of foundation elements by the Engineer required by reason of defective pile work shall be bourne by Contractor.
b. Allow 15 working days from submittal of pile location survey, for design of corrections for defective pile work.
3. Measures to be used to correct defective pile work will be selected by the Engineer. Corrective measures that may be acceptable to the Engineer include:
a. Installing additional piles at locations selected by the Engineer.
b. Pile caps will be redesigned by the Engineer and required details of modifications to pile caps will be given to the Contractor to accommodate piles that were installed out of tolerance.
4. Leave piles which are not accepted in the ground.
a. Cut off such piles at least 1 foot below bottom of pile cap and fill such holes with compacted aggregate base course material:
1) Fill tubes or holes with Class C concrete.

END OF SECTION

SECTION 02466B

AUGERED PRESSURE-GROUTED PILES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Augered pressure-grouted piles.
   2. Test piles per Section 02460 - Pile Load Tests.
   3. Dewatering within piles.
   4. Furnishing and installing materials, equipment, and measuring devices for testing pile capacity.
   5. All other work normally related to the above or specified under this section.

B. Related work:
   1. Provide excavation to required depth below pile cut-off elevation and remove drilling spoil as specified in this Section.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   2. C33 - Standard Specification for Concrete Aggregates.
   3. C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-Inch or 50-mm Cube Specimens).
   4. C150 - Standard Specification for Portland Cement.
   5. C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

1.03 SUBMITTALS

A. Daily reports:
   1. Provide a record for each pile driven or drilled and grouted. Provide daily reports which contain as a minimum the following information:
      a. Project name.
      b. Name of Contractor.
      c. Identification mark.
      d. Date and time of installation.
      e. Pile type and size.
      f. Elevation of point.
      g. Elevation of butt - before and after cut-off or extension.
      h. Ground elevation.
      i. Horizontal deviation from plan location.
      j. Plumbness deviation.
      k. Nature and location of obstructions.

l. Location of dog legs crimping or buckling.
m. Unusual occurrences during drilling, or reinforcing and grout placement.
n. Water conditions in pile, if applicable.

B. Pile group layout drawings:
1. Submit plan showing as-built location of each pile group no later than 1 week following the completion of each pile group.
a. Show the design and as-built centroid of the group as well as the deviation of each pile from its design alignment.

C. Gamma-gamma test data analysis and results.

1.04 QUALITY ASSURANCE

A. Engineer:
1. Piling operations will be continuously observed, and installed piles inspected by a qualified Engineer, selected and paid for by the Owner.

B. Testing agency:
1. All mortar testing during pile operations will be done by an approved testing laboratory selected and paid by the Owner.
a. Furnish testing agency access to work, facilities, and incidental labor required for testing and inspection.

C. Contractor qualifications:
1. Regularly engaged in the installation of augered pressure grouted pile foundation systems.
2. Minimum of 10 years previous experience on projects of similar size, complexity, and subsurface conditions.
a. The job supervisor directly responsible for pile installation shall have a minimum of 10 years previous experience on augered pressure-grouted pile installation.
3. The crane operator or "keymen" who give directions to the crane operators shall have at least 2 years of experience.
4. Forward qualifications of crew to the Engineer for review prior to commencement of work.
5. Gamma-gamma logging (or gamma density logging) organization and personnel: The testing organization shall have performed gamma-gamma log tests on a minimum of 3 deep-foundation projects in the last 2 years. Personnel conducting the tests for the testing organization shall have a minimum of 1 year of experience in gamma-gamma logging and interpretation.

D. Piles:
1. Meet requirements of the building code as specified in Section 01410 - Regulatory Requirements.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Reinforcing steel:
1. Unload and store reinforcing bars in such a manner that they will be kept free of mud. Store on timber skids while awaiting use.

B. Miscellaneous:
   1. Store other materials in a weathertight and dry place until ready to use.
      a. Store packaged materials in their original unbroken package or container.

C. Equipment:
   1. The equipment provided for installation of augered pressure grouted piles, is subject to acceptance by the Engineer.
      a. At least 10 working days prior to mobilization, provide the Engineer a complete list and technical description of the equipment.

D. Auger:
   1. A full-size continuous-flight, 36-inch diameter (less a maximum wear of 1/2 inch) hollow-shaft to be rotated into the ground to the specified pile depth.
      a. The injection opening in the auger shaft shall be at the bottom of the auger head and below the cutting teeth.

E. Auger drive:
   1. Use auger drive head having a minimum static weight of 4,000 pounds and drive of 150 horsepower.

F. Auger leads:
   1. Prevent auger leads from rotating by a suitable stabilizing arm.

G. Crane:
   1. Use crane equipped with torque converter drive system to permit a slow, continuous auger lifting (grouting) operation.

H. Pumping and mixing:
   1. Use pumping and mixing equipment for preparation and handling of the mortar.

I. Mortar pump:
   1. Positive displacement pump capable of developing and maintaining a pressure of 350 pounds per square inch-gauge at the pump discharge.
      a. The combination of pump, diameter of hose, length of hose, and height of crane shall be such that the grout pressure is at least 100 pounds per square inch-gauge at the tip of the auger.

PART 2 PRODUCTS

2.01 MATERIALS

A. Portland cement: ASTM C150, Type II.

B. Fly ash: ASTM C618, Class F.

C. Sand: ASTM C33 with Fineness Modulus from 1.3 - 3.4.

D. Fluidifier:
    1. Fluidifier shall be a compound which will increase the flowability of the mix and assist in neutralizing the setting shrinkage of the mortar.
        a. Contractor's choice of fluidifier will be subject to acceptance by the Engineer.

E. Water: Clean and free from matter injurious to the mix.

F. Reinforcing steel: ASTM A615, Grade 60.

G. Mortar:
    1. Mixture of portland cement, a mortar fluidifier, sand, and water so proportioned and mixed to provide a mortar capable of maintaining the solids in suspension without appreciable water gain, but which may be pumped without difficulty and will penetrate laterally to fill voids in the soil.
    2. Proportion to provide a hardened mortar having an ultimate compressive strength of 5000 pounds per square inch minimum at 28 days as determined by standard 2-inch cubes.
        a. Submit proposed mix design to the Engineer for acceptance not less than 6 weeks prior to the time of its first use.

H. Access tubes for gamma-gamma logging:
    1. Access tubes for gamma-gamma logging shall be Schedule 40 PVC pipe and at least 2-inch inside diameter.
    2. The access tubes shall have a round, regular inside diameter free of defects and obstructions, including all pipe joints, in order to permit the free, unobstructed passage of probes used for the gamma-gamma log tests. The access tubes shall be watertight, free from corrosion with clean internal and external tubes to ensure good bond between the concrete and the access tubes. The access tubes shall be fitted with watertight threaded PVC caps on the bottom and on the top.
    3. Provide a minimum of 2 tubes per pier. Place tubes at uniform spacing not exceeding 2 feet 9 inches measured along a circle passing through the centers of the access tubes:
        a. Provide clear spacing to reinforcing in accordance with Caltrans Test 233.

I. Grout: Grout for filling the access tubes at the completion of the gamma-gamma logging shall be neat cement grout with a maximum water/cement ratio of 0.45.

PART 3 EXECUTION

3.01 PREPARATION

A. Layout:
    1. Pile locations will be staked out and maintained by a Registered Surveyor retained by the Pile Installer.
        a. Cross-stake pile locations so that centerlines are retained after driving.

2. Surveyor shall establish and maintain permanent benchmarks as necessary for monitoring of elevations.
    a. Reference benchmarks to a common datum and place at locations not subject to disturbance by the pile installation operation and acceptable to the Engineer.

3.02 INSTALLATION

A. Install piles as specified in Section 02466A - Bored and Augered Piles.

B. General:
1. A continuous helical-flight hollow-shaft auger shall be drilled into the ground to the required depth.
    a. Inject specified mortar under pressure, through the auger shaft as the auger is being withdrawn, using the earth-filled auger to retain the shape of the hole.
    b. Positively rotate the auger as it is being withdrawn.
2. Do not install within 8 hours of the installation of an adjacent pile which is within 4 feet unless accepted in writing by the Engineer.
3. Dip piles down to cut-off elevation while grout is still fluid. If required, place a metal sleeve in the top of each pile to become a permanent part of the pile.
4. Distribute concentrated loads from equipment properly to prevent collapsing of the hole until mortar has set.
5. Should any obstructions (including boulders or timbers) be encountered which prevent a pile from being installed to the desired depth at the design location, stop work on that pile until corrective measure instructions are received from the Engineer.
    a. Payment for piles partially completed or abandoned due to such obstructions will be adjusted at agreed Contract unit prices.
6. Install piles to required tip elevation.

C. Mortar:
1. Prepare mortar carefully in the proportions of accepted mix design.
    a. Inject mortar during withdrawal of auger maintaining minimum head of 15 feet of mortar above the injection tip to ensure lateral penetration and to prevent the hole from collapsing.
    b. Do not pump mortar until Soils Engineer has accepted the final tip elevation.
2. Use only approved mixing and pumping equipment.
    a. Remove oil or rust inhibitors from mixer parts in contact with mortar prior to use.
    b. To produce a homogeneous mortar of the desired consistency, if there is a lapse in the operation of pumping, recirculate mortar through pump, mixer drum or agitator, and pump.
3. Determine the quantity of grout pumped into each pile hole.
    a. Calibrate the mortar pump by pumping mortar into a 55-gallon drum.

D. Reinforcing:
    1. Install reinforcing, including dowels, as shown on Plans while the grout is in a fluid state.
        a. Field bending of dowels is not permitted unless specifically shown.
    2. Embed reinforcing to required depth before mortar has hardened.
        a. Extend tension-reinforcing bars in tension piles to bottom of pile.

E. Damaged or mislocated pile:
    1. Use piling procedures to avoid excessive or undue abuse.
    2. Repair or replace damaged piles, or piles located outside the required placing tolerances, at the direction of the Engineer.
    3. Install additional pile or piles where the pile centerline deviates from the specified tolerances and where a redesign indicates a load in any pile exceeding 110 percent of the design load.
    4. Piles rejected after installation may, when acceptable to Engineer be abandoned, cut off, and replaced by additional piles installed at new, designated locations indicated by a redesign accounting for the actual installed pile capacities and locations.
    5. All required redesign shall be at the Contractor's expense.

F. Access tubes for gamma-gamma logging:
    1. Install access tubes for gamma-gamma logging in pier shafts to permit access for the testing probes. Provide a minimum of 2 tubes per pier. Place tubes at uniform spacing not exceeding 2 foot 9 inches measured along a circle passing through the centers of the access tubes, generally positioned in an equidistant pattern.
    2. Location of the access tubes with respect to the outer spiral and vertical reinforcing shall be in accordance with the requirements of CT 233. Securely attach the access tubes to the interior of the reinforcement cage of the pier shaft.
    3. The access tubes shall be installed in straight alignment and as near to parallel to the vertical axis of the reinforcement cage as possible. The access tubes shall extend from the bottom of the reinforcement cage to at least 2 feet above the top of the shaft. Splice joints in the access tubes, if required to achieve full length access tubes, shall be watertight. The Contractor shall clear the access tubes of all debris and extraneous materials before installing the access tubes. Care shall be taken to prevent damaging the access tubes during reinforcement cage installation and concrete placement operations in the shaft excavation.
    4. The access tubes shall be filled with potable water as soon as possible after concrete placement (but no later than 1 day after concrete placement), and the top watertight threaded PVC caps shall be reinstalled. Remove water in the tubes completely prior to testing.

G. Tolerances:
    1. Vertical piles:
        a. Plan location: Plus or minus 3 inches from location indicated for piles in a group, or plus or minus 1 inch from location indicated for individual piles, measured at the cut-off elevation.

b. Plumbness: Deviation from plumb shall not exceed 2 percent of the pile length or one-half the edge-to-edge pile spacing, whichever is less.
c. Cut off: Pile shall be cut off level to within plus 0 inch or minus 1 inch of the specified elevation.

3.03 FIELD QUALITY CONTROL

A. Mortar testing:
1. Test mortar in accordance with ASTM C109. Prepare a minimum of 6 cubes per day and test 2 cubes at 3 days, 2 at 7 days, and 2 at 28 days.

END OF SECTION

SECTION 02467A

DRILLED CONCRETE PIERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Drilled concrete piers.

B. Payment procedures:
   1. Basis of payment:
      a. Payment for pier work:
         1) Base lump sum bid price for pier work on the number and lengths of piers indicated on the Drawings:
            a) This price shall include all costs in connection with the Work, including pier material, installation, reinforcing, concrete, pier cutoff, and other related items for a complete installation.
         2) In addition, quote a unit price per foot for additional pier length and reduction in pier length for changes in pier length made before the manufacture of production piers:
            a) This change in length will be based on the results of Engineer's analysis of the Pier Load Test Program.
         3) Payment will be made only for the length of pier established by the Engineer's analysis of the Pier Load Test Program:
            a) No payment will be made for any defective pier.
            b) Install piers to the elevations and lengths indicated on the Drawings, unless otherwise indicated in writing by the Engineer:
               (1) No payment will be made for the length of pier greater than the length indicated on the Drawings.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
   2. 350 - Code Requirement for Environmental Engineering Concrete Structures and Commentary.

B. ASTM International (ASTM):
   1. C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   2. C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   3. C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
   4. C172 - Standard Practice for Sampling Freshly Mixed Concrete.
   5. C192 - Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.

1.03 DEFINITIONS

A. Cementitious Materials: Defined as portland cement and pozzolan admixture.

1.04 SUBMITTALS

A. Reinforcing bar placement drawings.

B. Bar lists and bending details.

C. Concrete mix design report as specified in Section 03300 - Cast-in-Place Concrete.

D. Aggregate tests.

E. Trial batch results.

F. Concrete testing requirements as specified in Section 03300 - Cast-in-Place Concrete.

G. A list and description of proposed equipment to be used for the construction of piers such as cranes, drills, cleaning equipment, and tremie concrete pumps.

H. Details of overall construction operation, sequence, and drilling construction methods.

I. Qualifications of crew for review at bid time. Substitution of approved personnel will not be allowed without written authorization by the Owner.

J. Pier location plan and location information:
   1. Pier layout plan: Pier plan showing location indicated on the Drawings, including:
      a. Assigned number for each pier as identification for use in pier installation record.
      b. Pier tip elevation.

K. Pier location survey.

L. Pier Load Test Program and results.

M. Load test system: Submit at least 2 weeks prior to installing the load test system.

N. At least 2 weeks prior to installation of load test piers, submit calibration charts for all the hydraulic jacks to be used in the load test program.

1.05 QUALITY ASSURANCE

A. Contractor qualifications:
   1. The Contractor shall be regularly engaged in the installation of drilled piers foundation systems.
   2. Have a minimum of 10 years previous experience on projects of similar or larger size, complexity, and subsurface conditions.

3. The job supervisor directly responsible for pier installation shall have continuous experience on drilled pier installation throughout the last 10 years.
4. The crane operators or “keymen” who give directions to the crane operators shall have at least 2 years of experience.
5. Gamma-gamma logging (or gamma density logging) organization and personnel: The testing organization shall have performed gamma-gamma log tests on a minimum of 3 deep-foundation projects in the last 2 years. Personnel conducting the tests for the testing organization shall have a minimum of 1 year of experience in gamma-gamma logging and interpretation.

PART 2 PRODUCTS

2.01 MATERIALS

A. Reinforcing steel: Use reinforcing steel as specified in Section 03200 - Concrete Reinforcing.

B. Tie wire: Use Number 18 double annealed iron wire, tie wire.

C. Concrete:
1. Use concrete materials as specified in Section 03300 - Cast-in-Place Concrete.
2. Use Class P concrete as specified in Section 03300 - Cast-in-Place Concrete.

D. Temporary steel casing: Steel casing for drilled piers shall conform to ASTM A 252, Grade 2. The use of temporary steel casing segments is anticipated on this site.

E. Access tubes for gamma-gamma logging:
1. Access tubes for gamma-gamma logging shall be Schedule 40 PVC pipe and at least 2-inch inside diameter.
2. The access tubes shall have a round, regular inside diameter free of defects and obstructions, including all pipe joints, in order to permit the free, unobstructed passage of probes used for the gamma-gamma log tests. The access tubes shall be watertight, free from corrosion with clean internal and external tubes to ensure good bond between the concrete and the access tubes. The access tubes shall be fitted with watertight threaded PVC caps on the bottom and on the top.
3. Provide a minimum of 2 tubes per pier. Place tubes at uniform spacing not exceeding 2 feet 9 inches measured along a circle passing through the centers of the access tubes:
    a. Provide clear spacing to reinforcing in accordance with Caltrans Test 233.

F. Grout: Grout for filling the access tubes at the completion of the gamma-gamma logging shall be neat cement grout with a maximum water/cement ratio of 0.45.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
   1. Install piers only in the presence of the Engineer.
   2. Piers that fail to meet the requirements of these Specifications for alignment and piers which for other reasons are unacceptable will be rejected.
   3. Correct damaged or rejected piers by methods acceptable to the Engineer.

B. Drilling:
   1. Drill holes by means of a power driven, rotary bucket, rotary auger type, or core barrel foundation drilling machine designed to excavate a cylindrical shaft:
      a. Have sufficient power and cutting capacity to excavate the pier holes to the required depths into the soil or rock at the site.
   2. Use drilling method which prevents the shaft sidewalls from caving in or sloughing into the excavated hole, except that dewatering will not be permitted.
   3. Proceed with the work in the “wet” if the groundwater level is found above pier tip elevation.
   4. Do not drill holes within 4 pier diameters (center-to-center) of a previously drilled hole until after the concrete in the previous hole has set up, but in no case until the concrete has been placed for at least 15 hours.
   5. Do not drill holes until the excavation or fill in the area in which the shafts are to be located has been completed to the elevations indicated on the Drawings.
   6. Clean out the hole until no more than 1/4 inch of loose or soft material is left in the bottom of the hole.
   7. Clean and protect top of holes to prevent soil from falling into hole.
   8. Drill piers from the ground surface to tip elevations as indicated on the Drawings.
      a. The Engineer will determine the final bottom of hole elevation and will keep a record of each drilled hole during installation.

C. Reinforcing steel:
   1. Upon completion of drilling, position the reinforcing steel cage in the pier shaft as indicated on the Drawings and suspend it above the bottom of excavation before any concrete is placed in the shaft.
   2. Support the reinforcing steel cage so that it rotates freely just prior to final suspension.
   3. If soil caving occurs after reinforcing steel is placed and before placement of concrete, remove the reinforcing steel and ream the hole to permit repositioning of the cage.
   4. Support the cage in a manner that will ensure that it remains centered in the pier shaft during placement of concrete.
      a. Use plastic roller type centering devices attached to spiral reinforcing bars.
      b. The centering devise shall position reinforcing cages in center of hole and provide proper cover for reinforcing bars.

D. Concrete placement:
   1. Placement of concrete shall be as specified for dry or wet conditions as may be applicable for the conditions found at the time of the work.
   2. During concrete placement, take care to prevent concrete from hitting the sides of the steel reinforcing bar cage which will cause segregation.
   3. To prevent segregation, do not allow concrete to fall more than 5 feet.
   4. Proceed with concrete placement that starts underwater, using underwater placement requirements until the hole is completely filled.
      a. Do not dewater the shaft after partial concrete placement.
   5. Provide for a supply of concrete that is adequate to complete placement on any given drilled pier in one continuous uninterrupted operation without cold joints.
   6. Construct concrete work in a manner that dense, monolithic concrete is provided throughout the full length and diameter of the drilled pier.
   7. Immediately after acceptance of the excavation, place the concrete.
   8. Water in excavation:
      a. Excavations containing more than 3 inches of water shall be pumped dry prior to concrete placement.
         1) Except for the bottom 3 inches, do not drop concrete through water:
      b. In a dry excavation, place concrete with a concrete chute or pumping method acceptable to the Engineer.
      c. Direct the flow of concrete down the center of the pier shaft in order to minimize sloughing of the sides of the hole and segregation of the concrete on the reinforcing steel.
   9. Water seepage:
      a. If seepage occurs at such a rate that the concrete cannot be properly placed, even if the pier hole is cased, place concrete using the “tremie” method:
      b. Use a tremie pipe having a disposable plug that keeps the tremie free of fluid until the plug is blown out by the concrete pressure.
      c. Preferably, use a tremie pipe which is 12 inches, but not less than 8 inches in diameter.
      d. Alternatively, use pumped concrete discharging through a pipe at least 5 inches in diameter.
      e. Use a tremie or pump pipe having watertight joints.
      f. Provide for no more than 3 inches of height between the bottom of the tremie pipe and the bottom of excavation during initial concrete placement.
      g. Provide positive control to make certain that the bottom of the tremie or pump pipe is at all times below the concrete surface.
      h. At least a 1 foot head of concrete shall be maintained above the top of the water.

E. Temporary casing:
   1. Use temporary casing.
      a. Withdraw casing as the concrete is placed:
   2. Provide steel casing onsite in various appropriate lengths.
   3. Case the drilled pier holes through any fill and native soil or rock as required to maintain a stable excavation.
   4. Withdraw casing as concrete placement proceeds while maintaining at least 3 feet of concrete depth over the bottom of the casing pipe.

5. Use steel casing with an inside diameter at least as large as the design pier diameter.
6. Use a casing wall thickness such that it is not damaged by water or ground pressures or by the stresses of installation.
7. Attach cutting teeth to the casing, if required to penetrate to the planned depth.
8. Use casing length so that at the end of drilling, the top of the casing projects above the ground surface and any adjacent mound of drill cuttings.
9. Provide positive control to make certain that the bottom of the casing is at least 3 feet below the top of the concrete being placed to prevent a reduction in the diameter of the pier shaft due to earth pressure and to prevent in situ materials from falling into and mixing with the concrete.

F. Cave-ins:
   1. Remove soil which sloughs into the excavated pier shaft prior to concrete placement:
   2. During concrete placement, if the Engineer has reasons to suspect that concrete was breached by the soil or that the pier, for any other reason, may contain extraneous material, or otherwise is not in conformance with Drawings and Specifications, the Engineer may order testing of the pier by coring or other methods:
      a. Pay for testing and additional construction as required by the Engineer, if the work is found defective.
      b. If work is found to be not defective, testing cost will be paid by the Owner.

G. Where required due to pier being constructed too high, cut off piers to the butt elevations indicated on the Drawings.

H. Access tubes for gamma-gamma logging:
   1. Install access tubes for gamma-gamma logging in pier shafts to permit access for the testing probes. Provide a minimum of 2 tubes per pier. Place tubes at uniform spacing not exceeding 2 foot 9 inches measured along a circle passing through the centers of the access tubes, generally positioned in an equidistant pattern.
   2. Location of the access tubes with respect to the outer spiral and vertical reinforcing shall be in accordance with the requirements of CT 233. Securely attach the access tubes to the interior of the reinforcement cage of the pier shaft.
   3. The access tubes shall be installed in straight alignment and as near to parallel to the vertical axis of the reinforcement cage as possible. The access tubes shall extend from the bottom of the reinforcement cage to at least 2 feet above the top of the shaft. Splice joints in the access tubes, if required to achieve full length access tubes, shall be watertight. The Contractor shall clear the access tubes of all debris and extraneous materials before installing the access tubes. Care shall be taken to prevent damaging the access tubes during reinforcement cage installation and concrete placement operations in the shaft excavation.
   4. The access tubes shall be filled with potable water as soon as possible after concrete placement (but no later than 1 day after concrete placement), and the top watertight threaded PVC caps shall be reinstalled. Remove water in the tubes completely prior to testing.

I. Site tolerances:
   1. Pier installation tolerances:
      a. Deviation of center of pier butts: Not deviate from locations indicated on the Drawings more than 6 inches in any direction.
      b. Deviation of elevation of pier butts: Not more than 1 inch higher nor more than 3 inches lower than elevation indicated on the Drawings.
      c. Deviation of piers from vertical: Not more than 1/4 inch per foot of length.
      d. After installation, a line from center of butt to center of tip shall be wholly within body of pier.

3.02 FIELD QUALITY CONTROL

A. Inspection of drilled hole:
   1. If inspection of hole is required by Engineer, dewater holes to make the holes accessible to inspection and construction personnel.
   2. Provide fresh air and adequate light for workmen and Engineer during such time that they occupy the shafts.
   3. Test each drilled hole for toxic or explosive gas prior to entry into the hole.

B. Field measurements:
   1. Pier location survey:
      a. After piers are installed and prior to placing reinforcing steel, formwork, or concrete for the structure, prepare pier location survey showing coordinates of final location of butt of piers and elevations of butt of piers to accuracy of plus or minus 0.01 feet.
      b. Pier location survey shall be performed by Surveyor licensed in the state where the Project is located.
      c. Provide survey that includes as minimum following information:
         1) Location coordinates of:
            a) Location of pier butts as indicated on the Drawings.
            b) Location of pier butts as installed.
            c) Calculate distance between location coordinates of pier butts as indicated on the Drawings and actual location coordinates of pier butts as installed.
         2) Elevation of pier butts:
            a) Elevation of pier butts as indicated on the Drawings.
            b) Elevation of pier butts as installed.
            c) Calculate difference in elevations of pier butts as indicated on the Drawings and actual elevation of pier butts as installed.
         3) Highlight piers that are not within specified tolerances for location in plan and butt elevation.
         4) Provide preceding information in tabular form and keyed to a pier plan by pier number:
            a) Submit pier plan that shows each pier for each structure.
      d. Engineer will utilize pier location survey information to evaluate acceptability of pier locations and elevations.

C. Pier load test program:
   1. Provide pier load tests as per Section 02460 - Pile Load Tests.

3.03 ADJUSTING

A. Correction of defective pier work:
   1. Pier work not in accordance with the requirements indicated on the Drawings and specified in the Specifications is considered defective.
   2. Take corrective measures acceptable to the Engineer, if piers are damaged, out of tolerance, mislocated, or otherwise defective:
      a. Cost of redesign of foundation elements by the Engineer required by reason of defective pier work shall be paid by Contractor.
      b. Allow 15 working days from submittal of pier location survey, for design of corrections for defective pier work.
   3. Measures to be used to correct defective pier work will be selected by the Engineer. Corrective measures that may be acceptable to the Engineer include:
      a. Installing additional piers at locations selected by the Engineer.
      b. Pier caps will be redesigned by the Engineer and required details of modifications to pier caps will be given to the Contractor to accommodate piers that were installed out of tolerance.
   4. Leave piers which are not accepted in the ground. Cut off such piers at least 2 feet below bottom of pier cap and fill such holes with compacted aggregate base course material.
   5. Fill holes drilled for piers that are not used with Class C concrete.

END OF SECTION

New Section

SECTION 02471[AD3]

GEOTECHNICAL INSTRUMENTATION AND MONITORING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for the installation, monitoring, and removal of geotechnical instrumentation for monitoring of ground movements within and around tunnel and shaft excavations, as well as movement of existing utilities and structures adjacent to tunnels and shafts.

B. The Scope of Work to be performed under this Section includes:
   1. Installing geotechnical instrumentation as indicated on the Drawings and at 9 locations per trenchless crossing.
   2. Monitoring, by survey, the geotechnical instrumentations at the frequencies and to the precision stated this Section.
   3. Removing the geotechnical instrumentation as described in this Section.
   4. Labor, material, tools, equipment, and incidentals necessary to complete the work described above.

1.02 REFERENCES

A. Occupational Safety and Health Administration (OSHA).

1.03 GENERAL

A. Contractor shall give the Engineer a minimum of 10 days advance notice of the start of work.

B. Perform all work in the presence of the Engineer, unless the Engineer has granted prior approval in writing to perform such work in his absence.

C. Perform all work in accordance with all current applicable regulations and codes of federal, state, and local agencies.
   1. In the event of conflict, comply with the strictest or most restrictive applicable requirements.

D. Contractor shall designate an Instrumentation Specialist to be in charge of installation and monitoring of instrumentation.
   1. Develop instrumentation plan, then supervise and be responsible for the instrument installation and monitoring.
   2. In charge of procurement, installation, monitoring, and removal or abandonment of all instrumentation.
   3. Direction of and review of surveys associated with the geotechnical instrumentation.

E. Minimum instrumentation and monitoring requirements are presented in this Section.
   1. Conduct additional instrumentation and monitoring as necessary to control the work and ensure the safety of the work.

F. Remove or abandon in place all instrumentation in accordance with applicable laws, regulations, guidelines, and Owner requirements. Restore the ground at the completion of the project.
   1. As a minimum, instrumentation shall be demolished within 5 feet of the ground surface and all resulting holes or voids filled with cementitious grout to the ground surface.

G. The Contractor shall perform a preconstruction survey prior to commencement of work at the site.

1.04 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. All submittals, including drawings and calculations, shall be required for the sole purpose of providing the Engineer with sufficient details to confirm that the Contractor's planned work and work in progress is in accordance with Contract Documents.
   1. Engineer's review shall not be construed to relieve Contractor in any way of responsibilities under the Contract.
   2. Do not begin work on any item requiring a submittal until the required relevant submittals have been reviewed and approved by the Engineer.

C. At least 4 weeks prior to the start of the work, submit the following qualifications:
   1. The name and qualifications of the Contractor(s) that will perform the work with descriptions of reference projects including Owner's name and contact information.
      a. Contractor performing the work shall have performed installed and monitored geotechnical instrumentations for a minimum of 5 years on at least 3 separate projects.
   2. The name and qualifications of the surveyor who will perform the work.
      a. Contractor's Instrumentation Surveyor must be licensed by the State of California and have previous similar experience surveying for the detection of structural or surface deformations.
      b. The surveyor shall be a licensed professional surveyor in the State of California.
   3. The name and qualifications of the Instrumentation Specialist:
      a. The Instrumentation Specialist shall have at least 3 years of experience with the installation, maintenance, and monitoring of geotechnical instrumentation similar to that specified in this Section.
   4. The name and qualifications of the Safety Supervisor:
      a. The Contractor's Safety Supervisor shall have at least 5 years of experience in safety management on at least 3 separate projects.

D. At least 4 weeks prior to the start of the work, submit a health and safety plan/accident prevention program, including a code of safe practices and an emergency plan.

E. At least 4 weeks prior to the start of the work, submit a Geotechnical Instrumentation and Monitoring Work Plan, including at least the following:
   1. Description of methods and materials for installing and protecting instruments.
   2. Materials and mixture proportions for cement-bentonite grout for installing and backfilling extensometers.
   3. For all instrumentation installed in borings, a proposed schedule for installing instruments, detailed step by step procedures for installation, including post installation acceptance test, together with a sample installation record sheet. The installation procedures shall include:
      a. The method to be used for cleaning the inside of casing or augers.
      b. Specifications for proposed grout mixtures, including commercial names, proportions of admixtures and water, mixing sequence, mixing methods and duration, pumping methods and tremie pipe type, size, and quantity.
      c. Drill casing or auger type and size.
      d. Depth increments for backfilling boreholes with sand and granular bentonite.
      e. Method for overcoming buoyancy of instrumentation components during grouting.
      f. Method of sealing joints in pipes and casing to prevent ingress of grout.
   4. Product data and samples:
      a. Submit all applicable manufacturer's literature describing operation and maintenance procedures for the instrumentation.
      b. Provide manufacturer's brochures on each product.
      c. Provide product description and drawings, along with samples where applicable.
   5. Permits: List permits, third party approvals, and approval contract submittals required to perform the work.

F. Prior to starting shaft or tunnel excavation in any reach, submit the initial readings of all geotechnical instruments in that reach and the results of the preconstruction survey.

G. Prior to instrument installation submit, as applicable, a certificate issued by the instrument's manufacturer stating that the manufacturer has inspected, calibrated, and tested each instrument before it leaves the factory to see that the instrument is working correctly and has no defects or missing parts.

H. Submit the following during construction within the specified time restrictions:
   1. Installation records:
      a. Within 5 calendar days of installation of each instrument, submit drawings showing the installed location, the instrument identification number, the instrument type, the installation date and time, established elevations, initial elevations, offset and stationing, initial coordinates, boring logs, and the anchor to tip elevation and instrument length, when applicable.
      b. Furnish details of installed instruments showing all dimensions and materials used, a separate statement describing installation procedures

for each instrument, and as-built drawings of each instrument including depths, lengths, elevations, and dimensions of key elements.

2. Reporting:
    a. Contractor shall provide data from readings of all instruments to the Engineer within 1 working day of obtaining the information.
    b. The data shall include, but are not limited to, the following:
        1) A copy of the data sheets containing a cumulative history of readings, proximity of the excavation to the instrument location itself at the time of each reading.
        2) A copy of the plot of measured values versus time, including a time history of construction activity likely to influence such readings.
3. Interpretation:
    a. Contractor shall provide interpretations of monitoring data and submit them to the Engineer along with the data.
    b. Data or interpretations shall not be published or disclosed to other parties without advance written permission of the Engineer.
    c. Engineer may make his/her interpretations of the data available to the Contractor.

1.05 QUALITY CONTROL

A. Quality Control as specified in Section 01450 - Quality Control.

PART 2 PRODUCTS

2.01 SURFACE PROTECTION

A. Surface protection shall be flush with the ground surface in areas where the instrument may be damaged or be an impediment to other activities.
    1. Roadway or lock boxes shall be provided for utility monitoring points.

2.02 MATERIALS

A. Surface monitoring points:
    1. As indicated on the Drawings and as specified, to the conditions at the ground surface.
    2. For trenchless crossings, surface monitoring shall be performed in the middle of the crossing and at half the distance from the middle to each launch and reception pit. Each location shall consist of 3 points, one centered over the alignment and one on both sides 5 feet from centerline.
    3. Rebar installed in pavement shall be driven or drilled through the pavement.
    4. Deep anchors installed in soil areas.
    5. Each shall have a tag or marking indicating the identification number, tunnel station and/or offset from centerline.

B. Utility monitoring points:
    1. As indicated on the Drawings.
    2. Each shall consist of a plastic pipe casing that exposes the utility and retains the ground to allow for multiple readings throughout the work.
    3. Provide a protective cover (roadway box).

PART 3 EXECUTION

3.01 PREPARATION AND INSTALLATION

A. Instrumentation installation: Instrumentation shall be installed at the locations indicated on the Drawings and as specified, or as directed or approved by Engineer.

B. All instrumentation within 100 feet of the work to be performed shall be installed and the initial reading taken a minimum of 7 days prior to start of excavation.

C. Access: Provide and facilitate safe access to the instrumentation to the Engineer including keys for lock boxes.

D. Existing conditions:
   1. Locate conduits and underground utilities in all areas where subsurface geotechnical instrumentation is to be drilled and installed.
   2. Subsurface geotechnical instrumentation locations shall be modified, as approved by Engineer, to avoid interference with existing conduits, utilities, and foundation elements.

E. Instrument designation:
   1. A unique instrument identification number shall be assigned to each instrument and each point.
   2. The instrument identification number shall be clearly marked on each instrument in a nondestructive manner.
   3. Both protective housing and box or vault covers shall be marked.

F. Instrument protection: All instruments and markings shall be protected to avoid being obstructed or otherwise damaged by construction operations or the general public.

G. Surveying:
   1. Immediately following installation, the location of the top of all instruments shall be surveyed to provide horizontal and vertical coordinates.
   2. Data shall be provided to Engineer.
   3. Re-surveying from control points shall be required monthly or more frequently to address potential disturbance or resolve conflicting data.

H. Drilling from the ground surface:
   1. Instrumentation holes drilled from the ground surface shall be subject to the same permitting and drilling requirements as those for geotechnical exploration boreholes.
   2. Obtain necessary permits for each such instrument and conform to the permit requirements during drilling, installation, monitoring, and abandonment.

I. Installation:
   1. Install all instruments within 3 feet of the horizontal location indicated on the Drawings, or as approved or directed by Engineer.
   2. Should actual field conditions prevent installation of instruments at the location and elevations indicated on the Drawings or specified in this Section, obtain prior acceptance from Engineer for new instrument location and elevation.

3.02 SAFETY REQUIREMENTS

A. Methods of construction shall be such as to ensure the safety of the workers, project participants, the public, third parties, and adjacent property, whether public or private.
   1. Contractor is solely and completely responsible for maintaining safe working conditions at the site at all times.

B. Safety Supervisor shall administer a health and safety plan/accident prevention program, including a code of safe practices and an emergency plan.
   1. Contractor shall hold safety meetings and provide safety instruction for new employees.

C. All work shall conform to the requirements of OSHA:
   1. Perform all work in accordance with the current applicable regulations of the Federal, State, and local agencies.
   2. In the event of conflict, comply with the more restrictive applicable requirements.

D. Conduct all construction by methods and with equipment that will control noise, dust, fumes, vapors, gases, fibers, fogs, mists, and other atmospheric impurities in accordance with applicable Federal, State, and local laws, safety codes, regulations, and ordinances.
   1. Contractor shall provide adequate ventilation, as necessary, and shall design the ventilating system to include such factors as the volume required to furnish fresh air and the volume to remove dust and vapor to safe levels.

E. All work areas shall have sufficient lighting to facilitate proper performance and inspection of work in accordance with applicable Federal, State, and local laws, safety codes, regulations, and ordinances.

3.03 MAINTENANCE

A. Contractor shall keep the site clean and tidy at all times.
   1. Site improvements shall be protected from damage or becoming soiled through suitable temporary covering.

B. Upon completion of the work, all waste shall be removed from the site and the site restored to as near its original condition as possible.
   1. Any remnants of drilling fluid or grout that may have splattered on improvements shall be completely removed.

3.04 INSTALLATION

A. Project Survey Datum shall be as indicated on the Drawings.

B. Surface monitoring points:
   1. Located as indicated on the Instrumentation Schedule in the Drawings.
   2. After completion of installation, the as-built location in horizontal position shall be determined to an accuracy of within 1 foot and the elevation to an accuracy of within 0.01 feet.

C. Utility monitoring points:
   1. Install on utilities as indicated on the Instrumentation Schedule in the Drawings.
   2. The location of the utility in the field shall be determined and the borehole advanced to the top of the utility.
      a. Contractor shall be responsible for any damage to the utility during installation of the Utility Monitoring Point.
   3. After completion of installation, the as-built location in horizontal position shall be determined to an accuracy of within 0.1 foot and the elevation of the top of the utility to an accuracy of within 0.01 feet.

3.05 MONITORING

A. Initial readings: Contractor shall take initial readings of all instruments to establish a baseline and provide the Engineer with this data.

B. Frequency:
   1. Contractor shall read required instrumentation and provide the Engineer with these data.
   2. As a minimum, Contractor shall maintain the following schedule:

Instrument Type	**Inside Active Zone/Period[a,b,c]**	**Outside Active Zone/Period[a,b,c]**
Surface Monitoring Points	Daily	Weekly/Monthly[d]
Utility Monitoring Points	Daily	Weekly/Monthly[d]

Notes:

a) Active zone/period for tunnels is within 50 feet of Microtunneling Boring Machine or face of Auger Bore.
b) Active zone/period for shafts is when the instrument is within 50 feet of the shaft, and from the beginning of shaft excavation and 2 weeks following the end of shaft backfilling.
c) Active zone/period for Soil Preparation is when the instrument is within 50 feet of any drilling, probing, and/or grout injection is occurring and shall extend a minimum of 48 hours after completion of any Soil Preparation work.
d) Monthly prior to the instrument being in an Active Zone/Period, weekly once the instrument has passed the Active Zone/Period until movement substantially stops, and monthly thereafter until the project is complete or where 4 months pass without any settlement.

   3. Contractor shall perform additional monitoring as necessary to control construction and to ensure the safety of the work.

3.06 MAINTENANCE

A. Damaged installations:
   1. Protect the instruments from damage.
   2. Damaged installations shall be replaced or repaired prior to continuing excavation.

B. Maintenance: Maintain the instruments by draining water and flushing debris from under protective covers and keeping covers locked and sealed at all times.

3.07 FINAL DISPOSITION

A. Surface monitoring points:
   1. Remove all Surface Monitoring Points installed in soil.
   2. Points in pavement may remain or be removed and the pavement patched, at the option of the governing agency.

B. For all underground instrumentation and instrumentation installed in bore holes:
   1. Remove protective housings and caps,
   2. Restore surface to the conditions existing prior to installation of the instruments.
   3. Drill out and grout, or backfill grout in accordance with permits, and environmental laws and regulations.

3.08 RESPONSE VALUES

A. Contractor shall abide by the following response values:

Instrument	**Threshold Value[(a)]**	**Shutdown Value[(a)]**
Surface Monitoring Points	0.04 feet vertical	0.08 feet vertical
Utility Monitoring Points	Threshold and shutdown values shall be set by the Contractor with review of the Engineer based on the sensitivity of the utilities identified as requiring monitoring.	
Notes: a) Threshold and Shutdown Values shall be considered for both settlement and heave.		

B. When a given response value is reached, Contractor shall as follows:
   1. Threshold value: Contractor shall meet with Engineer within 24 hours of the occurrence to:
      a. Review interpretation of the data and results,
      b. Review the construction means and methods, and
      c. Determine what changes shall be made to control ground movement.
   2. Shutdown value: Contractor shall stop tunnel or shaft excavation immediately and meet with Engineer to develop a plan of action before excavation can be resumed.

END OF SECTION

[AD3] Addendum No. 3

SECTION 02581

PRECAST ELECTRICAL HANDHOLES AND ELECTRICAL MANHOLES

PART 1 GENERAL

1.01 SUMMARY

A. Design, fabricate, and install precast electrical handholes and precast electrical manholes of the size and type indicated on the Drawings and specified.
   1. Construction of cast-in-place concrete electrical structures, including handholes and manholes, are specified in other sections.

B. Section includes:
   1. Precast portland cement concrete handholes and accessories.

C. Alternates:
   1. Contractor may propose to construct cast-in-place structures in lieu of the precast structures specified.
      a. Obtain Engineer's acceptance of this alternative before submitting, providing, or installing.
      b. Submit full information on design and detailing of proposed alternatives including design details and drawings of the same types required by this Section for precast structures.

1.02 REFERENCES

A. American Association of State Highway Transportation Officials (AASHTO):
   1. Standard Specifications for Highway Bridges.

B. American Concrete Institute (ACI):
   1. 318 - Building Code Requirements for Structural Concrete and Commentary.

C. ASTM International (ASTM):
   1. A48 - Standard Specification for Gray Iron Castings.
   2. C857 - Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
   3. C858 - Standard Specification for Underground Precast Concrete Utility Structures.
   4. C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures.
   5. C1028 - Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.
   6. C1037 - Standard Practice for Inspection of Underground Precast Concrete Utility Structures.

D. Code of Federal Regulations (CFR):
   1. Title 29, Chapter XVII, Part 1910 - Occupational Safety and Health Standards (OSHA).

E. National Fire Protection Association (NFPA):
   1. National Electrical Code (NEC).

F. National Precast Concrete Association (NPCA).

G. Society of Cable Telecommunications Engineers (SCTE):
   1. 77 - Specification for Underground Enclosure Integrity.

H. Underwriters Laboratories (UL).

1.03 DEFINITIONS

A. Handhole: An enclosure for use in underground systems that has been sized and detailed to allow personnel to reach into, but not enter, the enclosure to install, operate, or maintain equipment or wiring or both. (Reference: NEC, Article 100).
   1. As used in this Section, “handhole” will refer to a precast electrical handhole.

B. Manhole: An enclosure for use in underground systems that has been sized and detailed to allow personnel to enter the enclosure to install, operate, or maintain equipment or wiring or both.
   1. As used in this Section, “manhole” will refer to a precast electrical manhole.

C. Portland cement concrete: A composite material consisting of a portland cement binder, water, admixtures, and a combination of fine and coarse mineral aggregates.
   1. Abbreviated “PCC” as in “PCC HANDHOLE” or “PCC MANHOLE.”

D. Precast concrete: A concrete fabrication designed by a qualified engineer and subsequently fabricated at a qualified fabrication site, which is usually located some distance from the site where the fabrication will be installed.

1.04 SUBMITTALS

A. Product data: Manufacturer’s catalog data, details, and warranties for the following items.
   1. Portland cement concrete handholes and manholes:
      a. Materials of construction.
      b. Joint details and joint-sealing materials.
      c. Data for hatches or covers and rings.
      d. Preformed channels and accessories for cable racking.
      e. Drain and sump details, including removable covers.
      f. Pulling iron details.

B. Shop drawings:
   1. Portland cement concrete handholes and manholes:
      a. Shop drawings for each structure shall bear the seal and signature of a professional engineer licensed in the state where the structures will be installed.
      b. Dimensioned and “to-scale” plans, sections, and details for each structure including:
         1) Layout plan for that structure.
         2) Sizes, locations, and vertical positions of duct bank windows and knockout panels.
         3) Locations and details for access openings, pulling irons, embedded cable supports and racks, and sumps.
         4) Details of structural reinforcement showing bar size and spacing; true position of reinforcement in structural members with clear concrete cover at both inside and outside faces; location, bar size, and spacing of added reinforcement around openings; and other details relevant to design and fabrication of the structure.
         5) Details of joints between adjacent precast sections, including provisions for overlap and for placement of sealants.

C. Samples:
   1. Portland cement concrete handholes and manholes:
      a. N/A.

D. Design data:
   1. Portland cement concrete handholes and manholes:
      a. Structural calculations:
         1) Submit complete structural calculations for each structure.
         2) Provide calculations bearing the seal and signature of a professional engineer licensed in the state where the structures will be installed.
      b. Manufacturer’s statement of materials used for fabrication and construction, in accordance with ASTM C858, for record. Include the following:
         1) Concrete mix design: For each concrete mix design to be used for the structures, include data describing:
            a) Source and type of cement.
            b) Sources, grading, and specific gravities of aggregates.
            c) Aggregate reactivity data.
            d) Concrete mix proportions and design strength.
            e) Type, name, and dosage of admixtures included in the concrete mix.
         2) Reinforcing steel: Mill certificates.

E. Test reports:
   1. Portland cement concrete handholes and manholes:
      a. Fabricator’s tests for compressive strength of concrete used in structures, made in accordance with recommendations of ASTM C858.

F. Certificates:
    1. Portland cement concrete handholes and manholes:
        a. Manufacturer's current plant certification under NPCA for the structures to be supplied.
            1) Certification shall be current and in-effect at the time structures are manufactured.
        b. Manufacturer's certification that handholes and manholes are in accordance with the requirements of ASTM C858.

G. Manufacturer's instructions:
    1. Instructions for handling and setting structures in place.
    2. Portland cement concrete handholes and manholes:
        a. Instructions for operation and maintenance of hatches.

H. Manufacturer's field reports:
    1. Portland cement concrete handholes and manholes:
        a. Manufacturer's inspection reports in accordance with ASTM C1037.

I. Closeout documents:
    1. Project record documents:
        a. Portland cement concrete handholes and manholes:
            1) Final, revised plans and details of as-constructed precast handholes and manholes if requested for record by the Engineer.
    2. Warranties:
        a. Manufacturer's standard warranty for:
            1) Portland concrete handholes and manholes and accessories.

1.05 QUALITY ASSURANCE

A. Qualifications:
    1. Designer:
        a. Portland cement concrete handholes and manholes:
            1) Professional engineer qualified in the design of concrete structures and holding a current license in the state where the structures will be installed.
    2. Manufacturer:
        a. Polymer concrete handholes:
            1) Demonstrating at least 5 years of experience in the design and production of products of the type required for this Work.
            2) Holding product testing records demonstrating load resistance of products to be installed.
        b. Portland cement concrete handholes and manholes:
            1) Holding current NPCA plant certification for the products produced.
            2) Demonstrating at least 5 years of experience in the design, production, and installation of products of the type required for this Work.
            3) Capable of providing structural designs prepared by a professional engineer licensed in the state where the structures will be installed.
            4) Providing inspection during fabrication and handling in accordance with the requirements of ASTM C1037.

3. Installer:
    a. Capable of providing equipment of adequate capacity and mobility to handle and set units with proper bearing on the subgrade and without damage to the unit.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing, shipping, handling, and unloading:
    1. Package and brace structures to avoid damage during shipping and handling.
    2. Furnish crane or forklift for unloading and setting of portland cement concrete handholes and manholes.

B. Acceptance at site:
    1. Structures delivered to the site with cracks, damage, and damaged or missing accessories shall be removed from the site and replaced at no additional cost to the Owner.

C. Storage and protection:
    1. Store handholes and manholes and their appurtenances in areas protected from damage due to weather and site operations.

1.07 PROJECT CONDITIONS

A. Operating environment: As specified in Section 01850 - Design Criteria.

1.08 SEQUENCING

A. Coordinate installation of precast electrical handholes and manholes with duct banks specified in Section 16133 - Duct Banks.

1.09 WARRANTY

A. Provide manufacturer’s standard warranty for precast handhole and manhole structures and accessories.

1.10 SYSTEM START-UP

A. As specified in Section 16050 - Common Work Results for Electrical.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS - PORTLAND CEMENT CONCRETE HANDHOLES AND MANHOLES

A. General:
    1. Provide portland cement concrete handholes and manholes configured and designed as indicated on the Drawings and specified.
    2. In accordance with ASTM C858 unless otherwise noted.

B. Manufacturers: One of the following, or equal:
   1. Oldcastle Precast.
   2. Jensen Precast.

C. Components:
   1. Floor:
      a. Construct floors as a monolith.
      b. Where sump or low-point drain is included, slope floor to that point.
   2. Roof, walls, and base:
      a. Designed and rated to support vehicle and pedestrian loads at the spans indicated.
      b. See the Electrical Handhole and Manhole Schedule indicated on the Drawings for required load rating by structure location.
   3. Access covers:
      a. Handholes: Aluminum plate hinged floor access door (hatch) as specified in Section 08320 - Floor Access Doors.
         1) Load rating:
            a) “Heavy Duty” for covers at locations designated for “Roadway” loads.
            b) “Medium Duty” or stronger for covers at locations designated for “Sidewalk” loads.
         2) Minimum access door size not less than 36 inches square, unless otherwise indicated on the Drawings.
         3) Provide bearing surface with pre-installed continuous elastomeric gasket to minimize water infiltration at lid.
         4) Provide skid-resistant lid with cast-in or machined-in grid pattern and the word “ELECTRICAL” in block letters at least 1.5 inches high.
      b. Manholes: Cast iron frame and cover:
         1) Manhole rings and covers:
            a) Gray cast iron in accordance with ASTM A48, Class 30B with ring and cover machined to fit with flat bearing surfaces.
            b) Custom cover as indicated on the Drawings.
            c) Cover with word “ELECTRICAL” cast into the top exposed face for electrical manholes.
            d) Manhole riser access:
               (1) Heavy-duty bottom flange frame with solid cover for placement on grade adjustment rings above top slab.
               (2) 36-inch diameter nominal opening.
               (3) Security bolting: Pentagon head special monel security bolts.
               (4) Manufacturers: The following or equal.
                  (a) Neenah Foundry Co., R1640-D.
            e) Embedded in top slab of structure:
               (1) Heavy-duty top flange frame with solid cover for embedment in top slab of a structure.
               (2) 36-inch diameter nominal opening.
               (3) Security bolting: Pentagon head special monel security bolts.
               (4) Manufacturers: The following or equal.
                  (a) Neenah Foundry Co., R6095.

D. Accessories:
   1. Provide accessories as indicated on the Drawings and specified.
   2. Materials at duct bank penetrations:
      a. Joint filler as specified in Section 03150 - Concrete Accessories.
      b. Backer rod and sealant as specified in Section 07900 - Joint Sealants.
   3. Pulling irons:
      a. Provide non-corroding cable pulling irons located for use with each current duct bank location and additional irons for use with duct banks that may be installed through future knockout panels.
      b. Pulling irons may not be located on the floor.
      c. Where pulling irons are installed on the wall, any pockets surrounding the irons shall have bottom surfaces sloped to drain.
      d. Secure pulling eyes to structure reinforcement.
   4. Cable racks and racking hardware:
      a. Materials: Hot-dip galvanized steel, stainless steel as specified in Section 16070 - Hangers and Supports.
      b. Embedded slots: Maximum depth of 1.5 inches.
   5. Sumps and drains:
      a. Fiberglass or HDPE fabrications including removable lids to prevent tripping hazards.
   6. Exterior dampproofing:
      a. As specified in Section 07110 - Dampproofing.
      b. Field applied to wall and roof surfaces exposed to soil.

E. Fabrication:
   1. Embeds:
      a. Install embedded items with provisions for drainage to remove dripping or standing water, and to minimize corrosion.
         1) Pulling irons may not be placed on the floor or in pockets that will collect water.
         2) Detail bottom of cable rack channels to provide a downward sloping “sill” at the bottom of each vertical channel, so that the channel slot drains toward the floor.
      b. Concrete cover:
         1) Provide minimum 0.75-inch clear concrete cover between embeds and surrounding reinforcement.
         2) Provide minimum 1.25-inch clear concrete cover between embed and exterior face of wall.

F. Tests and inspections:
   1. Test and inspect structures in accordance with ASTM C858 and ASTM C1037.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. General requirements for handholes and manholes:
   1. As specified in Section 16050 - Common Work Results for Electrical for general requirements for electrical work.
   2. Provide structures of the sizes and shapes indicated on the Drawings, with layouts, dimensions, and details as indicated on the Drawings and as specified.

3. Conform to the requirements of:
    a. NEC.
    b. Project regulatory requirements as specified in Section 01410 - Regulatory Requirements.

B. Portland cement concrete handholes and manholes:
    1. Load resistance of boxes and covers.
    2. Design requirements: Loads on structures:
        a. In accordance with ASTM C857, except as modified in this Section.
        b. Loads at the ground surface:
            1) See “Electrical Handhole and Manhole Schedule” indicated on the Drawings for minimum surface loading requirements at each structure. Loads are designated as “sidewalk,” or ”roadway”.
            2) The vehicle and pedestrian loadings in the following paragraphs need not be additive; however, structures designated for “roadway” loading shall also support “sidewalk” loads.
            3) “Sidewalk”: Load from regular pedestrian traffic with considerations for occasional non-deliberate vehicular traffic:
                a) Designation "A-0.3" in ASTM C857 Table 1 (300-psf uniform load).
            4) ”Roadway”: Load from heavy, frequently repeated vehicle traffic:
                a) Designation "A-16" in ASTM C857 Table 1 (AASHTO HS20-44).
        c. Lateral earth pressure loads:
            1) Determine in accordance with the following requirements. Include effects of groundwater and seismic accelerations on lateral earth pressures.
                a) Equivalent lateral pressure: 67 pounds per square foot per foot of depth (triangular distribution).
                b) Surface surcharge load:
                    (1) In accordance with ASTM C857 Vehicle Load Designation "A-16" for "Roadway" or "A-0.3" for "Sidewalk" where such surcharge exceeds backfill loads described in the preceding paragraph.
                c) Groundwater effects:
                    (1) Include effects from groundwater and soils saturated by flooding using design elevations specified in Section 01850 - Design Criteria. Use equivalent lateral pressure of 34 pounds per square foot per foot of depth (triangular distribution) for soil below the design groundwater elevation.
                d) Seismic design:
                    (1) As specified in Section 01850 - Design Criteria.
                    (2) On opposite sides of the structure that are perpendicular to the direction of acceleration, include equivalent lateral pressure (inverted fluid pressure distribution), beginning with a pressure of 0 at the base of the structure, and increasing at a rate of 30 pounds per square foot per foot of rise toward the ground surface.
                    (3) Apply seismic effects as additive force on side where the soil mass is being accelerated toward the structure, and as

subtractive force on the opposite side where the soil mass is being accelerated away from the structure.

d. Groundwater and flood loads - buoyancy effects:
   1) Flooding: Design for 100-year flood at elevation. Buoyancy: For groundwater and flood conditions, provide factor of safety against flotation of at least 1.20.
      a) If the weight of soil overlying footing projections on the structure is considered to resist flotation, use a buoyant unit weight of soil equal to not more than 30 pounds per cubic foot.
      b) Concrete fill may be provided in the bottom section of precast portland cement concrete structures to add weight. Submit proposed details.
e. Soil-bearing pressure at base:
   1) Maximum 1,000 pounds per square foot total pressure on prepared subgrade soils or pressure not greater than the weight of the vertical column of soil removed (assuming a soil unit weight of 125 pounds per cubic foot).
f. Lifting and handling loads:
   1) Make provision in the design for the effects of loads or stresses that may be imposed on structures during fabrication, transportation, or erection.
g. Load combinations:
   1) Design structures to sustain the specified loads individually or in combination.

3. Design requirements: Structural analysis, design, and detailing:
   a. General:
      1) Analyze and design structures including the effects of 2-way action (“plate action”) and of load transfer around current and future openings.
      2) Where structures include panels designed for future removal (“knockout panels”), design structures for loads and stresses with any combination of any or all such panels in place or removed.
   b. Precast portland cement concrete handholes and manholes:
      1) Design structures in accordance with the requirements of ACI 318 and this Section.
      2) Provide reinforcement at areas subject to tensile stress when loaded with the specified loads and combinations thereof.
      3) Provide temperature and shrinkage reinforcement to equal or exceed ACI 318 requirements in concrete sections.
      4) Provide minimum clear concrete cover over reinforcement at both interior and exterior faces of members in accordance with the following:
         a) Handholes: 1.25 inches.
         b) Manholes: 2 inches.
      5) Reinforcement details:
         a) Walls: For structures with wall thickness of 8 inches or less, locate a single mat of reinforcement at the center of the wall.
         b) Slabs: For structures with slab thickness of 7 inches or less, locate a single mat of reinforcement at the center of the slab.
         c) Structures with wall or slab thicknesses exceeding these limits shall have a reinforcement at each face of the member.

6) Joints:
a) Provide structures with watertight joints between sections and detailed to minimize water infiltration at duct bank and conduit penetrations.
b) Provide structures with non-skid, shiplap or tongue and groove joints between sections.

c. Portland cement concrete handholes and manholes:
1) In accordance with ASTM C858.

2.03 MATERIALS

A. Cast-in-place concrete for fill at base sections of portland cement concrete manholes with deep sumps or ballast to resist buoyancy shall be “Class A” concrete as specified in Section 03300 - Cast-in-Place Concrete.

2.04 SOURCE QUALITY CONTROL

A. Portland cement concrete handholes and manholes.
1. As specified in Section 01450 - Quality Control

PART 3 EXECUTION

3.01 GENERAL

A. Furnish and install precast electrical handholes and manholes as indicated on the Drawings and specified.

B. Install additional handholes and manholes required so installation procedures will conform to cable manufacturer’s pulling tension requirements.
1. Include proposed locations and details of such additional handholes and manholes with the submittals under this Section.

3.02 PREPARATION

A. Design:
1. Prepare detailed and scalable layouts for each manhole structure showing locations of conduit or duct bank penetrations, clearances, locations, and sizes of access openings and major accessories.

B. Protection:
1. Where handhole and manhole structures are installed adjacent to existing site structures or utilities, provide excavation support or other protection as required to maintain those facilities in service and to prevent damage to both existing and new facilities.

C. Site preparation:
1. Excavate and prepare exposed subgrade as indicated on the Drawings and as specified.
2. Install and compact foundation layer as indicated on the Drawings and specified.

3. Level foundation materials so that structures will be set plumb, and duct banks will be at proper grade and alignment.
    a. Install with uniform bearing on foundation materials.
    b. Wedging or blocking of base sections for leveling over the foundation materials will not be permitted.

3.03 INSTALLATION

A. General:
    1. Protect handholes and manholes from displacement, flooding, or flotation.

B. Portland cement concrete handholes and manholes:
    1. Install structures in accordance with ASTM C891 and the provisions of this Section.
        a. In the event of conflicts, the more restrictive provisions shall apply.
    2. Clean and prime joints between adjacent precast sections.
        a. Install sealing compound between sections and provide watertight joints.
    3. Set covers and hatches at elevations indicated on the Drawings.
        a. Securely attach frames to top of precast structures and grade adjustment rings.
    4. Penetrations:
        a. Holes for duct banks and other penetrations may not be cut into precast handholes and manholes unless they are located at designated locations shown on the shop drawings or at knockout panels cast into the structure during manufacturing.
        b. Carefully remove concrete from knockout panel areas with saws.
            1) Ensure that break-back does not extend beyond the designated limits of the knockout panel.
        c. Coat any reinforcement cut or exposed during removal of knockout panel sections with minimum 2 coats of high solids epoxy as specified in Section 09960 - High-Performance Coatings.
            1) Apply epoxy coating applied over and at least 1-inch past the perimeter of the reinforcement.
    5. Install duct banks and conduit penetrations in accordance with the penetration details indicated on the Drawings.
        a. Place joint fillers, caulks, and sealants before coating exterior concrete surface with bituminous dampproofing.
    6. Fill holes that were provided for handling or other temporary purposes with non-shrink cement grout using procedures as specified in Section 03300 - Cast-in-Place Concrete unless otherwise detailed by the manufacturer.
    7. After structures are set and before backfilling, coat exterior below-grade surfaces (around the sidewalls, over the top slab, and around any vertical risers to grade) with 2 heavy coats of bituminous dampproofing as specified in Section 07110 - Dampproofing.
        a. Apply dampproofing in accordance with the coating manufacturer’s instructions and at a rate of 40 to 60 square feet per gallon per coat.
        b. Mask over at least 1 inch back from joint caulks or sealants and prevent dampproofing from coming in contact with those materials.
    8. Backfill handholes and manholes as indicated on the Drawings and as specified in Section 02300 - Earthwork.

C. Site tolerances:
   1. Set electrical handholes and manholes plumb and true at locations indicated on the Drawings.
   2. Tolerances on placing:
      a. Horizontal location: Plus or minus 1 inch.
      b. Vertical elevation: Plus or minus 1/2 inch.
      c. Plumb: Plus or minus 1/8 inch over 10 feet.

3.04 REPAIR/RESTORATION

A. Repair cracks or blemishes in concrete by methods acceptable to the Engineer. Submit proposed repairs for acceptance before commencing work.

3.05 ADJUSTING

A. After final grading is complete, adjust access covers to grade.

3.06 CLEANING

A. Before installation of cables in any duct banks and handholes or manholes, remove concrete spoil, forms, debris, silt, dust, and other foreign material.

3.07 SCHEDULES

A. See Drawings for Electrical Handhole and Electrical Manhole Schedule.

END OF SECTION

SECTION 02600

CONCRETE MANHOLES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Manhole frames and covers.
   2. Manhole grade rings.
   3. Manholes cones and risers.
   4. Manhole bases.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO).
   1. Standard Specifications for Highway Bridges.

B. ASTM International (ASTM):
   1. A48 - Standard Specification for Gray Iron Castings.
   2. C33 - Standard Specification for Concrete Aggregates.
   3. C150 - Standard Specification for Portland Cement.
   4. C443 - Standard Specification for Joints for Concrete Pipe and Manholes Using Rubber Gaskets.
   5. C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections.
   6. C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint.
   7. C923 - Standard Gide for In-Plant Performance Evaluation of Automatic Pedestrian SNM Monitors.
   8. C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.

C. International Organization of Standardization (ISO):
   1. 9001 - Quality Management Standard.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Shop drawings:
   1. Manufacturer’s catalog data and details of following items for approval:
      a. Frame and covers.
      b. Grade rings.
      c. Manhole cones and risers.
      d. Manhole bases, if precast.

2. Manhole construction details, jointing methods, connection details, materials, and dimensions.
3. Repair procedures and details.

C. Calculations and criteria used in manhole design including material properties, loadings, load combinations, and dimensions assumed.

D. Test methods and results including certification that the manhole riser exceeds the minimum requirements in accordance with ASTM C478.

E. Sealed drawings and design calculations by a registered Professional Engineer licensed in the State where the project is located.

F. Certificates:
1. ISO 9001 certificate by a third party confirming that ASTM test reports are valid and up to date at the time of the bid and during construction period.
2. Manufacturer's Certificate of Source Testing.

1.04 PRODUCT REQUIREMENTS

A. As specified in Section 01600 - Product Requirements.

B. Provide suitable quantities of lifting equipment to handle the manholes/risers and castings.
1. In no case shall any equipment be used that is not rated to handle the intended loading or conditions of use to which it will be subjected, or which will damage or gouge the manhole components.
2. Dragging or dropping the manhole components shall not be allowed.

C. Source testing.
1. Perform pre-production and post-production tests by manufacturer staff with a minimum of 5 years of experience in quality control, inspection, and testing of manholes.
a. In lieu of this experience, witness of tests by up to 3 full-time Owner representatives.
2. Examine each completed manhole section for dimensional requirements, strength, and workmanship.
3. Complete required testing in accordance with ASTM C478.
4. Provide the Manufacturer's Certificate of Source Testing.

1.05 DESIGN CRITERIA:

A. Manholes shall not include steps.

B. Manhole lids: Locking type.

C. Manhole bases:
1. Constructed as part of the pipe installation or using tee risers.

D. Manhole riser:
   1. Made of the same pipe material selected for the project, providing a sealed connection between the pipe base and riser as indicated on the Drawings.
   2. Manufactured specifically for this project and no materials shall be furnished from stock unless approved by the Engineer.

E. Manhole provider shall coordinate with the pipe manufacturer for dimensions and connections.

F. Manhole systems:
   1. Provided by a single manufacturer.

G. Frames and covers:
   1. Provided by a single manufacturer unless approved by the Engineer.

1.06 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manhole grade rings, cones, and risers: One of the following or equal.
   1. Oldcastle Infrastructure.

B. Manhole frames and covers: Manufacturers: One of the following or equal.
   1. Alhambra Foundry Company.
   2. Neenah Foundry Company.

2.02 BASIS OF DESIGN

A. Design in accordance with local jurisdiction requirements, including but not limited to the following:
   1. Manhole frames and covers.
   2. Manhole diameter tolerance.
   3. Manhole length.
   4. Manhole cover bolting.
   5. Manhole backfill.

B. Structural design calculations:
   1. Load rating of manhole:
      a. Design to support an AASHTO Standard Specifications for Highway Bridges, H-20 vehicle loading**.**
   2. Resist buoyancy:
      a. Design with sufficient bottom anchorage and side friction to resist buoyancy.
      b. Depths will be as indicated on the Drawings.

c. Refer to the geotechnical report for soil condition including fully saturated soil conditions.
d. Concrete ballast:
1) Pour sufficient concrete around tee-base pipe fitting and manhole riser base to prevent buoyancy as indicated on the Drawings.

C. Manholes, grade rings, risers, and bases:
1. Manhole:
a. Nominal sizes as indicated on the Drawings.
2. Grade rings:
a. At least 1 but not more than 2 grade rings shall be used.
b. Maximum total distance from top of cone section to final grade: 18 inches.
3. Cone and riser sections:
a. As specified in this Section and as indicated on the Drawings.
b. Cone sections shall be concentric.
4. Manhole bases:
a. As specified in this Section and as indicated on the Drawings.
b. Provide corrosion protection system on unlined concrete.

D. Threaded lifting inserts:
1. Design inserts to be fully threaded:
a. Do not fully penetrate through entire manhole wall.
2. Provide lifting device compatible with spreader bar and chains, hooks, and slings.
3. Design with minimum safety factor of 4.0.
4. Do not use reinforcing steel bars.

2.03 MATERIALS

A. Cast iron manhole frames and covers.
1. In accordance with ASTM A48.
2. Covers: Bolted as specified.
3. Concrete collars: As indicated on the Drawings.

B. Manhole bases, risers, and grade rings:
1. Cement: Type V portland cement in accordance with ASTM C150.
2. Concrete aggregates: In accordance with ASTM C33, gradation as specified in approved mix design.
3. Sections: Steel reinforced.
4. Precast concrete sections: Manufactured by a process that will produce a dense, homogeneous concrete ring.
5. Top and bottom of sections: Parallel.

C. Joint sealant:
1. Preformed, cold applied flexible joint sealant in accordance with ASTM C990 and ASTM C443.
2. Manufacturers: One of the following or equal.
a. Henry Corp., Ram-Nek.
b. Kent Seal - Hamilton Kent Corp.

2.04 COMPONENTS

A. Pipe stubs:
   1. Provide pipe stubs at manhole locations and in accordance with details indicated on the Drawings and as specified.
   2. Plugging stubs:
      a. Plug stubs with vitrified clay stopper, brick plug, or other materials as indicated on the Drawings.
      b. Unless otherwise indicated on the Drawings, comply with following:
         1) Stubs up to and including 21 inches: Vitrified clay stoppers.
         2) Stubs greater than 21 inches: Brick plugs.

B. Resilient pipe connectors:
   1. Unless otherwise indicated on the Drawings or specified, provide a flexible compression type connector between manhole and pipes entering and leaving the manhole in accordance with ASTM C923.
   2. Resilient pipe connectors:
      a. Manufacturers: The following or equal.
         1) A-LOK Premium.

C. Threaded lifting inserts.

D. Drop manholes:
   1. Construct drop manholes at locations and in accordance with details indicated on the Drawings.
   2. Provide inside diameter of drop inlet pipe the same as intercepted sewer unless otherwise indicated on the Drawings or specified in this Section.
   3. Furnish and set fittings as indicated on the Drawings

2.05 IDENTIFICATION MARKINGS

A. Identification marks on the exterior of bases, risers, grade rings, and include the following information:
   1. Date of manufacture of the item.
   2. Name or trademark of the manufacturer.
   3. Internal diameter in inches.
   4. Number of the manhole as indicated on the Drawings.

2.06 QUALITY CONTROL

A. Manufacturer to provide permanent quality control department and laboratory facility capable of performing inspections and testing as specified by this Section.

B. Material testing, inspection procedures, and manufacturing process are subject to inspection by the Owner or Owner's representative.

C. Perform manufacturer's tests and inspections in accordance with the referenced standards and as specified in this Section including the following:
   1. Provide the Manufacturer's Certificate of Source Testing as specified in Section 01600 - Product Requirements.

2. Manufacturer shall make available services of representative throughout the project duration when deemed necessary by the Engineer.
3. Calibrate within last 12 months for equipment such as scales, measuring devices and calibration tools used in the manufacturing of pipe.
    a. Each device used in the manufacture of manholes is required to have a tag recording date of last calibration.
    b. Devices are subject to inspection by Engineer.

D. Furnish labor necessary to assist the Engineer in inspecting manholes upon delivery.

E. Remove rejected manholes immediately.

PART 3 EXECUTION

3.01 MANHOLE INSTALLATION

A. Excavate and backfill as specified in Section 02318 - Trenching and as indicated on the Drawings.

B. Maintain identification markings on installed pieces throughout installation.

C. Do not use sections with chips or cracks in the joint.

D. Engineer may inspect manhole sections, prior to installation.

E. Repair of manhole sections damaged during installation in accordance with manufacturer's repair procedures; with the concurrence of the Engineer.

F. Bedding and backfill for tee-base pipe fitting: In accordance with Section 02318 - Trenching.
1. Tee-base outlet: Vertical.
2. Upper end of the vertical pipe stub creates a horizontal plane.

G. Tee bases:
1. Cast-in-place reinforced concrete as indicated on the Drawings.
2. Vibrate to densify concrete and screed so first precast manhole riser section has a level, uniform bearing for full circumference.
3. Use steel impression ring to create a groove into which the first manhole riser section tongue can be inserted.
4. Install preformed plastic sealing gasket between groove and tongue and first manhole riser section.

H. Install joint sealant material in accordance with manufacturer's instructions:
1. Completed manhole: Rigid and watertight.

I. Fill threaded lifting inserts with grout.

J. Lay grade rings on joint sealant with sides plumb and tops level.

K. Set frame and covers as specified and as indicated on the Drawings.

L. Apply dampproofing as specified in Section 07110 - Dampproofing and as indicated on the Drawings.
   1. Apply material in accordance with manufacturer recommendations over the entire exterior surface of the completed manhole, including base section, riser sections, cone section, and grade rings prior to backfilling the manhole.
   2. Allow waterproofing material to dry sufficiently before backfilling.

3.02 CLEANING

A. After completing each manhole, remove debris, construction materials, and equipment from the site of the work, grade, and smooth over the surface and leave the entire right-of-way in a clean, neat, and serviceable condition.

B. After completing each manhole, remove construction material debris from inside the manhole.

3.03 FUNCTIONAL TESTING

A. Provide materials for grouting and patching recommended by the manufacturer or an approved equal.

B. Vacuum testing in accordance with ASTM C1244.
   1. Install the vacuum test head on top of the manhole.
      a. Install and brace sealing devices on influent and effluent pipes.
   2. Draw a vacuum of 10 inches of mercury with a vacuum pump, deactivate the pump, and measure the actual elapsed time for the vacuum to drop to 9 inches of mercury.
   3. Compare test results with the minimum time requirements stated in the table below.
      a. If the actual elapsed time is less than the time in the table, the manhole is defective, and it shall be repaired and retested until it is acceptable.

Minimum Elapsed Time, Minutes: Seconds				
Manhole Depth, ft.	**Manhole Diameter, inches**			
	36	48	60	72
8	0:14	0:20	0:26	0:33
10	0:18	0:25	0:33	0:41
12	0:21	0:30	0:39	0:49
14	0:25	0:35	0:46	0:57
16	0:28	0:40	0:52	1:07
18	0:32	0:45	0:59	1:13
20	0:35	0:50	1:05	1:21
22	0:38	0:55	1:12	1:29
24	0:42	0:59	1:18	1:37
26	0:46	1:04	1:25	1:45

Minimum Elapsed Time, Minutes: Seconds				
Manhole Depth, ft.	**Manhole Diameter, inches**			
28	0:49	1:09	1:31	1:53
30	0:53	1:14	1:38	2:01

END OF SECTION

SECTION 02620

FILTER FABRIC

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Nonwoven filter fabric.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
   2. D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
   3. D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
   4. D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
   5. D4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile.
   6. D5261 - Standard Test Method for Measuring Mass per Unit Area of Geotextiles.
   7. D6241 - Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.

1.03 DEFINITIONS

A. Filter fabric: Nonwoven geotextile fabric manufactured from polypropylene fibers.

1.04 SUBMITTALS

A. Product data.

B. Samples.

C. Quality control submittals:
   1. Certificates of Compliance.
   2. Manufacturer's Instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Storage and protection:
   1. Furnish filter fabric in protective covers capable of protecting the fabric from ultraviolet rays, abrasion, and water.

1.06 PROJECT CONDITIONS

A. Take field measurements to determine the lengths and dimensions of the surfaces to receive the fabric.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Propex, Geotex 401.
   2. Ten Cate Geosynthetics, Mirafi 140N.

2.02 MATERIAL REQUIREMENTS

A. Physical properties: Meet the following minimum requirements:

Property (1)	Test Method	Unit	Requirements (1)
Minimum Weight	ASTM D5261	oz	4.0
Grab Tensile Strength	ASTM D4632	lbs	100
Grab Elongation	ASTM D4632	%	50
Trapezoid Tear Strength	ASTM D4533	lbs	50
CBR Puncture Resistance	ASTM D6241	lbs	300
UV Resistance (strength retained at 500 hrs)	ASTM D4355	%	70
Apparent Opening Size (AOS)	ASTM D4751	US sieve	70
Permittivity	ASTM D4491	sec^{-1}	1.7
Flow Rate	ASTM D4491	gpm/ft^2	130
(1) Minimum average roll values.			

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Verify that conditions are satisfactory for the installation of filter fabric.

3.02 PREPARATION

A. Surface preparation:
   1. During grading operations, take care not to disturb the subgrade.
   2. This may require use of lightweight dozers for low strength soils such as saturated, cohesionless, or low cohesion soils.

B. Prior to placement of fabric: Prepare surface to smooth condition free of debris, depressions, or obstructions that may damage the fabric.

3.03 INSTALLATION

A. Follow manufacturer's installation instructions and as complimented in this Section.

B. Place the filter fabric smoothly without folds or wrinkles.

C. Use special care when placing the filter in contact with the soil so that no void spaces occur between the filter and the prepared surface.

D. Overlap the parallel rolls and ends of rolls a minimum of 24 inches and not less than manufacturer's instructions.

E. Do not drag filter fabric across subgrade.

F. Make overlaps at ends of rolls in the direction of the aggregate placement with the previous roll on top.

G. Use lightweight dozers if necessary. Do not allow equipment directly on filter fabric.

3.04 FIELD QUALITY CONTROL

A. Inspection:
   1. Before covering, the condition of the fabric will be observed by the Engineer to determine that no holes or rips exist in the fabric.
   2. Repair all holes and rips by placing a new layer of fabric extending beyond the defect in all directions a distance equal to the minimum overlap required for adjacent rolls.

END OF SECTION

SECTION 02621

STABILIZATION FABRIC

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Woven stabilization fabric used for subgrade enhancement.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D4355 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.
   2. D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
   3. D4533 - Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
   4. D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
   5. D4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile.
   6. D6241 - Standard Test Method for the Static Puncture Strength of Geotextiles and Geotextile-Related Products Using a 50-mm Probe.

1.03 DEFINITIONS

A. Stabilization fabric: Woven geotextile fabric manufactured from polypropylene yarns.

1.04 SUBMITTALS

A. Product data.

B. Samples.

C. Quality control submittals:
   1. Certificates of Compliance.
   2. Manufacturer's Installation Instructions.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Storage and protection:
   1. Furnish stabilization fabric in protective covers capable of protecting the fabric from ultraviolet rays, abrasion, and water.

1.06 PROJECT CONDITIONS

A. Field measurements:
   1. Take field measurements to determine the exact lengths and dimensions of the surfaces to receive the fabric.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Propex, Geotex 315ST.
   2. Ten Cate Geosynthetics, Mirafi 600X.

2.02 MATERIAL REQUIREMENTS

A. Physical properties: Meet the following minimum requirements:

Property (1)	Test Method	Unit	Requirements (1)
Grab Tensile Strength	ASTM D4632	lbs	315
Grab Elongation	ASTM D4632	%	15
Trapezoid Tear Strength	ASTM D4533	lbs	120
CBR Puncture Resistance	ASTM D6241	lbs	900
UV Resistance (strength retained at 500 hrs)	ASTM D4355	%	70
Apparent Opening Size (AOS)	ASTM D4751	US sieve	40
Permittivity	ASTM D4491	sec^{-1}	0.05
Flow Rate	ASTM D4491	gpm/ft^2	4
(1) Minimum average roll values.			

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Verify that conditions are satisfactory for the installation of stabilization fabric.

3.02 PREPARATION

A. Surface preparation: During grading operations, take care not to disturb the subgrade. This may require use of lightweight dozers for low strength soils such as saturated, cohesionless, or low cohesion soils.

B. Prior to placement of fabric: Prepare surface to smooth condition free of debris, depressions, or obstructions that may damage the fabric.

3.03 INSTALLATION

A. Follow manufacturer's installation instructions and as complimented in this Section.

B. Place the stabilization fabric smoothly without folds or wrinkles.

C. Use special care when placing the stabilization fabric in contact with the soil so that no void spaces occur between the stabilization fabric and the prepared surface.

D. Overlap the parallel rolls and ends of rolls a minimum of 24 inches and not less than recommended by manufacturer.

E. Do not drag stabilization fabric across subgrade.

F. Make overlaps at ends of rolls in the direction of the aggregate placement with the previous roll on top.

G. Use lightweight dozers, if necessary. Do not allow equipment directly on stabilization fabric.

3.04 FIELD QUALITY CONTROL

A. Inspection: Before covering, the condition of the fabric will be observed by the Engineer to determine that no holes or rips exist in the fabric. Repair all holes or rips by placing a new layer of fabric extending beyond the defect in all directions, a distance equal to the minimum overlap required for adjacent rolls.

END OF SECTION

SECTION 02693

DUCTILE IRON PIPE: AWWA C151

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Ductile iron pipe, joints, connections, fittings, and pipe linings and coatings.

B. As specified in Section 02001 - Common Work Results for General Piping.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

B. American Water Works Association (AWWA):
   1. C104 - Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
   2. C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
   3. C110 - Standard for Ductile-Iron and Gray-Iron Fittings.
   4. C111 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   5. C150 - Standard for Thickness Design of Ductile-Iron Pipe.
   6. C151 - Standard for Ductile-Iron Pipe, Centrifugally Cast.
   7. C153 - Standard for Ductile-Iron Compact Fittings for Water Service.
   8. C210 - Liquid-Epoxy Coatings and Linings for Steel Water Pipe and Fittings.
   9. C222 - Polyurethane Coatings and Linings for Steel Water Pipe and Fittings.
   10. C600 - Installation of Ductile Iron Water Mains and Their Appurtenances.
   11. C606 - Standard for Grooved and Shouldered Joints.

C. American Welding Society (AWS):
   1. D11.2 - Guide for Welding Iron Castings.

D. ASTM International (ASTM):
   1. A536 - Standard Specifications for Ductile Iron Castings.
   2. B1000 - Standard Practices for Casting Preparation and Test Procedure of Porcelain Enamel-Lined Pipe, Fittings, and Valves for Use in the Municipal Wastewater, Sewage, and Water Treatment Industry.
   3. C33 - Standard Specification for Concrete Aggregates.
   4. C150 - Standard Specification for Portland Cement.
   5. C283 - Standard Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.
   6. D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
   7. D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

E. Ductile Iron Pipe Research Association (DIPRA):
   1. Thrust Restraint Design Manual.

F. International Organization for Standardization (ISO):
   1. 8179 - Ductile iron pipe, fittings, accessories and their joints - External zinc-based coating –Part 1: Metallic zinc with finishing layer.

G. National Association of Pipe Fabricators, Inc. (NAPF):
   1. 500-03 - Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings.

H. Society for Protective Coatings (SSPC):
   1. SP 5 - White Metal Blast Cleaning.
   2. PA-2 - Measurement of Dry Coating Thickness With Magnetic Gages.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data.

C. Manufacturer's qualifications.
   1. Manufacturer qualifications and list of projects using the specified material: 5 years minimum.

D. Manufacturer's Quality Assurance Manual:
   1. Submit manufacturer's coating and lining application quality assurance manual to Engineer prior to beginning coating application.
      a. Strict conformance to the requirements of the manual will be required.
      b. Deviation from the requirements of the manual will be grounds for the Engineer to reject the applied coating.

E. Shop drawings:
   1. Detailed layout drawings showing alignment of pipes, location of valves, fittings, and appurtenances, types of joints, and connections to pipelines or structures.
   2. Thrust restraint systems.
   3. Photographs, drawings, and descriptions of fittings, gaskets, couplings, grooving of pipe and fittings.

F. Calculations:
   1. Calculations for thrust restraint system design.

G. Manufacturer's Certificate of Source Testing for ceramic epoxy, glass lined, plural component polyurethane, and zinc materials:
   1. Certify successful performance of holiday detection tests on 100 percent of lining in accordance with ASTM B1000.
   2. Identify each test piece by mark designation and show the actual test results during the final inspection by manufacturer prior to shipment.

3. Zinc coating: Regular measurements in accordance with ISO 8179 Part 4.4.
4. Include Coating Manufacturer's Technical Representative's reports.

1.04 QUALITY ASSURANCE

A. Ductile iron pipe shall be supplied by a single manufacturer.

B. Hydrostatically test each joint of ductile iron pipe in accordance with AWWA C151.

C. Pre-installation meeting:
1. Arrange for Coating Manufacturer's Technical Representative to attend preconstruction conferences, and to make periodic visits to factory or shop to inspect surface preparation of pipe, fittings, and accessories; and to inspect application of linings to interior and coatings to exterior of pipe, fittings, and accessories.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Block piping and associated fittings for shipment to prevent damage to coatings and linings.

B. Carefully handle piping and associated fittings during loading, unloading, and installation:
1. Do not drop piping material from cars or trucks.
2. Lower piping by mechanical means.
3. Do not drop or pound pipe to fit grade.

C. Handle pipe from the outside if lined with ceramic epoxy, glass or plural component polyurethane.
1. No forks, chains, straps, hooks, or other lifting device shall be placed inside the pipe or fittings for lifting, positioning, or laying.

D. Protect gaskets and polyethylene encasement from long-term exposure to sunlight.

E. Store piping, fittings, and other accessories such that they do not accumulate and hold rainwater, dirt, and debris.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Ductile iron piping:
1. Manufacturers: One of the following or equal:
a. American Cast Iron Pipe Co.
b. McWane Ductile.
c. SIP Industries.
d. U.S. Pipe.

2.02 THRUST RESTRAINT SYSTEM DESIGN

A. The length of pipe that must be restrained on each side of the focus of a thrust load as indicated on the Drawings.

B. Design pressure: Test pressure.

C. Laying condition: Type 5 in accordance with AWWA C150.

D. Soil type: Silt 1.

E. Unit friction resistance for polyethylene encasement of pipe: DIPRA factor multiplied by a safety factor of 1.5.

2.03 CONCRETE THRUST BLOCK RESTRAINT

A. Joint thrust restraint system designed by Contractor.
   1. Concrete thrust blocks will only be permitted in certain locations where indicated on the Drawings.

2.04 DUCTILE IRON JOINTS AND CONNECTIONS

A. General:
   1. Pressure class or special thickness class as indicated in the Piping Schedule provided in Section 02001 - Common Work Results for General Piping.
   2. In accordance with AWWA C150 and AWWA C151.
   3. Joints:
      a. Flanged.
      b. Grooved.
      c. Mechanical.
      d. Push-on Rubber Gasket.
      e. Integrally Restrained Mechanical.
      f. Mechanical Wedge Action.
      g. Integrally Restrained Push-On.
      h. Push-On Joint Restraint Harness.
   4. Connections:
      a. Tapping saddle.
      b. Tapping sleeve.
      c. Welded outlet.
   5. Fittings.

B. Joints:
   1. Flanged joints:
      a. Screw-on flanges:
         1) Comply with the diameter, thickness, drilling, and other characteristics in accordance with ASME B16.1.
         2) Ductile iron.
         3) Long hub, threaded, and specially designed for ductile iron pipe.
         4) After attaching to pipe, machine flange face to make pipe end and flange even and perpendicular to the axis of the pipe.
      b. Bolt holes on flanges: 2-holed and aligned at both ends of pipe.

c. Cap screw or stud bolt holes: Tapped.
d. Bolts and nuts:
    1) As specified in Section 02001 - Common Work Results for General Piping.
e. Gaskets:
    1) Standard styrene butadiene copolymer (SBR) unless specified otherwise in Section 02001 - Common Work Results for General Piping.

2. Grooved joints:
    a. In accordance with AWWA C606, as complemented and modified below, radius-cut type.
    b. Couplings:
        1) Rigid type, cast from ductile iron in accordance with ASTM A536, Grade 65-45-12.
    c. Bolts and nuts:
        1) As specified in Section 02001 - Common Work Results for General Piping.
    d. Gaskets:
        1) As specified in Section 02001 - Common Work Results for General Piping.
    e. Fittings:
        1) In accordance with AWWA C606, rigid radius-cut groove:
        2) Center-to-center dimensions: In accordance with AWWA C110.
        3) Wall thickness and other characteristics: In accordance with AWWA C606.
    f. Flanged unit connections:
        1) Flanged to grooved joint adapters or a long enough spool with one end flanged and the other end grooved to prevent interference with the operation of adjacent valves, pumps, or other items.
3. Mechanical joints:
    a. In accordance with AWWA C111.
    b. Gaskets:
        1) As specified in Section 02001 - Common Work Results for General Piping.
    c. Bolts and nuts, including T-bolts:
        1) As specified in Section 02001 - Common Work Results for General Piping.
4. Push-on rubber gasket joints:
    a. In accordance with AWWA C111.
    b. Gaskets:
        1) As specified in Section 02001 - Common Work Results for General Piping.
5. Mechanical wedge action joint restraints:
    a. Manufacturers: One of the following or equal:
        1) EBAA Iron, Inc., Megalug® Series 1100.
        2) Star Pipe Products, Split Stargrip Series 3000.
        3) Sigma Corp., One-Lok Model SLDE.
    b. Materials:
        1) Gland body:
            a) Ductile iron in accordance with ASTM A536.

2) Wedges and wedge actuating components:
    a) Ductile iron in accordance with ASTM A536.
    b) Wedges shall be heat treated to a minimum of 370 BHN.
3) Actuating bolts and nuts:
    a) Ductile iron in accordance with ASTM A536.
    b) Provide torque-limiting twist off components to ensure proper installation.
4) Gaskets:
    a) As specified in Section 02001 - Common Work Results for General Piping.

c. Coatings:
1) Provide manufacturer applied coating system.
2) Manufacturers: One of the following or equal:
    a) EBAA Iron Inc., Mega-Bond.
    b) Star Pipe Products, Star-Bond.
    c) Sigma Corp., Corrsafe™ Electro-deposition coating.

d. Working pressure:
1) Shall include a minimum safety factor of 2:1.
2) For sizes 3- through 16-inch: 350 pounds per square inch.
3) For sizes 18- through 48-inch: 250 pounds per square inch.

e. Restraint shall consist of multiple gripping wedges incorporated into a follower gland meeting the requirements of AWWA C111.

f. Restraint shall allow post assembly angular deflection that is a minimum of 50 percent of the angular deflection allowed by the mechanical joint.

g. Restraint must be in accordance with applicable requirements of AWWA C110 and AWWA C111 for mechanical joints.

6. Push-on joint restraint harnesses:
a. Manufacturers: One of the following or equal:
1) EBAA Iron, Inc., Megalug® Series 1700.
2) Star Pipe Products, Split Stargrip Series 3100S.
3) Sigma Corp., One-Lok Model SLDEH.

b. Materials:
1) Restraint and backup ring: Ductile iron in accordance with ASTM A536.
2) Wedges and wedge actuating components: Ductile iron in accordance with ASTM A536.
    a) Wedges shall be heat treated to a minimum of 370 BHN.
3) Actuating bolts and nuts:
    a) Ductile iron in accordance with ASTM A536.
    b) Provide torque-limiting twist off components to ensure proper installation.
4) Tie rods:
    a) Low alloy steel in accordance with AWWA C111.
5) Bolts and nuts, including T-bolts:
    a) As specified in Section 02001 - Common Work Results for General Piping.

c. Coatings:
1) Provide manufacturer applied coating system.
2) Manufacturers: One of the following or equal:
    a) EBAA Iron Inc., Mega-Bond.

b) Star Pipe Products, Star-Bond.
c) Sigma Corp., Corrsafe™ Electro-deposition coating.

d. Working pressure:
1) Shall include a minimum safety factor of 2:1.
2) For sizes 3- through 16-inch: 350 pounds per square inch.
3) For sizes 18- through 48-inch: 250 pounds per square inch.

e. Restraint shall consist of a backup ring behind the ductile iron bell and a restraint ring consisting of multiple gripping wedges connected with number and type of tie rods as recommended by the manufacturer.

f. Restraint shall allow post assembly deflection of a minimum of 50 percent of the deflection capability of the push-on joint.

C. Connections:
1. Tapping saddle as specified in Owner standard specification.
a. If Owner does not have a standard specification, provide tapping saddles as specified in Section 02005 - Piping Specialties.
2. Tapping sleeve as specified in Owner standard specification.
a. If Owner does not have a standard specification, provide tapping sleeves as specified in Section 02005 - Piping Specialties.
3. Welded outlet:
a. Fabrication:
1) Welded outlets shall be fabricated by the pipe manufacturer at the same facility where the pipe is produced.
2) The pipe manufacturer shall have a minimum of 5 years of experience in the fabrication and testing of outlets of similar size and configuration as those used on the Project.
3) Application is limited to branch outlets having a nominal diameter not greater than 70 percent of the nominal diameter of the main line pipe or 36 inches.
4) Parent pipe and branch outlet candidate pipe shall be centrifugally cast ductile iron pipe designed in accordance with AWWA C150 and manufactured in accordance with AWWA C151. Minimum classes for parent and outlet pipe:
a) Sizes 4- through 54-inch: Special Thickness Class 53.
b) Sizes 60- through 64-inch: Pressure Class 350.
5) Electrodes for reinforcing welds:
a) Manufacturers: One of the following or equal:
(1) NCO Alloys, Ni-Rod 55-0 flux cored wire.
(2) INCO Alloys, Ni-Rod 55 welding electrode.
(3) Stoody Castweld, Ni 55-0 flux cored wire.
(4) INCO Alloys, Ni-Rod 44 Filler Metal.
b) Carbon steel electrodes are not acceptable.
b. Pressure rating:
1) Welded outlets 6- through 30-inch:
a) Rated for a working pressure of 250 pounds per square inch.
2) Welded outlets 36-inch and larger:
a) Rated for a working pressure of 200 pounds per square inch.

3) Welded outlets of all diameters and configurations:
   a) Have a minimum safety factor of 2.0 based on proof of design hydrostatic test results.
   b) Contractor shall, at the request of Engineer, provide the manufacturer's representative proof test data confirming the design, hydrostatic test results, and safety factors.

c. Source quality control:
   1) Branch outlets shall be subjected to an air pressure test of at least 15 pounds per square inch.
      a) Air leakage is not acceptable.
      b) Any leakage shall be detected by applying an appropriate foaming solution to the entire exterior surface of the weldment and adjoining pipe edges or by immersing the entire area in a vessel of water and visually inspecting the weld surface for the presence of air bubbles.
      c) Hydrostatic testing to 500 pounds per square inch on each branch outlet can be used in lieu of air testing.
      d) Any weldment that shows any signs of leakage shall be repaired and retested in accordance with the manufacturer's written procedures.
   2) Pipe manufacturer shall have a fully documented welding quality assurance system and maintain resident quality assurance records in accordance with AWS D11.2.
   3) Pipe manufacturer shall maintain appropriate welding procedure specification, procedure qualification, and welder performance qualification test records as well as appropriate air-test logs documenting air-leakage tests on all welded-on outlet pipes furnished to the Project.

D. Fittings:
   1. Ductile iron in accordance with AWWA C110.
   2. Joint type:
      a. Same as that of the associated piping as specified in Section 02001 - Common Work Results for General Piping.
   3. Plain end-to-flanged joint connectors using setscrews are not acceptable.

2.05 ASPHALT VARNISH

A. Coating:
   1. Factory apply.

B. Primer:
   1. Factory applied for field coating.

C. Compatible with materials as specified in Section 09960 - High-Performance Coatings.
   1. B1000.

2.06 POLYETHYLENE ENCASEMENT

A. General:
   1. Polyethylene encasement shall be supplied by the pipe manufacturer.

B. Materials: Supply one of the following polyethylene encasements:
   1. 2 layers of linear low-density polyethylene (LLDPE) film, minimum thickness of 8 mils in accordance with AWWA C105; or,
   2. Single layer of high-density, cross-laminated polyethylene (HDCLPE) film, minimum thickness of 4 mils in accordance with AWWA C105.
   3. Single layer of V-Bio® enhanced polyethylene encasement (3 layers of coextruded LLDPE film with anti-microbial additive and volatile corrosion inhibitor infused on the inside surface), meeting all requirements of AWWA C105.

2.07 ZINC COATING

A. Zinc pipe coating:
   1. The exterior shall be coated with a layer of arc-sprayed zinc in accordance with ISO 8179.
   2. The mean mass of zinc based coating measured in accordance with ISO 8179 shall not be less than 200 grams per square meter of pipe surface area with a local minimum of 180 grams per square meter.
   3. Manufacturer shall carry out regular measurements of zinc coating masses in accordance with ISO 8179.
   4. Pipe markings shall include the word "zinc" or a similar designation clearly identifying the pipe has a zinc coating.
   5. Zinc pipe topcoat:
      a. The finishing layer shall be bituminous paint compatible with the zinc based layer. The mean dry film thickness shall be in accordance with AWWA C151.

B. Zinc fittings coatings:
   1. The exterior shall be coated with a zinc rich paint in accordance with ISO 8179. Dry film thickness shall be as recommended by the paint manufacturer, but not less than 2.0 mils.
   2. Fitting markings shall include the word "zinc".
   3. Zinc fittings topcoat: Same as Pipe coatings.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
   1. Install ductile iron piping in accordance with AWWA C600, or as modified in Section 02001 - Common Work Results for General Piping.
   2. For underground piping, the trenching, backfill, and compaction:
      a. Inspect coating prior to backfill.
      b. As specified in Section 02318 - Trenching.

B. Joints:
   1. Install types of joints as specified in the piping schedule provided in Section 02001 - Common Work Results for General Piping.
   2. Mechanical joints are not acceptable in above ground applications.
   3. Field closure for restrained push-on pipe:
      a. Locate field closures in areas where thrust calculations demonstrate restraint is not required.
   4. Grooved joints:
      a. Install piping with grooved joints where specified in the piping schedule as specified in Section 02001 - Common Work Results for General Piping.
      b. Assemble grooved joints in accordance with manufacturer's published instructions.
      c. Support grooved-end pipe in accordance with manufacturer's published instructions.
         1) Install at least 1 support between consecutive couplings.

C. Connection:
   1. Tapping ductile iron pipe:
      a. Direct tapping of ductile iron pipe may be performed but is limited to the following conditions:
         1) Maximum allowable tap diameter by pipe diameter and pressure class:

Pipe Size (inches)	Pressure Class				
	150	200	250	300	350
	Maximum Allowable Direct Tap Size (inches)				
3	-	-	-	-	3/4
4	-	-	-	-	3/4
6	-	-	-	-	1
8	-	-	-	-	1
10	-	-	-	-	1
12	-	-	-	-	1-1/4
14	-	-	1-1/4	1-1/2	1-1/2
16	-	-	1-1/2	2	2
18	-	-	2	2	2
20	-	-	2	2	2
24	-	2	2	2	2

      b. The maximum allowable tap diameter for pipelines greater than 24 inches is 2 inches.
      c. 2 layers of 3-mil thread sealant are required to minimize the torque required to effect a watertight connection.
   2. Direct tapping of glass lined ductile iron pipe may be performed only when approved in writing by the Engineer. Direct tapping of glass lined pipe shall be

performed in accordance with the above conditions for tapping ductile iron pipe in addition to the following conditions:

a. Drilling and tapping shall be performed using a hole saw.
    1) Use of a large drill bit is not acceptable.
b. As the hole saw approaches the glass lining, lessen the inward pressure to avoid excess chipping or cracking of the lining.
c. Minor chipping or spalling of the glass lining shall be repaired using an epoxy resin “glass repair kit” provided by the fabricator.
    1) Manufacturers: One of the following or equal:
        a) Devoe - Devran 224 HS.
        b) Sherwin-Williams Co. - Sher-Tile High Solids Epoxy.
    2) Repair kit use is only allowed for areas of damage less than 1/2 inch in diameter.
        a) Larger areas of damage will require replacement.
    3) Surface shall be prepared and repair kit shall be applied in accordance with manufacturer and/or fabricator’s instructions.

3.02 DEFECTS IN COATINGS EXCEPT TAPE WRAP AND CEMENT MORTAR COATING

A. Engineer will identify defective coating to be field repaired in accordance with the applicable AWWA standard.
    1. Pipe joints exceeding the following defect maximum will be rejected.
        a. Minor defects:
            1) No more than 1.5 per 100 square feet of surface area.
            2) 2 or more minor repairs within an 8-inches diameter circle will be considered a single repair.
            3) Repairs for adhesion testing will not be included in the total number of repairs.
            4) Repair in accordance with manufacturer's requirements.
        b. Major defects:
            1) No more than 3 major repairs on each pipe joint.
            2) No more than 30 percent repairs on the pipe surface area with defects.
    2. Minor repairs:
        a. Repairs less than 8-inches in the greatest dimension.
        b. Repair in accordance with manufacturer's requirements.
    3. Major repairs:
        a. Repairs that exceed 8-inches in the greatest dimension.
        b. Repair in accordance with manufacturer's requirements.

3.03 POLYETHYLENE ENCASEMENT

A. Wrap buried ductile iron pipe and fittings a single layer of V-Bio polyethylene wrap in accordance with AWWA C105 and as specified in this Section.

B. Wrap polyethylene encasement to be continuous and terminated neatly at connections to below grade equipment or structures.

C. At wall penetrations, extend encasement to the wall and neatly terminate.

D. At slab penetrations, extend encasement to 2 inches below the top of slab and neatly terminate.

E. When rising vertically in unimproved areas, extend encasement on pipe 6 inches above existing grade and neatly terminate.

F. Repair tears and make joints with 2 layers of plastic tape.

G. Work shall be inspected prior to backfilling of pipe and associated items.

3.04 FIELD QUALITY CONTROL

A. Testing ductile iron piping:
   1. Test as specified in Section 02001 - Common Work Results for General Piping and Section 02009 - Piping Systems Testing.

B. Repair damaged cement mortar lining to match quality, thickness, and bonding of original lining in accordance with AWWA C104.
   1. When lining cannot be repaired or repairs are defective, replace defective piping with undamaged piping.

C. Verify that interior surfaces of ceramic epoxy and glass lined pipe and fittings have continuous coverage:
   1. Test random samples, as directed by Engineer, in accordance with ASTM B1000.
   2. Discard lined piping and fittings found to have pinholes, crazing, or fish scales, which expose the metal substrate.

END OF SECTION

SECTION 02705

POLYVINYL CHLORIDE (PVC) PIPE: GRAVITY

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Gravity sewer pipe and fittings in accordance with ASTM D3034 and ASTM F679 standards.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
   2. D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
   3. D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
   4. D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
   5. D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
   6. F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
   7. F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

1.03 ABBREVIATIONS

A. PVC: Polyvinyl chloride.

B. SDR: Standard dimension ratio; the outside diameter divided by the pipe wall thickness.

1.04 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: As specified in Section 02001 - Common Work Results for General Piping.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect from sunlight, scoring, and distortion.

B. Do not allow surface temperatures to exceed 120 degrees Fahrenheit.

C. Store and handle as recommended by manufacturer in published instructions.

PART 2 PRODUCTS

2.01 PIPE

A. Extruding and molding material: Virgin material containing no scrap, regrind, or rework material except where permitted in the referenced standards.

B. PVC compound: Cell classification 12454-C in accordance with ASTM D1784.

C. Stabilizers, antioxidants, lubricants, colorants, and other additives and fillers not to exceed 10 parts by weight per 100 of PVC resin in the compound.

D. Pipe less than or equal to 15-inch diameter:
   1. In accordance with ASTM D3034.
   2. Wall thickness SDR 26 or as specified in the Piping Schedule in Section 02001 - Common Work Results for General Piping.
   3. Joints: Push-on in accordance with ASTM D3212.
      a. Integral bell.
      b. Factory installed gaskets meeting the requirements in accordance with ASTM F477.

E. Pipe greater than or equal to 18-inch diameter:
   1. In accordance with ASTM F679.
   2. Minimum pipe stiffness: PS115 in accordance with Table 1 in ASTM F679.
   3. Joints: Push-on in accordance with ASTM D3212.
      a. Integral bell.
      b. Factory installed gaskets meeting the requirements in accordance with ASTM F477.
   4. Bell:
      a. Fabricated from pipe sections.
      b. Bell wall thickness equivalent to pipe wall thickness.
   5. Gasket ring: Locked into the bell.
   6. Spigot end of the pipe: Marked by the manufacturer to identify the final in place position of the spigot in the bell.

2.02 FITTINGS

A. Same material as the pipe.

B. Minimum wall thickness: Same as the minimum wall thickness of the equivalent size pipe as specified in Table 1 of ASTM F679.

C. Supplied by the pipe manufacturer.

D. Factory molded with joints and gaskets equal to those of the pipe.

E. Gasket:
   1. In accordance with ASTM F477.
   2. Manhole adapter gasket: Stainless steel clamp with gasket or similar device to seal the penetration.

F. Flexible gaskets for precast bases with a flexible pipe connection: In accordance with ASTM C923:
   1. Manufacturer: One of the following or approved equal:
      a. Press-Seal Gasket Corp.: PSX.
      b. A-Lok Premium.

G. Waterstop grouting rings:
   1. Manufacturer: One of the following or approved equal:
      a. NPC.
      b. Press-Seal Gasket Corp.

2.03 SOURCE QUALITY CONTROL

A. Mark pipe and fittings in accordance with ASTM D3034 and ASTM F679 as appropriate.

B. Mark the production control code on pipe and fittings.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
   1. Install piping in accordance with ASTM D2321 and manufacturer's published installation instructions.
   2. Provide plugs or caps for stubs and branch pipes left unconnected to laterals.
   3. Lubricate and assemble joints in accordance with the pipe manufacturer's published instructions.
   4. Trenching and backfill as specified in Section 02318 - Trenching.
   5. For open cut installations, install underground warning tape as specified in Section 02003 - Pipe Identification.
   6. Install pipe with tracer wire as specified in Section 02003 - Pipe Identification.

B. Connections to manholes:
   1. Make connections to manholes with a manhole gasket that prevents infiltration and exfiltration through the penetrations using 1 of the following methods:
      a. Precast bases with a flexible pipe connection:
         1) Pipe connectors shall be cast into the base.
            a) Pipe openings shall contain flexible gaskets.
         2) Follow manufacturer's recommendation for lubrication to prevent damage to the gasket during pipe insertion.
         3) When PSX gaskets are used, the take-up screws for the gasket clamps shall be positioned a minimum of 90 degrees apart.
         4) Install and grout in place per manufacturer's instructions.
      b. Cast in place or precast bases using grouting rings:
         1) Provide opening for connection large enough to allow subsequent grouting around the grouting ring.
         2) Grout around the pipe penetration manhole gasket and seal the opening.

3.02 FIELD QUALITY CONTROL

A. Test pipe as specified in Section 02009 - Piping Systems Testing.

B. Mandrel tests:
   1. Perform initial mandrel test:
      a. After cleaning and completion of other tests.
      b. After placement and compaction of backfill.
      c. Before construction of pavement or surfacing.
      d. Not sooner than 30 days after pipe installation.
      e. Not later than 60 days after installation.
   2. Utilize a 9 rod mandrel with minimum length equal to NPS and diameter as follows:

Nominal Pipe Size (NPS)	Mandrel Dia (in) (SDR 35/PS46)	Mandrel Dia (in) (SDR 26/PS 115)
6	5.45	5.33
8	7.28	7.11
10	9.08	8.87
12	10.79	10.55
15	13.20	12.90
18	16.13	15.76
21	19.00	18.57
24	21.36	20.87
27	24.06	23.51
30	27.68	27.04

   3. Test procedure: Pull the mandrel through the line under test by 1 person, by hand, with reasonable effort, without the aid of mechanical equipment.
   4. Failing test: Where the mandrel test is not successful, remove and replace the section of piping with the obstruction; test the piping again, including visible leaks test, pressure test with maximum leakage allowance, mandrel tests, and other specified tests:
      a. Correction of excessive deflection or obstructions by methods other than removal of the affected piping and replacement of the removed piping with new piping will not be accepted.

END OF SECTION

SECTION 02706

POLYVINYL CHLORIDE (PVC) PIPE: PRESSURE - LINEAR INFRASTRUCTURE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. AWWA C900 PVC pipe and fittings.
   2. AWWA C900 compliant FPVC.

1.02 REFERENCES

A. American Water Works Association (AWWA):
   1. C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   2. C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
   3. C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In.
   4. C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. through 48 In., for Water Transmission and Distribution.
   5. M23 - PVC Pipe - Design and Installation Manual.

B. ASTM International (ASTM):
   1. A536 - Standard Specification for Ductile Iron Castings.
   2. D1784 - Standard Specification for Rigid PolyVinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
   3. D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
   4. F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
   5. F645 - Standard Guide for Selection, Design, and Installation of Thermoplastic Water-Pressure Piping Systems.

C. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.

1.03 ABBREVIATIONS

A. DR: Dimension Ratio = OD/t (OD is pipe outer diameter, t is pipe wall thickness).

B. NPS: Nominal pipe size followed by the size designation.

1.04 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. As specified in Section 02001 - Common Work Results for General Piping.

C. Shop drawings:
    1. Fusion technician qualifications.
    2. The following AS-RECORDED DATA is required from the Contractor and/or fusion provider:
        a. Fusion report for each fusion joint performed on the project, including joints that were rejected and the following information:
            1) Pipe size and dimensions.
            2) Machine size.
            3) Fusion technician identification.
            4) Job identification.
            5) Fusion joint identification.
            6) Fusion, heating, and drag pressure settings.
            7) Heat plate temperature.
            8) Pipe extrusion time stamp.
            9) Heating and cool down time of fusion.
            10) Ambient temperature.

1.05 QUALITY ASSURANCE

A. Pipe in potable water applications: Provide pipe bearing NSF 61 seal.

B. Mark plastic pipe with date of extrusion, nominal size, class, manufacturer, and markings required in accordance with ASTM and AWWA standards.

C. Fusion technician requirements:
    1. Qualified by the pipe supplier to fuse FPVC of the type(s) and size(s) being used.
    2. Current qualification as of the actual date of fusion performance on the project.
    3. Training records for qualified fusion technicians available to Owner or Engineer upon request.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect from sunlight, scoring, and distortion.

B. Do not allow surface temperatures to exceed 120 degrees Fahrenheit.

C. Deliver, offload, handle, and store pipe in accordance with manufacturer’s or pipe supplier’s recommendations and best practices provided by AWWA M23 and AWWA C605, including compliance with minimum recommended bending radius and maximum safe pulling forces for each specific pipe.

PART 2 PRODUCTS

2.01 PIPE

A. General:
    1. As specified in Section 02001 - Common Work Results for General Piping.
    2. Extruding and molding material: Virgin material containing no scrap, regrind, or rework material except where permitted in the referenced standards.

3. In accordance with AWWA C900.
4. Made from a PVC compound conforming to cell classification 12454 in accordance with ASTM D1784.

B. Pipe:
1. Bell and spigot:
a. Pipe with integral bell.
b. Pressure Class as scheduled in Section 02001 - Common Work Results for General Piping with a maximum DR of 18.
c. Manufacturers: One of the following or equal.
1) Diamond Plastics Corp.
2) CertainTeed.
3) North American Pipe Corp.
2. Fusible:
a. Extruded with plain ends square to the pipe and free of any bevel or chamfer.
b. Pressure Class as scheduled in Section 02001 - Common Work Results for General Piping with a maximum DR of 18.
c. Pipe: Manufacturers: One of the following or equal:
1) Underground Solutions, Inc., Fusible C-900®.
d. Extruders: Manufacturers: One of the following or equal:
1) Northern Pipe Products.
2) CertainTeed.
3) North American Pipe Co.

2.02 FITTINGS

A. Material:
1. Cast or ductile iron fittings as specified in Section 02693 - Ductile Iron Pipe: AWWA C151 sized for the dimensions of the pipe being used.

B. Equal to or greater pressure rating than the pipe.

2.03 JOINTS

A. Bell and spigot joints:
1. Push-on or mechanical joint type as identified in the Piping Schedule in Section 02001 - Common Work Results for General Piping.
2. Gasketed joint assembly: Meet or exceed the requirements in accordance with ASTM D3139.
3. Factory installed gaskets: SBR in accordance with ASTM F477.
4. Joint restraint at fittings:
a. Concrete thrust blocks:
1) Install thrust blocks at changes in pipe diameter and at fittings.
2) Design thrust blocks using a safety factor of at least 1.5:1 for both the test and peak operating pressures.
b. Mechanical wedge action joint restraints:
1) Manufacturers: One of the following or approved equal:
a) EBAA Iron, Inc.:
(1) For pipes 3 to 36-inch: Series 2000PV.
(2) For pipes 42 and 48-inch: Series 2200.

b) Star Pipe Products, Series 4000.
c) Sigma Corp.:
(1) For pipes 3 to 36-inch: One-Lok Model SLCE.
(2) For pipes 42 and 48-inch: PV-Lok Model PWM.

2) Materials:
a) Mechanical joints bolts and nuts as Specified in Section 02001 - Common Work Results for General Piping.
b) Gland body: Ductile iron in accordance with ASTM A536.
c) Wedge and wedge actuating components: Ductile iron in accordance with ASTM A536.
(1) Wedges: Heat-treated to a minimum of 370 BHN.
d) Actuating bolts and nuts: Ductile iron in accordance with ASTM A536.
(1) Provide torque-limiting twist off components to ensure proper installation.

3) Coatings:
a) Provide a manufacturer applied coating system.
b) Manufacturers: One of the following or equal:
(1) EBAA Iron Inc., Mega-Bond.
(2) Star Pipe Products, Star-Bond.
(3) Sigma Corp., Corrsafe™ Electro-Deposition Coating.

4) Consist of multiple gripping wedges incorporated into a follower gland meeting the requirements in accordance with AWWA C111.
5) Allow post assembly angular deflection that is a minimum of 50 percent of the angular deflection allowed by the mechanical joint.
6) Pressure rating equal to or greater than that of the pipe on which it is being used and a minimum safety factor of 2:1 for all sizes.

c. Push-on joint restraint harnesses:
1) Manufacturers: One of the following or approved equal:
a) EBAA Iron, Inc.:
(1) For pipes 4 to 12-inch: Series 1500.
(2) For pipes 14 to 48-inch: Series 2800.
b) Star Pipe Products, Series 4100P.
c) Sigma Corp., PV-Lok Model PWP.

2) Materials:
a) Restraint and backup rings: Ductile iron in accordance with ASTM A536.
b) Wedge and wedge actuating components: Ductile iron in accordance with ASTM A536.
c) Tie rods: Low alloy steel in accordance with AWWA C111.

3) Coatings:
a) Provide manufacturer applied coating system.
b) Manufacturers: One of the following or equal:
(1) EBAA Iron Inc., Mega-Bond.
(2) Star Pipe Products, Star-Bond.
(3) Sigma Corp., Corrsafe ™ Electro-deposition coating.

4) Consist of a backup ring behind the PVC bell and a restraint ring consisting of multiple gripping wedges connected with number and type of tie rods as recommended by the manufacturer.

5) Allow post assembly angular deflection that is a minimum of 50 percent of the angular deflection allowed by the push-on joint.
6) Pressure rating equal to or greater than that of the pipe on which it is being used and a minimum safety factor of 2:1 for all sizes.

B. Fusion joints:
1. Unless otherwise specified, assemble FPVC lengths in the field using butt-fusion joining methodology as recommended by the pipe supplier.

2.04 SOURCE QUALITY CONTROL

A. Bell and spigot piping:
1. Hydrostatic proof testing in accordance with AWWA C900: Test pipe and integral bell to withstand, without failure, 2 times the pressure class of the pipe for a minimum of 5 seconds.

B. Fusible:
1. Test at the extrusion facility for properties required to meet applicable parameters as outlined in AWWA C900.
2. Conduct hydrostatic proof testing in accordance with the provisions of AWWA C900 for pipes manufactured to non-standard lengths (i.e., lengths other than 20-foot).

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
1. Install PVC piping in accordance with ASTM F645, AWWA C605, and manufacturer's or pipe supplier’s published installation instructions.
2. Trenching and backfill as specified in Section 02318 - Trenching.
3. Install pipe with tracer wire as specified in Section 02003 - Pipe Identification.

B. Fusible PVC:
1. Layout:
a. Perform fusion of the pipe at surface level.
1) No fusion will be completed in the excavated area or trench without prior special approval.
b. Fuse pipe lengths in their entirety and stage prior to installation in the trench.
c. Handle and install the FPVC pipe in a manner so as not to exceed the recommended bend radius.
2. Installation:
a. Install fused lengths of pipe by lowering into the trench or excavation using manufacturer approved methods.
1) Once the lowering operation is initiated, proceed until the entire length of the fused section of pipe is installed.

b. Coordinate lifting equipment to ensure the fused pipe does not exceed the bending and buckling limitations of the pipe, in accordance with manufacturer's or pipe supplier's recommendations.
    1) Do not "drop" or "roll" pipe into the trench or excavation.
    2) Support pipe at all times, including placement in final alignment.
c. Bed and remove lengths of FPVC from direct sunlight for a period of at least 2 minutes per inch-diameter before any connections are made.
d. Do not exceed the manufacturer's recommended safe pulling force for the specific pipe size and DR being installed by pulling in tension.

C. Fusion process:
1. FPVC will be fused by qualified fusion technicians certified and experienced in the type and size of FPVC pipe being used.
    a. Pipe supplier submit technician's documented qualifications valid for date of project welding.
2. Use only appropriately sized and outfitted fusion machines that have been approved by the pipe supplier for the fusion process.
3. Fusion machines must meet the following requirements:
    a. Heat plates:
        1) Appropriately sized.
        2) In good condition with no deep gouges or scratches within the pipe circle being fused.
        3) Clean and free of any contamination.
        4) Capable of maintaining a uniform and consistent heat profile and temperature for the size of pipe being fused in accordance with pipe manufacturer's recommendations.
    b. Verify heater controls properly function.
    c. Smooth traveling carriage with no binding at less than 50 pounds per square inch.
    d. Jaws: Good condition with proper inserts for the pipe size being fused.
    e. Install insert pins with no interference to carriage travel.
    f. Machine body: No obvious defects, missing parts, or potential safety issues during fusion.
4. Use pipe rollers for support of pipe on either side of the machine.
5. Provide a weather protection canopy that allows full machine motion of the heat plate, fusion assembly, and carriage for fusion in inclement and/or windy weather.
6. Use facing blades specifically designed for cutting FPVC.
7. Record and log each fusion joint using an electronic monitoring device (data logger) connected to the fusion machine.
    a. Generate the fusion data logging and joint report using software developed specifically for the fusion of FPVC.
    b. Use the current version of the pipe manufacturer's recommended data logger software.
    c. Manually log data not logged by the data logger and include in the fusion technician's joint report.

D. Tapping PVC:
    1. Direct tapping:
        a. Direct taps are allowed for AWWA C900 have a pipe class of Class 235 or greater, NPS 6-inch through 12-inch only.
        b. 1-inch is the maximum allowable outlet size for performing a direct tap.
    2. Saddle tapping:
        a. Saddle taps are allowable on all sizes and classes of AWWA C900 pipe.
        b. 2-inch is the maximum allowable outlet size for performing a saddle tap.
        c. As specified in Section 02005 - Piping Specialties for allowable service saddles.
    3. Tapping sleeves:
        a. Tapping sleeves are allowable on all sizes and classes of PVC AWWA C900.
        b. As specified in Section 02005 - Piping Specialties for allowable tapping sleeves.

E. Tapping FPVC:
    1. Direct tapping of FPVC is not allowed.
    2. Saddle tapping:
        a. Saddle taps are allowable on all sizes and classes of AWWA C900 FPCVP.
        b. As specified in Section - Piping Specialties for allowable service saddles.
    3. Tapping sleeves:
        a. Tapping sleeves are allowable on all sizes and classes of AWWA C900 FPVC.
        b. As specified in Section 02005 - Piping Specialties for allowable tapping sleeves.
    4. Use only allowable tap sizing and recommended tapping procedures provided by the pipe supplier for all tapping operations on FPVC.

3.02 FIELD QUALITY CONTROL

A. Leakage test for piping:
    1. Subject to visible leak test and pressure test with maximum leakage allowance, as specified in Section 02009 - Piping Systems Testing.
    2. Pressure test with maximum leakage allowance:
        a. Perform test after placing sufficient backfill.
        b. In areas requiring immediate backfill, test prior to placement of permanent surfacing.
        c. Test pressure: As specified in the Piping Schedule in Section 02001 - Common Work Results for General Piping.

d. FPVC fusion joints: No leakage allowed.
e. Maximum leakage allowance for bell and spigot pipe is as listed in the table below:

Test Pressure (psi)	Bell and Spigot Pipe Allowable Leakage (Gallons per 50 joints per hour) Nominal Pipe Size (inches)									
	4	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**24**
50	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.96	1.15
75	0.23	0.35	0.47	0.59	0.70	0.82	0.94	1.05	1.17	1.40
100	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62
125	0.3	0.45	0.6	0.76	0.91	1.06	1.21	1.36	1.51	1.81
150	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99
175	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15
200	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29
225	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43
250	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56
275	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.69
300	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81

END OF SECTION

SECTION 02710

POLYVINYL CHLORIDE (PVC) PIPE: SCHEDULE TYPE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Schedule type PVC pipe and fittings.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
   2. D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
   3. D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
   4. D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
   5. D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
   6. D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
   7. F645 - Standard Guide for Selection, Design and Installation of Thermoplastic Water-Pressure Piping Systems.

B. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: As specified in Section 02001 - Common Work Results for General Piping.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect from sunlight, scoring, and distortion.

B. Do not allow surface temperatures to exceed 120 degrees Fahrenheit.

C. Store and handle as recommended by manufacturer in published instructions.

PART 2 PRODUCTS

2.01 MATERIALS

A. Extruding and molding material: Virgin material containing no scrap, regrind, or rework material except where permitted in the referenced standards.
   1. Pipe: Designation PVC 1120 in accordance with ASTM D1785 and appendices:
      a. Extruded from Type I, Grade 1, Class 12454 material in accordance with ASTM D1784.
      b. Schedule 80 unless otherwise indicated on the Drawings or specified in the Piping Schedule.
   2. Fittings: In accordance with ASTM D2467.
      a. Same material as the pipe and of equal or greater pressure rating.
      b. Supplied by pipe manufacturer.
      c. Unions 4 inches and smaller:
         1) Use socket end screwed unions.
      d. Unions 6 inches and larger:
         1) Use socket flanges with 1/8-inch full-face soft gasket.
            a) Gasket material: As indicated on the Piping Schedule.
   3. Solvent cement:
      a. In accordance with ASTM D2564.
      b. Manufacturers: The following or equal:
         1) IPS Corp.
            a) Primer: Type P70 or another primer certified by the manufacturer for chemical service.
            b) Cement: Type 724.
      c. Certified by the manufacturer for the service of the pipe.
      d. In potable water applications: Provide solvent cement listed by NSF for potable water applications.

2.02 SOURCE QUALITY CONTROL

A. Meets or exceeds all quality assurance test requirements stated in ASTM D1785.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install piping in accordance with ASTM F645, or manufacturer's published instructions for installation of piping, as applicable.

B. Provide molded transition fittings for transitions from plastic to metal pipe.
   1. Do not thread pipe.
   2. Do not use flanged transition fittings unless specifically indicated on the Drawings.

C. Locate unions where indicated on the Drawings, and elsewhere where required for adequate access and assembly of the piping system.

D. Provide serrated nipples for transition from pipe to rubber hose.

E. Solvent weld joints in accordance with ASTM D2855.

3.02 FIELD QUALITY CONTROL

A. Test pipe as specified in Section 02001 - Common Work Results for General Piping and Section 02009 - Piping Systems Testing.

END OF SECTION

SECTION 02742A

ASPHALTIC CONCRETE PAVING (CA)

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Asphalt pavement on prepared subgrade or aggregate base course to lines, grades, and compacted thickness as indicated on the Drawings.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. T 209 - Standard Method of Test for Theoretical Maximum Specific Gravity and Density of Asphalt Mixtures

B. ASTM International (ASTM):
   1. D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft. lbf/f_4^3)(2,700 kN-m/m^3).
   2. D1561 - Standard Practice for Preparation of Bituminous Mixture Test Specimens by Means of California Kneading Compactor.

C. Caltrans Standard Test Methods:
   1. California Test 304 - Preparation of Bituminous Mixtures for Testing.
   2. California Test 362 - Determining Asphalt Content in Bituminous Mixtures by Vacuum Extraction.
   3. California Test 375 - Determining the In-Place Density and Relative Compaction of AC Pavement.
   4. California Test 382 - Determining Asphalt Content in Bituminous Mixtures (Ignition Oven Method).

D. State of California Department of Transportation Standard Specifications, latest edition (Caltrans Standard Specifications):
   1. Section 37 - Bituminous Seals.
   2. Section 39 - Asphalt Concrete.
   3. Section 92 - Asphalt Binders.
   4. Section 94 - Asphaltic Emulsions.
   5. Section 96 - Geosynthetics

1.03 SUBMITTALS

A. Mix design.

B. Shop drawings.

C. Product data:
   1. Asphalt.
   2. Asphalt aggregate.

3. Pavement reinforcing fabric.
4. Tack Coat application rate calculations.

D. Quality control submittals:
1. Test results.
2. Certificate of Compliance.
3. Certificate of Competence.

E. Equipment list.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Asphalt pavement delivery:
1. Transport the mixture from the mixing plant to the point of use in vehicles having tight bodies previously cleaned of foreign materials.
2. Treat bodies as necessary to prevent material from sticking to the bodies.
3. Cover each load with canvas or other suitable material of sufficient size and thickness to protect the asphalt mixture from the weather.

1.05 PROJECT CONDITIONS

A. Environmental requirements:
1. Asphalt concrete:
a. Place asphalt concrete only when surface is dry, and when atmospheric temperature in the shade is 40 degrees Fahrenheit and rising, or above 50 degrees Fahrenheit if falling.
b. Do not place asphalt concrete when weather is foggy or rainy, when base on which material is to be placed is in wet or frozen conditions, or when, in the opinion of the Engineer, weather conditions will prevent proper handling, finishing, or compaction of the mixtures.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. This Work shall consist of furnishing and mixing aggregate and asphalt binder at a central mixing plant, spreading and compaction of the mixture as specified and as indicated on the Drawings.

B. In general, asphalt concrete and asphalt concrete base shall conform to Section 39 “Asphalt Concrete,” and applicable referenced sections of the Caltrans Standard Specifications:
1. Where conflicts exist, this specification shall govern.

2.02 ASPHALT PAVEMENT MATERIALS

A. Asphalts:
   1. Asphalt binder: Steam-refined paving asphalt, PG 64-10, conforming to Section 92-1.02B “Performance Grades Asphalt Binders” of the Caltrans Standard Specifications.
   2. Tack coat: Asphaltic emulsion, Grade SSA1, conforming to Section 94 of the Caltrans Standard Specifications.

B. Asphalt aggregate:
   1. Aggregate shall conform to Section 39-2.02B(4)(b) of the Caltrans Standard Specifications for Type A HMA grading:
      a. For pavement placed in multiple lifts:
         1) Aggregate for the final lift (surface layer) shall be 1/2-inch maximum, medium.
         2) Aggregate for all other lifts/layers shall be 3/4-inch maximum, medium.
      b. For pavements placed in a single lift:
   2. Aggregate shall be 1/2-inch maximum, medium.

C. Asphalt pavement shall be produced in a batch mixing plant, a continuous pugmill mixing plant, or dryer-drum mixing plant:
   1. Proportioning shall conform to Section 39-2.01B(8)(a) of the Caltrans Standard Specifications.
   2. Mixing shall conform to Section 39-2.01B(8)(a) of the Caltrans Standard Specifications.

2.03 SLURRY SEAL

A. Slurry seal, Type II, shall be applied in conformance with the provisions in Section 37-3, and applicable referenced sections of the Caltrans Standard Specifications, at the following locations:
   1. At locations indicated on the Drawings.
   2. All asphalt pavement.

2.04 AGGREGATE BASE COURSE

A. Aggregate base course: As specified in Section 02050 - Soils and Aggregates for Earthwork.

B. Aggregate base course shall be placed at the following locations:
   1. At locations indicated on the Drawings.
   2. All asphalt pavement.

C. Compacted thickness of aggregate base course shall be as indicated on the Drawings.

2.05 EQUIPMENT

A. Spreading and compacting equipment:
   1. Spreading equipment shall conform to Section 39-2.01C(2) and applicable referenced sections of the Caltrans Standard Specifications:
      a. Only in areas inaccessible to the machine, by approval of the Engineer, will hand spreading be permitted.
   2. Compaction equipment shall conform to Section 39-2.01C(2) and applicable referenced sections of the Caltrans Standard Specifications.

2.06 SOURCE QUALITY CONTROL

A. The Engineer will perform sampling and tests of materials in accordance with California Test Method Number 304 and California Test Method Number 362 or 382, as applicable. Samples will be taken from materials as delivered to the site.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Verify surfaces and site conditions are ready to receive work. If unsatisfactory conditions exist, do not commence installation until such conditions have been corrected. Beginning application means acceptance of existing conditions.

3.02 PREPARATION

A. Protection:
   1. Protect concrete pavements and walks, curbs and bases, and other improvements adjacent to the operations with suitable materials.
   2. Building and other surfaces shall be covered with paper or other protection, when required.
   3. Contractor shall be responsible for any damage caused by Contractor's employees. Damage caused by the Contractor's operations shall be repaired to the satisfaction of the Engineer at no additional cost to Owner.

B. Subgrade preparation:
   1. Immediately prior to applying tack coat, or immediately prior to placing the asphalt pavement when tack coat is not required, the subgrade to receive asphalt pavement shall conform to the compaction requirement and elevation tolerances specified for the material involved and shall be cleaned to remove any loose or extraneous material.
   2. If the asphalt pavement is to be placed on an existing base or pavement that was not constructed as part of the contract, the Contractor shall clean the surface by sweeping, flushing, or other means to remove loose particles of paving, dirt, and other extraneous material immediately before applying the tack coat.

3.03 TACK COAT

A. Tack coat:
   1. A tack coat of asphaltic emulsion shall be applied to vertical surfaces of existing pavement, curbs, gutters, and construction joints in the surfacing against which additional material is to be placed, or as otherwise specified in this Section.
   2. Tack coat shall be applied in one application at a rate according to Section 39-2.01A(3)(j) and residual rate requirements according to the mix design and application.

3.04 ASPHALT PAVEMENT

A. Placing materials in a windrow, then picking it up and placing it in the asphalt paver with loading equipment, will be permitted provided that:
   1. The asphalt paver is of such design that the material will fall into a hopper that has a movable bottom conveyor to feed and screed.
   2. The loader is constructed and operated so that substantially of the material deposited into windrows is picked up and deposited into the paving machine.
   3. The windrow is deposited only so far in advance of the paver to provide for continuous operation of the paver and not so far as to allow the temperature of the asphalt pavement in the windrow to fall below 260 degrees Fahrenheit.

B. Unless lower temperatures are directed by the Engineer, open graded asphalt concrete shall be spread and complete the first coverage using 2 rollers before the surface temperature drops below 230 degrees Fahrenheit. All compaction shall be complete before the surface temperature drops below 190 degrees Fahrenheit.

C. Asphalt pavement shall be spread and compacted in the number of layers and of the thicknesses indicated in the following table:
   1. A thickness tolerance of within 0.1 inches is allowed for asphalt concrete.
   2. A total thickness tolerance of within 0.2 inches is allowed for asphalt concrete base.

Total Thickness Indicated on Drawings[1]	Number of Lifts	Top Layer Thickness (inches)		Next Lower Layer Thickness (inches)		All Other Lower Layer Thicknesses (inches)	
		Min.	Max.	Min.	Max.	Min.	Max.
<2-3/4 inches	1	-----	-----	-----	-----	-----	-----
3 inches[2]	2	1-1/4	1-1/2	1-1/4	1-1/2	-----	-----
3-1/4 - 4-3/4 inches	2	1-3/4	2-1/4	1-3/4	3	-----	-----
>5 inches	[3]	1-3/4	2-1/4	1-3/4	3	1-3/4	4-3/4

Notes:
(1) When pavement-reinforcing fabric is shown to be placed between layers of asphalt pavement, the thickness of asphalt pavement above the pavement-reinforcing fabric shall be considered to be the "Total Thickness Indicated on the Drawings" for the purpose of spreading and compacting the asphalt pavement above the pavement-reinforcing fabric.
(2) If approved by the Engineer, one lift of 3 inches may be placed.
(3) At least 2 layers shall be placed if the total thickness is less than 5 inches. At least 3 layers shall be placed if the total thickness is more than 5 inches, and less than 10-1/2 inches. At least 4 layers shall be placed if the total thickness is greater than 10-1/2 inches.

D. A layer shall not be placed over another layer which exceeds 3 inches in compacted thickness until the temperature of the layer which exceeds 3 inches in compacted thickness is less than 160 degrees Fahrenheit at mid depth.

E. If the temperature of any layer drops below 140 degrees Fahrenheit, or if directed by the Engineer, apply tack coat before placing next layer.

F. Unless otherwise indicated on the Drawings, asphalt mixtures shall not be handled, spread, or windrowed in a manner that will stain the finished surface of any pavement or other improvements.

G. The completed mixture shall be deposited on the prepared subgrade at a uniform quantity per linear foot, as necessary to provide the required compacted thickness without resorting to spotting, picking up, or otherwise shifting the mixture.

H. Spreading:
   1. All layers of asphalt pavement shall be spread with an asphalt paver and shall conform to Section 39-2.01C and applicable referenced sections of the Caltrans Standard Specifications.
   2. At locations where the asphalt pavement is to be placed over areas inaccessible to spreading and rolling equipment, layers of asphalt pavement shall be distributed directly out of the back of the dump truck and spread by hand:
      a. Asphalt pavement spread by hand shall be compacted thoroughly to the required lines, grades, and cross-sections by means of pneumatic tampers, or by other methods that will produce the same degree of compaction as pneumatic tampers.

I. Compaction:
   1. Compaction of asphalt pavement shall conform to Sections 39-2.01C, and applicable referenced sections of the Caltrans Standard Specifications.
   2. Percent of maximum theoretical density for each layer of asphalt pavement shall be 95 percent. Theoretical maximum density to be determined using AASHTO T 209 and Caltrans Standard Specifications Section 39.

J. Segregation shall be avoided, and the surfacing shall be free of pockets of coarse or fine material. Asphalt pavement containing hardened lumps shall not be used:
   1. In areas inaccessible to paving and compacting equipment where spreading is done by hand, minimize the amount of segregation.

K. Location of longitudinal joints in the top layer will be determined by the Engineer and shall not adversely affect the quality of the finished product.

L. At locations, or as directed by the Engineer, the asphalt concrete shall be square and at least 1-inch thick when conforming to existing surfacing. Tapering or feathering is not allowed.

3.05 FIELD QUALITY CONTROL

A. Contractor shall control the quality of Work and shall provide adequate testing to ensure compliance with these Specifications:
   1. The type and size of the samples shall be suitable to determine conformance with stability, density, thickness, and other specified requirements. Use an approved power saw or core drill for cutting samples. Furnish tools, labor, and materials for cutting samples, testing, and replacing the pavement where samples were removed. Take a minimum of 1 sample for every 4,000 square feet of asphalt pavement placed.
   2. Where open graded friction course is to be placed, core samples shall be taken prior to friction course placement.

B. All asphalt pavement shall match the grades indicated on the Drawings and shall be completely free from unintended hollows and high spots:
   1. After completion of paving work, paving shall be flooded with water. Any ponding that results in standing water greater than 3/4 inch in depth shall be ringed with chalk. Such hollows shall be corrected by removing and replacing the asphalt concrete. The asphalt concrete patch shall be square and at least 1-inch thick when conforming to existing surfacing. Tapering or feathering is not allowed.

C. Contractor shall perform in-place density and compaction tests of the completed pavement in accordance with California Test Method Number 375, to determine compliance with the specified requirements. Submit test results to Engineer for approval.

D. Cracks, settling of surface, improper drainage, improper compaction, and sloppy connection to previously laid surfaces will be construed as improper workmanship and will not be accepted.

3.06 MAINTENANCE OF PAVEMENT

A. Upon completion of final rolling, traffic shall not be permitted on the finished pavement for at least 6 hours, or until the asphalt pavement has cooled sufficiently to withstand traffic without being deformed.

3.07 WORKMANSHIP AND WARRANTY

A. Contractor shall provide written warranty against defects in materials or workmanship for a period of not less than 1 year upon completion of Work.

END OF SECTION

SECTION 02747

BITUMINOUS PAVEMENT SURFACE SEAL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Seal Coat.
   2. Asphaltic Emulsion.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. T 49 - Standard Method of Test for Penetration of Bituminous Materials.
   2. T 59 - Standard Method of Test for Emulsified Asphalts.

B. CalTrans:
   1. Section 37 - Bituminous Seals.
   2. Section 94 - Asphaltic Emulsions.
   3. Test 205 - Method of Test for Percentage of Crushed Particles.
   4. Test 227 - Method of Test for Evaluating Cleanness of Coarse Aggregate.
   5. Test 332 - Method of Test for Recovery from Deformation of Latex Modified Asphalt Emulsion Residue.

1.03 SUBMITTALS

A. Product data.

B. Material sample.

C. Manufacturer's Installation Instructions.

D. Warranty.

1.04 PREPARATION FOR SEAL COAT

A. Prepare the surface to be sealed in accordance with Section 37 and Section 94.

B. Include preparation for seal coat in seal coat price, not as a separate item.

PART 2 PRODUCTS

2.01 SEAL COAT

A. Seal coat shall be a medium chip as indicated on the Drawings.

B. Use of building paper at the beginning and end of each application of bituminous binder will not be required when, in the opinion of the Engineer, satisfactory control of the spread of the bituminous binder can be obtained by other methods.

2.02 SCREENING MATERIAL

A. At least 90 percent by weight of the screenings shall consist of crushed particles in accordance with CalTrans Test 205.
   1. A crushed particle is defined as a particle having 2 or more fresh mechanically fractured faces.

2.03 MATERIAL SAMPLE SUBMITTAL

A. Prior to beginning work the Contractor shall submit four 2-liter bottle samples of asphaltic emulsion from each source and a 70 pound sample of screenings from each source and size for testing.

B. Asphaltic emulsion testing requires a maximum of 10 working days and screenings testing require 5 working days from the time the samples are received at the Laboratory. Work on the project shall not begin until submitted samples have passed all test procedures.
   1. Resubmitted failing asphaltic emulsion samples will take an additional 10 working days for each consecutive resubmittal.
   2. Resubmitted failing screening samples will take an additional 5 working days for each consecutive resubmittal.

2.04 ASPHALTIC EMULSION

A. Bituminous binder: Cationic type polymer modified asphaltic emulsion Grade PMCRS-2h.

B. For purposes of this contract, the words latex and polymer shall be considered synonymous.

C. The polymer modified' asphaltic emulsion shall be in conformance with the requirements specified in CalTrans Section 94 Asphaltic Emulsion when tested in accordance with the specified test method.

D. Test results for polymer modified asphaltic emulsion not within the allowable ranges specified, based upon the Engineer's tests, will be assessed a pay factor value in increments as follows.

PART 3 EXECUTION

3.01 PREPARATION

A. The rubber latex shall be added to the emulsion at the location of manufacture. The rubber may be either neoprene or a blend of butadiene and styrene.

B. Samples of the polymer modified asphaltic emulsion delivered to the project will be taken from the spray bar of the distributor truck at mid-load.

C. The temperature of the polymer modified asphaltic emulsion at the time of application shall be between 130 degrees Fahrenheit and 180 degrees Fahrenheit.

D. The application rate for polymer modified asphaltic emulsion shall be between 0.25 gallons per square yard and 0.40 gallons per square yard for medium screenings.
   1. The exact rate will be determined by Engineer.

E. Polymer modified asphaltic emulsion will be measured and paid for by the ton.

F. The use of different colored screenings will not be permitted on contiguous traffic lanes and uniform screening color shall be maintained for not less than 1 mile.

G. Stockpiling of screenings will be permitted provided Contractor notifies the Engineer sufficiently in advance of stockpiling so that an inspector can be provided at the stockpile site, and screenings are stockpiled in a continuous operation at a minimum rate of 75 tons per hour.

H. Spreading:
   1. Spread screenings both transversely and longitudinally at a uniform rate established by Engineer.
   2. Testing the rate of spread will be determined by placing 3 containers having an area of 3 square feet each across the width of spread at intervals determined by Engineer.
      a. The spreader will pass over the containers at the normal operative speed and the screenings deposited on each container will be weighed.
      b. The corresponding rate per square yard determined from the weight of screenings deposited on each container shall not vary more than 10 percent above or below the rate established by Engineer.
   3. Spreading equipment which cannot spread the screenings within the tolerances specified above will not be allowed.

I. Lane widths and the location of joints between adjacent applications of bituminous binder and screenings will be determined by Engineer.

END OF SECTION

SECTION 02762

PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Pavement marking requirements for striping, text, and graphics; traffic signs.

1.02 SUBMITTALS

A. Product data.

B. Manufacturer's instructions.

1.03 QUALITY ASSURANCE

A. Applicator qualifications: Minimum 5 years of experience of applying traffic markings with satisfactory performance record.

B. Regulatory requirements: Comply with applicable requirements of governmental agencies having jurisdiction, including airborne emissions and industrial waste disposal requirements.

1.04 PROJECT CONDITIONS

A. Apply pavement marking paint when:
   1. Pavement is clean and thoroughly dry.
   2. Ambient temperature is above 40 degrees Fahrenheit.
   3. Precipitation is not expected within 12 hours of completion of application.

PART 2 PRODUCTS

2.01 PAVEMENT MARKING PAINT

A. Manufacturers: One of the following or equal:
   1. Dunn-Edwards Corp.
   2. Glidden Co.
   3. Sherwin Williams Co.

B. Materials:
   1. Pavement marking paint, latex based: One of the following or equal:
      a. Dunn-Edwards: No. W 801, Vin-L-Stripe, epoxy-modified acrylic-latex based paint.
      b. Glidden: 63240 Series, UltraHide Latex Traffic Paint.
      c. Sherwin Williams: Set fast acrylic water borne traffic marking paint.

2. Masonry conditioner: The following or equal:
    a. Sherwin Williams: B46WZ1000, Masonry Conditioner.
3. Colors:
    a. Text: White.
    b. Parking dividers: White.
    c. No parking zone markings: Yellow.
    d. No parking curb: Red.
    e. Handicap zone markings: Blue and white.
        1) Blue paint: Match color No. 15090 in Federal Standard 595A as specified in Section 2-1720 of California Administrative Code Title 24 Handicap Regulations.
    f. Accessible parking dividers and accessible route: Yellow.
    g. Directional arrows: White.
    h. Driving lane dividers: White.

2.02 TRAFFIC SIGNS

A. Manufacturers: One of the following or equal:
    1. Seton Name Plate Co.
    2. Emedco.

B. Material, shapes, and graphics: Post mounted baked enamel on steel sheet, reflectorized to show the same shape and color both day and night, with mounting holes, in accordance with the Uniform Traffic Control Devices manual. Fasten sign to post with stainless steel bolts.

PART 3 EXECUTION

3.01 PREPARATION

A. Remove dirt, oil, grease, and other materials which may affect paint adhesion.

B. Apply masonry conditioner on weathered or sandblasted surfaces, brick, or stucco.

3.02 APPLICATION

A. Apply paint at package consistency whenever possible. Thin paint as little as possible.

B. Apply paint with specifically designed and manufactured equipment for pavement marking. Provide:
    1. Uniform straight edges without overspray.
    2. 4-inch-wide lines, unless indicated otherwise.
    3. Hatching in handicap parking areas.

C. Provide striping between parking stalls as indicated on the Drawings:
    1. Identify parking spaces with text as indicated on the Drawings:
        a. Compact spaces: COMPACT.
        b. Carpool spaces: CARPOOL.
        c. Motorcycle spaces: MOTORCYCLE.

d. Visitor spaces: VISITOR.
e. Clean Air Vehicle spaces: CLEAN AIR VEHICLE.
1) Lettering shall be at least 8 inches high.

D. Apply paint to obtain thickness recommended by paint manufacturer.

E. Paint traffic control markings, including striping, directional arrows, cross walks and lettering, and handicap striping and symbols as indicated on the Drawings and in accordance with local governing agency's standards. Use stencils for arrows, lettering, and symbols.

F. Apply 700 square inch international handicap symbol on pavement surface where indicated on the Drawings:
1. On asphalt surfaces, paint blue symbol on white square.
2. On concrete surfaces, paint white symbol on blue square.

G. Install traffic signs where indicated on the Drawings. Set post in concrete to depth to resist sign damage from wind speed of 100 miles per hour.

END OF SECTION

SECTION 02772

CONCRETE CURBS, GUTTERS, AND SIDEWALKS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Concrete curbs, gutters, sidewalks, driveways, access ramps, and alley intersections.

1.02 SUBMITTALS

A. Product data: Submit data completely describing products.

B. Samples: Submit samples when requested.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Performance requirements: Construct various types of concrete curb, gutter, sidewalk, driveways and alley intersections to dimensions and details indicated on the Drawings.

2.02 MATERIALS

A. Concrete: Class A, as specified in Section 03300 - Cast-In-Place Concrete.

B. Curb finishing mortar: 1 part portland cement to 2 parts sand.

C. Form release material: Light oil or other releasing agent of type which does not discolor concrete or interfere with the application of finishing mortar to curb tops and faces.

D. Joint materials:
   1. Expansion: As specified in Section 03150 - Concrete Accessories.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of Conditions:
   1. Verify field conditions, including subgrade condition and interferences, before beginning construction.

3.02 PREPARATION

A. Surface preparation:
   1. Subgrade:
      a. Construct and compact true to grades and lines indicated on the Drawings and requirements as specified Section 02050 - Soils and Aggregates for Earthwork.
      b. Remove soft or unsuitable material to depth of not less than 6 inches below subgrade elevation and replace with satisfactory material.
   2. Forms and subgrade: Water immediately in advance of placing concrete.

3.03 INSTALLATION

A. Special techniques:
   1. Contractor's option:
      a. Construct concrete curbs and gutters by conventional use of forms, or by means of curb and gutter machine when acceptable to the Engineer.
      b. When use of machines designed specifically for work of this Section are accepted by the Engineer, results must be equal to or better than those produced by use of forms.
      c. Applicable requirements of construction that apply to use of forms also apply to use of machines.
      d. Discontinue use of machines when results are not satisfactory to the Engineer.

B. Forms:
   1. Carefully set to line and grade and securely stake in position forms conforming to dimensions of items to be constructed.
   2. Thoroughly clean prior to each use and coat with form releasing material.

C. Expansion and weakened-plane joints:
   1. Expansion joints:
      a. Construct vertically, and at right angles to centerline of street and match joints in adjacent pavement or sidewalks.
      b. Constructed at radius points, driveways, alley entrances, and at adjoining structures.
      c. Fill joints with expansion joint filler material.
   2. Weakened-plane joints:
      a. Construct as indicated on the Drawings.
      b. Match joint locations and details in adjacent curbs, gutters, and sidewalks.

D. Concrete:
   1. Placing:
      a. Thoroughly spade concrete away from forms so that no rock pockets exist next to forms and so that no coarse aggregate will show when forms are removed.
   2. Compacting:
      a. Compact by mechanical vibrators accepted by the Engineer.
      b. Continue tamping or vibrating until mortar flushes to surface and coarse aggregate is below concrete surface.

3. Form removal:
    a. Front form faces: Do not remove before concrete has taken initial set and has sufficient strength to carry its own weight.
    b. Gutter and rear forms: Do not remove until concrete has hardened sufficiently to prevent damage to edges. Take special care to prevent damage.
4. Finishing and curing: Comply with requirements as specified in Section 03366 - Tooled Concrete Finishing except as modified here:
    a. As soon as curb face forms are stripped, apply finishing mortar to the top and face of curb and trowel to a smooth, even finish. Finish with fine haired broom in direction of work.
    b. Where curb is installed without integral gutter, extend finish 2 inches below grade.
    c. Edge concrete at expansion joints to 1/4-inch radius.
    d. Flow lines of gutters shall be troweled smooth 4 inches out from curb face for integral curb and gutter and 4 inches on both sides of flowline for gutters without curbs.
    e. Sidewalks and ramps: Broom finish.

E. Backfilling:
1. Unless otherwise specified, backfill behind curbs, gutters, or sidewalks with soil native to area and to lines and grades indicated on the Drawings.

3.04 FIELD QUALITY CONTROL

A. Tests:
1. Curbs and gutters:
    a. Test face, top, back, and flow line with 10-foot straightedge or curve template longitudinally along surface.
    b. Correct deviations in excess of 1/4 inch.
2. Gutters:
    a. Frequency of testing: When required by the Engineer, where gutters have slope of 0.8 foot per 100 feet or less, or where unusual or special conditions cast doubt on capability of gutters to drain.
    b. Test method: Establish flow in length of gutter to be tested by supplying water from hydrant, tank truck, or other source.
    c. Required results:
        1) 1 hour after supply of water is shut off, inspect gutter for evidence of ponding or improper shape.
        2) In event water is found ponded in gutter to depth greater than 1/2 inch, or on adjacent asphalt pavement, correct defect or defects in manner acceptable to the Engineer without additional cost to the Contract.

3.05 ADJUSTING

A. Repair portions of concrete damaged while stripping forms or, when damage is severe, replace such work at no additional cost to the Contract. Evidence of repairs shall not be noticeable in the finished product.

B. Remove and replace sections of work deficient in depth or not conforming to requirements indicated on the Drawings and specified in the Specifications at no additional cost to the Contract. Removal and replacement shall be the complete section between 2 joints.

END OF SECTION

SECTION 02820

FENCES AND GATES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Fence, framework, fabric, and accessories.
   2. Excavation for post bases and concrete foundation for posts.
   3. Manual gates and related hardware.
   4. Gate operators.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. A121 - Standard Specification for Metallic-Coated Carbon Steel Barbed Wire.
   2. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   3. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   4. A385 - Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip).
   5. A392 - Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
   6. A702 - Standard Specification for Steel Fence Posts and Assemblies, Hot-Wrought.
   7. F626 - Standard Specification for Fence Fittings.
   8. F668 - Standard Specification for Polyvinyl Chloride (PVC) and Other Organic Polymer-Coated Steel Chain-Link Fence Fabric.
   9. F1043 - Standard Specification for Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework.
   10. F1184 - Standard Specification for Industrial and Commercial Horizontal Slide Gates.

B. State of California Department of Transportation (Caltrans).

C. Underwriters Laboratories, Inc. (UL):
   1. 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.

1.03 SUBMITTALS

A. Product data: Submit data completely describing products.

B. Shop drawings:
   1. Remote and automatic gates: Submit drawings showing connection details indicating methods and means of mounting, attaching, and installing operators and locks to gates, including wiring diagrams.

C. Samples: Provide for polyvinyl chloride coated fabric and accessories.

D. Quality control submittals:
   1. Certificates of compliance: Provide certification that materials conform to referenced specifications.
   2. Qualifications: Provide installer's references and list of local references.
   3. Manufacturer's instructions: Provide for gate operator equipment.

E. Contract closeout submittals:
   1. Operation and maintenance manuals: Provide for electrical and mechanical equipment.

1.04 QUALITY ASSURANCE

A. Pre-installation conference: Participate in conference, if required.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Storage and handling: Unload, store, and protect materials such that they are not damaged.

1.06 PROJECT CONDITIONS

A. Field measurements:
   1. Verify actual field distances so that post spacing can be made uniform.
   2. Verify and coordinate gate opening and column distances for driveway.

1.07 SEQUENCING AND SCHEDULING

A. Fences and gates: May be constructed at any time after earthwork, pipe work, and structures to which fence is related has been completed, but prior to erosion control application.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Chain link fence and gates: One of the following or equal:
   1. Allied Tube and Conduit.
   2. Master-Halco.

2.02 MATERIALS

A. Chain link fence:
   1. Fabric:
      a. Height:
         1) Plant fence: 6 feet 0 inch.
      b. Mesh: 2 inches.
      c. Size wire: 11 gauge:
         1) Coating: Zinc coating, ASTM A392, Class 1.
         2) Tensile strength: 80,000 pounds per square inch minimum.

2. Framework: In accordance with ASTM F1043 Group 1A or 1C. Pipe shall be straight and conform to the following weights:

Pipe Size Outside Diameter (Inches)	Group IA Weight (Lbs/ft)	Group IC Weight (Lbs/ft)
1-5/8	2.27	1.84
1-7/8	2.72	2.28
2-3/8	3.65	3.12
2-7/8	5.79	4.64
3-1/2	7.58	5.71
4	9.11	6.56
6-5/8	18.97	-
8-5/8	24.70	-

   a. Top rail:
      1) Size: 1-5/8 inches outside diameter.
      2) Tension wire: 7-gauge galvanized coil spring wire.
   b. Bottom rail:
      1) Size: 1-5/8 inches outside diameter.
      2) Tension wire: 7-gauge galvanized coil spring wire.
   c. Line posts:
      1) Size: 1-7/8-inch outside diameter.
   d. Terminal, corner, and pull posts:
      1) Size: 2-7/8-inch outside diameter.
   e. Coatings:
      1) Group IA: External coatings in accordance with ASTM F1043 Type A; internal coatings in accordance with ASTM F1043 Type A.
      2) Group IC: External coatings in accordance with ASTM F1043 Type B; internal coatings in accordance with ASTM F1043 Type D.

3. Accessories:
   a. Fence fittings: In accordance with ASTM F626:
      1) Post top fittings:
         a) Provide post caps that fit snugly over posts to exclude moisture. Provide dome style caps for terminal posts and loop style caps for line posts.
      2) Rail and brace ends: Provide pressed steel or malleable castings that are cup shaped to receive rail and brace ends.
   b. Fabric accessories:
      1) Wire clips: Minimum 6 gauge hot-dip galvanized.
      2) Tension bars: 1/4 inch by 3/4 inch, galvanized.
      3) Steel bands: 11 gauge, 1 inch wide, hot-dip galvanized.
      4) Bolts and nuts: 3/8-inch diameter.
      5) Hog rings: 11 gauge.

B. Chain link and barbed wire gates:
   1. Gate posts and concrete foundations for gate posts: Except where differently indicated on the Drawings, determine gate posts and concrete foundations for gate posts in accordance with following schedule:

Gate Leaf Widths (Feet)	Gate Posts	Foundations	
	Post O.D. ASTM F1043 Group IA or IC (Inches)	Diameter (Inches)	Depth (Feet)
0 to 6	2-7/8	12	4
Over 6 to 13	4	18	4
Over 13 to 18	6-5/8 (Group IA)	18	4
Over 18 to 25	8-5/8 (Group IA)	18	4.5

   2. Chain link gates:
      a. Frames and center supports: 1-7/8-inch outside diameter galvanized steel pipe that in accordance with ASTM F1043 Group IA or IC.
      b. Gate accessories:
         1) Post top fittings:
            a) Provide post caps that fit snugly over posts to exclude moisture.
            b) Provide dome style caps for terminal posts and loop style caps for line posts.
         2) Corner fittings: Heavy pressed steel or malleable castings.
         3) Gate tensioning:
            a) Cross tensioning rods: 3/8 inch, galvanized.
            b) Turnbuckles: Heavy duty.
         4) Tension rods for 4-foot gates: 3/8 inch, easily adjustable, galvanized.
         5) Gate frame corner fittings: Fitting designed for purpose, Manufacturer's standard.
         6) Horizontal gate stiffeners: 1-5/8-inch outside diameter galvanized steel pipe that in accordance with ASTM F1043 Group IA or IC.
         7) Gate hardware:
            a) Catch and locking attachment: Combination steel or malleable iron catch and locking attachment of acceptable design.
            b) Stops:
               (1) Type 1: Capable of holding gates open.
               (2) Type 2: Center rest with catch.
            c) Color: Match color of fabric.

C. Barbed wire gates:
   1. Frame: 1-3/8-inch outside diameter tubular steel, galvanized.
   2. Center support: 7/8 inch outside diameter tubular steel, galvanized.
   3. Filler wire: 11 gauge.
   4. Wire clamps: Wire T-clamps, galvanized.
   5. Hardware: Suitable hinges and latches.
   6. Padlocks: 1-1/2-inch minimum galvanized. Key padlocks alike.
   7. Chain:
      a. Links: Hardened steel, minimum 1-3/8 inches long, minimum 3/16-inch diameter links.
      b. Length: Sufficient to padlock 2 gates together.

2.03 FABRICATION

A. Shop finishing:
   1. Galvanizing: For items not fabricated of galvanized materials hot-dip galvanize products after fabrication in accordance with following as applicable:
      a. ASTM A123.
      b. ASTM A153.
      c. ASTM A385.
   2. Mark galvanized products with name of galvanize, applicable ASTM designation, and weight of zinc coating.
   3. Galvanize fabricated items complete, or in largest practicable sections.
   4. Provide galvanizing at rate of 2.0 ounces per square foot, minimum.
   5. Hardware:
      a. Padlocks: Cadmium plated.
      b. Chain: Galvanized.

B. Finish schedule:
   1. Ferrous metal:
      a. Typical: Clean, then hot-dip galvanize in accordance with galvanizing standards.

C. Field finish touch-up painting:
   1. Galvanized repair paint: Apply paint having minimum dry film thickness of 2.0 to 3.5 mils.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Verify field conditions prior to construction.

3.02 PREPARATION

A. Surface preparation:
   1. Before locating fence posts grade ground to permit grade of fence to remain constant over any local elevations or depressions in ground line.

3.03 INSTALLATION

A. Chain link fences and gates:
   1. General:
      a. Install chain link fence and gates as indicated on the Drawings and specified in this Section.
      b. Provide fence systems that are plumb, taut, true to line and grade, and complete in details.
      c. Install fencing to generally follow finish grade of ground and provide pull posts at points where required to conform to change in grade.
      d. Install fencing such that space between bottom of fence and finish ground line does not exceed 3 inches.

2. Concrete foundation for fence posts:
    a. Set fence posts in concrete foundations, that extend at least 3 feet into ground, and space posts not over 10 feet apart.
    b. Provide concrete foundations having minimum of 10 inches in diameter for line posts and 12 inches in diameter for corners and gates.
    c. Provide foundations that extend minimum of 1 inch above finish grade and have tops that are shaped to slope to drain away from posts.
    d. Trowel finish tops of footings, and slope or dome to direct water away from posts.
    e. Set keepers, stops, sleeves, tracks, eye bolts, and other accessories into concrete as required.
    f. Wheel rolling area for sliding gates shall be steel-trowel smooth finish concrete.
3. Post bracing:
    a. End corner, pull, and gate posts: Brace with same material as top rail and trussed to line posts with 3/8-inch rods and tighteners.
    b. Bracing end, corner, slope, and gate posts:
        1) Brace to midpoint of nearest line post or posts with horizontal braces used as compression members.
        2) Then from such line posts truss from brace back to bottom of end, corner, slope, or gate post with 3/8-inch steel truss rods with turnbuckles or other suitable tightening devices used as tension members.
4. Top rail:
    a. Unless otherwise specified or indicated on the Drawings, install fencing with top rail and bottom tension wire.
5. Fabric:
    a. Place fabric on outward facing side of the posts and install so that top edge projects over top rail of fence.
    b. Stretch fabric taut and securely fasten to posts, top rail, and bottom tension wire.
    c. Install tension wire parallel to line of fabric.
    d. Fabric: Connect fabric to:
        1) Line posts with wire clips minimum every 14 inches.
        2) Terminal, corner, and gate posts with tension bars tied to posts minimum 14 inches on center and with steel bands and bolts and nuts.
        3) Tension wires with hog rings minimum 24 inches on center.
6. Post top fittings: Provide post tops with extension arms.
7. Swing gates:
    a. Provide chain link fencing with swing gates, unless otherwise indicated on the Drawings or specified in this Section.
    b. Provide swing chain link gates where indicated on the Drawings.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's field service:
    1. Manufacturer shall check and test powered gates and accessories before acceptance.

2. Test gate operator through 10 full cycles and adjust operation without binding, scraping, or uneven motion.
3. Test limit switches for proper “at rest” gate position.

3.05 ADJUSTING

A. Adjust gate travel, stops, and operator position to meet field conditions.

3.06 CLEANING

A. Clean up surplus dirt, concrete, and other waste material and dress grade up upon completion of the work.

3.07 PROTECTION

A. Protect installed fences and gates against damage and, if damaged, repair prior to final acceptance.

END OF SECTION

SECTION 02939

SEEDING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes seeding.

1.02 REFERENCES

A. Association of Official Seed Analysts (AOSA).

B. United States Department of Agriculture (USDA).

C. United States Environment Protection Agency (EPA).

1.03 DEFINITIONS

A. Duff layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

B. Finish grade: Elevation of finished surface of planting soil.

C. Manufactured topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

F. Planting soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

H. Surface soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.04 SUBMITTALS

A. Product data: For each type of product indicated:
   1. Pesticides and herbicides: Include product label and manufacturer's application instructions specific to this Project.
   2. Fertilizer and organic matter: Include product label and manufacturer's application instructions specific to this Project.
   3. Soil amendment: Analysis.

B. Certification of grass seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
   1. Certification and inspection as required by governmental authorities of each seed mixture. Include identification of source and name and telephone number of supplier.

C. Qualification data: For qualified landscape Installer.

D. Samples: Imported topsoil, organic matter, erosion control blanket and mulch.

E. Product certificates: For soil amendments and fertilizers, from manufacturer.

F. Maintenance instructions: Recommended procedures to be established by Owner for maintenance of turf and meadows during a calendar year. Submit before expiration of required initial maintenance periods.

1.05 QUALITY ASSURANCE

A. Installer qualifications: A qualified landscape Installer whose work has resulted in successful turf and meadow establishment.
   1. Professional membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
   2. Experience: 5 years' successful experience in the installation of seeded areas similar in size to this project.
   3. Installer's field supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
   4. Personnel certifications: Installer's field supervisor shall have certification in all of the following categories from the Professional Landcare Network:
      a. Certified Landscape Technician - Exterior, with installation and irrigation specialty area(s).
   5. Maintenance proximity: Not more than 2 hours' normal travel time from Installer's place of business to Project site.
   6. Pesticide applicator: State licensed, commercial.

B. Soil-testing laboratory qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.

C. Soil analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil. Refer to plan notes for number and location of soil analysis tests.
   1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
   2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Engineer.
      a. A minimum of 3 representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
   3. Report suitability of tested soil for turf growth:
      a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated.
         1) State recommendations in weight per 1,000 square feet or volume per cubic yard for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
      b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

D. Pre-installation conference: Conduct conference at project site.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Seed and other packaged materials:
   1. Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.
   2. Protect seed during delivery and storage.
   3. Seed that has become wet or otherwise damaged will not be acceptable.

B. Deliver packaged materials in waterproof bags showing weight, chemical analysis and name or trademark of manufacturer.
   1. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, percentage of purity (PLS), percentage of germination and location of packaging.

C. Local sourcing of seed not in sealed containers is permitted for smaller projects.

D. Label seed bags per variety.

E. Store materials in protected and covered storage until application or use.

F. Bulk materials:
   1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

G. Truck receipts: For verification of all soil amendments and imported topsoil.

H. Hydroseeding:
1. Ensure that seed packages are packed to provide adequate protection against injury during transit.
2. Deliver undamaged sealed seed bags with legible labels showing weight, analysis, vendor's name and address, and point of origin.
   a. Label seed bags per variety.
3. Deliver dry commercial process or packaging, such as fertilizer, in undisturbed original unopened containers with legible labels showing the manufacturer's guaranteed analysis or description.
4. Inspect materials and packages upon delivery.
   a. Discard damaged packages or containers immediately.
5. Store materials in protected and covered storage until application or use.

1.07 WARRANTY

A. Warranty:
1. Guarantee all seeding to be alive and healthy for 2 years following date of final completion by the Engineer.
2. Seeded areas shall have an even stand of grass with germination, over 100 percent of the site within 45 days of seeding.
3. All seeded grass areas are to be ensured of obtaining a satisfactory stand of growth.
4. The total area occupied by bare spots larger than 0.25 square feet must not exceed 10 percent of the total seeded area.
5. Maximum single bare spot size of irrigated seed 3 inches by 3 inches.
6. Maximum single bare spot size of non-irrigated seed is 1 square foot.
7. All seeded grass areas which do not meet the satisfactory stand of growth qualification shall be reseeded and mulched.

B. Replace seeding when it is no longer in a satisfactory condition or do not meet the preceding standard as determined by the Engineer or the duration of the Guarantee/Warranty Period.
1. Make replacements as soon as possible within the recommended seeding schedule.

C. Replacements:
1. Seed of same mix, quality and species as originally specified, as soon as possible within the recommended seeding schedule, with a new 1-year warranty commencing on date of replacement.
2. Repairs and replacements shall be made at no expense to the Owner.

PART 2 PRODUCTS

2.01 STAKES

A. Softwood lumber, chisel pointed.

2.02 SOIL AMENDMENTS AND FERTILIZERS

A. Apply soil amendments and fertilizer as indicated on the Drawings.

B. Submit soil amendment and fertilizer recommendations, along with supporting soil test analysis, for Engineer approval prior to application on the site.

C. Fertilizer:
   1. Uniform in composition, free flowing and suitable for application with approved equipment, of the proportions necessary to eliminate any deficiencies of topsoil, as indicated in analysis.
   2. Delivered to the site fully labeled according to applicable laws.
   3. Packaging: Display the name, tradename, trademark and warranty of the provider.

D. Fertilizer grade description format:
   1. Three sets of 2-digit numbers.
   2. Numbers represent the percent by weight of nutrients.
   3. First number is the amount of nitrogen (N).
   4. Second number is the amount of phosphate (P2O5).
   5. Third number is the amount of potash (K2O).
   6. Example: 10 10 10.

2.03 HERBICIDE AND PESTICIDE

A. Submit labels for Engineer approval.

B. Pesticides:
   1. Registered and approved by EPA.
   2. Acceptable to authorities having jurisdiction.
   3. Type recommended by manufacturer for each specific problem.
   4. As required for Project conditions and application.
   5. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

C. Pre-emergent herbicide (Selective and Non-Selective):
   1. Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

D. Post-emergent herbicide (Selective and Non-Selective):
   1. Effective for controlling weed growth that has already germinated.

2.04 WATER

A. Use potable water for making up seed mixture.

B. Plant effluent may be used for hydroseeding watering, as specified in this Section.

2.05 SOILS

A. Topsoil:
   1. Fertile soil, typical for locality, capable of sustaining vigorous plant growth.
   2. Taken from drained site.
   3. Free of subsoil, stones more than 1 inch in diameter, clay clumps, or impurities, plants weeds and roots.
   4. Organic content:
      a. Minimum 2 percent by mass.
   5. pH value:
      a. Minimum: 5.5.
      b. Maximum: 7.5.

2.06 SEED

A. Provide seed as indicated on the Drawings.

B. Packaging: Provide separate bags or containers for each variety of seed.

C. Plant seed that is appropriate for planting season.

D. Provide seed from tested lots and delivered to project site in standard containers labeled as required by U.S. Department of Agriculture regulations and applicable state regulations.

E. Use labels that show variety of strain of seed, degree of purity (percent), rate of germination (percent), weed content (percent), and date of test.

F. Grass seed:
   1. Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.
   2. Species: Match existing grass type or Selected by Owner.
   3. Seed mixture:
      a. Germination minimum: 95 percent.
      b. Pure seed minimum: 85 percent.
      c. Weed seed maximum: 0.5 percent.
      d. Other than grass seed, non-viable seed, chaff, hulls, live seed of crop plants (other than those specified), harmless inert matter, and maximum: 18 percent.
   4. Proprietary seed mix: Western Native Seed near Salida, CO.

G. Buffalo grass mix:
      a. Common name: "Topgun" or "Texoka" seed.
      b. Drill rate: 90 pounds of seed per acre (2 pounds 100 feet square).

c. Timing: April 1 - September 1.
d. Cannot be hydro-mulched.
1) Areas susceptible to erosion: Cover drilled seeded area with hydro-mulched fiber.

H. Wildflower seed:
1. Wildflower seed mix from latest crop.
2. Seed mixture:
a. Pure live seed content minimum: 80 percent.
3. Seed testing maximum: 6 months from planting date.
a. Do not use seed mix after expiration date.
4. Seeding rate:
a. Lupinus luteus: 8 pounds per acre.
b. Eschscholtzia Californica: 1.9 pounds per acre.
c. Gazania Splendeus: 12 pounds per acre.
d. Clarkia Amoena: 4.5 pounds per acre.
e. Lasthenia Glabrata: 4 pounds per acre.
f. Achillea Borealis: 3 pounds per acre.
g. Stipa Pulchrum: 3 pounds per acre.
h. Gilia Capitata: 6 pounds per acre.
i. Festuca Idahoeasis: 4 pounds per acre.

I. Erosion control seed:
1. Erosion control seed mix from latest crop.
2. Seed mixture:
3. Pure live seed content minimum: 80 percent.
4. Seed testing maximum: 6 months from planting date.
a. Do not use seed mix after expiration date.
5. Seeding rate:
a. Blando Brome: 20 pounds per acre.
b. Annual Rye: 25 pounds per acre.
c. Rose Clover: 20 pounds per acre.
d. Zorro Annual Fescue: 10 pounds per acre.

2.07 MULCHES

A. As indicated on the Drawings.

B. Straw mulch:
1. Oats, barley, wheat, or rye only.
2. Free from weeds, foreign matter detrimental to plant life, and dry.
3. Minimum length 10 inches long: 50 percent of straw.
4. Not acceptable:
a. Hay or chopped cornstalks.
b. Old straw mulch which breaks during crimping.
c. Straw in such an advanced stage of decomposition as to smother or retard the normal growth of grass.

C. Wood cellulose fiber mulch:
1. Wood fibers must be capable of being evenly dispersed and suspended when agitated in water.

2. Furnish with a biodegradable green dye to allow visual metering of its application.
3. Not acceptable:
    a. Substance or factor which might inhibit germination or growth of grass seed, with organic tacifier.

2.08 HYDRO-MULCH

A. Hydro-mulch fiber:
    1. Manufacturers: The following or equal:
        a. Conwed "Hydro-mulch 2000 Fiber".
    2. Natural cellulose fiber mulch produced from grinding clean, whole wood chips, or fiber produced from ground newsprint.
    3. Mulch requirements:
        a. Moisture content: 10.0 percent.
        b. Organic matter: 99.2 percent + within 0.8 percent.
        c. Ash content maximum: 0.8 percent.
        d. pH: 4.8.
            1) Furnish with a biodegradable green dye which does not inhibit plant growth to allow visual metering of its application.
    4. Mulch shall be such that, when applied, the material shall form a strong, moisture-retaining mat without the need of an asphalt binder.

B. Hydro-mulch seed:
    1. Seeding:
        a. Mixture:
            1) Ratio of wood cellulose fiber, seeds, and fertilizer: 4:1:6 mixture.
                a) Fiber: 20 pounds.
                b) Seeds: 5 pounds.
                    (1) Modify mixture according to the planting season as follows:
                        (a) February through August: 20 pounds of hulled common Bermuda grass per acre.
                        (b) August through February: combination of 15 pounds of unhulled common Bermuda and 15 pounds of unhulled Gulf Coast Annual Rye seed per acre.
                c) Fertilizer: 30 pounds.
            2) Coverage: 1,000 square feet.
        b. Provide a recommendation for proposed mixture based on time of year hydro-mulch is actually performed.

C. Hydro-mulching equipment:
    1. Manufacturers: One of the following or equal:
        a. Bowie Industries, Inc.
        b. Reinco.
        c. Finn Equipment Co.
    2. Equipment requirements:
        a. Built-in agitation system sufficient to agitate, suspend, and homogeneously mix slurry containing fiber, fertilizers, chemicals, and seed mix.

b. Capable of slurry distribution line large enough to prevent stoppage.
c. Equipped with set of hydraulic spray nozzles which provide continuous non-fluctuating discharge of minimum 225 pounds per square inch at end of spray nozzle.

2.09 HYDROSEEDING MATERIALS

A. Seed mix:
1. Manufacturers: One of the following or equal:
a. Grass Growers.
b. Conwed Corp.
c. Eva Cell Co.
2. Seed mix from the latest crop.
3. Minimum pure live seed content to be 80 percent, and tested within the preceding 6 months.
4. Do not use seed mix after expiration date:
a. Blando Brome: 20 pounds per acre.
b. Annual Rye: 25 pounds per acre.
c. Rose Clover: 20 pounds per acre.
d. Zorro Annual Fescue: 10 pounds per acre.

B. Mulch:
1. Wood fiber manufactured for hydroseeding: Fiber mulch:
2. Manufacturers: One of the following or equal:
a. Grass Growers.
b. Conwed Corp., Fibers Div.
c. Eva Cell Co.

C. Water:
1. Use potable water for making up seed mixture.
2. Plant effluent may be used for hydroseed watering as specified in this Section.

D. Granular fertilizers:
1. Manufacturers: One of the following or equal:
a. Sierra Chemical Co.
b. Green Light Co., Wonder Grow Chemicals.
c. Kay-Fries Chemicals.
2. Fertilizer grade: 16-20-0.

2.10 EROSION CONTROL BLANKETS

A. As indicated on the Drawings.

B. Erosion control blanket:
1. Manufacturer: The following or equal:
a. American Excelsior Company, Curlex®.
2. Jute matting, open weave.
3. Regular blanket, machine produced mat of curled wood excelsior of 80 percent 6 inch or longer fiber length with a consistent width of fibers evenly distributed throughout mat.
4. Photo-biodegradable extruded plastic netting cover the top side of blanket.

5. Secure netting to wood excelsior by extra heavy lines of plastic woven into the width of each blanket.
6. Smolder resistant with no chemical additives.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
   2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
   3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
   4. Uniformly moisten excessively dry soil that is not workable, and which is too dusty.

B. Start of work covered in this Section constitutes Contractor's approval of all existing site conditions.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by the Engineer and replace with new planting soil.

3.02 SITE CONDITIONS

A. Planting restrictions: Plant during 1 of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date.
   1. Irrigated seed areas: Seed from ground thaw to July 31 and September 1 to October 15.
   2. Non-irrigated seed areas: Seed from March 15 to July 4 and September 1 to October 15.
   3. Pure Warm Season Grass Seed Areas: Seed from June 1 to August 15.
   4. Dormant Seeding Areas: Seed from October 15 to ground freeze.
   5. Per seed detail.

B. Coordinate with Contractor's work requiring access to site over existing vegetation areas.
   1. No trucking or moving of equipment or materials shall be permitted over completed seed areas.

C. Coordinate with installation of all underground system piping and outlets.

D. Weather limitations:
   1. Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained.
   2. Apply products during favorable weather conditions according to manufacturer's written instructions.

3.03 EXISTING VEGETATION RENOVATION

A. Renovate existing vegetation.

B. Renovate existing vegetation damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
   1. Reestablish vegetation where settlement or washouts occur or where minor regrading is required.
   2. Install topsoil as required.

C. Remove sod and vegetation from diseased or unsatisfactory vegetation areas; do not bury in soil.

D. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

E. Mow, dethatch, core aerate, and rake existing vegetation.

F. Prior to seeding, irrigate for a minimum of 2 weeks to allow germination of weed seeds.
   1. Apply Round-Up herbicide per manufacturer's specifications after germination of weed seeds and at least 2 weeks prior to seeding.
   2. Do not spray on a day when wind is detectable.
   3. Remove remaining vegetative matter.
   4. Repeat irrigation and herbicide application until no weeds are evident for 14 days after last herbicide application, as determined by the Engineer.

G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.

H. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

I. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches of existing soil.
   1. Install new planting soil to fill low spots and meet finish grades.

J. Apply seed and protect with hydro mulch as required for new vegetation.

K. Water newly planted areas and keep moist until new turf is established.

3.04 PREPARATION

A. Protect existing and new structures, fences, utilities, sidewalks, paving, curbs, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
   1. Protect adjacent and adjoining areas from hydromulching overspray.
   2. Protect grade stakes set by others until directed to remove them.
   3. Protect landscaping and other features remaining as final work.

B. Limit turf subgrade preparation to areas to be planted.

C. Newly graded subgrades:
   1. Loosen/scarify subgrade to a minimum depth of 6 inches.
   2. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
   3. Repeat cultivation in areas where equipment used for hauling and spreading topsoil has compacted the subgrade.
   4. Tolerances: Top of subgrade plus or minus 1 inch.

D. Prepare subgrade and eliminate uneven areas and low spots.
   1. Maintain lines, levels, profiles, and contours.
   2. Make changes in grade gradual. Blend slopes into level areas.

E. Do not prepare subgrade in areas of on-site plant preservation.

F. Do not bury foreign material beneath areas to be seeded.

G. Remove any contaminated subgrade.
   1. Apply superphosphate fertilizer directly to subgrade before loosening.
      a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
      b. Mix lime with dry soil before mixing fertilizer.
   2. Spread planting soil to a depth of 6 inches but not less than required to meet finish grades after light rolling and natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.
      a. Spread approximately 1/2 the thickness of planting soil over loosened subgrade. Mix thoroughly into top 4 inches of subgrade. Spread remainder of planting soil.
      b. Reduce elevation of planting soil to allow for soil thickness of sod.

H. Unchanged subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:
   1. Remove existing grass, vegetation, and turf.
      a. Do not mix into surface soil.
   2. Loosen surface soil to a depth of at least 6 inches.
      a. Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil.
      b. Apply superphosphate fertilizer directly to surface soil before loosening.

3. Remove stones larger than 1 inch in any dimension and sticks, roots, trash, and other extraneous matter.
4. Legally dispose of waste material, including contaminated soils, grass, vegetation, and turf, off Owner's property.

I. Finish grading:
1. Grade seeding areas to a smooth, uniform surface plane with loose, uniformly fine texture.
2. Grade to within plus or minus 1/2 inch of finish elevation.
3. Roll and rake, remove ridges, fill depressions to meet finish grades, and ensure positive surface drainage.
4. Maintain profiles and contour of subgrade.
5. Limit finish grading to areas that can be planted in the immediate future.

J. Rip topsoil that has been spread to a minimum depth of 8 inches in one direction using an agricultural ripper with tines spaced at no greater than 18 inches.
1. Areas adjacent to walks, structures, curbs, etc., where the use of large mechanical equipment is difficult, shall be worked with smaller equipment or by hand.

K. Manually spread topsoil close to plant materials and structures to prevent damage.

L. Spread amendments, as determined by the soil test results or indicated on the Drawings, over the entire area to be seeded and incorporate into the top 6 inches of soil by disking or rototilling until a uniform mixture is obtained with no pockets of soil or amendments remaining.

M. Restore fine grade with float drag to remove irregularities resulting from tilling operations.
1. Float drag or rake in 2 directions.
2. Remove any additional stones over 1 inch that have come to the surface.
3. Perform drainage test by applying water with the irrigation system.
4. Do not plant until the finished grade is reviewed by the Engineer.
5. This review does not reduce Contractor's responsibility to provide a finished product that drains.

N. Apply fertilizer, if necessary, after smooth raking of topsoil and prior to planting of seed.
1. Apply fertilizer at a rate as determined by the soil tests or indicated on the Drawings.
2. Do not apply fertilizer at same time or with same machine as will be used to apply seed.
3. Mix thoroughly into upper 6 to 8 inches of soil.

O. Lightly water to aid the dissipation of fertilizer.

P. Remove any additional stones over 1 inch that have come to the surface.

Q. Moisten prepared area before planting if soil is dry.
1. Water thoroughly and allow surface to dry before planting.
2. Do not create muddy soil.

R. Before planting, obtain Engineer’s acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

S. Tolerances: Top of topsoil plus or minus 1/2 inch.

3.05 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations.
   1. Coordinate applications with Owner's operations and others in proximity to the Work.
   2. Notify Owner before each application is performed.

B. Post-emergent herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written recommendations.

3.06 SEED

A. Preparation for seeding:
   1. Prior to seeding, if weeds exist, apply Round-Up herbicide per manufacturer's specifications after germination of weed seeds and at least 2 weeks prior to seeding.
   2. Do not spray on a day when wind is detectable.
   3. Remove remaining vegetative matter.
   4. Repeat herbicide application until no weeds are evident for 14 days after last herbicide application, as determined by the Engineer.

B. Drill seeding:
   1. Drill seed by means of a Brillion mechanical power-drawn drill seeders, or equal, to a maximum depth of 1/4-inch followed by packer wheels or drag chains to provide smooth finish.
   2. Seed at the rates given below.
   3. Seed in 2 passes at right angles to one another.
   4. Sow half the seed in each pass.
   5. Provide markers or other means to ensure that the successive seeded strips will overlap or be separated by a space no greater than the space between the rows planted by the equipment being used.
   6. Do not seed during windy weather.
   7. Restore fine grade after seeding as requested by the Engineer.
   8. Remove irregularities by hand raking or rolling.
   9. In areas inaccessible to a drill seeder, broadcast seed by hand in 2 opposite directions.
      a. Rake in seed after broadcasting.
      b. Do not broadcast seed during windy weather.
   10. Seeding rates:
      a. Seeding rates shall be as recommended by the seed supplier for drill seeded areas.
      b. Hand and broadcast seeded areas shall receive 2 times the seeding rate indicated.

11. Do not seed areas in excess of that which can be mulched on same day.
12. Do not sow immediately following rain, when ground is too dry, frozen, or during windy periods.
13. Roll seeded area with roller not exceeding 100 pounds.
14. Immediately following seeding and compacting, apply mulch.
15. Sow seed with spreader or seed drill machine.
    a. Do not broadcast or drop seed when wind velocity exceeds 5 miles per hour.
    b. Evenly distribute seed by sowing equal quantities in 2 directions at right angles to each other.
        1) Do not use wet seed or seed that is moldy or otherwise damaged.
        2) Do not seed against existing trees.
            a) Limit extent of seed to outside edge of planting saucer.
16. Sow seed at a total rate as recommended by the seed supplier.
17. For any Broadcast seeded areas rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.
18. Protect seeded areas with erosion-control mats where indicated on the Drawings; install and anchor according to manufacturer's written instructions.
19. In final preparations for seeding, use level board not less than 8 feet in length to ensure true and accurate grades.
20. Finish grade lawn areas to 2 inches below elevation of adjacent paving.
21. Do not take heavy objects, except lawn rollers, over areas that have been prepared for seeding.
22. Prior to seeding, Engineer shall accept areas for grade and compaction.

C. Seed establishment on slopes:
    1. Protect seeded areas with slopes and swales exceeding 1:4 with erosion-control blankets installed and stapled according to manufacturer's written instructions.
    2. Roll fabric onto slopes without stretching or pulling.
    3. Lay fabric smoothly on surface in direction of water flow.
    4. Bury top end of each section in 6-inch-deep excavated topsoil trench.
    5. Provide 6-inch overlap of adjacent rolls.
    6. Backfill trench and rake smooth, level with adjacent soil.
    7. Secure outside edges and overlaps at 24-inch intervals with stakes.
    8. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.
    9. For sides of ditches, lay fabric laps in direction of water flow.
    10. Lap ends and edges minimum 6 inches.

D. Satisfactory seed areas:
    1. Turf installations shall meet the following criteria as determined by the Engineer:
    2. Acceptance for soil preparation (topsoil installation) and final grading shall be given by the Engineer upon satisfactory completion of each section or area prior to seeding.
    3. Final completion for seeded areas shall be given by the Engineer as soon as there is an even stand of grass with germination over 100 percent of the site.
        a. Warranty:
            1) Guarantee all seeding to be alive and healthy for 2 years following date of final completion by the Engineer.

2) Seeded areas shall have an even stand of grass with germination, over 100 percent of the site within 45 days of seeding.
3) All seeded grass areas are to be ensured of obtaining a satisfactory stand of growth.
4) The total area occupied by bare spots larger than 0.25 square feet must not exceed 10 percent of the total seeded area.
5) Maximum single bare spot size of irrigated seed 3 inches by 3 inches.
6) Maximum single bare spot size of non-irrigated seed is 1 square foot.
7) All seeded grass areas which do not meet the satisfactory stand of growth qualification shall be reseeded and mulched.

b. Re-seed areas that in the opinion of the Engineer do not meet the preceding standards.

4. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

E. Seeded area maintenance:
1. Maintain and establish seeded area by watering, noxious weed management, mowing, trimming, replanting, and performing other operations as required to establish a healthy, viable seeded area.
2. Roll, regrade, and replant bare or eroded areas and remulch.
3. Provide materials and installation the same as those used in the original installation.
a. Fill in as necessary soil subsidence that may occur because of settling or other processes.
1) Replace materials and seeded area damaged or lost in areas of subsidence.
b. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
c. Apply treatments as required to keep seeded area and soil free of pests and pathogens or disease.
1) Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
4. Watering: Install and maintain temporary piping, hoses, and seeded area watering equipment to convey water from sources and to keep meadow uniformly moist.
5. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch.
a. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
6. Water meadow with fine spray at a minimum rate of 1/2 inch per week or more for seed establishment for 6 weeks after planting or until seed establishment is determined by the Engineer (whichever is longer) unless rainfall precipitation is adequate.

3.07 MULCH

A. Straw mulching:
   1. After seeding, apply 2 tons of small-grained straw per acre.
      a. Spread straw to give a 1/2 inch to 1-inch-thick layer of mulch (3 to 5 straws thick) and crimp in 2 to 3 inches with a mechanical crimper or other approved equipment.
   2. Hand crimping shall be employed in areas inaccessible to crimper, or where excessive slopes would cause unsatisfactory results.
   3. Crimping against the contour shall not be accepted.
   4. Apply water and tackifier with a fine spray immediately after each area has been mulched.
      a. Saturate to 4 inches of soil.

3.08 HYDRO-MULCH

A. Hydromulching:
   1. Hydromulch all dormant seeded areas with a slurry mix containing additional tacifier.
   2. Utilize hydraulic equipment with nozzle adapted for hydraulic mulching with storage tanks having means of estimating volume used or remaining in the tank.
   3. Hydromulch shall consist of tacifier applied at a rate of 100 pounds per acre and a cellulose fiber mulch mixed to form a homogeneous slurry; spray applied to seeded area at a rate of 2,200 pounds per acre.
      a. Hydromulch applied to dormant seeded areas shall consist of tacifier applied at a rate of 150 pounds per acre and a cellulose fiber mulch mixed to form a homogeneous slurry; spray applied to seeded area at a rate of 2,200 pounds per acre.
   4. Protect seeded areas with slopes not exceeding 1:4 by spreading straw mulch.
      a. Spread uniformly at a minimum rate of 2 tons per acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas.
      b. Spread by hand, blower, or other suitable equipment.
         1) Anchor straw mulch by crimping into soil with suitable mechanical equipment.
         2) Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gallons per 1,000 square feet.
            a) Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas.
            b) Immediately clean damaged or stained areas.
   5. Protect seeded areas from hot, dry weather or drying winds by applying hydro mulch and tackifier within 24 hours after completing seeding operations.
      a. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch and roll surface smooth.

3.09 HYDROSEED

A. Installation:
   1. Surface preparation:
      a. Area to be hydroseeded to be weed free and have a firm seed bed which has previously been roughened by scarifying, disking, harrowing, chiseling, or otherwise worked to a depth of 2 to 4 inches.
      b. Do not use any implements that will create an excessive amount of downward movement or clods on sloping areas.
      c. Hydroseed bed may be prepared at time of completion of earth-moving work.
   2. Application:
      a. Mark test plots to calibrate equipment and rate of vehicle.
         1) Continue test operations until satisfied with performance of even, smooth application.
      b. Apply seed with wood cellulose fiber at 500 pounds per acre.
         1) Do not allow seed to stay within slurry longer than 30 minutes.
      c. Immediately after seeding, apply wood fiber mulch at 3,000 pounds per acre with a tackifier adhesive at 75 pounds per acre.
         1) Mixture to be sufficient green in color to determine coverage.
         2) Use nontoxic dye that is water-soluble.
      d. Foot traffic on hydroseed is not permitted.
   3. Slurry preparation:
      a. Prepare slurry at project site, using potable water.
         1) Plant effluent is acceptable.
      b. Dispose of any slurry that has not been used within 2 hours at a location off-site at Contractor’s expense.

B. Hydroseed watering:
   1. Provide temporary watering system or apply water with a water truck acceptable to Engineer.
      a. Plant effluent may be used for hydroseed watering.
      b. Do not place irrigation lines on top of embankment slope.
   2. Germination stage:
      a. Initiate watering sequence within 24 hours after hydromulching planted areas. Leave water on long enough to moisten soil thoroughly to a depth of the fiber, taking care not to supersaturate or wash fiber or soil particles off the slopes. Observe irrigation system continually while in operation.
      b. Contractor to repair all seed washing or erosion immediately.
      c. Irrigate fiber and seed lightly and frequently to maintain optimum moisture content for maximum germination. Determine irrigation sequence according to air temperature, prevailing wind velocity, soil texture, orientation, and other logistical problems.
      d. Keep soil moist at all times during germination period. Continue irrigation sequence until seedlings have grown beyond the germination stage, approximately 30 to 60 days.
   3. Establishment stage:
      a. Reduce watering frequency while increasing duration of the water sufficiently to allow for maximum water penetration for the expanding root system. Take care not to cause erosion.
      b. Precise watering reduction program to be determined by Contractor.

4. Hardening-off stage:
    a. Reduce irrigation frequency while increasing the duration of each water cycle.
    b. A specific watering program to be approved by Owner.

C. Hydroseed fertilizer:
1. Distributed uniformly over seed bed and incorporated into the soil. Incorporation may be part of the seed bed preparation or as part of the seeding operation, unless seed is broadcast.
    a. If fertilizing is a part of the seed bed preparation, do not fertilize more than 15 days prior to seeding.
2. Apply fertilizer at 250 pounds per acre.

D. Hydroseed mowing:
1. Contractor to mow seeded areas prior to spring germination.

E. Hydroseed maintenance:
1. Maintain hydroseed areas for 1 year following final acceptance.
2. Maintenance involves watering, mowing, and any other activities required to establish and maintain the ground cover.

3.10 EROSION CONTROL BLANKETS

A. Preparation for erosion-control materials:
1. Install erosion-control materials in accordance with manufacturers recommendations.
2. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions.
    a. Fasten as recommended by material manufacturer.
3. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
4. Erosion control hydroseeding to be applied to all exterior slopes of the sludge and scum bed dikes, and to the interior slopes of the stormwater retention basin, as indicated on the Drawings.
    a. Hydroseeding shall be the last activity conducted by Contractor prior to project acceptance.
5. Moisten prepared area before planting if surface is dry.
6. Water thoroughly and allow surface to dry before planting.
7. Do not create muddy soil.

3.11 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas.
1. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect temporary fencing or barricades and warning signs as required to protect newly seeded areas from traffic.
1. Maintain fencing and barricades throughout initial seed establishment.

C. Remove nondegradable erosion-control measures after grass establishment period.

D. During landscape installation:
   1. All areas shall be reasonably clean at the end of each workday.
   2. Sidewalks and other paved areas shall be swept or washed down as needed.

E. Project completion:
   1. All debris, soil, and trash resulting from landscape operations shall be removed from the site.
   2. All paved areas shall be washed down.

END OF SECTION

SECTION 02952

PAVEMENT RESTORATION AND REHABILITATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Resurfacing roads and paved surfaces in which surface is removed or damaged by installation of new work.

1.02 SUBMITTALS

A. Mix designs:
   1. Prior to placement of asphalt concrete, submit full details, including design and calculations for the asphalt concrete mix proposed.
   2. Submit gradation of aggregate base.
   3. Submit proposed mix design of portland cement concrete.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Performance requirements:
   1. Limiting dimensions:
      a. Determine the exact lengths and dimensions of such roads, pavements, parking areas, and walks that will require removal and replacement for new work.
      b. Join existing surfaces to terminals of new surfacing in smooth juncture.

2.02 MATERIALS

A. Aggregate base course: As specified in Section 02050 - Soil and for Earthwork.

B. Asphalt pavement: As specified in Section 02742A - Asphaltic Concrete Paving (CA).

C. Portland cement concrete replacement material: Class A concrete as specified in Section 03300 - Cast-in-Place Concrete.

2.03 EQUIPMENT

A. Roads, pavements, parking areas, and walks:
   1. Equipment requirements: Good condition, capable of performing work intended in satisfactory manner.

2.04 ACCESSORIES

A. Material for painting asphalt concrete pavement: Tack coat as specified in Section 02742A - Asphaltic Concrete Paving (CA).

PART 3 EXECUTION

3.01 INSTALLATION

A. Aggregate surface removal replacement:
   1. When trench cut is in aggregate surfaced areas, replace aggregate base course material with material matching existing material compacted to 95 percent of its maximum density.

B. Pavement removal and temporary asphalt replacement:
   1. Install temporary asphalt pavement or first course of permanent pavement replacement immediately following backfilling and compaction of trenches that have been cut through existing pavement.
   2. Except as otherwise provided, maintain this temporary pavement in safe and reasonably smooth condition until required permanent pavement is installed.
   3. Remove and dispose of temporary paving from project site.
   4. Where longitudinal trench is partly in pavement, replace pavement to original pavement edge, on a straight line, parallel to centerline of roadway.
   5. Where no part of longitudinal trench is in pavement, surfacing replacement shall only be required where existing surfacing materials have been removed.

C. Asphalt pavement replacement:
   1. Replace asphalt pavement to same thickness as adjacent pavement and match as nearly as possible adjacent pavement in texture, unless otherwise indicated on the Drawings.
   2. Cut existing asphalt pavements to be removed for trenches or other underground construction by wheel cutter, clay spade, or other device capable of making neat, reasonably straight and smooth cut without damaging adjacent pavement. Cutting device operation shall be subject to acceptance of Engineer.
   3. Cut and trim existing pavement after placement of required aggregate base course and just prior to placement of asphalt concrete for pavement replacement, and paint trimmed edges with material for painting asphalt concrete pavement immediately prior to constructing new abutting asphalt pavements. No extra payment will be made for these items, and costs incurred in performing this work shall be incidental to pipe laying or pavement replacement.
   4. Conform replacement of asphalt pavement to contour of original pavement.

D. Portland cement concrete pavement replacement:
   1. Where trenches lie within portland cement concrete section of streets, alleys, sidewalks, and similar concrete construction, saw cut such concrete (to a depth of not less than 1-1/2 inches) to neat, vertical, true lines in such manner adjoining surfaces are not damaged.

2. Place portland cement concrete replacement material to dimension as indicated on the Drawings.
3. Provide expansion joints that match existing.
4. Before placing replacement concrete, thoroughly clean edges of existing pavement and wash with neat cement and water.
5. Surface finish: Wood float finish.

E. Curb, gutter, and sidewalk replacement:
1. Where any concrete curb, gutter, or sidewalk has been removed or displaced, replace to nearest construction joints with new Class A curb, gutter, or sidewalk to same dimensions and finish as original construction that was removed:
a. Provide expansion joints of same spacing and thickness as original construction.

F. Asphalt pavements:
1. Trim existing asphalt pavements which are to be matched by pavement widening or pavement extension to neat true line with straight vertical edges free from irregularities with saw specifically designed for this purpose. Minimum allowable depth of cut shall be 1-1/2 inches.
2. Cut and trim existing pavement after placement of required aggregate base course and just prior to placement of asphalt concrete for pavement widening or extension, and paint trimmed edges with material for painting asphalt concrete pavement immediately prior to constructing new abutting asphalt concrete pavements.
3. No extra payment will be made for these items and costs incurred in performing this work shall be incidental to widening or pavement extension.

3.02 FIELD QUALITY CONTROL

A. Tests:
1. Asphalt concrete as specified in Section 02742A - Asphaltic Concrete Paving (CA).
2. Concrete as specified in Section 03300 - Cast-in-Place Concrete.

B. Inspection:
1. Asphalt concrete:
a. Lay 10-foot straightedge parallel to centerline of trench when the trenches run parallel to street, and across pavement replacement when trench crosses street at angle.
b. Remove and correct any deviation in cut pavement replacement greater than 1/4 inch in 10 feet.
2. Portland cement concrete replacement pavement:
a. Lay 10-foot straightedge either across pavement replacement or longitudinal with centerline of gutter or ditch.
b. Remove and correct any deviation in cut pavement replacement greater than 1/4 inch in 10 feet.

END OF SECTION

SECTION 03055

ADHESIVE-BONDED REINFORCING BARS AND ALL THREAD RODS IN CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Bonding reinforcing bars and all thread rods in concrete using adhesives.

1.02 REFERENCES

A. American Concrete Institute (ACI).
   1. 355.4 - Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary.

B. American National Standards Institute (ANSI):
   1. Standard B212.15 - Carbide Tipped Masonry Drills and Blanks for Carbide Tipped Masonry Drills.

C. ASTM international (ASTM):
   1. C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

D. Concrete Reinforcing Steel Institute (CRSI).

E. ICC Evaluation Service, Inc. (ICC-ES):
   1. AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.

F. Society for Protective Coatings (SSPC):
   1. SP-1 - Solvent Cleaning.

1.03 DEFINITIONS

A. Evaluation Service Report (ESR): Report prepared by ICC-ES, or other testing agency acceptable to Engineer and to the Building Official, that documents testing and review of a product to confirm that it complies with the requirements of designated ICC-ES Acceptance Criteria, and to document its acceptance for use under the Building Code specified in Section 01410 - Regulatory Requirements.

1.04 SUBMITTALS

A. Product data: Technical data for adhesives, including:
   1. Manufacturer's printed installation instructions (MPII).
   2. Independent laboratory test results indicating allowable loads in tension and shear for concrete of the types included in this Work, with load modification

factors for temperature, spacing, edge distance, and other installation variables.
3. Handling and storage instructions.

B. Quality control submittals:
1. Special inspection: Detailed step-by-step instructions for the special inspection procedures required by the building code specified in Section 01410 - Regulatory Requirements.
2. For each adhesive to be used, Evaluation Report confirming that the product complies with the requirements of AC308 for both un-cracked and cracked concrete and for use in Seismic Design Categories A through F.
3. Installer qualifications:
a. Submit evidence of successful completion of adhesive manufacturer's installation training program.
b. Submit evidence of current certification for installation of inclined and overhead anchors under sustained tension loading.

C. Inspection and testing reports:
1. Inspections: Field quality control: Reports of inspections and tests.
a. Inspections: Field quality assurance: Reports of special inspections and tests.

1.05 QUALITY ASSURANCE

A. Qualifications:
1. Installation requirements:
a. Have available at the site, and install anchors in accordance with, the adhesive manufacturer's printed installation instructions.
2. Installer qualifications:
a. Demonstrating successful completion of adhesive manufacturer's on-site training program for installation of adhesive-bonded anchors.
b. Holding current certification for installation of adhesive-bonded anchors by a qualified organization acceptable to the Engineer and to the Building Official.
1) Organizations/certification programs deemed to be qualified are:
a) ACI-CRSI Adhesive Anchor Installer Certification Program.
b) Adhesive anchor manufacturer's certification program, subject to acceptance by the Engineer and the Building Official.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store and protect products as follows, unless more restrictive requirements are recommended by the manufacturer:
1. Store adhesives and adhesive components on pallets or shelving in a covered-storage area protected from weather.
2. Control temperature to maintain storage within manufacturer's recommended temperature range.
a. If products have been stored at temperatures outside manufacturer's recommended range, test by methods acceptable to the Engineer to confirm acceptability before installing in the Work.
3. Dispose of products that have passed their expiration date.

1.07 PROJECT CONDITIONS

A. As specified in Section 01850 - Design Criteria.

B. Seismic Design Category (SDC) for structures: As indicated on the Drawings.

PART 2 PRODUCTS

2.01 GENERAL

A. Like items of materials: Use end products of one manufacturer in order to achieve structural compatibility and singular responsibility.

B. Adhesives shall have a current Evaluation Report documenting testing and compliance with the requirements or ACI 355.4 and of ICC-ES AC308 for use with un-cracked concrete and with cracked concrete in the Seismic Design Category specified.

C. Bond reinforcing bars and all thread rods in concrete using epoxy adhesive unless other adhesives specified are specifically indicated on the Drawings or approved in writing by the Engineer.

2.02 EPOXY ADHESIVE

A. Materials:
   1. Meeting the physical requirements of ASTM C881, Type IV, Grade 3, Class B or C depending on site conditions.
   2. 2-component, 100 percent solids, insensitive to moisture.
   3. Cure temperature, pot life, and workability: Compatible with intended use and environmental conditions.

B. Packaging:
   1. Disposable, self-contained cartridge system furnished in side-by-side cartridges designed to fit into a manually or pneumatically operated caulking gun, and with resin and hardener components isolated until mixing through manufacturer's static mixing nozzle.
      a. Nozzle designed to dispense components in the proper ratio and to thoroughly blend the components for injection from the nozzle directly into prepared hole.
      b. Provide nozzle extensions as required to allow full-depth insertion and filing from the bottom of the hole.
   2. Container markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

C. Manufacturers: One of the following or equal:
   1. Hilti, Inc., HIT-RE 500-V3.
   2. Simpson Strong-Tie Co., Inc., SET-XP.

2.03 ALL THREAD RODS

A. Materials: As specified in Section 05120 - Structural Steel Framing for rods, nuts, and washers.

2.04 REINFORCING BARS

A. As specified in Section 03200 - Concrete Reinforcing.

PART 3 EXECUTION

3.01 GENERAL

A. Execution of this work is restricted to installers who have personally completed the adhesive manufacturer's on-site training for the products to be installed, and who are personally certified through a qualified certification program described under Quality Assurance and accepted by the Engineer and the Building Official.
   1. Do not install holes or adhesive until training is complete.

B. Perform work in strict compliance with the accepted MPII and the following instructions. Where the accepted MPII and the instructions conflict, the MPII shall prevail.

C. Install reinforcing bars and all thread rods to embedment depth, and at spacing and locations indicated on the Drawings.
   1. If embedment depth is not indicated, contact Engineer for requirements.
   2. Do not install adhesive-bonded all thread rods or reinforcing bars in upwardly inclined or overhead applications unless accepted in advance by Engineer.

3.02 PREPARATION

A. Do not begin installation of adhesive bonded anchors until:
   1. Concrete has achieved an age of at least 21 days after placement.
   2. On-site training in installation of adhesive bonded anchors by manufacturer's technical representative is complete. Do not drill holes in concrete or install adhesive and embeds in holes.

B. Review manufacturer's printed installation instructions (MPII) and "conditions of use" stipulated in the Evaluation Report before beginning work.
   1. Bring to the attention of the adhesive manufacturer's technical representative any discrepancies between these documents and resolve before proceeding with installation.

C. Install adhesive bonded anchors in full compliance with manufacturer's printed installation instructions using personnel who have successfully completed

manufacturer's on-site training for products to be used and who hold certifications specified in this Section.

D. Confirm that adhesive and substrate receiving adhesive are within manufacturer's recommended range for temperature and moisture conditions, and will remain so during the curing time for the product.

3.03 HOLE SIZING AND INSTALLATION

A. Drilling holes:
   1. Determine location of reinforcing bars or other obstructions with a nondestructive indicator device, and mark locations with construction crayon on the surface of the concrete.
   2. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without prior acceptance by Engineer.

B. Hole drilling equipment:
   1. Electric or pneumatic rotary impact type with medium or light impact.
      a. Installation of anchors in cored holes is not permitted.
      b. Set drill to "rotation only" mode, or to "rotation plus hammer" mode in accordance with the manufacturer's installation instructions and the requirements of the Evaluation Report.
      c. Where edge distances are less than 2 inches and "rotation plus hammer" mode is permitted, use lighter impact equipment to prevent micro-cracking and concrete spalling during the drilling process.
   2. Drill bits: Carbide-tipped in accordance with ANSI B212-15 unless otherwise recommended by the manufacturer or required as a "condition of use" in the Evaluation Report.
      a. Hollow drill bits with flushing air systems are preferred. Air supplied to hollow drill bits shall be free of oil, water, or other contaminants that will reduce bond.

C. Hole diameter: As recommended in the manufacturer's installation instructions and the Evaluation Report.

D. Hole depth: As recommended in the manufacturer's installation instructions to provide minimum effective embedment indicated on the Drawings.

E. Obstructions in drill path:
   1. If an existing reinforcing bar or other obstruction is hit while drilling a hole, unless otherwise accepted by Engineer, stop drilling. Prepare and fill the hole with dry-pack mortar. Relocate the hole to miss the obstruction and drill another hole to the required depth.
      a. Obtain Engineer's acceptance of distance between abandoned and relocated holes before proceeding with the relocation.
      b. Allow dry-pack mortar to cure to a strength equal to that of the surrounding concrete before resuming drilling in the area.
      c. Epoxy grout may be substituted for dry-pack mortar when accepted by Engineer.

2. Avoid drilling an excessive number of holes in an area of a structural member, which would excessively weaken the member and endanger the stability of the structure.
3. When existing reinforcing steel is encountered during drilling and when specifically accepted by Engineer, enlarge the hole by 1/8 inch, core through the existing reinforcing steel at the larger diameter, and resume drilling at original hole diameter using pneumatic rotary impact drill.
4. Bent bar reinforcing bars: Where edge distances are critical, and interference with existing reinforcing steel is likely, if acceptable to Engineer, drill hole at 10 degree (or less) angle from axis of reinforcing bar or all thread rod being installed.

F. Cleaning holes:
1. Insert air nozzle to bottom of hole and blow out loose dust.
   a. Use compressed air that is free of oil, water, or other contaminants that will reduce bond.
   b. Provide minimum air pressure of 90 pounds per square inch for not less than 4 seconds.
2. Using a stiff bristle brush with diameter that provides contact around the full perimeter of the hole, vigorously brush hole to dislodge compacted drilling dust.
   a. Insert brush to the bottom of the hole and withdraw using a simultaneous twisting motion.
   b. Repeat at least 4 times.
3. Repeat the preceding steps as required to remove drilling dust or other material that will reduce bond, and in the number of cycles required by the MPII and the Evaluation Report.
4. Leave prepared holes clean and dry.
5. Protect prepared and cleaned holes from contamination and moisture until adhesive is installed.
6. Re-clean and dry previously prepared holes if, in the opinion of the Engineer, the hole has become contaminated after initial cleaning.

3.04 INSTALLATION OF ADHESIVE AND INSERTS

A. Clean and prepare inserts reinforcing bars and all thread rods:
1. Prepare embedded length of reinforcing bars and all thread rods by cleaning to bare metal. Inserts shall be free of oil, grease, paint, dirt, mill scale, rust, or other coatings that will reduce bond.
2. Solvent clean prepared reinforcing bars and all thread rods over the embedment length in accordance with SSPC SP-1. Provide an oil and grease free surface for bonding of adhesive to steel.

B. Fill holes with adhesive:
1. Starting at the bottom of the hole, fill hole with adhesive inserting the reinforcing bar or all thread rod.
2. Fill hole as nozzle is withdrawn without creating air voids.

3. Unless otherwise indicated on the Drawings, fill hole with sufficient adhesive so that excess adhesive is extruded out of the hole when the reinforcing bar or all thread rod is inserted.
4. Where necessary, seal hole at surface of concrete to prevent loss of adhesive during curing.

C. Installing reinforcing bars and all thread rods:
1. Unless otherwise indicated on the Drawings, install bars and rods perpendicular to the concrete surface.
2. Insert reinforcing bars and all thread rods into adhesive in accordance with manufacturer's recommended procedures.
3. Confirm that insert has reached the designated embedment in the concrete, and that adhesive completely surrounds the embedded portion.
4. Securely brace bars and all thread rods in place to prevent displacement while the adhesive cures. Bars and rods displaced during curing will be considered damaged and replacement will be required.
5. Clean excess adhesive from the mouth of the hole.

D. Curing and loading:
1. Provide and maintain curing conditions recommended by the adhesive manufacturer for the period required to fully cure the adhesive at the temperature of the concrete.
2. Do not disturb or load bonded embeds until manufacturer's recommended cure time, based on temperature of the concrete, has elapsed.

3.05 POST-INSTALLATION ACTIVITIES

A. Do not bend bars or all-thread rods after bonding to the concrete, unless accepted in advance by the Engineer.

B. Attachments to all thread rods:
1. After assemblies to be connected are placed, install nuts and washers for threaded rods as indicated on the Drawings.
2. Draw nuts down tight, using practices specified for "snug tight" installation of bolts in steel to steel connections.

3.06 FIELD QUALITY CONTROL

A. Provide field quality control over the Work of this Section as specified in Section 01450 - Quality Control.

B. Do not allow work described in this Section to be performed by individuals who do not hold the specified certifications and who have not completed the specified job site training.

C. Manufacturer's services:
1. Before beginning installation, furnish adhesive manufacturer's technical representative to conduct on-site training in proper storage and handling of

adhesive, drilling and cleaning of holes, and preparation and installation of reinforcing bars and all thread rods.
    a. Provide notice of scheduled training to Engineer and to Special Inspector(s) not less than 10 working days before training occurs. Engineer and Special Inspector may attend training sessions.
  2. Submit record, signed by the manufacturer's technical representative, listing Contractor's personnel who completed the training. Only qualified personnel who have completed manufacturer's on-site training shall perform installations.

D. Field inspections and testing:
  1. Hole drilling and preparation.
  2. Results: Submit records of inspections and testing to Engineer by electronic copies within 24 hours after completion.

3.07 FIELD QUALITY ASSURANCE

A. Provide field quality assurance over the Work of this Section as specified in Section 01450 - Quality Control.

B. Special inspections, special tests, and structural observation:
  1. Provide as specified in Section 01455 - Regulatory Quality Assurance.
  2. Frequency of inspections:
    a. Unless otherwise indicated on the Drawings or in this Section, provide periodic special inspection as required by the Evaluation Report for the product installed.
    b. Provide continuous inspection for the initial installation of each type and size of adhesive bonded reinforcing bar and all thread rod. Subsequent installations of the same anchor may be installed with periodic inspection as defined in subsequent paragraphs.
    c. Provide continuous inspection of all drilling, cleaning and bonding activities for bars and rods installed in horizontal an upwardly inclined positions.
  3. Preparation:
    a. Review Drawings and Specifications for the Work to be observed.
    b. Review adhesive manufacturer's MPII and recommended installation procedures.
    c. Review Evaluation Report "Conditions of Use" and "Special Inspection" requirements.
  4. Inspection: Periodic:
    a. Initial inspection. Provide an initial inspection for each combination of concrete and reinforcing bar strength or concrete strength and all thread rod material being installed. During initial inspection, observe the following for compliance with the installation requirements.
      1) Concrete: Class (minimum specified compressive strength) and thickness.
      2) Environment: Temperature conditions at work area, and moisture conditions of concrete and drilled hole.
      3) Holes: Locations, spacing, and edge distances; verification of drill bit compliance with requirements; cleaning equipment and procedures; cleanliness of hole. Before adhesive is placed, confirm that depth and preparation of holes conforms to the requirements of the

Contract Documents, the MPII, and the "conditions of use" listed in the Evaluation Report.

4) Adhesive: Product manufacturer and name; lot number and expiration date; temperature of product at installation; installation procedure. Note initial set times observed during installation.
5) Reinforcing bars and all thread rods: Material diameter and length; steel grade and/or strength; cleaning and preparation; cleanliness at insertion; minimum effective embedment provided.

b. Subsequent inspections: Subsequent installations of the same reinforcing bars or all thread rods may be performed without the presence of the special inspector, provided that:
1) There is no change in personnel performing the installation, the general strength and characteristics of the concrete receiving the inserts, or the reinforcing bars and all thread rods being used.
2) For ongoing installations, the special inspector visits the site at least once per day during each day of installation to observe the work for compliance with material requirements and installation procedures.

5. Inspection: Continuous.
a. Make observations as described under "Inspection - Periodic, Initial Inspection" during all drilling, cleaning, and bonding activities for all bars and rods installed.

6. Records of inspections:
a. Provide a written record of each inspection using forms acceptable to the Engineer and to the Building Official.
b. Submit electronic copies of inspection reports to Engineer within 24 hours after completion of inspection.

END OF SECTION

SECTION 03071

EPOXIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Epoxy.
   2. Epoxy gel.
   3. Epoxy bonding agent.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C881 - Standard Specification for Epoxy-Resin-Base Systems for Concrete.
   2. C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
   3. D638 - Standard Test Method for Tensile Properties of Plastics.
   4. D695 - Standard Test Method for Compressive Properties of Rigid Plastics.

1.03 SUBMITTALS

A. General: Submit as specified in Section 01330 - Submittal Procedures.

B. Product Data: Submit manufacturer's data completely describing epoxy materials:
   1. Submit evidence of conformance to ASTM C881. Include manufacturer’s designations of Type Grade, Class, and Color.
   2. Submit documentation that materials meet or exceed the specified strength and performance characteristics. Indicate test methods and test results.

C. Quality control submittals:
   1. Manufacturer's installation instructions.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Performance requirements:
   1. Provide epoxy materials that are new.
   2. Store and use products within limitations set forth by manufacturer.
   3. Perform and conduct work of this Section in neat orderly manner.

2.02 MATERIALS

A. General:
   1. Moisture tolerant, water-insensitive, two-component epoxy resin adhesive material containing 100 percent solids, and meeting or exceeding the

performance properties specified when tested in accordance with the standards specified.

B. Epoxy: Low viscosity product in accordance with ASTM C881; Types I, II and IV; Grade 1; Class C , except as modified in this Section.
   1. Manufacturers: One of the following or equal:
      a. Master Builders Solutions, MasterInject 1380.
      b. Dayton Superior, Unitex Pro-Poxy 100.
      c. Sika Corporation, Sikadur 35 Hi-Mod LV.
   2. Required properties:

Table 1 - Material Properties - Epoxy.		
Property	**Test Method**	**Required Results ("neat")**
Tensile Strength (7-day)	ASTM D638	7,000 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D695	10,000 pounds per square inch, minimum.
Bond Strength (harded concrete to harded concrete after 2-day cure)	ASTM C882	1,000 pounds per square inch, minimum. Concrete failure before failure of epoxy.
Viscosity (mixed)		250-550 centipoise
Notes:	Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.	

C. Epoxy gel: Non-sagging product in accordance with ASTM C881, Types I and IV, Grade 3, Class C.
   1. Manufacturers: One of the following or equal:
      a. Master Builders Solutions, MasterEmaco ADH 327.
      b. Dayton Superior, Sure Anchor J50.
      c. Sika Corp., Sikadur 31, Hi-Mod Gel.
   2. Required properties:

Table 2 - Material Properties - Epoxy Gel.		
Property	**Test Method**	**Required Results ("neat")**
Tensile Strength (7-day)	ASTM D638	2,000 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D695	8,000 pounds per square inch, minimum.
Bond Strength (14-day)	ASTM C882	1,500 pounds per square inch, minimum.
Notes:	Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.	

D. Epoxy bonding agent: Non-sagging product in accordance with ASTM C881, Type II, Grade 2, Class C.
   1. Manufacturers: One of the following or equal:
      a. Master Builders Solutions, MasterEmaco ADH 326.
      b. Dayton Superior, Sure Bond J58.
      c. Sika Chemical Corp., Sikadur 32 Hi-Mod LPL.
   2. Required properties.

Table 3 - Material Properties - Epoxy Bonding Agent		
Property	**Test Method**	**Required Results**
Tensile Strength (7-day)	ASTM D638	3,300 pounds per square inch, minimum.
Compressive Yield Strength (7-day)	ASTM D695	8,300 pounds per square inch, minimum.
Bond Strength (14-days)	ASTM C882	1,800 pounds per square inch, minimum. Concrete failure before failure of epoxy bonding agent.
Pot Life	-	Minimum 75 minutes at 77 degrees Fahrenheit. Minimum 90 minutes at 73 degrees Fahrenheit.
Notes:	Testing results are for materials installed and cured at a temperature between 72 and 78 degrees Fahrenheit for 7 days, unless otherwise noted.	

   3. If increased contact time is required for concrete placement, epoxy resin/portland cement bonding agent as specified in Section 03072 - Epoxy Resin/Portland Cement Bonding Agent may be used instead of epoxy bonding agent.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install and cure epoxy materials in accordance with manufacturer's installation instructions.

B. Epoxy:
   1. Apply in accordance with manufacturer's installation instructions.

C. Epoxy gel:
   1. Apply in accordance with manufacturer's installation instructions.
   2. Use for vertical or overhead work, or where high viscosity epoxy is required.
   3. Epoxy gel used for vertical or overhead work may be used for horizontal work.

D. Epoxy bonding agent:
   1. Apply in accordance with manufacturer's installation instructions.
   2. Bonding agent will not be required for filling form tie holes or for normal finishing and patching of similar sized small defects.

END OF SECTION

SECTION 03072

EPOXY RESIN/PORTLAND CEMENT BONDING AGENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Epoxy resin/portland cement bonding agent.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens).
   2. C348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.
   3. C496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
   4. C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.

B. Federal Highway Administration (FHWA):
   1. FHWA-RD-86-193 - Highway Concrete Pavement Technology Development and Testing Volume V: Field Evaluation of SHRP C9206 Test Sites (Bridge Deck Overlays).

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sika Corp., Sika Armatec 110.

B. Substitutions: The use of other than the specified product will be considered, providing the Contractor requests its use in writing to the Engineer. This request shall be accompanied by:
   1. A certificate of compliance from an approved independent testing laboratory that the proposed substitute product meets or exceeds specified performance criteria, tested in accordance with the specified test standards.
   2. Documented proof that the proposed substitute product has a 1-year proven record of performance of bonding portland cement mortar/concrete to hardened portland cement mortar/concrete, confirmed by actual field tests and 5 successful installations that the Engineer can investigate.

2.02 MATERIALS

A. Epoxy resin/portland cement adhesive:
   1. Component "A" shall be an epoxy resin/water emulsion containing suitable viscosity control agents. It shall not contain butyl glycidyl ether.

2. Component "B" shall be primarily a water solution of a polyamine.
3. Component "C" shall be a blend of selected portland cements and sands.
4. The material shall not contain asbestos.

2.03 DESIGN AND PERFORMANCE CRITERIA

A. Properties of the mixed epoxy resin/portland cement adhesive:
   1. Pot life: 75 to 105 minutes.
   2. Contact time: 24 hours.
   3. Color: Dark gray.

B. Properties of the cured epoxy resin/portland cement adhesive:
   1. Compressive strength in accordance with ASTM C109:
      a. 3 day: 4,500 pounds per square-inch minimum.
      b. 7 days: 6,500 pounds per square-inch minimum.
      c. 28 days: 8,500 pounds per square-inch minimum.
   2. Splitting tensile strength in accordance with ASTM C496:
      a. 28 days: 600 pounds per square-inch minimum.
   3. Flexural strength:
      a. 1,100 pounds per square-inch minimum in accordance with ASTM C348.
   4. Bond strength in accordance with ASTM C882 modified at 14 days:
      a. 0 hours open time: 2,800 pounds per square-inch minimum.
      b. 24 hours open time: 2,600 pounds per square-inch minimum.
   5. The epoxy resin/portland cement adhesive shall not produce a vapor barrier.
   6. Material must be proven to prevent corrosion of reinforcing steel when tested under the procedures as set forth by the FHWA Program Report Number FHWA-RD-86-193. Proof shall be in the form of an independent testing laboratory corrosion report showing prevention of corrosion of the reinforcing steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Mixing the epoxy resin: Shake contents of Component "A" and Component "B." Empty all of both components into a clean, dry mixing pail. Mix thoroughly for 30 seconds with a jiffy paddle on a low-speed with 400 to 600 revolutions per minute drill. Slowly add the entire contents of Component "C" while continuing to mix for a minimum of 3 minutes and until uniform with no lumps. Mix only the quantity that can be applied within its pot life.

B. Placement procedure:
   1. Apply to prepared surface with stiff-bristle brush, broom, or "hopper-type" spray equipment:
      a. For hand applications: Place fresh plastic concrete/mortar while the bonding bridge adhesive is wet or dry, up to 24 hours.
      b. For machine applications: Allow the bonding bridge adhesive to dry for 12 hours minimum.

C. Adhere to all limitations and cautions for the epoxy resin/portland cement adhesive in the manufacturer's current printed literature.

3.02 CLEANING

A. Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent areas.

END OF SECTION

SECTION 03102

CONCRETE FORMWORK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Concrete formwork.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 117 - Specifications for Tolerances for Concrete Construction and Materials and Commentary.

B. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.

C. Underwriters Laboratories (UL).

1.03 DEFINITIONS

A. Green concrete: Concrete with less than 100 percent of the minimum specified compressive strength (f'_c).

1.04 SUBMITTALS

A. Information on proposed forming system:
   1. Submit in such detail as the Engineer may require to assure themselves that intent of the Specifications can be complied with by use of proposed system.
   2. Alternate combinations of plywood thickness and stud spacing may be submitted.

B. Form release agent. NSF 61 certification prepared by NSF, Underwriters Laboratories (UL) or other, similar, nationally recognized testing laboratory acceptable to the Engineer.

1.05 QUALITY ASSURANCE

A. Qualifications of formwork manufacturers: Use only forming systems by manufacturers having a minimum of 5 years of experience, except as otherwise specified, or accepted in writing by the Engineer.

B. Regulatory requirements: Install work of this Section in accordance with local, state, and federal regulations.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Design requirements:
   1. Design of concrete forms, falsework, and shoring in accordance with local, state, and federal regulations.
   2. Design forms and ties to withstand concrete pressures without bulging, spreading, or lifting of forms.

B. Performance requirements:
   1. Construct forms so that finished concrete conforms to shapes, lines, grades, and dimensions indicated on the Drawings.
   2. It is intended that surface of concrete after stripping presents smooth, hard, and dense finish that requires minimum amount of finishing.
   3. Provide sufficient number of forms so that the work may be performed rapidly and present uniform appearance in form patterns and finish.
   4. Use forms that are clean and free from dirt, concrete, and other debris.
      a. Coat with form release agent if required, prior to use or reuse.

2.02 MANUFACTURED UNITS

A. Forms: Built-up plywood:
   1. Built-up plywood forms may be substituted for prefabricated forming system subject to following minimum requirements:
      a. Size and material:
         1) Use full size 4-foot by 8-foot plywood sheets, except where smaller pieces are able to cover entire area.
         2) Sheet construction: 5-ply plywood sheets, 3/4-inch nominal, made with 100 percent waterproof adhesive, and having finish surface that is coated or overlaid with surface which is impervious to water and alkaline calcium and sodium hydroxide of cement.
      b. Wales: Minimum 2-inch by 4-inch lumber.
      c. Studding and wales: Contain no loose knots and be free of warps, cups, and bows.

B. Forms: Steel or steel framed:
   1. Steel forms:
      a. Rigidly constructed and capable of being braced for minimum deflection of finish surface.
      b. Capable of providing finish surfaces that are flat without bows, cups, or dents.
   2. Steel framed plywood forms:
      a. Provide forms that are rigidly constructed and capable of being braced.
      b. Plywood paneling: 5-ply, 5/8-inch nominal or 3/4-inch nominal, made with 100 percent waterproof adhesive, and having finish surface that is coated or overlaid with surface which is impervious to water and alkaline calcium and sodium hydroxide of cement.

C. Form release agent:
   1. Effective, non-staining, bond-breaking coating compatible with form surfaces and concrete mixes used.

D. Form ties:
   1. General:
      a. Provide form ties for forming system selected that are manufactured by recognized manufacturer of concrete forming equipment.
      b. Do not use wire ties or wood spreaders of any form.
      c. Provide ties of type that accurately tie, lock, and spread forms.
      d. Provide form ties of such design that when forms are removed, they locate no metal or other material within 1-1/2 inches of the surface of the concrete.
      e. Do not allow holes in forms for ties to allow leakage during placement of concrete.
   2. Cone-snap ties:
      a. Cone-snap ties shall form a cone shaped depression in the concrete with minimum diameter of 1 inch at the surface of the concrete and minimum depth of 1-1/2 inches.
      b. Provide neoprene waterseal washer that is located near the center of the concrete.
   3. Taper ties:
      a. Neoprene plugs for taper tie holes: Size so that after they are driven, plugs are located in center third of wall thickness.

E. Incidentals:
   1. External angles:
      a. Where not otherwise indicated on the Drawings, provide with 3/4-inch bevel, formed by utilizing true dimensioned wood or solid plastic chamfer strip on walkways, slabs, walls, beams, columns, and openings.
      b. Provide 1/4-inch bevel formed by utilizing true dimensioned wood or solid plastic chamfer strip on walkways, walls, and slabs at expansion, and construction joints.
   2. Keyways: Steel, plastic, or lumber treated with form release agent.

PART 3 EXECUTION

3.01 EXAMINATION

A. Site verification of conditions:
   1. Do not place concrete until forms have been checked for alignment, level, and strength, and mechanical and electrical inserts or other embedded items for correct location.

3.02 INSTALLATION

A. Forms: Built-up plywood:
   1. Studding:
      a. Spaced at 16 inches or 24 inches on center.
      b. Closer spacing may be required depending upon strength requirements of the forms, in order to prevent any bulging surfaces on faces of finished concrete work.
      c. Install studs perpendicular to grain of exterior plys of plywood sheets.
   2. Wales: Form wales of double lumber material with minimum size as specified in this Section.
   3. Number of form reuses: Depends upon durability of surface coating or overlay used, and ability to maintain forms in condition such that they are capable of producing flat, smooth, hard, dense finish on concrete when stripped.

B. Forms: Steel or steel framed:
   1. Steel forms:
      a. Adequately brace forms for minimum deflection of finish surface.
   2. Steel framed plywood forms:
      a. Rigidly construct and brace with joints fitting closely and smoothly.
      b. Number of form reuses: Depends upon durability of surface coating or overlay used.
   3. Built-up plywood forms: As specified in this Section may be used in conjunction with steel forms or steel framed plywood forms for special forming conditions such as corbels and forming around items which will project through forms.

C. Form bracing and alignment:
   1. Line and grade: Limit deviations to tolerances which will permit proper installation of structural embedded items or mechanical and electrical equipment and piping.
   2. Formwork:
      a. Securely brace, support, tie down, or otherwise hold in place to prevent movement.
      b. Make adequate provisions for uplift pressure, lateral pressure on forms, and deflection of forms.
   3. When second lift is placed on hardened concrete: Take special precautions in form work at top of old lift and bottom of new lift to prevent:
      a. Spreading and vertical or horizontal displacement of forms.
      b. Grout "bleeding" on finish concrete surfaces.
   4. Pipe stubs, anchor bolts, and other embedded items: Set in forms where required.
   5. Cracks, openings, or offsets at joints in formwork: Close those that are 1/16-inch or larger by tightening forms or by filling with acceptable crack filler.

D. Forms: Incidentals:
   1. Keyways: Construct as indicated on the Drawings.
   2. Reentrant angles: May be left square.
   3. Level strips: Install at top of wall concrete placements to maintain true line at horizontal construction joints.

4. Inserts:
    a. Encase pipes, anchor bolts, steps, reglets, castings, and other inserts, as indicated on the Drawings or as required, in concrete.
5. Pipe and conduit penetrations:
    a. Install pipe and conduit in structures as indicated on the Drawings, and seal with materials as specified in Section 07900 - Joint Sealants.

E. Form release agent:
1. Apply in accordance with manufacturer's instructions.

F. Form ties:
1. Cone-snap ties: Tie forms together at not more than 2-foot centers vertically and horizontally.

3.03 FORM REMOVAL

A. Keep forms in place for at least the periods indicated in the following paragraphs.
1. Vertical forms:
    a. Keep vertical forms in place for a minimum of 24 hours after concrete is placed.
    b. If, after 24 hours, concrete has sufficient strength and hardness to resist surface or other damage, forms may be removed.
2. Other forms and shoring: Keep in place:
    a. Sides of footings: 24 hours minimum.
    b. Vertical sides of beams, girders, and similar members: 48 hours minimum.
    c. Bottom of slabs, beams, and girders: Until concrete strength reaches specified strength f'_c or until shoring is installed.
    d. Shoring for slabs, beams, and girders: Shore until concrete strength reaches specified strength.
    e. Wall bracing: Brace walls until concrete strength of beams and slabs laterally supporting wall reaches specified strength.

B. Green concrete:
1. No heavy loading on green concrete will be permitted.

3.04 SURFACE REPAIRS AND FINISHING

A. Immediately after forms are removed, carefully examine concrete surfaces, and repair any irregularities in surfaces and finishes as specified in Section 03300 - Cast-in-Place Concrete.

B. Form ties: Remove form ties from surfaces. Fill tie holes as follows:
1. Remove form ties from surfaces.
2. Roughen cone shaped tie holes by heavy sandblasting before repair.
3. Dry pack cone shaped tie holes with dry-pack mortar as specified in Section 03600 - Grouting.
4. Taper ties:
    a. After forms and taper ties are removed from wall, plug tie holes with neoprene plug as follows:
        1) Heavy sandblast and then clean tie holes.

2) After cleaning, drive neoprene plug into each of taper tie holes with steel rod. Final location of neoprene plug shall be in center third of wall thickness. Bond neoprene plug to concrete with epoxy.
3) Locate steel rod in cylindrical recess and against middle of plug during driving.
a) At no time are plugs to be driven on flat area outside cylindrical recess.

b. Dry pack of taper tie holes:
1) After installing plugs in tie holes, coat tie hole surface with epoxy bonding agent and fill with dry-pack mortar as specified in Section 03600 - Grouting.
a) Place dry-pack mortar in holes in layers with thickness not exceeding tie hole diameter and heavily compact each layer.
b) Dry pack the outside of the hole no sooner than 7 days after the inside of the hole has been dry packed.
c) Wall surfaces in area of dry-packed tie holes: On the water side of water containing structures and the outside of below grade walls:
(1) Cover with minimum of 10 mils of epoxy gel.
(2) Provide epoxy gel coating on wall surfaces that extend minimum of 2 inches past dry-pack mortar filled tie holes.
(3) Provide finish surfaces that are free from sand streaks or other voids.

3.05 TOLERANCES:

A. Finished concrete shall conform to shapes, lines, grades, and dimensions indicated on the Drawings.

B. Construct work within the tolerances in accordance with ACI 117, except as modified in the following paragraphs or as indicated on the Drawings.
1. General:
a. At certain locations in the Work, tolerances required for equipment placement and operation may be more restrictive than the general tolerance requirements of this Section.
b. Confirm equipment manufacturers' required tolerances for location and operation of equipment that will be installed, and construct concrete to satisfy those requirements.
2. Slabs:
a. Slope: Uniformly sloped to drain when slope is indicated on the Drawings.
b. Slabs indicated to be level: Have maximum vertical deviation of 1/8-inch in 10-foot horizontal length without any apparent changes in grade.
3. Circular tank walls:
a. The Contractor may deviate from finish line indicated on the Drawings by use of forms with chord lengths not to exceed 2 feet.

4. Inserts and embedments:
   a. Set inserts and embedments to tolerances required for proper installation and operation of equipment or systems to which insert pertains.
   b. Maximum tolerances: As follows:

Item	Tolerance
Sleeves and inserts	Plus 1/8 Minus 1/8 inches.
Anchor bolts:	
Projected ends	Plus 1/4 Minus 0.0 inches.
Axial alignment	Not more than 2 degrees off the axis indicated on the Drawings.
Setting location	Plus 1/16 Minus 1/16 inches.

C. Remove and replace work that does not conform to required tolerances. Procedures and products employed in and resulting from such re-work shall be acceptable to the Engineer.

END OF SECTION

SECTION 03150

CONCRETE ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Waterstops.
   2. Joint fillers.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D570 - Standard Test Method for Water Absorption of Plastics.
   2. D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
   3. D638 - Standard Test Method for Tensile Properties of Plastics.
   4. D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
   5. D747 - Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
   6. D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
   7. D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
   8. D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
   9. D2240 - Standard Test Method for Rubber Property - Durometer Hardness.

B. American National Standards Institute (ANSI):
   1. A135.4 - Basic Hardboard.

C. U. S. Army Corps of Engineers (USACE):
   1. CRD-C-572, Specification for Polyvinyl Chloride Waterstop.

1.03 SUBMITTALS

A. Product data:
   1. Polyvinyl chloride waterstops: Complete physical characteristics.
   2. Preformed expansion joint material: Sufficient information on each type of material for review to determine conformance of material to requirements specified.

B. Samples:
   1. Polyvinyl chloride waterstop.

C. Laboratory test reports: Indicating that average properties of polyvinyl chloride waterstops material and finish conform to requirements specified in this Section.

D. Quality control submittals:
   1. Certificates of Compliance:
      a. Written certificates that polyvinyl chloride waterstops supplied on this Project meet or exceed physical property in accordance with USACE CRD-C-572 and the requirements of this Section.
   2. Manufacturer's instructions: For materials specified in this Section that are specified to be installed with such instructions.

1.04 QUALITY ASSURANCE

A. Mock-ups:
   1. Welding demonstration:
      a. Demonstrate ability to weld acceptable joints in polyvinyl chloride waterstops before installing waterstop in forms.

B. Field joints:
   1. Polyvinyl chloride waterstops field joints: Free of misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of material to water pressure at any point. Replace defective joints. Remove faulty material from site and disposed of by Contractor at its own expense.

C. Inspections:
   1. Quality of welded joints will be subject to acceptance of Engineer.
   2. Polyvinyl chloride waterstop: Following defects represent partial list that will be grounds for rejection:
      a. Offsets at joints greater than 1/16 inch or 15 percent of the material thickness, at any point, whichever is less.
      b. Exterior crack at joint due to incomplete bond, which is deeper than 1/16 inch or 15 percent of material thickness, at any point, whichever is less.
      c. Any combination of offset or crack that will result in net reduction in cross section of waterstop in excess of 1/16 inch or 15 percent of material thickness, at any point, whichever is less.
      d. Misalignment of joint that will result in misalignment of waterstop in excess of 1/2 inch in 10 feet.
      e. Porosity in welded joint as evidenced by visual inspection.
      f. Bubbles or inadequate bonding.

PART 2 PRODUCTS

2.01 JOINT FILLERS

A. General:
   1. Use specific type in applications as indicated on the Drawings.
   2. Do not use scrap or recycled materials to manufacture joint fillers.

B. Preformed expansion joint materials:
   1. Bituminous fiber expansion joint material:
      a. Properties:
         1) Thickness: To match joint width indicated on the Drawings.
         2) Asphalt-impregnated fiber in accordance with ASTM D1751.
      b. Manufacturers: One of the following or equal:
         1) Durajoint.
         2) W.R. Meadows, SealTight Fibre Expansion Joint.
   2. Synthetic sponge rubber expansion joint material:
      a. Properties:
         1) Thickness: As recommended for width indicated on the Drawings.
         2) Material in accordance with ASTM D1752, Type I.
      b. Manufacturers: One of the following or equal:
         1) Williams Products Inc., Everlastic 1300.
         2) W.R. Meadows, SealTight Sponge Rubber.

2.02 WATERSTOPS

A. Waterstops - polyvinyl chloride (PVC):
   1. Manufactured from prime virgin polyvinyl chloride plastic compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the requirements as specified in this Section.
   2. Manufacturers: One of the following or equal:
      a. Vinylex Corp.
      b. Sika Corp., Greenstreak PVC Waterstop.
   3. Type: Ribbed waterstop:
      a. Construction joints: 6-inch wide ribbed type.
      b. Expansion joint for wall penetrations for concrete encased electrical duct banks: 6-inch ribbed type with hollow center bulb.
      c. Expansion joints: 9-inch wide ribbed type with hollow center bulb.
      d. Dumbbell-type waterstop will not be allowed unless otherwise specified or indicated on the Drawings.
      e. No scrap or reclaimed material shall be used.
   4. Properties as indicated in the following table:

Physical Characteristics	Test Method	Required Results
Specific Gravity	ASTM D792	Not less than 1.3.
Hardness	ASTM D2240	70 to 90 Type A15 Shore durometer.
Tensile Strength	ASTM D638	Not less than 2,000 pounds per square inch.
Ultimate Elongation	ASTM D638	Not less than 300 percent.
Alkali Extraction	CRD-C-572	Change in weight after 7 days: Between minus 0.1 percent and plus 0.25 percent. Change in hardness after 7 days: Not more than plus 5 points.

Physical Characteristics	Test Method	Required Results
Low Temperature Brittle Point	ASTM D746	No sign of cracking or chipping at -35 degrees Fahrenheit.
Water Absorption	ASTM D570	Not more than 0.15 percent after 24 hours.
Accelerated Extraction Test	CRD-C-572	Tensile strength: Not less than 1,600 pounds per square inch. Elongation: Not less than 280 percent.
Stiffness in Flexure	ASTM D747	Not less than 600 pounds per square inch.
Tear Resistance	ASTM D624	Not less than 225 pounds per inch.
Thickness	-	3/8 inch.
Center Bulb		
6-inch Waterstops	-	7/8 inch or 1-inch nominal outside diameter.
9-inch Waterstops	-	For expansion joints 1 inch and narrower: 1-inch nominal outside diameter. For expansion joints wider than 1 inch: 2-inch nominal outside diameter.
Allowable Tolerances		
Width	-	Plus or minus 3/16 inch.
Thickness	-	Plus or minus 1/32 inch.

PART 3 EXECUTION

3.01 INSTALLATION

A. Waterstops:
   1. General:
      a. Store waterstops so as to permit free circulation of air around waterstop material and prevent direct exposure to sunlight.
      b. Install waterstops in concrete joints where indicated on the Drawings.
      c. Carry waterstops in walls into lower slabs and join to waterstops in slabs with appropriate types of fittings.
      d. In waterbearing structures: Provide all joints with waterstops, whether indicated on the Drawings or not.
      e. Provide waterstops that are continuous.
      f. Set waterstops accurately to position and line as indicated on the Drawings.
      g. Hold and securely fix edges in position at intervals of not more than 24 inches so that they do not move during placing of concrete.

h. Position the waterstop so that symmetrical halves of waterstop are equally divided between concrete pours. Center axis of waterstop shall be coincident with centerline of the joint.
i. Do not drive nails, screws, or other fasteners through waterstops in vicinity of construction joints.
j. Use wires at not more than 24 inches on centers near outer edge of waterstop to tie waterstops into position.
k. Special clips may be used in lieu of wires, at Contractor's option.
l. Terminate waterstops 3 inches from top of finish surfaces of walls and slabs unless otherwise specified or indicated on the Drawings.
m. When any waterstop is installed in concrete on one side of joint, while the other half or portion of the waterstop remains exposed to the atmosphere for more than 2 days, take suitable precautions to shade and protect exposed waterstop from direct rays of sunlight during entire exposure and until exposed portion is embedded in concrete.
n. When placing concrete at waterstops in slabs, lift edge of waterstop while placing concrete below the waterstop. Manually force waterstop against and into concrete, and then cover waterstop with fresh concrete.

2. Polyvinyl chloride waterstop:
a. Install waterstops so that joints are watertight.
b. Weld joints such as unions, crosses, ells, and tees, with thermostatically controlled equipment recommended by waterstop manufacturer:
1) Do not damage material by heat sealing.
2) Make joints by overlapping, then simultaneously cut ends of sections to be spliced so they will form smooth even joint. Heat cut ends with splicing tool until the plastic melts. Press 2 ends together until plastic cools.
3) Maintain continuity of waterstop ribs and tubular center axis.
4) The splices shall have tensile strength of not less than 60 percent of unspliced materials tensile strength.
c. Butt joints of ends of 2 identical waterstop sections may be made while material is in forms.
d. Manufacturer shall factory prefabricate joints for crosses and tees.
e. Split-type waterstops will not be permitted except where specifically indicated on the Drawings.

B. Joints:
1. Construct construction and expansion joints as indicated on the Drawings.
2. Preformed expansion joint material: Fasten expansion joint strips to concrete, masonry, or forms with adhesive. No nailing will be permitted, nor shall expansion joint strips be placed without fastening.

END OF SECTION

SECTION 03154

HYDROPHILIC RUBBER WATERSTOP

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Hydrophilic rubber waterstop.

1.02 REFERENCES

A. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.

1.03 SUBMITTALS

A. General:
   1. Submit the following items for each type, style and size of hydrophilic waterstop to be installed.
   2. Product data:
      a. Manufacturer’s product data sheets.
         1) Include complete physical dimensions, expansion characteristics, and laboratory test reports indicating that average material properties conform to the requirements specified.
         2) Provide data sheets for all materials to be included in the waterstop system.
   3. Samples:
      a. Minimum 6-inch long samples of each type of waterstop to be used if requested by the Engineer.
   4. Manufacturer's installation instructions:
      a. Installation instructions and recommended installation details for the complete waterstop system, and for each component used in that system.

PART 2 PRODUCTS

2.01 HYDROPHILIC RUBBER WATERSTOP

A. General:
   1. System composed of flexible hydrophilic urethane polymer with preformed strips, adhesives, paste, fasteners, and other accessories required for a complete and watertight installation.
      a. To ensure compatibility of materials, a single manufacturer shall provide all products and accessories for the hydrophilic waterstop system.
      b. Products incorporating bentonite are not acceptable under this Section.
      c. Provide waterstop and accessories resistant to degradation under cyclic wetting and drying and to chemicals typically found in water treatment structures.

B. Hydrophilic strip waterstop:
   1. Pre-formed strips of flexible hydrophilic rubber designed to undergo controlled expansion when exposed to moisture:
      a. Strips manufactured to limit expansion in directions parallel to the plane of the joint, and to direct expansion against confining material perpendicular to that plane.
   2. Provide normal or low-expansion pressure as scheduled and as indicated on the Drawings.
   3. Manufacturers: One of the following or equal:
      a. Hydrophilic strip:
         1) Adeka Ultra Seal USA, MC-2010MN.
         2) Sika Corp., Hydrotite CJ1020-2K.
      b. Low expansion hydrophilic strip:
         1) Adeka Ultra Seal USA, KBA-1510FP.
         2) Sika Corp., Hydrotite CJ0725-3K.

C. Hydrophilic paste waterstop.
   1. Single-component gun grade paste of hydrophilic rubber designed to undergo controlled expansion when exposed to moisture after initial curing.
   2. Manufacturers: One of the following or equal:
      a. Adeka Ultra Seal USA: P-201.
      b. Sika Corp., Leakmaster LV-Z.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer's instructions and recommended details.

B. Prepare concrete joint surfaces:
   1. Use wire brushing or scraping to expose an uncontaminated, solid surface.
   2. Clean prepared surface with high-pressure air or water to remove residue and debris.
   3. Confirm that prepared surfaces conform to manufacturer’s recommendations for surface profile and moisture conditions before installing materials.

C. Provide manufacturer’s recommended lap, splice, and corner details for hydrophilic waterstops.
   1. Use hydrophilic paste at all corner joints and overlap splices of hydrophilic strips.

D. Hydrophilic strip waterstop:
   1. Install primers and adhesives when recommended by the manufacturer before setting hydrophilic strips.
   2. Keep hydrophilic strip taut during the fastening process.
   3. Secure hydrophilic strip in place with concrete nails, screws, or adhesive.

4. Provide installation with no gap between the hydrophilic strip and the concrete to which it is attached. At rough or irregular surfaces, set hydrophilic strip waterstop strip in a bead of hydrophilic paste.
    a. Fill all voids and rough areas under the hydrophilic strip with hydrophilic paste.
    b. Allow hydrophilic paste to cure in accordance with manufacturer's recommendations before encapsulating paste in fresh concrete.

3.02 SCHEDULE

A. At the following joint locations/conditions, use the hydrophilic strip waterstop configuration noted unless otherwise indicated on the Drawings.

B. Concrete construction joints:
    1. Under all of the following conditions, use hydrophilic strip waterstop set in a bed of hydrophilic paste waterstop, and screw strip waterstop to concrete surface:
        a. Slab or wall thickness is greater than 10 inches.
        b. Waterstop is placed between 2 rows of steel reinforcement.
        c. Concrete cover from waterstop to nearest concrete face is at least 4 inches.
    2. Under any one of the following conditions, use low-expansion hydrophilic strip waterstop set in bed of hydrophilic paste waterstop and screw strip to concrete surface:
        a. Waterstop is placed on 1 side of a single row of steel reinforcement.
        b. Concrete cover from waterstop to nearest concrete face is less than 4 inches.

C. Pipe penetrations through concrete:
    1. Pipe diameter less than 4 inches: Not allowed.
    2. Pipe diameter of 4 to 24 inches: Continuous bead of hydrophilic paste waterstop, minimum 1/4-inch high by 1/2-inch wide, encircling pipe.
    3. Pipe diameter greater than 24 inches: Continuous hydrophilic strip waterstop around perimeter of pipe, with hydrophilic paste seal at lapped ends of strip.

END OF SECTION

SECTION 03200

CONCRETE REINFORCING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Reinforcing bars:
      a. Carbon steel.
   2. Thread bars.
   3. Bar supports.
   4. Tie wires.
   5. Welded wire fabric.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 318 - Building Code Requirements for Structural Concrete and Commentary.
   2. SP-66 - ACI Detailing Manual.

B. American Iron and Steel Institute (AISI).

C. American Welding Society (AWS):
   1. D1.4 - Structural Welding Code - Reinforcing Steel.

D. ASTM International (ASTM):
   1. A493 - Standard Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging.
   2. A615 - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
   3. A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
   4. A1064 - Standard Specification of Carbon-Steel wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

E. Concrete Reinforcing Steel Institute (CRSI):
   1. Manual of Standard Practice.

1.03 DEFINITIONS

A. Architectural concrete: Concrete surfaces that will be exposed to view in the finished work.
   1. Additionally, for purposes of this Section,includes:
      a. Concrete surfaces that are designated to receive paints or coatings.
      b. Exposed concrete in open basins, channels, and similar liquid containing structures: Surfaces shall be considered exposed to view if located above a line 2 feet below the normal operating water surface elevation in that structure.

B. Bars: Reinforcement or reinforcing bars as specified in this Section.

C. Evaluation Report: Report prepared by ICC-ES , or by other testing agency acceptable to the Engineer and to the Building Official, that documents testing and review of a product to confirm that it complies with the requirements of designated ICC-ES Acceptance Criteria, and its acceptance for use under the Building Code specified in Section 01410 - Regulatory Requirements.

D. Give away bars: Reinforcing bars that are not required by the Contract Documents, but are installed by the Contractor to provide support for the required reinforcing bars.

E. Wire supports: Metal reinforcing supports constructed of steel wire as specified. Includes individual high chairs, continuous high chairs, bolsters and other similar configurations and shapes.

1.04 SUBMITTALS

A. General:
   1. Submit in accordance with Section 01330 - Submittal Procedures.
   2. Changes to reinforcement in Contract Documents:
      a. Indicate in a separate letter submitted with shop drawings any changes to reinforcement indicated on the Drawings or specified.
      b. Such changes will not be acceptable unless Engineer has accepted them in writing.

B. Product data:
   1. Bar supports:
      a. Wire bar supports:
         1) Schedule of support materials to be provided and locations of use.
      b. Precast concrete bar supports ("dobies"):
         1) Manufacturer's data indicating compression strength of concrete and confirming dimensions and thickness(es).height(s) to be provided for each location where used.

C. Shop drawings:
   1. Reinforcement shop drawings:
      a. Submit drawings showing bending and placement of reinforcement required by the Contract Documents.

b. Clearly indicate structures or portions of structures covered by each submittal.
    1) Submit reinforcement shop drawings for each structure as a complete package. Submittals addressing only a portion of a structure will be rejected and returned without review, unless such presentation is accepted by Engineer in advance.
c. Shop drawings shall conform to the recommendations of the CRSI Manual of Standard Practice and ACI SP-66.
d. Use the same bar identification marks on bending detail drawings, placement drawings, and shipping tags.
e. Submittals consisting solely of reinforcing bar schedules, without accompanying placement drawings, will not be accepted unless accepted under prior written agreement with Engineer.

2. Reinforcement placement drawings:
    a. Clearly show placement of each bar listed in the bill of materials, including additional reinforcement at corners and openings, and other reinforcement required by details in the Contract Documents.
    b. Clearly identify locations of reinforcement with coatings (e.g., galvanized or epoxy) and with yield strength other than ASTM A615, Grade 60.
    c. Show anchor bolt locations based on anchor bolt templates for approved equipment.
    d. Show splice locations.
3. Reinforcement fabrication drawings:
    a. If bend types or nomenclature differs from that recommended in the CRSI Manual of Standard Practice, provide details showing bend types and dimensional designations.
    Clearly identify reinforcement with coatings and with yield strength other than ASTM A615, Grade 60.

D. Samples (when requested by Engineer):
1. Bar supports/wire reinforcement supports: Samples of each type of chair and bolster proposed for use. Submit with letter stating where each type will be used.
2. Precast concrete bar supports: Samples of each type of precast support proposed for use. Submit with letter stating where each will be used.

E. Test reports:
1. Certified copy of mill test for each steel used. Show physical properties and chemical analysis.
    a. Mill test reports may be submitted as record documents at the time the reinforcement from that heat of steel is shipped to the site.
    b. In such cases, submit certificates under the shop drawing submittal number with the letter "R" (for record date) appended to the end (e.g., of the reinforcement was submitted as 03200-002-1, deliver the associated mill certificate as submittal 03200-002-1R).

F. Manufacturer's instructions.

G. Special procedures:
    1. Welding procedures conforming to AWS D1.4 for reinforcement to be field welded.
        a. Procedures qualification record.

H. Qualifications statements:
    1. Welder qualifications.

I. Closeout documents:
    1. Field quality control and inspection reports.
    2. Field quality assurance special inspection and testing reports.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:
    1. Deliver bars bundled and tagged with identifying tags.

B. Acceptance at site:
    1. Reinforcing bars: Deliver reinforcing bars lacking grade identification marks with letter containing manufacturer's guarantee of grade.

1.06 SEQUENCING AND SCHEDULING

A. Bar supports:
    1. Do not place concrete until samples and product data for bar supports have been accepted by Engineer.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. The drawings contain notes describing the size and spacing of reinforcement and its placement, details of reinforcement at wall corners and intersections, and details of extra reinforcement around openings in concrete, and other related information.

2.02 MATERIALS

A. Reinforcing bars:
    1. Provide reinforcement of the grades and quality specified, fabricated from new stock, free from excessive rust or scale, and free from unintended bends or other defects affecting its usefulness.
    2. Reinforcing bars:
        a. ASTM A615 Grade 60 deformed bars, including the following requirements, or ASTM A706 Grade 60 deformed bars.
            1) Actual yield strength based on mil tests of reinforcement provided shall not exceed the minimum yield strength specified in this Section by more than 18,000 pounds per square inch.
            2) Ratio of actual ultimate tensile strength to actual tensile yield strength shall not be less than 1.25.

3. Reinforcing bars designated or required to be welded:
    a. Low-alloy, ASTM A706 Grade 60, deformed bars.
4. Reinforcing bars that are required to resist earthquake-induced flexural and axial forces in concrete frame members and in concrete shear wall boundary members where indicated on the Drawings:
    a. Low-alloy, ASTM A706 Grade 60, deformed bars.

B. Bar supports:
1. Wire supports:
    a. All stainless steel bar supports:
        1) Conforming to CRSI Manual of Standard Practice recommendations for types and details, but custom fabricated entirely from stainless steel wire conforming to ASTM A493, AISI Type 316.
    b. Stainless steel protected bar supports:
        1) Conforming to CRSI Manual of Standard Practice Class 2, Type B, and consisting of bright basic wire support fabricated from cold-drawn carbon steel wire with stainless steel ends attached at the bottom of each leg.
        2) Stainless steel wire ends shall conform to ASTM A493, AISI Type 316 and shall extend at least 3/4 inch inward from the formed surface of the concrete.
    c. Bright basic wire bar supports:
        1) Conforming to CRSI Manual if Standard Practice, Class 3.
2. Plastic supports:
    a. Manufacturers: The following or equal:
        1) Aztec Concrete Accessories.
3. Deformed steel reinforcing bar supports:
    a. Fabricated of materials and to CRSI details recommended for typical reinforcement embedded in concrete and bent to dimensions required to provide specified clearances and concrete cover.
4. Precast concrete bar supports ("dobies"):
    a. Pre-manufactured, precast concrete blocks with cast-in annealed steel wires, 16-gauge or heavier.
    b. Compression strength of concrete: Equal to or exceeding the compression strength of the surrounding concrete.
    c. Block dimensions:
        1) Height to provide specified concrete cover.
        2) Footprint not less than 3 inches by 3 inches, and adequate to support the weight of the reinforcement and maintain specified concrete cover without settling into the underlying surface.
5. Stainless steel wire supports on stainless steel plates:
    a. Type 304 stainless steel wire bar support chairs or bolsters supported on Type 304 stainless steel plates resting on the ground surface.
        1) Weld plates to at least 2 legs of wire support chairs.

C. Tie wires:
1. General use: Black annealed steel wire, 16-gauge or heavier.

D. Welded wire fabric reinforcement:
1. Material:
    a. Carbon steel conforming to ASTM A1064.

2. Provide welded wire reinforcement in flat sheet form. Rolled wire fabric is not permitted.
3. Fabric may be used in place of reinforcing bars if accepted by Engineer:
    a. Provide welded wire fabric having cross-sectional area per linear foot not less than the cross-sectional area per linear foot of reinforcing bars indicated on the Drawings.

2.03 FABRICATION

A. Shop fabrication and assembly:
1. Cut and bend bars in accordance with provisions of ACI 318 and the CRSI Manual of Standard Practice.
2. Bend bars cold. Use bending collars to develop the recommended bend radius.
3. Provide bars free from defects and kinks and from bends not indicated on the Drawings.
4. Circumferential and radiused reinforcement: Roll to the radius required for its location in the structure before installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
1. Reinforcing bars and welded wire reinforcement:
    a. Verify that reinforcement is new stock, free from rust scale, loose mill scale, excessive rust, dirt, oil, and other coatings that will adversely affect bonding capacity when placed in the Work.
2. Welded wire fabric:
    a. Verify that sheets are not curled or kinked before or after installation.

3.02 PREPARATION

A. Surface preparation:
1. Reinforcing bars - uncoated:
    a. Clean reinforcement of concrete, dirt, oil and other coatings that will adversely affect bond before embedding bars in subsequent concrete placements.
    b. Thin coating of red rust resulting from short exposure will not be considered objectionable. Thoroughly clean bars having rust scale, loose mill scale, or thick rust coat.
    c. Partially embedded reinforcement: Remove concrete or other deleterious coatings from dowels and other projecting bars by wire brushing or sandblasting before bars are embedded in subsequent concrete placements.

3.03 INSTALLATION

A. Reinforcing bars: General:
   1. Field-cutting of reinforcing bars is not permitted.
   2. Field-bending of reinforcing bars, including straightening and rebending, is not permitted.

B. Placing reinforcing bars:
   1. Accurately place bars to meet position and cover requirements indicated on the Drawings and specified. Secure bars in position.
   2. Tolerances for placement and minimum concrete cover: As listed in Table 1.

Table 1 - Reinforcement Placing Tolerances

Member	Tolerance on Reinforcement Location (1)	Tolerance on Minimum Concrete Cover (1,2)
Slabs, beams, walls, and columns except as noted below:		
10 inches thick and less	± 3/8 inch	- 3/8 inch
More than 10 inches thick	± 1/2 inch	- 1/2 inch
Formed soffits:	As noted above	- 1/4 inch
Longitudinal location of bends and ends of reinforcement:		
Conditions not listed below:	± 2 inches	- 1/2 inch
At discontinuous ends of brackets and corbels	± 1/2 inch	- 1/4 inch
At discontinuous ends of other members:	± 1 inch	- 1/2 inch

Notes:
(1) ± indicates "plus or minus;" - indicates "minus;" + indicates "plus."
(2) Tolerance on cover is limited as noted, but decrease in cover shall not exceed one third of the minimum cover indicated on the Drawings.

   3. Spacing between bars:
      a. Minimum clear spacing between bars in a layer:
         1) As indicated on the Drawings, but not less than the larger of 1.5 times the bar diameter or 1-1/2 inches.
      b. Minimum clear spacing between bars in 2 or more parallel layers:
         1) Place bars in upper layers directly above bars in lower layers.
         2) Minimum spacing between layers: As indicated on the Drawings, but not less than the larger of 1.5 times the bar diameter or 1-1/2 inches.
      c. Limits on minimum clear spacing between bars also applies to the clear spacing between a lap splice and the adjacent bars and/or lap splices.
   4. Lap splices for bars:
      a. Lap splice locations and lap splice lengths: as indicated on the Drawings. Where lap lengths are not indicated, provide in accordance with ACI 318.

b. Unless otherwise specifically indicated on the Drawings (and noted as "non-contact lap splice"), install bars at lap splices in contact with each other and fasten together with tie wire.
c. Where bars are to be lap spliced at concrete joints, ensure that bars project from the first concrete placement a length equal to or greater than minimum lap splice length indicated on the Drawings.
d. Stagger lap splices where indicated on the Drawings.
e. Where lap splice lengths are not indicated on the Drawings, provide lap splice lengths in accordance with ACI 318.

C. Reinforcing supports:
1. Provide supports of sufficient numbers, sizes, and locations to maintain concrete cover, to prevent sagging and shifting, and to support loads during construction without displacement and without gouging or indentation into forming surfaces.
a. Quantities and locations of supports shall not be less than those indicated in ACI SP-66 and the CRSI Manual of Standard Practice.
2. Do not use brick, concrete masonry units, concrete spalls, rocks, wood, or similar materials for supporting reinforcement.
3. Do not use "give away bars" that have less cover than that required by the Contract Documents. Do not adjust the location of reinforcement required by the Contract Documents to provide cover for give away bars.
4. Provide bar supports of height required to maintain the clear concrete cover indicated on the Drawings.
5. Provide bar supports at formed vertical faces to maintain the clear concrete cover indicated on the Drawings.
6. Schedule of reinforcement support materials: Provide bar supports as indicated in Table 2.

Table 2 - Reinforcement Support Materials

Case	Location	Material
a.	Concrete placed over earth and concrete seal slabs ("mud mats"):	Precast concrete bar supports.
b.	Concrete placed against forms and exposed to water or wastewater process liquids (whether or not such concrete received additional linings or coatings):	All stainless steel bar supports.
c.	Concrete placed against forms and exposed to earth, weather, frequent washdown, or groundwater in the finished work	All stainless steel bar supports.
d.	Concrete placed against forms and exposed to interior equipment/piping areas in the finished work	All stainless steel bar supports.
e.	Between mats of reinforcement, and fully embedded within a concrete member	Bright basic wire bars supports, or deformed steel reinforcing bars.

D. Tying of reinforcing:
   1. Fasten reinforcement securely in place with wire ties.
   2. Tie reinforcement at spacings sufficient to prevent shifting.
      a. Provide at least 3 ties in each bar length. (Does not apply to dowel lap splices or to bars shorter than 4 feet, unless necessary for rigidity).
   3. Tie slab bars at every intersection around perimeter of slab.
   4. Tie wall bars and slab bar intersections other than around perimeter at not less than every fourth intersection, but at not more than the spacing indicated in Table 3:

Table 3 - Maximum Spacing of Tie Wires for Reinforcement

Bar Size	Slab Bar Spacing (inches)	Wall Bar Spacing (inches)
Bars Number 5 and Smaller	60	48
Bars Number 6 through Number 9	96	60
Bars Number 10 and Number 11	120	96

   5. After tying:
      a. Bend ends of wires inward towards the center of the concrete section. Minimum concrete cover for tie wires shall be the same as cover requirements for reinforcement.
      b. Remove tie wire clippings from inside forms before placing concrete.

E. Welded wire fabric reinforcement:
   1. Install only where indicated on the Drawings or accepted in advance by Engineer.
   2. Install necessary tie wires, spacing chairs, and supports to keep welded wire fabric at its designated position in the concrete section while concrete is being placed.
   3. Straighten welded wire fabric to make sheets flat in the Work.
   4. Do not allow wire fabric to drape between supports unless such a configuration is specifically indicated on the Drawings.
      a. If fabric is displaced during placement of concrete, make provisions to restore it to the designated location using methods acceptable to Engineer.
   5. Bend welded wire fabric as indicated on the Drawings or required to fit Work.
   6. Lap splice welded wire fabric as indicated on the Drawings.
      a. If lap splice length is not indicated, splice in accordance with ACI 318, but not less than 1 1/2 courses of fabric or 8 inches minimum. Tie laps at ends and at not more than 12 inches on center.

F. Welding reinforcing bars:
   1. Weld reinforcing bars only where indicated on the Drawings or where acceptance is received from Engineer prior to welding.
   2. Perform welding in accordance with AWS D1.4 and welding procedures accepted by Engineer.
      a. Conform to requirements for minimum preheat and interpass temperatures.

3. Submit:
    a. Welding procedures specification.
    b. Procedures qualification record.
    c. Welder qualification test record.
4. Do not tack weld reinforcing bars except where specifically indicated on the Drawings.

3.04 FIELD QUALITY CONTROL

A. Provide quality control for the Work of this Section as specified in Section 01450 - Quality Control.

B. Field inspections and testing:
    1. Submit records of inspections and testing to Engineer in electronic format within 24 hours after completion.

3.05 FIELD QUALITY ASSURANCE

A. Provide quality assurance as specified in Section 01450 - Quality Control.

B. Special inspections and tests:
    1. Provide as specified in Section 01455 - Regulatory Quality Assurance.
    2. Frequency of inspections:
        a. Unless otherwise indicated on the Drawings or in this Section, provide periodic special inspection as required by the Building Code specified in Section 01410 - Regulatory Requirements.
    3. Preparation:
        a. Review Drawings and Specification for the Work to be observed.
        b. Review approved submittal sand shop drawings.
    4. Inspections: Special inspection shall include, but is not limited to, the following items.
        a. Reinforcement: General:
            1) Type (material) and location of reinforcement supports.
            2) Bar material/steel grade and bar size.
            3) Location, placement, and spacing of bars.
            4) Clear concrete cover over reinforcement.
            5) Lap splice: Location and lap length. Bars within tolerances for contact (unless non-contact splice is indicated on the Drawings.)
            6) Bar hooks and development lengths embedded within concrete sections as indicated on the Drawings.
            7) Reinforcement tired in position and tie wire legs turned inward toward the center of the concrete section.
        b. Reinforcement: Welding:
            1) Inspector qualification and inspections shall be in accordance with the requirements of AWS D1.4.
            2) Provide periodic inspection for:
                a) Weldability of reinforcement other than ASTM A706.
                b) Single pass fillet welds with thickness less than or equal to 5/16 inch.

3) Provide continuous inspection for:
    a) Other welds.
    b) Welds at mechanical reinforcing bar couplers and end anchors.
4) In addition to visual inspection, Owner may inspect reinforcing bar welds by other methods, including radiographic inspection.

5. Records of inspections:
    a. Provide a written record of each inspection using forms acceptable to the Engineer and to the Building Official.
    b. Submit electronic copies of inspection reports to Engineer within 24 hours after completion of inspections.

3.06 NON-CONFORMING WORK

A. Before placing concrete, adjust or remove and re-install reinforcement to conform to the requirements of the Contract Documents.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

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PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Cast-in-place concrete:

B. The requirements of this Section will require advance planning for preparation and testing of trial batches. Review the mix design and testing requirements carefully, and schedule preparations and testing with sufficient time to complete tests, to obtain Engineer's review of mixes and testing results, and to complete revisions and re-testing if required.

1.02 REFERENCES

A. American Concrete Institute (ACI):
1. 212.3R - Report on Chemical Admixtures for Concrete.
2. 302.1R - Guide to Concrete Floor and Slab Construction.
3. 305R - Guide to Hot Weather Concreting.
4. 306R - Guide to Cold Weather Concreting.
5. 318 - Building Code Requirements for Structural Concrete and Commentary.
6. 350 - Code Requirements for Environmental Engineering Concrete Structures and Commentary.
7. Manual of Concrete Practice.

B. ASTM International (ASTM):
1. C29 - Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate.
2. C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
3. C33 - Standard Specification for Concrete Aggregates.
4. C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
5. C40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
6. C42 - Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
7. C88 - Standard Test Method of Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate.
8. C94 - Standard Specification for Ready-Mixed Concrete.
9. C114 - Standard Test Methods for Chemical Analysis of Hydraulic Cement.
10. C117 - Standard Test Method for Materials Finer that 75-m (No. 200) Sieve in Mineral Aggregates by Washing.
11. C123 - Standard Test Method for Lightweight Particles in Aggregate.
12. C131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
13. C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
14. C138 - Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete
15. C142 - Standard Test Method for Clay Lumps and Friable Particles in Aggregate.

16. C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
17. C150 - Standard Specification for Portland Cement.
18. C156 - Standard Test Method for Water Loss from a Mortar Specimen Through Liquid Membrane-Forming Curing Compounds for Concrete.
19. C157 - Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
20. C171 - Standard Specifications for Sheet Materials for Curing Concrete.
21. C172 - Standard Practice for Sampling Freshly Mixed Concrete.
22. C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
23. C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
24. C293 - Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Center-Point Loading).
25. C295 - Standard Guide to Petrographic Examination of Aggregates for Concrete.
26. C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
27. C311 - Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete.
28. C494 - Standard Specification for Chemical Admixtures for Concrete.
29. C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
30. C702 - Standard Practice for Reducing Samples of Aggregate to Testing Size.
31. C856 - Standard Practice for Petrographic Examination of Hardened Concrete.
32. C989 - Standard Specification for Slag Cement for Use in Concrete and Mortars.
33. C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
34. C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
35. C1260 - Standard Test Method of Potential Alkali Reactivity of Aggregates (Mortar Bar Method).
36. C1293 - Standard Test Method for Determination of Length Change of Concrete due to Alkali-Silica Reaction.
37. C1602 - Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
38. C1778 - Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete.
39. D29 - Standard Practice for Determining Volatile and Nonvolatile Content of Cellulosics, Emulsions, Resin Solutions, Shellac, and Varnishes.
40. D75 - Standard Practice for Sampling Aggregates.
41. D2103 - Standard Specification for Polyethylene Film and Sheeting.
42. D3665 - Standard Practice for Random Sampling of Construction Materials.
43. D4791 - Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

C. National Ready-Mixed Concrete Association (NRMCA).

1.03 DEFINITIONS

A. Alkali: The sum of sodium oxide and potassium oxide calculated as sodium oxide.

B. Alkali load: Amount of alkalis contributed by the Portland cement in a concrete mixture, expressed in pounds per cubic yard (lb/yd^3) and calculated by multiplying the Portland cement content of the concrete in lb/yd^3 by the alkali content of the Portland cement, or the Portland cement portion of a blended cement, divided by 100.

C. Architectural concrete: Concrete surfaces that will be exposed to view in the finished work.
   1. For purposes of this Section, includes only those surfaces that receive paint or coatings.
   2. Exposed concrete surfaces in open basins, channels, and similar liquid containing structures: Surfaces will be considered exposed to view if located above the water line as defined in Section 03366 - Tool Concrete Finishing.
   3. Exterior concrete surfaces with portions above and below grade: Surface will be considered exposed to view of located above the grade line as defined in Section 03366 - Tool Concrete Finishing.

D. Average daily temperature: Calculated by summing hourly measurements of air temperature in the shade at the face of the concrete and dividing that sum by 24. In calculating the sum of the temperatures recorded, any measurement less than 50 degrees Fahrenheit shall be recorded as 0 degrees Fahrenheit and included in the sum.

E. Cementitious materials: Portland cement and supplementary cementitious materials.

F. Class of concrete: Refers to a mix with characteristics, proportions, and constituents (including a specific combination of admixtures) as specified in this Section.
   1. Any change in the source or characteristics of constituent materials, in the proportions of materials, or in the admixtures included in a mix shall be considered as creating a new and separate class of concrete.
   2. Any mix to be placed by pumping shall be considered as creating a new and separate class of concrete.

G. Cold weather: Includes one or more of the following conditions:
   1. Current air temperature is 45 degrees Fahrenheit and falling.
   2. Air temperature during the first 24 hours after placement is expected to fall into the range of 45 degrees Fahrenheit to 40 degrees Fahrenheit.
   3. A period when, for more than 3 consecutive days, the following conditions exist:
      a. The average daily air temperature drops below 40 degrees Fahrenheit.
      b. The air temperature is not greater than 50 degrees Fahrenheit for more than one-half of any consecutive 24-hour period.

H. Cold weather concreting: Operations for placing, finishing, curing, and protecting concrete during cold weather.

I. Green concrete: Concrete that has not yet achieved 100 percent of the minimum specified compressive strength, f'c, for that mix.

J. Hairline crack: Crack with a crack width of less than 4 thousandths of an inch (0.004 inches).

K. Hot weather: Any combination of ambient temperature, concrete temperature, relative humidity, wind speed, and solar radiation intensity that creates conditions that will evaporate water from a free concrete surface at a rate equal to or greater than 0.2 pounds per square foot per hour as determined by the Menzel Formula and nomograph published in ACI 305R and in this Section, Attachment A - Menzel Formula and Nomograph.

L. Hot weather concreting: Operations for placing, finishing, curing, and protecting concrete during hot weather.

M. Paste content: The total concrete volume minus the volume of aggregate, expressed as a percentage of total volume. Paste volume includes volume of cementitious materials, water, air, admixtures materials, and any fibers.

N. Supplemental cementitious material: inorganic material such as fly ash, natural pozzolans, silica fume, or slag cement that reacts pozzolanically or hydraulically.

1.04 DELEGATED DESIGN

A. Provide Delegated Design for the following Work, based on the requirements of this Section.
   1. Concrete mix designs.

1.05 SUBMITTALS

A. General:
   1. Data for concrete mixes and mix constituents supplied to the Work shall be coordinated through a single supplier.
   2. A maximum of 2 mix designs will be reviewed by the Engineer for each class of concrete required.
      a. Review of additional mix designs shall be at the expense of the Contractor.

B. Product data:
   1. Submit data completely describing products and demonstrating compliance with the requirements of this Section.
   2. Data for all products in the mix for each class of concrete shall be submitted concurrently with that mix design.
   3. Where products conforming to NSF-61 are required, submit evidence of testing and listing under NSF-61 for use in direct contact with potable water. Testing and listing shall be by a nationally recognized agency acceptable to the Engineer.

4. Admixtures:
    a. For each admixture included in concrete mixes, submit manufacturer's product data demonstrating compliance with standards specified.
    b. If air entraining admixture requires test method other than ASTM C173 to accurately determine air content, make special note of requirements in submittal.
5. Curing compound: Submit complete data on proposed compound.

C. Design data:
1. Concrete mix designs:
    a. Submit full details, including mix design calculations and plots, for concrete mixes proposed for use for each class of concrete.
    b. Include mix design calculations of proportions by both weight and volume.
    c. Determine and include the alkali load of the proposed mix.
    d. Include information on correction of batching for varying moisture contents of fine aggregate.
    e. Submit source quality test records with mix design submittal.
    f. Provide calculations demonstrating that the mixes proposed provide the required average compression strength of concrete (f'cr) based on source quality test records.
    g. For each Class A mix design submitted, plot the mix design Attachment B - Coarseness Factor Chart and submit.
    h. For each Class A mix design submitted, plot the combined aggregate gradation on the chart Attachment C - Combined Aggregate Gradation Chart and submit.

D. Concrete mixes - Trial batches:
1. Drying shrinkage test results.
    a. Submit results of testing.
    b. Submit test specimens from drying shrinkage tests for trial batches.
        1) Submit all specimens from each mix accepted by Engineer.
        2) Using indelible marker, clearly label each specimen with concrete class, trial batch mix designator, and specimen number.
2. Compression strength test results.
    a. Submit results of testing. Provide data for each cylinder tested.
    b. Submit data indicating trial batch mix designator, slump, and specimen number for each test cylinder.
    c. Submit test specimens from compression strength tests for trial batches.
        1) Submit 2 cylinders from each mix accepted by Engineer.
        2) Using indelible marker, clearly label each cylinder with concrete class, trail batch number, and specimen number.
3. If there is any change in suppliers or in quality of concrete mix constituents, submit new test data.

E. Test reports:
1. Dated not more than 24 months prior to the date of submittal.
2. Aggregate:
    a. Submit certified copies of commercial laboratory tests proposed for use in concrete.

b. Sieve analyses:
    1) During construction, submit sieve analyses of coarse, fine, and combined aggregates used any time there is a change in supplier, or a significant change in the character and/or grading of materials, and when requested by the Engineer.
c. Aggregates - coarse:
    1) Physical properties:
        a) Sieve analysis.
        b) Percentage of particles having flat and/or elongated characteristics.
        c) Abrasion loss.
        d) Soundness.
    2) Deleterious substances:
        a) Clay lumps and friable particles content.
        b) Materials finer than 200 sieve (percentage).
        c) Shale and chert content.
        d) Coal and lignite content.
    3) Alkali reactivity.
    4) Deleterious substances:
        a) Clay lumps and friable particles content.
        b) Chert and shale content.
        c) Coal and lignite content.
        d) Materials finer than No. 200 sieve.
    5) Alkali reactivity.
d. Aggregates - Fine:
    1) Physical properties:
        a) Sieve analysis and fineness modulus.
        b) Soundness.
    2) Deleterious substances:
        a) Clay lumps and friable particles (percentage).
        b) Materials finer than No. 200 sieve (percentage).
        c) Coal and lignite (percentage).
        d) Shale and chert.
        e) Organic impurities ("Color" as determined by ASTM C40).
    3) Alkali reactivity.
e. Aggregates - Combined:
    1) Test combined gradation for the following sieve sizes: 1.5 inches, 1 inch, 3/4 inch, 1/2 inch, 3/8 inch, Number 4, Number 8, Number 16, Number 30, Number 100, Number 200.
    2) Bulk density in accordance with ASTM C29.
    3) Void content in accordance with ASTM C29.
    4) Submit at:
        a) Initial mixture design submittal,
        b) Intervals of not more than 4 weeks,
        c) Any time there is a change in character or grading of constituent materials,
        d) When requested by the Engineer.

3. Cement:
    a. Mill tests, including alkali content measured as equivalent alkalis, for each shipment of cement included in the Work.
        1) During construction, submit mill certificates for cement being used at intervals of not more than 90 days, any time there is a change in supplier or a significant change in the character of the materials, and when requested by the Engineer.
4. Supplemental cementitious material:
    a. Fly ash: Identify source and provide testing results to demonstrate compliance with requirements of ASTM C618 and this Section.
        1) Include supplier's report certifying the total alkali content of the material, expressed as equivalent percentage of sodium oxide (Na_2Oe).
    b. Slag cement: Identify source and provide testing results to demonstrate compliance with requirements of ASTM C989 and this Section.

F. Certificates:
1. Current NRMCA certification for all plants and trucks that will be used to supply concrete.

G. Source quality control submittals:
1. Truck batch tickets for each load of concrete delivered to the site, whether accepted or rejected.
2. Concrete supplier's quality control plan. Include the following elements, at a minimum:
    a. Names and qualifications of key quality control personnel:
        1) Quality control manager.
        2) Testing and inspection personnel.
    b. Names and qualifications of testing laboratories:
        1) Each laboratory shall hold current accreditation from the AASHTO Accreditation Program, or other accreditation program acceptable to the Engineer, for each test performed.
    c. Example forms for: inspection reports, certificates of compliance, and test results.
    d. Quality control procedures: Method and frequency of performing each procedure, including inspections and materials testing. At a minimum, the plan shall include:
        1) Daily testing of aggregate gradation.
        2) Monthly testing of cement quality.
        3) Monthly testing of fly ash quality.
    e. Procedures to control quality characteristics, including standard procedures to address properties outside the specified operating limits, and example reports to document non-conformances and corrective actions taken. Include procedure for notifying Contractor and Engineer of non-conformances.
    f. Procedures for verifying that:
        1) Materials are properly stored during concrete batching operations.
        2) Batch plants have the ability to maintain concrete consistency during periods of extreme heat and of low temperatures.

3) Admixtures are dispensed in the correct dosages within the accuracy requirements specified.
4) Delivery trucks have a valid NRMCA certification card.

g. Procedures for verifying that weighmaster certificate for each load of concrete shows:
1) Cement and supplementary materials are from sources designated in the approved submittals.
2) Concrete as-batched complies with the constituent weights designated in the approved submittals.
3) Corrections for aggregate moisture are being correctly applied.
4) Any mix water withheld from the batch.

h. Procedures for visually inspecting concrete during discharge.

H. Field quality control submittals:
1. Contractor's notifications of readiness for concrete placement.
2. Contractor's reports of field quality control testing.
a. Include with each report the concrete batch ticket number and identification numbers for associated cylinders used for compressive strength testing.
b. Testing results for slump, temperature, unit weight, and air entrainment.
c. Testing results for compressive strength at 7 and 28 days, and for any compressive strength tests after 28 days.
d. Note on batch ticket the amount of water that was withheld and the maximum amount that can be added on site as "Max add water." Record on the batch ticket the volume of water actually added at site.
e. Note on the batch ticket the concrete mix classification as defined in Table 3 of this Section.

I. Special procedure submittals:
1. Sequence of concrete placing:
a. Submit proposed sequence of placing concrete showing proposed beginning and ending of individual placements. Submittal shall include plans sections and details to address all pours.
2. Cold weather concreting plan.
3. Hot weather concreting plan.
4. Repair of defective concrete: Submit mix design for repair materials to be used.

1.06 QUALITY ASSURANCE

A. Pre-installation meetings:
1. Schedule and conduct pre-installation meeting at least 10 days prior to batching and placing of concrete.
a. Provide additional meetings if necessary, to discuss specific concrete submittals, mixes, or placing and curing conditions.
b. Notify Engineer of location and time of each conference.
2. Required attendees:
a. Contractor including Contractor's superintendent and key personnel.
b. Concrete supplier.
c. Technical representative(s) of supplier(s) of concrete admixtures.
d. Subcontractor(s) providing pumping, placing, finishing, and curing.

e. Subcontractor(s) providing embedded items (structural embedded plates, electrical conduit).
f. Sampling and testing personnel.
g. Engineer.
h. On-site inspectors representing Engineer.
i. Other persons deemed by the Engineer and the Contractor to be critical to the quality and efficiency of the Work.

3. Agenda:
   a. Review of requirements of Drawings and Specifications.
   b. Project and product safety requirements.
   c. Discussion of points of interface and coordination between various trades or products to be used in the Work.
   d. Contractor's schedule for cast-in-place concrete work.
   e. Mix designs, mix tests, and submittals.
   f. Admixture types, dosing, performance, requirements for monitoring, and limits on dosing or re-dosing at the site.
   g. Placement and consolidation methods, techniques, and equipment and the effects of those methods on form pressures.
   h. Slump and limits on placing time or conditions to maintain placeability.
      1) Field adjustment of slump and air content.
   i. Procedures for finishing, curing, and retention of moisture during these operations.
   j. Procedures and protection for hot and cold weather conditions.
   k. Requirements and coordination for inspections.
      1) Responsibility for test specimen curing and storage.
      2) Distribution of test reports.
   l. Other Specification requirements requiring coordination between parties to the work.
4. Prepare and submit minutes of the pre-installation meeting as specified in Section 01312 - Project Meetings.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:
   1. Deliver, store, and handle concrete materials in manner that prevents damage and inclusion of foreign substances.
   2. Deliver and store packaged materials in original containers until ready for use.
   3. Deliver aggregate to mixing site and handle in such manner that variations in moisture content will not interfere with steady production of concrete of specified degree of uniformity and slump.

B. Acceptance at site:
   1. Reject material containers or materials showing evidence of water or other damage.
   2. Concrete mixes: Do not accept or incorporate into the Work concrete mixes that do not comply with the specified requirements for water content, slump, temperature, and air content.

1.08 PROJECT CONDITIONS

A. Cold weather concreting: During periods of cold weather as defined in this Section, implement cold weather concreting procedures in this Section.

B. Hot weather concreting: During periods of hot weather as defined in this Section, implement hot weather concreting procedures in this Section.

1.09 SEQUENCING AND SCHEDULING

A. Schedule placing of concrete in a manner that completes all placing operations from one construction, contraction, or expansion joint to another construction, contraction, or expansion joint.

B. Joints at each end of the placement shall be as indicated on the Drawings, or as identified and accepted in advance by the Engineer.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. It is the intent of this Section to secure, for every part of the Work, concrete with a homogeneous mixture, that, when hardened, will have required strength, watertightness, and durability.

B. It is the intent of this Section to procure a workable, low-shrinkage concrete mix that maximizes aggregate content and minimizes paste content.

C. Performance requirements:
   1. General:
      a. Except as otherwise specified, provide concrete composed of Portland cement, supplemental cementitious materials, aggregate, admixtures and water, proportioned and mixed to produce a plastic, workable mixture in accordance with requirements of this Section, and suitable to specific conditions of placement.
      b. Proportion aggregates to produce an gradation of aggregate that combines fine and coarse aggregate in well-graded proportions that maximizes the aggregate content and minimizes the paste content of the mix. The gradation should maximize long-term durability and strength of the concrete mixture.
      c. Durability requirements will be deemed to be satisfied when:
         1) The mixture is proportioned with a well-graded combined aggregate.
         2) The specified water-cement ratio is satisfied.
         3) The concrete contains the specified range of air content.
         4) The maximum specified paste content is satisfied.
      d. Proportion materials in a manner that will secure the lowest cement content, water-cementitious materials ratio, and paste volume that is consistent with good workability, that provides a plastic and cohesive mixture, and that provides a slump that is within the specified range.

e. Construction and expansion joints have been positioned in structures as indicated on the Drawings, and curing methods have been specified, for purpose of to reduce the number and size of cracks, resulting from normal expansion and contraction expected from the concrete mixes specified.
f. Remove and replace, or repair as specified in this Section, non-conforming work and surfaces with cracks, voids and honeycombs, or surface wetness.

2. Workmanship and methods: Provide concrete work, including detailing of reinforcing, conforming with best standard practices and as set forth in ACI 318, ACI 350, and the ACI Manual of Concrete Practice.

2.02 MATERIALS - GENERAL

A. Water and ice:
1. Water for concrete mixes, for washing aggregate, and for curing concrete: Clean and free from oil and deleterious amounts of alkali, acid, organic matter, or other substances.
2. Non-potable water may be used with the following limits:
a. Chlorides (C 114): 500 1,000 ppm.
b. Sulfates, as SO4 (C 114): 1,500 ppm.
c. Alkalies, as NA2O + 0.658 K20 (C 114): 300 ppm.
d. Total inorganic solids by mass (C 1603): 5,000 ppm.
e. Organic solids by mass (T 26): 300 ppm.
f. pH (T 26): 4 to 9.
g. Oil (visual): No sheen.
3. Comply with the optional chemical limits of ASTM C1602.
4. Do not use water from concrete production operations, or combined water from concrete production operations as defined in ASTM C1602.

2.03 MATERIALS - CONCRETE MIX CONSTITUENTS

A. Water and ice:
1. As specified in the preceding paragraphs.

B. Cementitious materials:
1. Portland cement:
a. In accordance with ASTM C150.
1) Type II Single source: To provide uniformity of appearance, for each structure use only one source, type, and brand of Portland cement for walls and slabs that will be exposed in the finished work.
2) Confirm adequate supply of cement over duration of project before making trial batches or beginning concrete placements.
b. Cement for finishing: Provide cement from same source and of same type as concrete to be finished or repaired.

C. Supplementary cementitious materials:
    1. Fly ash:
        a. Class C or Class F fly ash in accordance with the requirements of ASTM C618, except as modified in this Section.
            1) Class C, may be used in concrete made with Type II Portland cement.
            2) Class F required if used in concrete mixes containing aggregates classified as potentially reactive based on ASTM C1293 or ASTM C1260.
                a) CaO content: Less than 18 percent.
        b. Loss on ignition: Not exceeding 3 percent.
        c. Replace Portland cement at ratio of 1.0 pound fly ash for each pound of cement, up to minimum and maximum replacement as specified in "Requirements for Mix Proportioning."
    2. Slag cement:
        a. Grade 80, 100, or 120 in accordance with ASTM C989, except as modified below:
            1) Fineness: Amount retained on a No. 325 sieve: 20 percent maximum.
            2) Total alkalies Na2O + 0.658 K2O:
                a) Minimum: 0.60 percent.
                b) Maximum: 0.90 percent.

D. Admixtures:
    1. General:
        a. Do not include admixtures, other than those specified, unless written acceptance has been obtained from the Engineer during submittal of mix designs.
        b. Admixtures shall be compatible with concrete constituents and with other admixtures.
            1) All admixtures in a given mix shall be products of the same manufacturer to ensure compatibility.
            2) Admixture manufacturers: One of the following, or equal.
                a) Master Builders Solutions.
                b) Euclid Chemical.
                c) GCP Applied Technologies (formerly W.R. Grace).
                d) Sika Corp.
        c. Do not use admixtures containing chlorides, calculated as chloride ion, in excess of 0.5 percent by weight of cement.
        d. Use in accordance with manufacturer's recommendations. Add each admixture to concrete mix separately.
        e. Admixtures used shall be the same products used in concrete trial batches, or the same products used in concrete represented by submitted field test records.
    2. Air entraining admixture (AEA):
        a. In accordance with ASTM C260, and dosed to provide entrained air percentages specified in this Section.
        b. Provides entrained air as bubbles, evenly dispersed at the time of placement and during curing.

3. Water reducing admixture(WRA):
    a. May be used at the Contractor's option.
    b. Conforming to ASTM C494, Type A (water-reducing).
        1) ASTM C494, Type D (water-reducing and retarding) may be used during periods of hot weather with prior acceptance by the Engineer.
    c. Not containing air-entraining agents.
    d. Liquid form before adding to the concrete mix.
4. High range water reducing admixtures ("super-plasticizers") (HRWR):
    a. Not permitted without acceptance by Engineer.
5. Shrinkage reducing admixture (SRA):
    a. May be used at Contractor's option.
        1) Provide shrinkage reducing admixture in sufficient dosage so as to produce shrinkage within the limits specified.
    b. Not containing expansive agents.
    c. In accordance with ASTM C494, Type S (specific performance).
    d. One of the following, or equal:
        1) Master Builders Solutions: SRA Series.
        2) Euclid Chemical: Eucon SRA Series.
        3) GCP Applied Technologies: Eclipse Series.
6. Set-controlling admixtures:
    a. Shall not be used without prior acceptance from Engineer.
    b. Accelerating admixtures: not permitted.

E. Coloring admixtures:
1. Conduit encasement coloring agent:
    a. Red color concrete used for encasement of electrical ducts, conduits, and similar type items.
    b. Manufacturers: One of the following or equal:
        1) Davis Co., No. 100 Utility Red.
        2) I. Reiss Co., Inc., equivalent product.
        3) Euclid Chemical Co., Increte Division, “Colorcrete Brick Red.”
    c. Conduit encasement concrete: Mix into each cubic yard of concrete 10 pounds of coloring agent.

F. Aggregate:
1. General:
    a. Provide concrete aggregates that are sound, graded as specified, and free of deleterious material in excess of allowable amounts specified.
    b. Provide aggregates to produce in place concrete with unit weight as follows:
        1) Normal weight concrete: Not less than 140 pounds per cubic foot.
    c. Do not use aggregate made from recycled materials such as crushed and screened hydraulic-cement concrete, brick, and other construction materials.
    d. Do not use aggregate recycled from fresh concrete returned to the batching facility.
2. Alkali-silica reactivity:
    a. Provide aggregate classified as aggregate-reactivity class of R0 in accordance with ASTM C1778 with expansion not greater than 0.10 percent at 14 days when tested in accordance with ASTM C1260,

and not greater than 0.04 percent at one year when tested in accordance with ASTM C1293.

3. Fine aggregate:
   a. Material graded such that 95 to 100 percent of material passes the No. 4 (4.75 mm) sieve, when sampled in accordance with ASTM D75 and D3665, and tested in accordance with ASTM C136.
   b. Provide fine aggregate consisting of clean, natural sand, or sand prepared from crushed stone or crushed gravel.
   c. In accordance with ASTM C33 requirements for grading, deleterious substances, soundness, and alkali reactivity, except as modified in the following paragraphs.
      1) Grading: For sieve sizes listed in ASTM C33 for fine aggregate, not more than 45 percent passing any sieve and retained on the next consecutive sieve.
      2) Deleterious substances: not in excess of the percentages by weight specified in Table 1 of this Section.

Table 1: Fine Aggregate, Limits on Deleterious Substances

Item	Test Method	Percent (maximum)
Materials finer than No. 200 sieve(2)	ASTM C117	3.00(2)
Clay lumps and friable particles	ASTM C142	1.00
Lightweight particles (SG < 2.40)	ASTM C123	1.00
• Chert or shale(1)	ASTM C295	1.00(1)
Coal and lignite	ASTM C123	0.50

Notes:
(1) ASTM C123 tests for particles in the sample having a specific gravity less than 2.40. ASTM C295 is used to identify which of those lightweight particles are chert, shale, or coal and lignite. If testing under ASTM C123 indicates a combined percentage of lightweight particles (sum of shale, chert, coal and lignite) not greater than 1.00, testing under ASTM C295 will not be required.
(2) For manufactured sand, if material finer than the No. 200 sieve consists of crusher dust and the aggregate is essentially free of clay or shale, maximum percentage may be increased to 5.0 percent.

      3) Organic impurities: Free of injurious amounts of organic matter and producing a supernatant liquid with color not darker than “standard color” when tested in accordance with ASTM C40.
      4) Soundness: In accordance with requirements of ASTM C33 when tested in accordance with ASTM C88 using sodium sulfite solution.
4. Coarse aggregate:
   a. Materials graded such that not more than 10 percent of material passes the 3/8-inch sieve, when sampled in accordance with ASTM D75 and D3665, and tested in accordance with ASTM C136.
   b. Consisting of gravel, crushed gravel, crushed stone, or a combination of these materials having clean, hard, durable particles free from calcareous coatings, organic matter, or other deleterious substances.

c. Conforming to the requirements of ASTM C33, Class 4S for physical properties, deleterious substances, and alkali reactivity, except as modified in the following paragraphs.
   1) Grading:
      a) Size number as specified in ASTM C33, and as indicated in Table 3 of this Section, except as otherwise specified or accepted by the Engineer.
      b) Weights of flat or elongated particles (particles having a length greater than 3 times average width or thickness) not exceeding 15 percent when tested in accordance with ASTM D4791.
   2) Deleterious substances: Not in excess of the percentages by weight specified in Table 2 of this Section and having total of all deleterious substances exceeding 2 percent.

Table 2: Coarse Aggregate, Limits on Impurities

Item	Test Method	Percent (maximum)
Clay lumps and friable particles	ASTM C142	0.50
Lightweight particles (SG < 2.40)	ASTM C123	1.25
• Chert or shale(1)	ASTM C295	1.00(1)
Materials finer than No. 200 sieve	ASTM C117	0.50(2)
Coal and lignite	ASTM C123	0.25

Notes:

(1) ASTM C123 tests for particles in the sample having a specific gravity less than 2.40. ASTM C295 is used to identify which of those lightweight particles are chert, shale, or coal and lignite. If testing under ASTM C123 indicates a combined percentage (sum of shale, chert, coal and lignite) not greater than 1.25, testing under ASTM C295 will not be required.

(2) When material finer than No. 200 sieve consists of crusher dust, maximum percentage may be increased to 1.00 percent. When mix design complies with provisions of ASTM C33, Table 4, footnote C, the maximum percentage may be increased in accordance with the equation in footnote C, up to a maximum of 1.5 percent.

   3) Abrasion loss: Loss not greater than 45 percent after 500 revolutions when tested in accordance with ASTM C131.
   4) Soundness: Loss not greater than 10 percent when tested in accordance with ASTM C88 using sodium sulfate solution.

2.04 MATERIALS FOR PLACING, CURING AND FINISHING

A. General:
   1. Materials shall be compatible with concrete and with other materials.

B. Cement grout:
   1. Use: For spreading over surface of construction and cold joints in concrete before placing additional concrete above those joints.
   2. As specified in Section 03600 - Grouting.

C. Concrete sealer:
   1. As specified in Section 03366 - Tooled Concrete Finishing.
   2. Not for use in water-containment structures.

D. Evaporation retardant:
   1. Use: For mitigating surface moisture evaporation from freshly placed concrete during rapid drying conditions. Placed after screeding.
   2. Waterborne, monomolecular, spray-applied compound, with fugitive dye to indicate coverage.
   3. Manufacturers: One of the following or equal:
      a. Master Builders Solutions, MasterKure ER 50.
      b. Euclid Chemical Co., Eucobar.

E. Nonslip abrasive:
   1. Aluminum oxide abrasive size 8/16, having structure of hard aggregate that is, homogenous, nonglazing, rustproof, and unaffected by freezing, moisture, or cleaning compounds.
   2. Manufacturers: One of the following or equal:
      a. Exolon Co.
      b. Abrasive Materials, Inc.
      c. “Non-Slip Aggregate”, Euclid Chemical Co.

F. Plastic membrane for curing:
   1. Polyethylene film: In accordance with ASTM C171.
   2. Properties:
      a. Color: White.
      b. Thickness: Nominal thickness of polyethylene film shall not be less than 0.0040 inches when measured in accordance with ASTM D2103. Thickness of polyethylene film at any point shall not be less than 0.0030 inches.
      c. Loss of moisture: Not exceed 0.055 grams per square centimeter of surface when tested in accordance with ASTM C156.

G. Sprayed membrane curing compound:
   1. Combination curing and sealing products ("cure and seal") will not be permitted.
   2. Properties:
      a. Clear type with fugitive dye conforming with ASTM C309, Type 1D and containing no wax, paraffin, or oils.
      b. For concrete placed or cured during hot weather, curing compound shall be as specified, except that:
         1) It shall include a white, reflective fugitive dye.
         2) Moisture loss during a 72-hour period shall not exceed 9 pounds per cubic yard when tested in accordance with ASTM C156.

H. Surface-applied sealing system:
   1. Manufacturers: One of the following or equal:
      a. Euclid Chemical Co., Vandex Super.
      b. Kryton International, Inc., Krystol T1.
      c. Xypex Chemical Corp., Xypex Concentrate.
   2. Where surface-applied sealing system is placed over concrete containing permeability reducing admixture for concrete exposed to hydrostatic conditions (PRAH), provide products of same manufacturer providing the admixture.

2.05 EQUIPMENT

A. General:
   1. Provide adequate equipment and facilities for accurate measurement and control of materials and for readily changing proportions of material into mixers.

B. Batching equipment, or batch plant.
   1. Capable of controlling delivery of all material to mixer within 1 percent by weight of individual material.

C. Mixing equipment:
   1. Mixers may be of stationary plant, paver, or truck mixer type, as appropriate to the Work.
   2. Capable of combining aggregates, water, and cementitious materials, and admixtures within specified time into a thoroughly mixed and uniform mass, and of discharging the mixture without segregation.
      a. Maintain concrete mixing equipment in good working order, and operate at loads, speeds, and timing recommended by manufacturer or as specified.
      b. Proportion cementitious materials and aggregate by weight.
   3. If bulk cementitious materials are used, weigh them on separate visible scale which will accurately register scale load at any stage of weighing operation from zero to full capacity.
   4. Prevent cementitious materials from coming into contact with aggregate or with water until materials are in mixer ready for complete mixing with all mixing water.
   5. Procedure of mixing cementitious materials with sand or with sand and coarse aggregate for delivery to project site, for final mixing and addition of mixing water will not be permitted.
   6. Retempering of concrete will not be permitted.
   7. Discharge entire batch before recharging.
   8. Volume of mixed material per batch: Not exceed manufacturer's rated capacity of mixer.
   9. Equip each mixer with device for accurately measuring and indicating quantity of water entering concrete, and operating mechanism such that leakage will not occur when valves are closed.
   10. Equip each mixer with device for automatically measuring, indicating, and controlling time required for mixing:
      a. Interlock device to prevent discharge of concrete from mixer before expiration of mixing period.

11. Transit-mixed concrete:
    a. Mix and deliver in accordance with ASTM C94.
    b. Total elapsed time between addition of water at batch plant and discharging completed mix:
    c. Not to exceed 90 minutes.
    d. Elapsed time at project site shall not exceed 30 minutes.
    e. Under conditions contributing to quick setting, total elapsed time permitted may be reduced by the Engineer.
    f. Equip each truck mixer with device interlocked to prevent discharge of concrete from drum before required number of turns and furnish device that is capable of counting number of revolutions of drum.
12. Continuously revolve drum after it is once started until it has completely discharged its batch:
    a. Do not add water until drum has started revolving.
    b. Right is reserved to increase required minimum number of revolutions or to decrease designated maximum number of revolutions allowed, if necessary, to obtain satisfactory mixing. The Contractor will not be entitled to additional compensation because of such increase or decrease.

D. Other types of mixers: For other types of mixers, mixing shall be as follows:
    1. Mix concrete until there is uniform distribution of materials, and discharge mixer completely before recharging.
    2. Neither speed nor volume loading of mixer shall exceed manufacturer's recommendations.
    3. Continue mixing for minimum of 1-1/2 minutes after all materials are in drum, and for batches larger than 1 cubic yard increase minimum mixing time 15 seconds for each additional cubic yard or fraction thereof.

2.06 CONCRETE MIXES

A. General:
    1. Develop and provide mix design for each Concrete Class listed in Table 3 of this Section.
    2. Select and proportion mixes and document properties using one of the two methods that follow. Procedures and requirements for use of each alternative are specified in subsequent paragraphs of this Section.
        a. Field experience method.
        b. Trial batch method.
    3. Organize and submit mix designs with data on all constituent materials and products for that mix, for Engineer's review.
    4. Do not place concrete until the mix design for that Concrete Class has been accepted by Engineer.
    5. After acceptance, do not modify accepted mixes or provide new mixes without Engineer's prior review and acceptance of the proposed alternative.
        a. Exception: At all times, adjust batching of water to compensate for free moisture content of the fine aggregate used.
        b. For any change to approved mixes, Engineer may require new trial batching and testing program as specified in this Section before acceptance and use.

c. For any change to approved mixes, make modifications within limits set forth in this Section.
d. If there is change in source or quality of any constituent of the concrete class or mix, the revised mix will be considered a new class of concrete and shall require full re-submittal of all data describing mix constituents, design, and testing.

6. Material sampling, mix designs, trial batch preparation and testing, modifications to mix designs, and any re-testing required to satisfy the requirements of this Section or to obtain satisfactory performance shall be at Contractor's expense and shall not be considered cause for delay.

B. Measurements of materials:
1. Measure materials by weighing, except as otherwise specified or where other methods are specifically authorized in writing by the Engineer.
2. Furnish apparatus for weighing aggregates and cementitious materials that is suitably designed and constructed for this purpose.
3. Accuracy of weighing devices: Furnish devices that have capability of providing successive quantities of individual material that can be measured to within 1 percent of desired amount of that material.
4. Measuring or weighing devices: Subject to review by the Engineer. Shall bear valid seal of the Sealer of Weights and Measures having jurisdiction.
5. Weighing cementitious materials:
a. Weigh cementitious materials separately.
b. Cement in unbroken standard packages (sacks): Need not be weighed.
c. Weigh bulk cementitious materials and fractional packages.
6. Measure mixing water by volume or by weight.

C. Requirements for mix proportioning:
1. Develop and provide mixes that:
a. Can be readily worked into corners and angles of forms and around reinforcement, without excessive vibration, and without permitting materials to segregate or free water to collect on surface.
b. Prevent unnecessary or haphazard changes in the consistency of the concrete supplied.
2. Constituent materials:
a. Provide concrete mixes composed of Portland cement, blended aggregates, admixtures and water.
1) Admixtures required for each concrete class are indicated in Table 3 of this Section. Admixtures not specifically required by that table for a specific Concrete Class are optional and may be included at the discretion of the Contractor based on Contractor's planned means and methods of construction.
b. In no case shall returned fresh concrete or its constituents be incorporated into concrete batched for the Work.
3. Minimum specified compressive strength:
a. Minimum specified compressive strength is designated at 28 days, unless otherwise indicated in Table 3 of this Section.
b. For locations where the placed concrete is adequately protected and is not subjected to loads for an extended period during construction, the Contractor may request that the period for achieving the minimum specified compressive strength be extended to 56 days. If accepted by the

Engineer, provide mixes that achieve at least 75 percent of their minimum specified compressive strength after 28 days.

4. Proportions and consistency:
    a. Ratio of water to cementitious materials, and cementitious materials content:
        1) Conform to maximum and minimum cementitious material content requirements specified in Table 3 of this Section.
        2) Cementitious materials content: Consisting of Portland cement as indicated in Table 3 of this Section, plus supplemental cementitious materials if aggregate testing indicates potentially reactive aggregates:
            a) Fly ash content:
                (1) Minimum: 15 percent of the total weight of cementitious materials.
                (2) Maximum: 25 percent of the total weight of cementitious materials.
            b) Slag cement content:
                (1) Minimum: 20 percent of the total weight of cementitious materials.
                (2) Maximum: 30 of the total weight of cementitious materials.
    b. Aggregate size and content:
        1) Blend aggregates to produce an optimized gradation that combines well-graded coarse, intermediate, and fine aggregates in proportions that maximize the aggregate content of the mix, and that minimize the cement paste content of the mix.
            a) Percentage of individual fractions of the combined aggregate gradation retained on individual sieve sizes: Within the range shown in Attachment C - Combined Aggregate Gradation Chart ("Tarantula Curve").
            b) Sum of the percentages of individual fractions retained on the No. 8, No. 16, and No. 30 sieves: Greater than 20 percent.
            c) Sum of the percentages of individual fractions retained on the No. 30, No. 50, No. 100, and No. 200 sieves: Within the range of 25 percent to 40 percent.
    c. Determine bulk density and void content of the combined gradation of aggregates in accordance with ASTM C29. Results for combined aggregates shall not be the summation of results of testing of the individual gradations.
        1) Sample the combined aggregate from a flowing aggregate stream or conveyor in accordance with ASTM D75. Take care to ensure that the sample is representative of the proportions of the combined aggregate of the proposed mix.
        2) Reduce sample of combined aggregate to test sample size in accordance with ASTM C702, Method A - mechanical splitter or Method B - quartering.
        3) Perform bulk density test of combined aggregate in accordance with ASTM C29, Procedure A - rodding.
        4) Determine void content of the combined aggregate in accordance with ASTM C29, Procedure A - rodding. Specific gravity of the combined aggregate shall be determined in accordance with ASTM C136.

d. Paste content: Limited to the following:
    1) Class A mixes without air entrainment: Maximum 28 percent measured by volume.
    2) Class A mixes with air entrainment: Maximum 28 percent measured by volume plus the target air content.
    3) Paste content shall be limited to 175 percent of the void content of the combined aggregate gradation determined by ASTM C29.
e. Total water content:
    1) Not exceeding the water to cementitious material ratio specified in Table 3 of this Section.
    2) Not exceeding 245 pounds of water per cubic yard of concrete for Class A mix.
f. Coarseness/workability (Shilstone Method):
    1) Proportion mixes to fall into the "Optimal" zone (Zone II) when plotted on the Coarseness Factor Chart ("Coarseness Factor" versus "Workability Factor") included as Attachment B - Coarseness Factor Chart to this Section. Provide plot for each Class A mix to be used in the Work.
    2) Coarseness factor (CF) for each mix shall be calculated as the percent of the combined aggregate gradation retained on the 3/8-inch sieve, divided by the percent of the combined aggregate gradation retained on the Number 8 sieve, multiplied by 100: or:

$$CF = \frac{(\%\ \text{retained on 3/8” sieve})}{(\%\ \text{retained on No. 8 sieve})} \times 100$$

    3) Workability factor (WF) for each mix shall be the percent of the combined aggregate gradation retained on the Number 8 sieve, adjusted for cement content in the mix.
        a) Determine volume of total cementitious material in the mix.
        b) For each 94 pounds of Portland cement content above 564 pounds per cubic yard, increase workability factor by 2.5 units.
        c) For each 94 pounds of Portland cement below 564 pounds per cubic yard, decrease workability factor by 2.5 units.
        d) Proportion adjustment factor by linear interpolation for each fraction of 94 pounds above or below the 564 pound basis.
        e) Example:
        650 pounds per cubic yard = 564 pounds + 86 pounds.
        Adjustment = (86 lb / 94 lb) x 2.5 = + 2.28.

D. Concrete Classes for use in the Work:
    1. Provide concrete classes listed in Table 3 of this Section.
    2. Provide normal weight concrete, having minimum weight of 140 pounds per cubic foot, unless otherwise noted.
    3. Pumped concrete:
        a. Provide pumped concrete that complies with all requirements of this Section.
        b. Mixes placed by pumping shall be considered a sub-class of each concrete class listed in Table 3 of this Section. Prepare and submit a separate mix design for each mix to be placed by pumping.

4. Class PM concrete: In addition to the requirements of Table 3 of this Section, conform to the following:
    a. Minimum 28 day flexural strength: 650 psi when tested in accordance with ASTM C293.
    b. Cementitious materials content: 75 percent Portland cement plus 25 percent Class F fly ash (by weight).
    c. Aggregate:
        1) Minimum 55 percent coarse aggregate conforming to ASTM C33 size number 357 or size number 467.
        2) Substitute ASTM C33 size number 57 or size number 67 if mechanical paving equipment is not used.

Table 3: Concrete Classes									
Concrete Class[1]	**Minimum Specified Compressive Strength at 28 days, f'c [2] (pounds per square inch)**	**Ratio of water to cementitious materials[3] (minimum - maximum).**	**Cementitious Materials Content (pounds per cubic yard of concrete by weight)[4]**	**Cement Type**	**Maximum Chloride Content (percent by weight of cement)**	**Maximum Size of Coarse Aggregate (ASTM C33)**	**Air Entrainment (percent), (n/a : not applicable)**	**Admixtures required[4,5,6]**	**Slump Range (inches)**
A	4,500	0.40 to 0.42	535 to 575	II	0.30	#57	6±1.5	AEA WRA	2 to 4
A-NA	4,500	0.40 to 0.45	535 to 575	II	0.30	#57	n/a	WRA	2 to 4
C	2,500	0.62 max.	min. 423	II	No limit	#57	6±1.5	AEA WRA	3 to 6
CE	3,000	0.62 max.	min 423	II	No limit	#8	5±1.5	AEA WRA	3 to 6
PM	5,000	0.40	535 to 575	II	0.15	#57	5+1.5	AEA WRA	3 to 6

Notes:

(1) Sub classes within major concrete classes are designated as follows:

NA: Without air entrainment.

(2) At locations where concrete will not be subjected to load from other elements of the structure or from Contractor's placing and/or backfilling operations, maximum time period for achievement of specified compressive strength may be extended to 56 days when accepted by the Engineer.

(3) W/C Ratio = Ratio of water to cementitious materials (Portland cement plus supplemental cementitious material) by weight. Include weight of admixtures in the water content of the mix when the quantity of the admixtures exceeds 10 ounces per 100 pounds of cement.

(4) Cementitious material includes Portland cement plus supplemental cementitious materials. If trial batch testing demonstrates that the required strength cannot be met at 28 or 56 days with the specified combined aggregate gradation and the paste content limits, cementitious material content may be increased with Engineer's approval if a shrinkage-reducing admixture (SRA) is included in the mix design.

(5) Admixtures are designated as follows:

AEA: Air entraining admixture

HRWR: High-range water-reducing admixture SRA: Shrinkage-reducing admixture.

SFR: Synthetic fiber reinforcement.

WRA: Water-reducing admixture

PRAH: Permeability-reducing admixture for concrete exposed to hydrostatic conditions.

E. Install Concrete Classes in accordance with the following requirements unless otherwise indicated on the Drawings.
   1. Class A concrete: Structural concrete:
      a. Use Class A concrete at all locations unless other Classes are specified or indicated on the Drawings.
   2. Class A-NA concrete: Structural concrete without air entrainment.
      a. Class A-NA concrete may be used in lieu of Class A at indoor slabs (not subject to freezing and thawing) where inclusion of an air-entraining admixture makes it difficult to achieve the specified concrete finish.
   3. Class C concrete: Miscellaneous concrete fill and encasement.
      a. Class C concrete may be used for fill for unauthorized excavation, for thrust blocks and ground anchors for piping, for bedding of pipe, and where indicated on the Drawings.
   4. Class CE concrete: Use Class CE for electrical conduit encasements.
   5. Class PM concrete: Use for concrete pavement, cart paths, curbs, gutters, and sidewalks.

F. Concrete mix design documented by field experience:
   1. Mix design:
      a. Prepare preliminary mix design for each Concrete Class. Submit mix design with product and testing data for materials to be used in the mix for Engineer's review.
   2. Historical records for similar mix.
      a. Determinations of similarity of materials and proportions between historical and proposed mixes shall be by the Engineer, and that shall be final.
      b. Historical record - Materials:
         1) Submit with each mix design the following data for a previously-supplied concrete mix similar to that proposed for this Work.
         2) Records demonstrating that the previously supplied mix included similar materials and proportions as those of the proposed mix.
            a) Documentation that the same concrete supplier will provide both mixes.
            b) Documentation that the materials used was from the same suppliers and had essentially the same properties, demonstrated by test data, as those proposed.
            c) Documentation that proportions of materials in the record mix are essentially the same as those proposed and that the specified compressive strength of the record mix is within 1,000 pounds per square inch of that required by this Section.
            d) Concrete supplier's statement describing any changes made to production of the record mix during the time period reported.
            e) Concrete supplier's statement that preparation and quality control procedures for the record mix were essentially the same as those to be employed for this Work.
      c. Historical record - Testing:
         1) Submit with each record mix, corresponding test data for slump, compressive strength (with relationships for rate of strength gain between testing ages), and drying shrinkage.
         2) Only records satisfying the following requirements will be accepted.
            a) All tests were conducted within a period of 1-year preceding the date of the submittal.
            b) All tests were conducted over a period including not less than 45 days.

c) The record of compressive strength testing includes at least 30 tests for slump and 28-day compressive strength.
d) The record of compressive strength tests is consecutive. In other words, it includes all tests conducted on the subject mix within the 1-year time period described above (not just selected tests during that period).
e) Submit concrete supplier's sworn statement confirming that all tests for the record mix have been reported.
f) Tests for drying shrinkage are described in subsequent paragraphs of this Section for "concrete mix design documented by trial batch preparation and testing,"
g) Provide supplementary testing if requested by Engineer.

d. For mixes determined to be similar and to have an acceptable test history, acceptance criteria shall be as follows:
1) Acceptance criteria:
a) Slump: All tests within limits specified for record mix.
b) Compressive strength: Average compression strength for tests, as determined by ACI 318 and ACI 350 not less than minimum required average strength.
c) Drying shrinkage: Within limits stated in subsequent paragraphs of this Section for "concrete mix design documented by trial batch preparation and testing."

G. Concrete mix design documented by trial batch preparation and testing:
1. Mix design and trial batches:
a. Prepare preliminary mix design for each Concrete Class. Submit mix design with product and testing data for each combination of materials and proportions to be used for Engineer's review.
1) Determine water content of the mix based on curves showing the relation between water-cementitious materials ratio and the 7 and 28 day compressive strength of the concrete.
2) Determine each curve using 4 or more points, each representing the average compressive strength value of at least 3 specimens tested at each age.
b. After materials and proposed mix designs have been accepted by Engineer, have trial batches for each concrete mix design prepared by Contractor's testing laboratory.
1) Prepare trial batches using the cementitious materials, aggregates, and admixtures proposed to be used for the Work.
2) Provide batches of sufficient quantity to determine slump, workability, consistency, setting time, and finishing characteristics, and to provide sufficient specimens for testing.
c. For each trial batch, make and test specimens to determine and report slump, compressive strength (with relationships for rate of strength gain between testing ages), and drying shrinkage.
1) If trial batches do not produce concrete conforming to the specified requirements for slump, strength, workability, consistency, drying shrinkage, restrained shrinkage, and finishing, change mix proportions and, if necessary, sources of materials.
2) Make additional trial batches and perform additional tests until a batch that conforms to requirements of this Section is produced.

2. Testing - Slump:
    a. Determine slump in accordance with ASTM C143.
    b. Acceptance criterion: Slump within range specified.
3. Testing - Compressive strength:
    a. Prepare 4 inch diameter by 8 inch long cylinders in accordance with ASTM C31 for tests specified in this Section.
    b. Determine average compressive strength:
        1) Test at least 12 cylinders from each trial batch for compressive strength in accordance with ASTM C39.
        2) Test 4 cylinders at 7 days, another 4 at 28 days, and another 4 at 56 days**.** Deliver 1 final cylinder to Engineer at 56 days.
        3) Calculate average compression strength for 7 day tests, for 28 day tests, and for 56 day tests.
        4) Calculate ratios for:
            a) Average 7 day strength to average 28 day strength.
            b) Average 28 day strength to average 56 day strength.
    c. Determine the required average compressive strength for each mix, f'cr, as described in the following paragraphs:
        1) Calculate required average compressive strength (f'cr) based on the minimum specified 28-day compressive strength, f'c, plus a standard deviation determined from the test history available for that mix.
        2) Determine f'cr as specified in ACI 318 and ACI 350, except as modified in the following paragraphs.
            a) Where 15 or more 28-day compressive strength tests are available, calculate standard deviation as described in the preceding paragraphs for "concrete mix design documented by field experience." Add this standard deviation to the specified minimum compressive strength to determine the required average compressive strength (f'cr) for the mix.
            b) Where fewer than 15 compressive strength tests at 28-days are available, determine minimum required compressive strength, (f'cr) from Table 4 of this Section.

Table 4: Required Average Compressive Strength, Fewer than 15 Tests Available

Minimum Specified Compressive Strength, f'c (pounds per square inch)	Required Average Compressive Strength, f'cr (pounds per square inch)
Less than 3,000	f'c + 1,000
3,000 to 5,000	f'c + 1,200
Over 5,000	f'c + 1,400

    d. Acceptance criterion: Average compressive strength of the 4 cylinders tested at 28 days, or of the 4 cylinders tested at 56 days when permitted by the Engineer, shall equal or exceed the required average compression strength, f'cr for that concrete mix design.
4. Testing - Chloride content:
    a. Submit test results showing that the concrete mix contains water-soluble chloride ion content contributed from the constituents including water, aggregates, cementitious materials, and admixtures is less than the limit specified in Table 3 of this Section. Test shall be performed in accordance with ASTM C1218 at age between 28 and 42 days.

5. Testing - Drying shrinkage - Prism specimens:
    a. Class A (including A, A-NA, A-SP, and A-NA-SP) and Class PM: From trial batch for each mix, prepare 10 drying shrinkage specimens in accordance with ASTM C157 Divide specimens into 2 groups of 5 specimens each: One group including shrinkage-reducing admixture, and one group without shrinkage-reducing admixture.
    b. Prepare, cure, and test both groups in accordance with ASTM C157, except as modified in the following paragraphs.
        1) Remove drying shrinkage specimens from molds at age of 23 hours plus or minus 1 hour after trial batching.
            a) Immediately place them in lime-saturated water maintained at 73 degrees Fahrenheit plus or minus 3 degrees for at least 30 minutes.
            b) Remove specimens from the water, and wipe with a damp cloth.
            c) Measure to nearest 0.0001 inch to determine original length.
            d) Record measurements and re-submerge specimens in lime-saturated water at 73 degrees Fahrenheit plus or minus 3 degrees for moist curing.
        2) Maintain submerged curing conditions at 73 degrees Fahrenheit plus or minus 3 degrees for 7 days. 7 days after batching, remove specimens from water and repeat measuring procedures.
        3) Immediately store specimens in a humidity controlled room maintained at 73 degrees Fahrenheit plus or minus 3 degrees, and at 50 percent relative humidity plus or minus 4 percent for remainder of the test.
        4) At periods of 14, 21, 28 and 56 days after batching, remove specimens from curing room and repeat measurements.
    c. Drying shrinkage test report:
        1) Report measurements of all specimens at 1, 7, 14, 21, 28, and 56 days after batching.
        2) Using measured length at 7 days as base length for drying shrinkage, calculate the following for each measuring period:
            a) Drying shrinkage of each specimen. Determine as difference between the 7-day base length and measured length for each period.
            b) Average of these differences. If drying shrinkage of any specimen departs from the average of the measurements for each period by more than 0.0004 inch, disregard results obtained from that specimen.
            c) Percentage of drying shrinkage from batching to date of measurement.
    d. Drying shrinkage acceptance criteria:
        1) Average shrinkage of trial batch concrete specimen group at 28 days after batching, when measured and cured as indicated, shall not exceed 0.035 percent.
    e. Mixes accepted by Engineer:
        1) Retain drying shrinkage test specimens. Bag in re-sealable plastic bags and submit to Engineer.
        2) Indicate trial batch identifier, specimen number, and date of final measurements on each specimen bag.

2.07 SOURCE QUALITY CONTROL

A. Sample and test materials in accordance with the following requirements:
    1. Sampling, testing, and reporting frequency:
        a. In preparation for mix design submittals and trial batch tests.

b. Whenever there is a change in source of the material, or a significant change in the characteristics or quality of materials from the same source.
c. For each 10,000 cubic yards of concrete mix produced.
d. At intervals not exceeding 90 calendar days, unless otherwise specified in the following paragraphs.

2. Supplemental cementitious materials.
   a. Sample and test fly ash in accordance with ASTM C311.
   b. Sample and test slag cement in accordance with ASTM C989.
3. Aggregate:
   a. Sample combined aggregate in accordance with ASTM D75 and D3665, and test for gradation in accordance with ASTM C136.
   b. At least once every 30 days, and when requested by the Engineer.
   c. Submit test results.
4. Portland cement:
   a. Sample and test Portland cement and provide mill certificates demonstrating compliance with ASTM C150, and additional requirements of this Section.
      1) Determine alkali content by method set forth in ASTM C114.
   b. At least once every 90 days, and when requested by the Engineer.
   c. Submit test results.

B. Batch materials in accordance with the following requirements:
1. Concrete batch weights: Control and adjust so as to secure maximum yield, and at all times maintain proportions of concrete mix within specified limits.
2. Aggregates:
   a. Obtain aggregate from a source capable of providing uniform quality, moisture content, and grading during any single day's operation.
   b. Furnish satisfactory means at batching plant for checking moisture content of fine aggregate for each batch.
3. Admixtures:
   a. Batch solutions using mechanical batcher capable of accurate measurement.
   b. Air entraining admixture: Add to batch in portion of the mixing water, unless otherwise recommended by the admixture manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

A. Prepare and submit mix designs for each Concrete Class indicated in Table 3 of this Section.

B. Submit proposed sequence of concrete placements. After acceptance, adhere to proposed sequence of placing concrete, except when specific changes are requested by the Contractor and accepted by the Engineer.
1. Use construction methods and sequence work to allow concrete placement to reach adequate strength and to be constructed with required support to prevent overstress of the concrete structure during construction.

C. Make provisions for monitoring weather conditions:
1. Install an outdoor weather station capable of measuring and recording ambient temperature, wind speed, and humidity. Furnish instruments accurate to within 2 degrees Fahrenheit, 5 percent relative humidity, and 1 mile per hour wind speed.

2. Monitor the weather forecast beginning at least 48 hours prior to any concrete placement and make provisions for cold weather concreting or hot weather concreting if those conditions exist or are forecast to exist during the period of placement, finishing, and curing.
    a. Record temperature, relative humidity, and wind speeds for each placement beginning at least 24 hours before scheduled delivery of concrete.

D. Place no concrete without Engineer's prior acceptance of conditions.

E. Notify the Engineer in writing that all preparations are complete and ready for placement of concrete. Such notification shall indicate readiness - not just intention - to place concrete for the designated portion of the Work.
    1. Submit notification to Engineer on forms provided by or acceptable to the Engineer and bearing the signature of Contractor's superintendent.
        a. Sample form is included at the end of this Section, see Attachment B - Coarseness Factor Chart.
    2. Submittal of notification will be Contractor's certification that preparations are complete and in accordance with the Contract Drawings and Specifications.
    3. Provide notification for Engineer to make final observations at the locations of concrete placements not less than 24 hours before commencing placement of concrete.

3.02 CONCRETE JOINTS

A. Locations of joints are indicated on the Drawings.
    1. In order to preserve strength and watertightness of structures, make no other joints, except as authorized by the Engineer.
    2. Construct joints where indicated, and as indicated on the Drawings.
    3. Where joint locations are not indicated on the Drawings, submit Contractor's proposed locations for Engineer's review and acceptance. Provide construction joints in slabs and walls at intervals not greater than 35 feet.

B. Time between placements of adjacent concrete separated by joints.
    1. Provide not less than 3 days (72 hours) between placement of adjacent sections for the following:
        a. Slabs.
        b. Walls.
    2. Provide not less than 7 days (168 hours) between placement of the lower and upper pours for the following:
        a. Walls over slabs.
        b. Slabs over walls.
        c. Slabs keyed into the sides of walls.

C. Edges of joints:
    1. Provide joints have edges detailed as indicated on the Drawings.
    2. Protect wall and slab surfaces at edges from concrete splatter. Thoroughly clean adjacent surfaces after completion of each placement.

D. Joint construction:
    1. Preparation of forms:
        a. Provide cleanout holes at base of each wall and column for inspection and cleaning.

b. Wash forms and adjacent joint surfaces of sawdust, chips, and other debris after forms are built, and immediately before concrete or grout placement.
c. Should formwork confine sawdust, chips, or other loose matter in such manner that it is impossible to remove them by flushing with water, use a vacuum cleaner for their removal, and then flush cleaned surfaces with water.

2. Before placing concrete against previously placed concrete, thoroughly clean the prior placement of laitance, grease, oil, mud, dirt, curing compounds, mortar droppings, or other objectionable matter by means of pressure washing.
3. Provide and install waterstops, expansion joint material, and other similar materials as indicated on the Drawings and as specified.
   a. Take special care to ensure that waterstops are secured in proper position.
   b. Take special care to ensure that concrete is well consolidated around and against waterstops during placement.
4. Horizontal joints:
   a. As initial placement over cold joints, thoroughly spread bed of cement grout as specified in Section 03600 - Grouting.
      1) Thickness: not less than 1/2 inch nor more than 1 inch.
   b. For wall placements above planned cold joints, placement of cement grout will not be required for locations where the wall mix includes high-range water-reducing admixture (“superplasticizers”), and the Contractor can demonstrate dense concrete joints without voids or honeycomb after the forms are removed.

3.03 MEASURING AND BATCHING MATERIALS

A. Measurements of materials:
   1. Proportion and measure cementitious materials and aggregates by weight.
      a. Weigh cementitious materials separately.
      b. If bulk cementitious materials are used, weigh them on separate visible scale that will accurately register scale load at any stage of weighing operation from zero to full capacity.
      c. Cement in unbroken standard packages (sacks) need not be weighed.
   2. Mixing water: Measure by volume or by weight.
   3. Other mix constituents: Measure by weight, except as otherwise specified or accepted by the Engineer.
   4. Weighing and measuring devices:
      a. Use equipment designed and constructed specifically for that purpose.
      b. Furnish devices capable of weighing successive quantities of individual material measured to within 1 percent of desired weight of that material.
      c. Bearing valid seal of the department of weights and measures for the authority having jurisdiction over the Work.
   5. Measurements and measuring devices:
      a. Subject to review by the Engineer.

B. Batching:
   1. Admixtures shall be added at the concrete batch plant.
   2. Addition of admixtures in the field is permitted only with prior acceptance by the Engineer, and only when the following conditions are satisfied:
      a. The dosage and mixing is personally overseen by concrete supplier's trained technologist.
      b. Adequate mixing is provided after addition.

c. The maximum time to placement of concrete remains 90 minutes after water added to mix - not 90 minutes after any field additions/adjustments.
d. Slump at discharge after additions/modifications conforms to the requirements of Table 3 of this Section.

3.04 MIXING AND TRANSPORTING

A. Machine mixing:
1. Prevent cementitious materials from coming into contact with aggregate or with water until materials are in mixer and ready for complete mixing with all mixing water.
2. Procedure of mixing cementitious materials with sand, or with sand and coarse aggregate, for delivery to project site for final mixing and addition of mixing water is not permitted.
3. Remixing of concrete that has started to take its initial set (“retempering”) is not permitted.
4. Discharge entire batch before recharging.
5. Volume of mixed material per batch: Not exceeding manufacturer's rated capacity of mixer.

B. Transit-mixed concrete:
1. Mix and deliver in accordance with ASTM C94, except as modified in this Section.
2. Total elapsed time between addition of water at batch plant and discharging completed mix:
a. Not to exceed 90 minutes nor 300 revolutions of the mixing drum.
b. Under conditions contributing to rapid setting, total elapsed time permitted may be reduced by the Engineer.
3. Temperature - minimum and maximum allowable during mixing and transporting:
a. Minimum: 50 degrees Fahrenheit.
b. Maximum: 90 degrees Fahrenheit.
4. Continuously revolve drum after it is started until it has completely discharged its batch.
a. Do not add water until drum has started revolving.
b. Engineer reserves the right to increase required minimum number of revolutions or to decrease designated maximum number of revolutions allowed, if necessary, to obtain satisfactory mixing. Contractor will not be entitled to additional compensation because of such increase or decrease.

C. Concrete delivery:
1. Furnish to the Engineer a delivery ticket for each batch of ready mixed concrete within 24 hours after delivery. Include the following information on each ticket:
a. Time of day concrete was batched, and time of day that discharge from the truck is complete.
b. Printed record of the individual weight of each of the following constituents in the batch: fine aggregate, coarse aggregate, cement, pozzolan, and water.
c. Concrete Class as defined in Table 3 of this Section.
d. Type, brand, and quantity of each admixture in the batch.
e. Total volume of water allowed in the mix, volume of mixing water added at the batch plant, volume of mixing water withheld from the mix during batching, and total volume of any water added to the mix after leaving the batch plant.
1) In no case shall volume of mixing water withheld result in a water/cementitious materials ratio less than the minimum values specified in Table 3 of this Section.

f. Number of revolutions of transit truck at arrival on site, and total number of revolutions when discharge is complete.
g. Volume of concrete delivered in the batch.
h. Numerical sequence of the batch delivered for that placement.

2. Additional water may only be added to the mix when the following conditions are fully satisfied:
   a. Batch ticket showing total volume of water already added and maximum volume of water that may be added is available for Engineer's observation before any additional water is added.
   b. Total volume of water in the mix after the addition will be less than the maximum allowable volume of water indicated on the ticket.
   c. The full concrete load is still within the truck's mixing drum, and truck has not begun to discharge the load. Under no conditions shall water be added in the field to a partial truckload of concrete.
   d. Volume of water added, and time of addition are clearly marked for record on the batch ticket delivered to the Engineer.
3. Addition of admixtures in the field is permitted only with prior approval by the Engineer, and when the following conditions are satisfied:
   a. Dosage and mixing is personally overseen by concrete supplier's trained technologist and admixtures supplier's representative.
   b. Adequate mixing time is provided after addition of admixtures.
   c. The maximum time to placement of concrete remains 90 minutes after water is added to the mix - not 90 minutes after any field additions/adjustments.
   d. Slump at discharge after additions/modifications conforms to the requirements of Table 3 of this Section.

D. Conveying concrete:
1. Convey concrete from mixer to location of final deposit by methods that prevent separation or loss of materials.
2. Use equipment for chutes, pumps, and conveying of concrete of such size and design as to ensure practically continuous flow of concrete, from delivery to the point of placement, without separation of materials.
3. Design and use chutes and devices for conveying and depositing concrete that direct concrete vertically downward when discharged from chute or conveying device.
4. Keep equipment for conveying concrete thoroughly clean by washing and scraping upon completion of any day's placement.

3.05 PLACING AND CONSOLIDATING

A. Preparation:
1. Obtain Engineer's acceptance of completed preparations before placing concrete.
   a. Notify Engineer in writing that all preparations are complete and ready for placement of concrete. Such indication shall indicate readiness, not just intention, to place concrete for the designated portion of the work.
   b. Submit completed Attachment D - Contractor's Concrete Placement Checklist Form.
2. Confirm completeness of the following before notification of readiness is given to Engineer:
   a. Place forms, reinforcement, screeds, anchors, ties, and inserts in final position.
   b. Reinforcement is secure and properly fastened in its correct position.
   c. Loose form ties at construction joints have been retightened.

d. Dowels, bucks, sleeves, hangers, pipes, conduits, anchor bolts, and any other fixtures required to be embedded in concrete have been placed and adequately anchored.
e. Forms have been cleaned of debris and form release agents are applied as specified.

3. Preparation for placement of footings and slabs on grade:
   a. Do not place concrete on ground or compacted fill until subgrade is in moist condition acceptable to the Engineer.
   b. If necessary, sprinkle subgrade with water not less than 6 or more than 20 hours in advance of placing concrete.
   c. If subgrade surface becomes dry prior to actual placing of concrete, sprinkle again, without forming pools of water.
   d. Do not place concrete if subgrade is muddy or soft.
4. Keep sufficient protective coverings on hand at all times for protection of concrete during and after placement.
   a. Protect concrete placed before rain to prevent water from coming in contact with such concrete
   b. Protect concrete placed before winds to prevent excessive drying or embedment of debris in the finished surfaces.

B. Concrete placement:
1. Do not place concrete:
   a. With slump outside the limits specified in Table 3 of this Section.
   b. In which initial set has occurred, or that has been retempered.
   c. During rainstorms or high velocity winds.
2. Deposit concrete at or near its final position to avoid segregation caused by rehandling or flowing.
   a. Do not deposit concrete in large quantities in one place, and then work material along forms with vibrator or by other methods.
3. Do not drop concrete freely into place from height greater than 5 feet. Use tremies for placing concrete where drop is over 5 feet.
4. Place concrete on slopes starting from bottom of slope and working upward.
5. Place concrete in horizontal lifts not exceeding 24 inches in depth and bring up evenly in all parts of forms.
6. After concrete placement begins, continue in a continuous operation without significant interruption until the end of the placement. Plan and implement precautions to prevent any delay, between layers or adjacent volumes, from exceeding 20 minutes.
7. If concrete is to be placed over previously placed concrete and more than 20 minutes has elapsed, spread layer of cement grout over surface before placing additional concrete. Provide grout layer thickness of not less than 1/2 inch, nor more than 1 inch.
8. Placement of concrete for slabs, beams, or walkways:
   a. If cast monolithically over walls or columns, do not commence until concrete in walls or columns has been allowed to set and shrink.
   b. Allow set time of not less than 1 hour for shrinkage.
      1) During waiting time, keep top surface of concrete moist, but not wet.
      2) Do not permit water to pond or stand on the surface.
      3) Do not coat surface with evaporation retarders or curing agents.
   c. Start placement above wall or column with layer of cement grout as described in the preceding paragraph.

C. Consolidating concrete:
   1. Consolidate concrete with aid of acceptable mechanical vibrators.
   2. Thoroughly consolidate concrete around reinforcement, pipes, or other shapes built into the work.
   3. Provide sufficiently intense vibration to cause concrete to flow and settle readily into place and to visibly affect concrete over radius of at least 18 inches.
   4. Vibrators:
      a. Keep sufficient vibrators on hand at all times to vibrate concrete as placed.
      b. In addition to vibrators in actual use while concrete is being placed, have on hand a minimum of 1 spare vibrator in operable condition.
      c. Do not place concrete until it has been confirmed that all vibrating equipment, including spares, are in operable condition.
   5. Place concrete solidly against forms and concrete surfaces, leaving no voids or honeycomb.
   6. Make concrete solid, compact, and smooth. If for any reason surfaces or interiors have voids or are in any way defective, repair such concrete in manner acceptable to the Engineer.
   7. Do not over-vibrate so as to produce segregation.

3.06 FINISHING CONCRETE

A. Provide concrete finishes in accordance with Section 03366 - Tooled Concrete Finishing unless otherwise indicated on the Drawings.

B. Liquid evaporation retardant:
   1. Under conditions that result in rapid evaporation of moisture from the surface of the concrete, coat the surface of the concrete with a liquid evaporation retardant immediately after screeding.
   2. Conditions that result in rapid evaporation of moisture are defined as any combination of ambient temperature, concrete temperature, relative humidity, wind speed, and solar radiation intensity that creates conditions that will evaporate water from a free concrete surface at a rate equal to or greater than 0.1 pounds per square foot per hour as determined by the Menzel Formula and nomograph published in ACI 305R, and included as Attachment A - Menzel Formula and Nomograph to this Section.
   3. Apply evaporation retardant again after each finishing operation as necessary to prevent drying shrinkage cracks.
   4. Do not work evaporation retardant into the surface of the concrete.
   5. Do no use evaporation retardant as finishing aid (to rehydrate surface a creamy state for finishing).

C. Concrete sealer:
   1. Floors and slabs to receive concrete sealer: See Room Finish Schedule on the Drawings, and Section 03366 - Tooled Concrete Finishing.

3.07 CURING

A. Cure concrete by methods specified in this Section.

B. Keep concrete continuously moist and at an average daily temperature of at least 50 degrees Fahrenheit for a minimum of 7 days after placement.
   1. Provide at least 350 degree days of curing (350 degrees times 7 days of 24 hours each).
   2. If hourly temperatures at any surface of a concrete placement drop below 50 degrees Fahrenheit during the curing period, count the period below 50 degrees Fahrenheit as zero degrees, and extend the curing time to compensate.

C. Schedule of curing methods:
   1. Cure the following concrete surfaces using water curing, or plastic membrane curing.
      a. Floor surfaces of water containment structures.
      b. Surfaces where additional concrete will be placed over or against the surface, including concrete joints.
      c. Surfaces where grout or other toppings will be placed over the surface.
      d. Slabs scheduled to receive concrete sealer, or other bonded or adhered architectural finishes.
      e. Formed surfaces scheduled to receive coatings, paint, adhered masonry, cementitious materials, or other similar finishes, and where formwork is removed within 7 days after concrete placement.
      f. Horizontal concrete surfaces at tops of walls.
   2. Cure the following concrete surfaces by water curing, plastic membrane curing, or sprayed curing membrane. Selection of methods shall be at the Contractor's option.
      a. Surfaces not listed in the preceding paragraph.

D. Water curing:
   1. Keep surfaces of concrete constantly and visibly wet, day and night, for period of not less than 7 days.
      a. Each day forms remain in place will be counted as 1 day of water curing.
      b. Do not loosen form ties during period when concrete is cured by leaving forms in place. No further curing credit will be allowed for forms remaining in place after contact has been broken between concrete surface and forms.
   2. Begin water curing as soon as concrete attains initial set.
   3. Maintain a wet surface by ponding, continuous sprinkling, covering with saturated burlap, or otherwise saturating the surface by means acceptable to Engineer.
      a. Flood top of walls with water at least 3 times per day and keep surfaces moist at all times during 7 day curing period.
      b. Provide plastic sheet material over surfaces if required to maintain a wet surface during arid or windy conditions. See plastic membrane curing requirements for additional details.
   4. Use water having a temperature within 20 degrees Fahrenheit of the temperature of concrete, and not lower than the minimum temperature allowed for the concrete surface during curing.

E. Plastic membrane curing:
   1. Install plastic membrane as soon as concrete is finished and can support limited pedestrian traffic without damage.
   2. Cover entire surface of finished concrete with membrane.
   3. Anchor membrane to prevent uplift from wind or air trapped below the sheet.

4. Fully seal joints and edges to provide full seal around perimeter.
5. Keep concrete under plastic membrane moist, regularly monitoring surfaces and adding supplemental moisture if necessary. Add water as specified for water curing.

F. Sprayed membrane curing compound:
   1. Apply curing compound to concrete surface after repairing and patching, and within 1 hour after forms are removed.
      a. If more than 1 hour elapses after removal of forms, do not use membrane curing compound. Instead, provide water curing for not less than 7 days.
      b. Do not remove sprayed membrane curing compound from concrete in less than 7 days after initial application.
      c. When application of curing compound at concrete joints is accepted by Engineer, take care to apply curing compound to all surfaces along full profile of joints.
   2. Apply curing compound by mechanical, power operated sprayer with mechanical agitator that will uniformly mix all pigment and compound.
      a. Apply curing compound in at least 2 coats.
      b. Apply each coat in direction turned 90 degrees from application direction of the preceding coat.
      c. Apply curing compound in sufficient quantity so that concrete has uniform appearance and its natural color is effectively and completely concealed immediately after spraying.
      d. Continue to coat and recoat surfaces until specified coverage is achieved and until coating film remains on concrete surfaces.
   3. Thickness and coverage of curing compound:
      a. Provide curing compound having film thickness that can be scraped from surfaces at any and all points after drying for at least 24 hours.
      b. Contractor is cautioned that method of applying curing compound specified in this Section may require more curing compound than normally suggested by manufacturer of curing compound and is more than is customary in the trade. Apply amounts specified in this Section, regardless of manufacturer's recommendations or customary practice.
   4. If Contractor desires to use a curing compound other than specified product, coat sample areas of concrete wall with proposed curing compound, and also coat similar adjacent area with the specified compound in the manner specified, for comparison:
      a. If proposed sample is not equal or better, in opinion of the Engineer, the proposed substitution will not be allowed.
   5. Removal of curing compound.
      a. After curing period is complete, remove curing compound placed on surfaces that will receive additional concrete, including all concrete joint surfaces, by heavy sandblasting or by other means acceptable to Engineer. Complete removal and cleanup prior to placing any new concrete against the surface.
      b. Where additional finishes will be applied over concrete surfaces, unless otherwise recommended by the manufacturer of the finish to be applied, remove curing compound by sandblasting. Provide blasting as necessary to fully remove curing compound.
   6. Prior to final acceptance of the work, remove, by sandblasting or by other method acceptable to the Engineer, any curing compound on surfaces exposed to process water or exposed to view, so that only natural color of finished concrete is visible and uniform over the entire surface.

3.08 PROTECTION

A. General:
   1. Keep forms in place, as specified in the following paragraphs, to provide curing and to protect concrete surfaces and edges from damage.
   2. Immediately after forms are removed, carefully examine concrete surfaces, and repair any irregularities in surfaces and finishes as specified.

B. Form removal:
   1. Do not remove forms from concrete which has been placed when outside ambient air temperature is below 50 degrees Fahrenheit until the following conditions are satisfied:
      a. Concrete has sufficient strength to allow form removal without damage to surfaces.
      b. At least 48 hours have elapsed since the end of concrete placement.
      c. Provisions are in place to maintain moisture for curing concrete, and temperature at or above the required minimum curing temperature specified.
   2. Vertical forms:
      a. Retain in place for a minimum of 24 hours after concrete is placed.
      b. If concrete has sufficient strength and hardness to resist surface or other damage after 24 hours, forms may be removed.
   3. Other forms supporting concrete, and shoring: Retain in place as follows:
      a. Formed sides of footings: 24 hours minimum.
      b. Formed vertical sides of beams, girders, and similar members: 48 hours minimum.
      c. Forms below slabs, beams, and girders: Until concrete strength reaches specified strength f'c or until shoring is installed.
         1) Shoring for slabs, beams, and girders: Shore until concrete strength reaches minimum specified 28-day compressive strength.
   4. Wall bracing: Brace walls until strength of concrete beams and slabs laterally supporting wall reaches minimum specified 28-day compressive strength.

C. Loading of concrete members:
   1. Placement of loads on or against green concrete is not permitted.
   2. Do not place soil against walls, or fill over the top of concrete until conditions designated in the following paragraphs are satisfied:
      a. Walls have been cast to their full height in the structure and have achieved their minimum specified 28-day compressive strength.
      b. Connecting slabs and beams that brace the walls are in place, are complete, and (in the case of concrete) have achieved their minimum specified 28-day compressive strength.

3.09 HOT WEATHER CONCRETING

A. Implement hot weather concrete procedures during periods of hot weather as defined in this Section.
   1. Comply with the recommendations of ACI 305R and this Section.

B. If placements during hot weather are expected, and when requested by the Engineer, prepare a hot weather concreting plan. Maintain at least 1 copy on site. Provide plan for review if requested by the Engineer.
   1. Include procedures for batching, delivery, placement, curing, protection, and monitoring and recording the temperature of the concrete and the surrounding environment.
   2. Describe procedures to be implemented in the event of abrupt changes in weather conditions, or in the event of equipment failure.
   3. Review hot weather concreting plan during pre-construction meeting. Make provisions to address any concerns expressed by Engineer before beginning concrete placements.

C. Preparation:
   1. Do not place concrete against forms, reinforcement, or embedments with a surface temperature greater than 120 degrees Fahrenheit.
      a. If necessary, to maintain maximum concrete temperature during placing, cool forms and reinforcement to temperature below 90 degrees Fahrenheit using water or shades.
      b. Do not allow water to puddle in forms or placement areas.
   2. Moisten forms or subgrade to maintain a saturated surface without standing water or soft spots.
   3. Provide windbreaks, shades, fog spray, sprinkling, wet cover, or other means required to protect concrete from premature loss of moisture and rapid temperature gain.

D. Batching and delivery:
   1. Retarding admixtures will not be permitted.
   2. Temperature of concrete delivered for placement shall not exceed 90 degrees Fahrenheit.
      a. Maintain uniform temperature in the mix below this level during batching, delivery, placing, and consolidation.
      b. Temperature of mix, even if below the maximum allowable temperature specified, shall be maintained at a level to avoid loss of slump, flash setting, or cold joints in placements.
   3. If necessary:
      a. Mix water may be chilled or replaced with ice to maintain mix temperature. Where mix water is replaced with ice, provide replacement at a 1 to 1 ratio by weight.
      b. Shade transit mixed concrete trucks, or cool mixing outside of container with water to control temperature of concrete.

E. Placing and finishing:
   1. Place and finish concrete promptly. Place so that vertical lift lines will not be visible in exposed concrete surfaces.
   2. Provide plastic sheeting, fog nozzles, shades or other means to reduce concrete temperature and protect from moisture loss.

F. Protection and curing:
   1. Furnish and locate maximum/minimum temperature recording thermometers in sufficient numbers to confirm concrete temperatures over full area and edges of concrete.

2. Flatwork: Protect and cure using water curing methods as specified in this Section.
    a. Water curing:
        1) Keep concrete continuously wet and make provisions for runoff.
        2) For sprinkling or soaker hoses, maintain temperature of water as close as possible to the temperature of the concrete to minimize effects of thermal shock.
3. Formed surfaces: Protect and cure using forms left in place or membrane curing methods as specified in this Section.
    a. Cover forms and keep continuously moist for at least 24 hours after placement.
    b. Loosen forms as soon as this can be accomplished without damaging the concrete.
    c. Maintain continuously moist surfaces by fogging or spraying with water, or by application of curing compound as specified.

3.10 FIELD QUALITY CONTROL BY CONTRACTOR

A. Provide quality control over the Work of this Section as required by Section 01450 - Quality Control.

B. Field tests:
1. During progress of construction, provide testing to determine whether the concrete, as being produced, complies with requirements specified.
2. Sampling and testing shall be performed by Contractor’s testing laboratory. See Section 01455 - Regulatory Quality Assurance - Special Tests and Inspections for requirements.
    a. Cooperate in testing by allowing free access to the Work for testing laboratory to sample and test materials.
    b. Provide full access for Engineer to observe concrete sampling and testing at any time.
    c. Contractor is responsible for providing care of and curing conditions for test specimens in accordance with ASTM C31 until specimens are collected by testing laboratory.
    d. Provide 4 firmly braced, insulated, heated, closed wooden curing boxes, each sized to hold 10 specimens. Include cold weather temperature and hot weather temperature control thermostat for initial curing and storage from time of fabrication through shipment to Owner’s testing laboratory.
3. Testing shall include:
    a. Sampling of concrete in accordance with ASTM C172.
    b. Temperature of concrete at delivery in accordance with the requirements of ASTM C1064 and as specified in this Section.
    c. Slump of concrete using slump cone in accordance with requirements of ASTM C143. Test slump at the following intervals:
        1) At the beginning of each placement.
        2) As often as necessary to keep slump within the specified range, but not less than every 6th truck.
        3) When requested to do so by the Engineer.
        4) Observe concrete during slump test for signs of segregation.
            a) Observe concrete to see if mortar or moisture flows from slumped concrete.
            b) Reject concrete if mortar or moisture flows out of mix.
    d. Unit weight of concrete in accordance with ASTM C138.

e. Air entrainment in accordance with ASTM C173. Test air content at the following intervals:
    1) At beginning of each placement.
    2) As often as necessary to keep entrained air within specified range, but not less than every 6th truck.
    3) When requested to do so by the Engineer.
    4) Test air entrainment in concrete in accordance with ASTM C173. If air entraining admixtures used for the Work require alternate testing procedures, advise the independent testing laboratory well in advance of the dates of testing, and confirm that appropriate equipment and personnel are provided for the test.
    5) Make air test at point of delivery (discharge from mixer). For pumped concrete, make air tests at point of delivery and at point where expelled after pumping for placement.
f. Compressive strength in accordance with ASTM C39. Required number of cylinders is as follows:
    1) Not less than 6 cylinder specimens, 4 inches in diameter by 8 inches long, will be tested for each 150 cubic yards of each class of concrete, with minimum of 6 specimens for each class of concrete placed; not less than 6 specimens for each half day's placement; and not less than 2 sets of 6 specimens for each structure.
    2) 1 cylinder will be broken at 7 days, 1 at 14 days, and 3 at 28 days. The 6th cylinder may be used to evaluate strength after 28 days if requested by the Engineer.
    3) Retain and store "6th cylinders" (tested and untested) at testing laboratory until 56 days. Break “6th cylinder” when directed by the Engineer.
g. Provide full access for Engineer to observe concrete sampling and testing at any time.

C. Test completed liquid containment structures listed in Section 01759 - Water Leakage Test for Concrete Structures for watertightness.

3.11 FIELD QUALITY CONTROL BY OWNER

A. Provide on-site inspection and field quality assurance for the Work of this Section as specified in Section 01450 - Quality Control.

B. Special tests and inspections: See Section 01455 - Regulatory Quality Assurance.

C. Field inspections:
1. Required inspections:
    a. Observe construction for conformance to the Contract Documents and the accepted submittals.
2. Records of inspections:
    a. Provide record of each inspection.
    b. Submit copies to Contractor upon request.

D. Field tests:
   1. Engineer may request, at any time, additional testing to confirm that materials being delivered and placed conform to the requirements of the Contract Documents.
      a. If such additional testing shows that the material do not conform to the specified requirements, Contractor shall pay the cost of these tests.
      b. If such additional testing shows that the materials do conform to the specified requirements, Owner will pay the cost of these tests.

3.12 NON-CONFORMING WORK

A. Remove and replace or repair non-conforming and defective work.
   1. Provide repairs having strength equal to or greater than specified concrete for areas involved.
   2. Provide replacement or repair of non-conforming work by means acceptable to the Engineer and at no additional cost to Owner.
   3. Project schedule will not be extended based on work to address non-conforming concrete.

B. Concrete not conforming to the specified requirements for properties of plastic concrete: Remove from the site and replace with conforming materials at no additional cost to Owner.
   1. Temperature: Do not use concrete having a temperature above or below the limits specified in this Section.
   2. Slump: Do not place concrete that does not conform to requirements for slump.
   3. Air entrainment: Do not use concrete that does not conform to requirements for percentage of entrained air.

C. Concrete not conforming to the specified requirements for compressive strength:
   1. Concrete is expected to reach a compressive strength equal to or greater than the minimum specified compressive strength f'c in Table 3 of this Section.
   2. Strength of concrete will be considered acceptable if following conditions are satisfied.
      a. Averages of all sets of 3 consecutive strength test results is greater than or equal to the specified compressive strength f'c.
      b. No individual strength test (average of 3 cylinders) falls below the strength specified in Table 5 of this Section.
      c. Where relationships between 7-day and 28-day compressive strength, or between 28-day and 56-day compressive strength, have been provided as part of the mix design submittals:
         1) 7-day strength may be considered as an indication of 28 day strength provided effects of temperature and humidity between 7 day and 28 day are taken into account.
         2) 28-day strength may be considered as indication of 56 day strength provided effects of temperature and humidity between 28 days and 56 days are taken into account.

Table 5: Strength Compliance Requirements	
Minimum Specified Compressive Strength, f'c (pounds per square inch)	**Lower Bound of an Individual Compressive Strength Test, (pounds per square inch)**
Less than 5,000	f'c - 500
Over 5,000	f'c - (0.10 x f'c)

3. Non-compliant strength tests:
    a. Mark non-compliant strength test reports to highlight the non-complying results, and immediately forward copies to all parties on the test report distribution list.
    b. Initial treatment may consist of additional curing of affected portion(s) followed by not less than 3 cores at each affected area, taken in accordance with ASTM C42 and ACI 318. Obtain Engineer's acceptance of proposed coring locations before proceeding with that work.
    c. Submit report of compressive strength testing for Engineer's review.
    d. If requested by the Engineer, provide additional cores, and obtain petrographic testing in accordance with ASTM C856. Submit results for Engineer's review.
    e. If additional curing does not bring the average strength of 3 cores taken in affected area to at least specified compressive strength f'c, designate such concrete in affected area will be considered defective.
    f. Engineer may require the Contractor to strengthen defective concrete by means of additional concrete, additional reinforcing steel, or replacement of defective concrete, all at the Contractor's expense.

D. Concrete sections or surfaces with honeycombing and voids:
1. Provide repairs having surface appearance and finish consistent with that of the surrounding work and acceptable to the Engineer.
2. Do not patch, repair, or cover defective Work without prior inspection by the Engineer.
3. Preparation of concrete for repair:
    a. Make no repair until Engineer has accepted methods for preparing surfaces and for making and curing repairs.
    b. Chip out and key-in imperfections in the Work to make them ready for repair.
    c. Coat bonding surfaces and edges of repair area with one of the following bonding agents as accepted by the Engineer.
        1) Epoxy bonding agent as specified in Section 03071 - Epoxies; or
        2) Epoxy resin/Portland cement bonding agent as specified in Section 03072 - Epoxy Resin/Portland Cement Bonding Agent.
4. Methods of repair:
    a. Dry pack mortar method:
        1) Use for holes having depth nearly equal to or greater than least surface dimension of hole, for cone-bolt holes, and for narrow slots cut for repair.
        2) Smooth Holes: Clean and roughen by heavy sandblasting before repair.
        3) Install dry-pack mortar as specified in Section 03600 - Grouting.
    b. Cement mortar method:
        1) Use for holes too wide to dry pack and too shallow for concrete replacement; and for comparatively shallow depressions, large or small, that extend no deeper than nearest surface reinforcement.
        2) Install cement mortar as specified in Section 03600 - Grouting.

c. Concrete replacement:
    1) Use when holes extend entirely through the concrete section or when holes are more than 1 square foot in area and extend halfway or more through the section.
    2) Form, place, consolidate, and cure concrete of same mix as the surrounding work.

E. Leaking construction joints and cracks in concrete walls and slabs:
1. Repair cracks that develop in walls or slabs, and repair cracks that show any signs of leakage until all leakage is stopped.
2. Pressure inject visible cracks in the following areas, other than hairline cracks and crazing, with repair products and methods acceptable to the Engineer.
    a. Floors and walls of water bearing structures.
    b. Walls and overhead slabs of passageways and occupied spaces where the opposite face of the member is exposed to weather or may be washed down and where the opposite face does not receive a separate waterproofing membrane.
    c. Other items not specified to receive separate waterproofing membrane including slabs over water channels, wet wells, reservoirs, and other similar surfaces.
3. Continue pressure injection of cracks as specified until structure is watertight and remains watertight for not less than 1 year after date of Substantial Completion or date of final repair, whichever occurs later in time.

F. Leaking expansion joints in concrete walls or slabs that include waterstops:
1. Repair any signs of leakage until all leakage is stopped.
2. Pressure inject visible leaks with hydrophilic polyurethane foam resin as specified in Section 03933 - Hydrophilic and Hydrophobic Foam Polyurethane Resin Injection System.
3. Continue pressure injection along joints lines as specified until structure is watertight and remains watertight for not less than 1 year after date of Substantial Completion or date of final repair, whichever occurs later in time.

G. Walls and slabs at overhead channels that leak or sweat because of porosity or cracks too small for successful pressure injection with epoxy.
1. Seal on water or weather side by coating using surface-applied sealing system as specified in this Section.
2. Apply as recommended by manufacturer published instructions. Where concrete continues to sweat or leak, apply additional coats of surface-applied sealing system until the sweating or leaks stop.
3. Continue application of surface-applied sealing system until structure is watertight and remains watertight for not less than 1 year after date of Substantial Completion, or date of final repair, whichever occurs later in time.

END OF SECTION

ATTACHMENT A - MENZEL FORMULA AND NOMOGRAPH

MENZEL FORMULA AND NOMOGRAPH

Source: ACI 350R

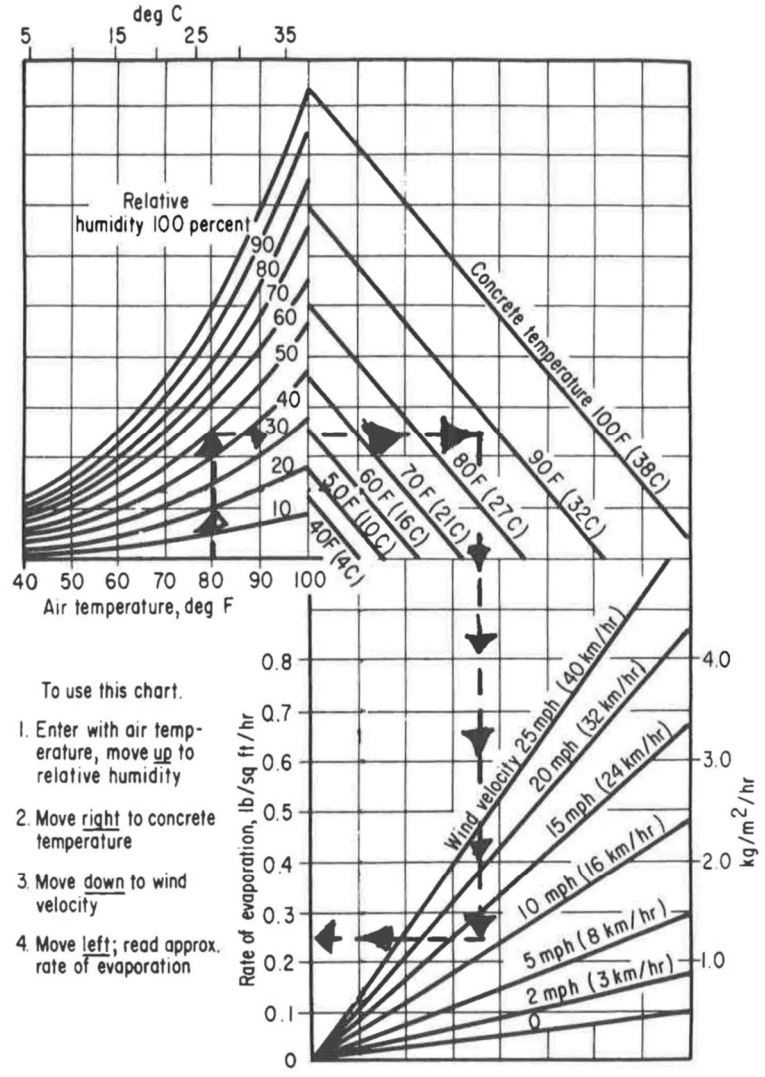


Fig. 2.1.5—Effect of concrete and air temperatures, relative humidity, and wind speed on the rate of evaporation of surface moisture from concrete. This chart provides a graphic method of estimating the loss of surface moisture for various weather conditions. To use this chart, follow the four steps outlined above. If the rate of evaporation approaches 0.2 lb/ft^2/h (1 kg/m^2/h), precautions against plastic-shrinkage cracking are necessary (Lerch 1957). Wind speed is the average horizontal air or wind speed in mph (km/h) and should be measured at a level approximately 20 in. (510 mm) higher than the evaporating surface. Air temperature and relative humidity should be measured at a level approximately 4 to 6 ft (1.2 to 1.8 m) higher than the evaporating surface on its windward side shielded from the sun's rays (PCA Journal *1957*).

ATTACHMENT B - COARSENESS FACTOR CHART

COARSENESS FACTOR CHART

Source: ACI 302.1R-15, Figure 8.9.2.2.

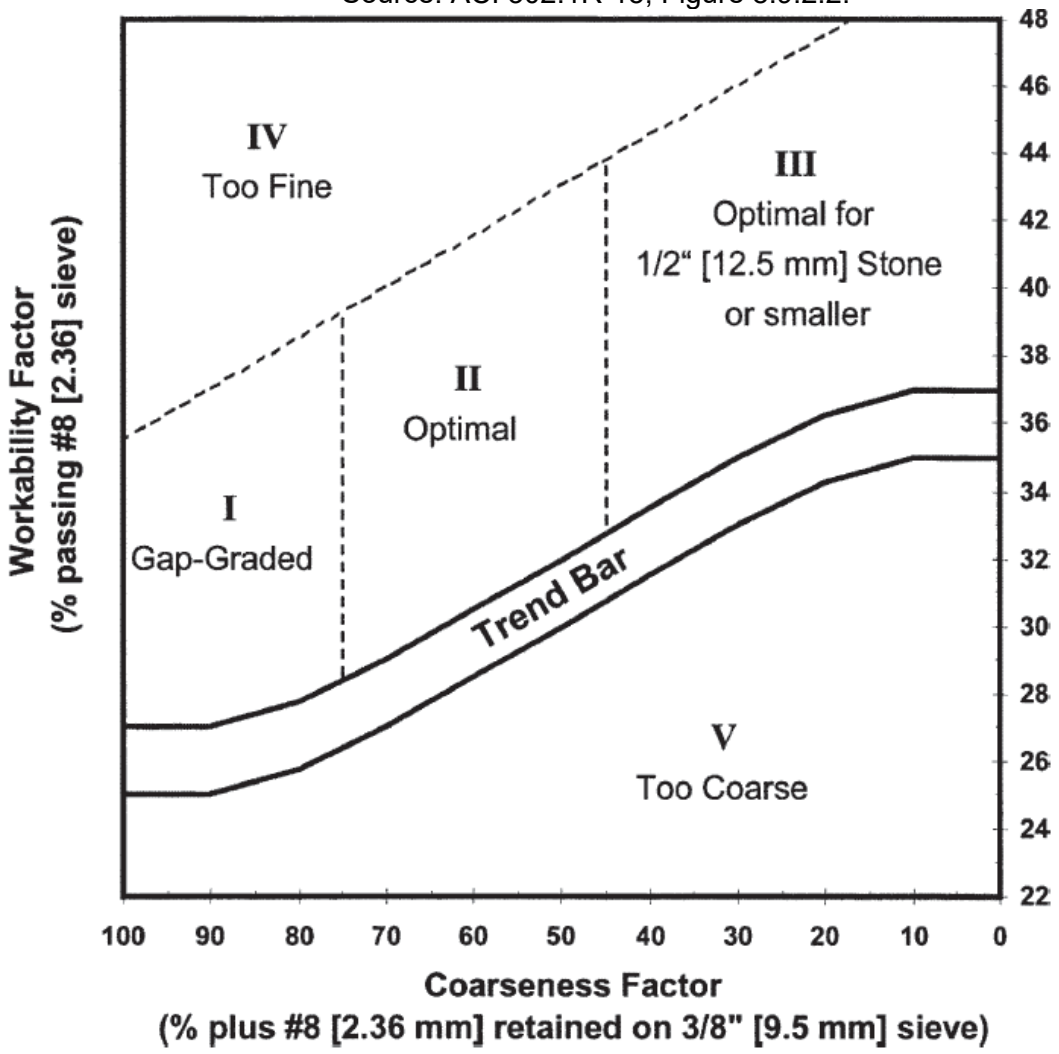
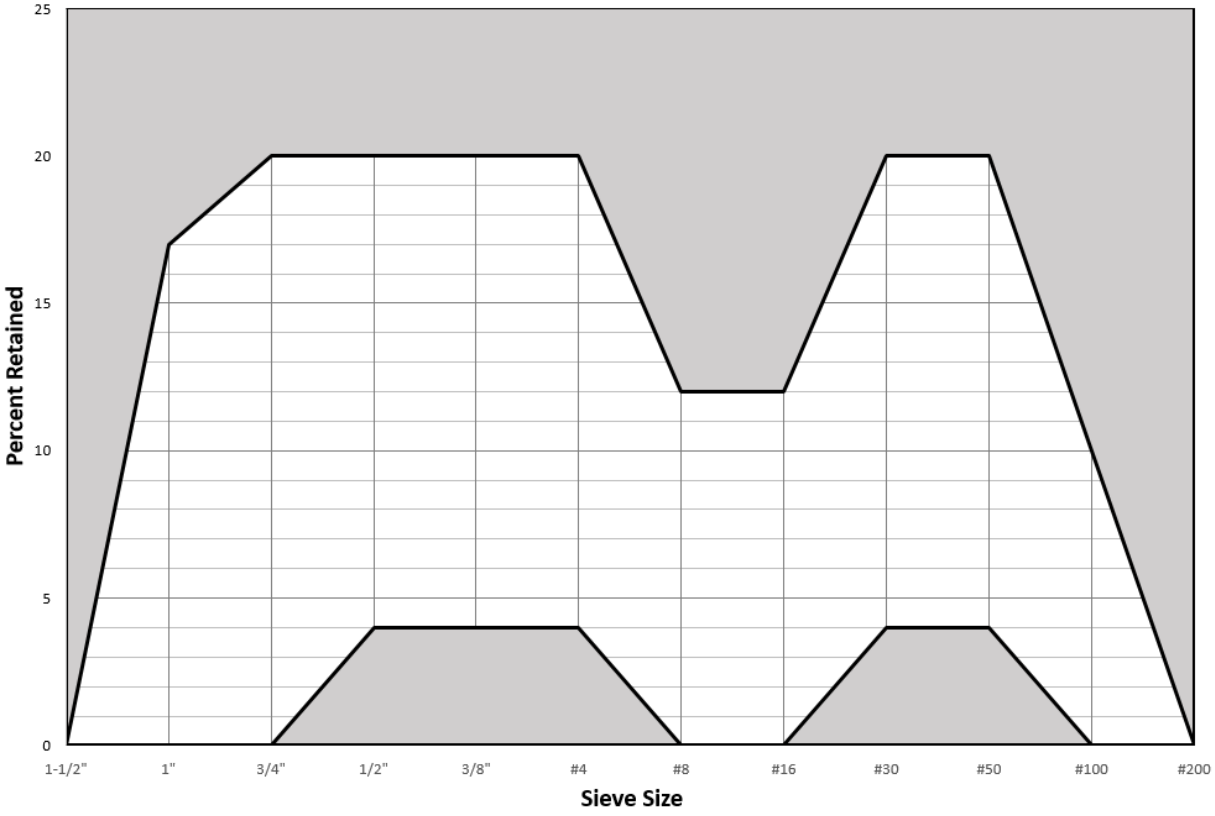


Fig. 8.9.2.2—Coarseness factor chart for evaluating potential performance of mixture.

ATTACHMENT C - COMBINED AGGREGATE GRADATION CHART

COMBINED AGGREGATE GRADATION CHART



ATTACHMENT D - CONCRETE PLACEMENT CHECKLIST

CONCRETE PLACEMENT CHECKLIST

Project: _____ Class of Concrete _____

Project No.: _____Test Cylinders Taken? Yes _____ No _____

Location of Placement _____

The Contractor certifies the above-proposed concrete placement is prepared as indicated and is in

Preparation Slab	Contractor	N/A
Compaction Subgrade		
Filter Fabric/Drain Rock-ABC/Separator Fabric		
Drain Rock, Pea Gravel & Void Form		
Starter Wall Forms		
Reinforcing Steel		
Screeds		

Embedded Items	Contractor	N/A
A. Anchor Bolts		
B. Water Stop		
C. Rebar		
D. Electrical		
E. Plumbing Rough-in		
F. Mechanical		
G. HVAC		

Concrete Placement Equip.	Contractor	N/A
A. Crane		
B. Buckets		
C. Hoppers		
D. Vibrators		
E. Elephant trunks		
F. Floodlights		
G. Pump Truck		

Building Department Notification	
Date:	Time:

Prep Wall Concrete	Contractor	N/A
Access To Work		
Ladders Secured		
Clean up and Washed Out		
Reinforcing Steel		

Forms	Contractor	N/A
A. Alignment & Grade		
B. Scaffolding		
C. Sleeves & Wall Castings		
D. Embedded Items		
E. Electrical		
F. Plumbing Rough-in		
G. Piping		

Record of Curing Conditions During Placement		
	Start	Finish
Date		
Time		
Weather		
Temperature		
Comments		

accord with the Contract Drawings and Specifications. The Contractor requests permission to begin placement of concrete on the date of _____ at _____. The estimated number of yards is: _____. The estimated duration of the placement is _____.

By: _____
Contractor

Released for placement by: _____
Engineer

SECTION 03366

TOOLED CONCRETE FINISHING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Tooled concrete finishes.

1.02 QUALITY ASSURANCE

A. Mock-ups:
   1. Test panels for concrete finishes:
      a. Prepare test panels for F4 and F5 finishes and tie-hole repairs for review by Engineer.
      b. Accepted test panels serve as standard of quality and workmanship for project.
   2. Prepare test panel showing horizontal and vertical joints proposed for project for review by the Engineer. Refer to finishes specified in this Section.
   3. Test panels indicating methods for making concrete repairs: Prepare test panels for proposed repairs at beginning of project for review by Engineer:
      a. Accepted test panels serve as standard for repairs during the project.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:
   1. Deliver and store packaged materials in original containers until ready for use.

PART 2 PRODUCTS

2.01 MIXES

A. Mortar mix for F4 finish: Consist of 1 part cement and 1-1/2 parts of fine sand passing Number 100 screen. Mix with enough water and emulsified bonding agent to have consistency of thick cream.

B. Mortar mix for F5 finish: Consist of 1 part cement to 1-1/2 parts of sand which passes Number 16 screen.

2.02 CONCRETE SEALER

A. Manufacturers: One of the following or equal:
   1. Euclid Chemical Company: Diamond Hard.
   2. L&M Construction Chemicals: SealHard.

PART 3 EXECUTION

3.01 CONCRETE FINISHES

A. Cement for finishes:
   1. Addition of white cement may be required to produce finish which matches color of concrete to be finished.

B. Finish vertical concrete surfaces with one of the following finishes as indicated in the Finish Schedule:
   1. F1 finish: No special treatment other than repair defective work and fill depressions 1 inch or deeper and tie holes with mortar after removal of curing compound.
   2. F2 finish: No special treatment other than repair defective work, remove fins, fill depressions 1/2 inch or deeper and tie holes with mortar after removal of curing compound.
   3. F3 finish: Repair defective work, remove fins, offsets, and grind projections smooth. Fill depressions 1/4 inch or larger in depth or width and tie holes with mortar after removal of curing compound.
   4. F4 finish: Receive same finish as specified for F3 finish, and, in addition fill depressions and holes 1/16 inch or larger in width with mortar.
      a. "Brush-Off" sandblast surfaces prior to filling holes to expose all holes near surface of the concrete.
      b. Thoroughly wet surfaces and commence filling of pits, holes, and depressions while surfaces are still damp.
      c. Perform filling by rubbing mortar over entire area with clean burlap, sponge rubber floats, or trowels.
      d. Do not let any material remain on surfaces, except that within pits and depressions.
      e. Wipe surfaces clean and moist cure.
   5. F5 finish: Receive same finish as specified for F3 finish, and, in addition, receive special stoned finish, in accordance with following requirements:
      a. Remove forms and perform required repairs, patching, and pointing as specified in this Section.
      b. Wet surfaces thoroughly with brush and rub with hard wood float dipped in water containing 2 pounds of portland cement per gallon.
      c. Rub surfaces until form marks and projections have been removed.
      d. Spread grindings from rubbing operations uniformly over surface with brush in such manner as to fill pits and small voids.
      e. Moist cure brushed surfaces and allow to harden for 3 days:
         1) After curing, obtain final finish by rubbing with carborundum stone of approximately Number 50 grit until entire surfaces have smooth texture and are uniform in color.
         2) Continue curing for remainder of specified time.
      f. If any concrete surface is allowed to become too hard to finish in above specified manner, sandblast and wash related surfaces exposed to view, whether finished or not.
         1) While still damp, rub over surface, plastic mortar, as specified for brushed surfaces and handstoned with Number 60 grit carborundum stone, using additional mortar for brushed surfaces until surface is evenly filled without an excess of mortar.

2) Continue stoning until surface is hard.
3) After moist curing for 3 days, make surface smooth in texture and uniform in color by use of Number 50 or Number 60 grit carborundum stone.
4) After stoning, continue curing until 7 day curing period is completed.

C. Finish horizontal concrete surfaces with one of the following finishes as indicated in the Finish Schedule after proper and adequate vibration and tamping:
1. S1 finish: Screeded to grade and leave without special finish.
2. S2 finish: Smooth steel trowel finish.
3. S3 finish: Steel trowel finish free from trowel marks. Provide smooth finish free of all irregularities.
4. S4 finish: Steel trowel finish, without local depressions or high points, followed by light hairbroom finish. Do not use stiff bristle brooms or brushes. Perform brooming parallel to slab-drainage. Provide resulting finish that is rough enough to provide nonskid finish. Finish is subject to review and acceptance by the Engineer.
5. S5 finish: Nonslip abrasive: After concrete has been screeded level and hardened enough to support man standing on a board, sprinkle abrasive from shake screen into surface at uniform rate of 25 pounds for each 100 square feet of surface area, wood float into finish, then trowel abrasive into surface with steel trowel properly exposing abrasive in surface as required to provide nonslip surface.
6. S6 finish: Roughened finish: After concrete has been screeded to grade, apply a roughened finish by use of a jitterbug roller or similar device.

D. Finish concrete floor surfaces to which surfacing material is applied: Finish smooth with tolerance within 1/8 inch in 10 feet in any direction from lines indicated on the Drawings.

3.02 CONCRETE FINISH SCHEDULE

A. Finish concrete surfaces as follows:
1. F4 finish for following vertical surfaces:
a. Concrete surfaces specified or indicated to be painted.
b. Concrete surfaces, interior or exterior, exposed to view.
2. Surfaces in open channels, basins, and similar structures:
a. F3 finish for vertical surfaces which are normally below water surface.
b. F4 finish for vertical surfaces located above normal water surface and exposed to view.
c. Remove fins and fill tie holes from concrete surfaces located in closed boxes or channels where there is normally no access or passageway.
3. S1 finish for following surfaces:
a. Projecting footings which are to be covered with dirt.
b. Slab surfaces which are to be covered with concrete fill.
4. S2 finish for following surfaces:
a. Tops of corbels.
b. Tops of walls and beams not covered above in this Section.
c. Tops of slabs not covered above in this Section.
d. All other surfaces not specified to be finished otherwise.

5. S3 finish for following surfaces:
    a. Building and machine room floors which are not covered with surfacing material: Provide floors that are free from trowel marks.
6. S4 finish for following surfaces:
    a. Exterior walkways.
    b. Tops of exterior walls or beams which are to serve as walkways.
    c. Tops of exterior walls or beams which are to support gratings.
    d. Top surface of slabs for basins, channels, digesters, and similar structures.
7. S6 finish for following surfaces:
    a. Basin bottoms, or other similar slab surfaces, over which layer of basin bottom grout will be applied.

END OF SECTION

SECTION 03371

SHOTCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Application of shotcrete onto prepared substrate, formed surfaces, or against earth, including preparation of substrate.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 506R - Guide to Shotcrete.
   2. 506.2 - Specification for Materials, Proportioning, and Application for Shotcrete.

B. ASTM International (ASTM):
   1. C150 - Standard Specification for Portland Cement.

1.03 SUBMITTALS

A. Quality control submittals:
   1. Certificate of Compliance for cement.

B. Test reports:
   1. Copy of sieve analysis for aggregate.

1.04 QUALITY ASSURANCE

A. Mock-ups:
   1. Preconstruction testing: Perform testing in accordance with ACI 506.2.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Performance requirements:
   1. Provide shotcrete in accordance with the requirements of ACI 506.2, except as modified by requirements of this Section.
   2. Shotcrete shall be of either wet mix or dry mix type.

2.02 MATERIALS

A. Formwork:
   1. Provide formwork as specified in Section 03102 - Concrete Formwork and following:
      a. Provide formwork in accordance with ACI 506.2, adequately stiffened and supported to withstand impact of shotcrete placement and permit escape of air and rebound.

B. Reinforcement: As specified in Section 03200 - Concrete Reinforcing.

C. Cement: ACI 506.2 and be portland cement in accordance with ASTM C150, Type II, low alkali.

D. Aggregate: In accordance with ACI 506R, normal weight conforming to Gradation Number 2 in Table 1.1.

E. Admixtures: In accordance with ACI 506.2 for wet mix shotcrete and as specified in Section 03300 - Cast-in-Place Concrete.

2.03 MIXES

A. Proportioning: Proportion shotcrete in accordance with ACI 506.2 having 28-day compressive strength f'_c of 4,000 pounds per square inch.

PART 3 EXECUTION

3.01 PREPARATION

A. Surface preparation:
   1. Prepare surfaces in accordance with ACI 506.2 to which shotcrete is to be applied.
   2. Ensure that surfaces are original undisturbed soil unless otherwise indicated on the Drawings or permitted by the Engineer.
   3. Where backfill is permitted, use aggregate base coarse as specified in Section 02050 - Soils and Aggregates for Earthwork compacted to 95 percent maximum density placed in horizontal lifts and trimmed where necessary.

3.02 PLACING

A. Cover on reinforcement:
   1. General: In accordance with ACI 506.2.
   2. Welded wire fabric: Kept within 1/2 inch of location indicated on the Drawings.

B. Control joints: Provide control joints in accordance with 506.2 and as indicated on the Drawings.

C. Curing:
   1. Cure shotcrete immediately after finishing in accordance with ACI 506.2.
   2. Natural curing as specified in ACI 506.2 shall not be permitted.

D. Finishing: Provide natural gun finish as specified ACI 506.2, except where otherwise indicated on the Drawings.

E. Tolerances:
   1. Provide finished shotcrete surfaces as specified in ACI 506.2, having maximum deviation from true line and grade not exceeding following:
      a. Side slopes: Not exceed 1 inch offset from true line in 12 feet of run along line.
      b. Horizontal surfaces: Not exceed 1-inch deviation in 10 feet of run. Sloped surfaces shall be graded to drain.
      c. Provide surfaces complying with following maximum tolerances:

Item	Maximum Tolerance inches
Reservoir Side Slopes	Plus 1/2 Minus 1/2
Ditch and Reservoir Bottoms	Plus 1/2 Minus 1/2
Ditch Side Slopes	Plus 1/2 Minus 1

      d. Thickness: Plus 1 inch or minus 1/4 inch of thickness values indicated on the Drawings.

3.03 FIELD QUALITY CONTROL

A. Tests:
   1. Construction testing: Perform testing by test panel method in accordance with requirements of ACI 506.2.

END OF SECTION

SECTION 03600

GROUTING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Cement grout.
   2. Cement mortar.
   3. Dry-pack mortar.
   4. Epoxy grout.
   5. Grout.
   6. Non-shrink epoxy grout.
   7. Non-shrink grout.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-inch cube specimens).
   2. C230 - Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.
   3. C531 - Standard Test Method for Liner Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
   4. C579 - Standard Test Method for Compressive Strength of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes.
   5. C939 - Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
   6. C942 - Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory.
   7. C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
   8. C1181 - Standard Test Methods for Compressive Creep of Chemical-Resistant Polymer Machinery Grouts.

B. International Concrete Repair Institute (ICRI):
   1. 310.2R - Selecting and specifying Concrete Surface Preparations for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

1.03 SUBMITTALS

A. Cement grout:
   1. Mix design.
   2. Material submittals.

B. Cement mortar:
   1. Mix design.
   2. Material submittals.

C. Non-shrink epoxy grout:
   1. Manufacturer's literature.

D. Non-shrink grout:
   1. Manufacturer's literature.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to jobsite in their original, unopened packages or containers, clearly labeled with manufacturer's product identification and printed instructions.

B. Store materials in cool dry place and in accordance with manufacturer's recommendations.

C. Handle materials in accordance with the manufacturer's instructions.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Non-shrink epoxy grout:
   1. Manufacturers: One of the following or equal:
      a. Five Star Products, Inc., Five Star DP Epoxy Grout.
      b. Master Builder Solutions, MasterFlow 648.
      c. L&M Construction Chemicals, Inc., EPOGROUT.
   2. Non-shrink epoxy grout shall be 100 percent solid, premeasured, prepackaged system containing 2-component thermosetting epoxy resin and inert aggregate.
   3. Maintain flowable consistency for at least 45 minutes at 70 degrees Fahrenheit.
   4. Shrinkage or expansion: Less than 0.0006 inches per inch when tested in accordance with ASTM C531.
   5. Minimum compressive strength: 10,000 pounds per square inch at 24 hours and 14,000 pounds per square inch at 7 days when tested in accordance with ASTM C579, Method B.
   6. Compressive creep: Not exceed 0.0037 inches/per inch when tested under 400 pounds per square inch constant load at 140 degrees Fahrenheit in accordance with ASTM C1181.
   7. Coefficient of thermal expansion: Not exceed 0.000018 inches per inch per degree Fahrenheit when tested in accordance with ASTM C531, Method B.

B. Non-shrink grout:
   1. Manufacturers: One of the following or equal:
      a. Five Star Products, Inc., Five Star Grout.
      b. Master Builder Solutions, MasterFlow 928.
      c. L&M Construction Chemicals, Inc., CRYSTEX.

2. In accordance with ASTM C1107.
3. Preportioned and prepackaged cement-based mixture.
4. Contain no metallic particles such as aluminum powder and no metallic aggregate such as iron filings.
5. Require only addition of potable water.
6. Water for pre-soaking, mixing, and curing: Potable water.
7. Free from emergence of mixing water from within or presence of water on its surface.
8. Remain at minimum flowable consistency for at least 45 minutes after mixing at 45 degrees Fahrenheit to 90 degrees Fahrenheit when tested in accordance with ASTM C230.
    a. If at fluid consistency, verify consistency in accordance with ASTM C939.
9. Dimensional stability (height change):
    a. In accordance with ASTM C1107, volume-adjusting Grade B or C at 45 degrees Fahrenheit to 90 degrees Fahrenheit.
    b. Have 90 percent or greater bearing area under bases.
10. Have minimum compressive strengths at 45 degrees Fahrenheit to 90 degrees Fahrenheit in accordance with ASTM C1107 for various periods from time of placement, including 5,000 pounds per square inch at 28 days when tested in accordance with ASTM C109 as modified by ASTM C1107.

2.02 MIXES

A. Cement grout:
    1. Use same sand-to-cementitious materials ratio for cement grout mix that is used for concrete mix.
    2. Use same materials for cement grout that are used for concrete.
    3. Use water-to-cementitious materials ratio that is no more than that specified for concrete.
    4. For spreading over surfaces of construction or cold joints.

B. Cement mortar:
    1. Use same sand-to-cementitious materials ratio for cement mortar mix that is used for concrete mix.
    2. Use same materials for cement mortar that are used for concrete.
    3. Use water-to-cementitious materials ratio that is no more than that specified for concrete being repaired.
    4. At exposed concrete surfaces not to be painted or submerged in water: Use sufficient white cement to make color of finished patch match that of surrounding concrete.

C. Dry-pack mortar:
    1. Proportions by weight: 1 part portland cement to 2 parts concrete sand:
        a. Portland cement: As specified in Section 03300 - Cast-in-Place Concrete.
        b. Concrete sand: As specified in Section 03300 - Cast-in-Place Concrete.

D. Epoxy grout:
    1. Consist of mixture of epoxy or epoxy gel and sand:
        a. Epoxy: As specified in Section 03071 - Epoxies.
        b. Epoxy gel: As specified in Section 03071 - Epoxies.
        c. Sand: Clean, bagged, graded, and kiln-dried silica sand.

2. Proportioning:
    a. For horizontal work: Consist of mixture of 1 part epoxy with not more than 2 parts sand.
    b. For vertical or overhead work: Consist of 1 part epoxy gel with not more than 2 parts sand.

E. Grout:
    1. Mix in proportions by weight: 1 part portland cement to 4 parts concrete sand.
        a. Portland cement: As specified in Section 03300 - Cast-in-Place Concrete.
        b. Concrete sand: As specified in Section 03300 - Cast-in-Place Concrete.

F. Non-shrink epoxy grout:
    1. Mix in accordance with manufacturer's installation instructions.

G. Non-shrink grout:
    1. Mix in accordance with manufacturer's installation instructions such that resulting mix has flowable consistency and is suitable for placing by pouring.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect concrete surfaces to receive grout or mortar and verify that they are free of ice, frost, dirt, grease, oil, curing compounds, paints, impregnations, and loose material or foreign matter likely to reduce bond or performance of grout or mortar.

3.02 PREPARATION

A. Surface preparation for grouting other baseplates:
    1. Remove grease, oil, dirt, dust, curing compounds, laitance, and other deleterious materials that may affect bond to concrete and bottoms of baseplates.
    2. Roughen concrete surfaces in contact with grout to ICRI CSP-6 surface profile or rougher.
        a. Remove loose or broken concrete.
    3. Metal surfaces in contact with grout: Grit blast to white metal surface.

3.03 INSTALLATION

A. Mixing:
    1. Cement grout:
        a. Use mortar mixer with moving paddles.
        b. Pre-wet mixer and empty out excess water before beginning mixing.
    2. Cement mortar:
        a. Use mortar mixer with moving paddles.
        b. Pre-wet mixer and empty out excess water before beginning mixing.
    3. Dry-patch mortar:
        a. Use only enough water so that resulting mortar will crumble to touch after being formed into ball by hand.

4. Non-shrink epoxy grout:
    a. Keep temperature of non-shrink epoxy grout from exceeding manufacturer's recommendations.
5. Non-shrink grout:
    a. May be drypacked, flowed, or pumped into place. Do not overwork grout.
    b. Do not retemper by adding more water after grout stiffens.

B. Placement:
1. Cement grout:
    a. Exercise care in placing cement grout because it is required to furnish structural strength, impermeable water seal, or both.
    b. Do not use cement grout that has not been placed within 30 minutes after mixing.
2. Cement mortar:
    a. Use mortar mixer with moving paddles.
    b. Pre-wet mixer and empty out excess water before beginning mixing.
3. Epoxy grouts:
    a. Wet surfaces with epoxy for horizontal work or epoxy gel for vertical or overhead work prior to placing epoxy grout.
4. Non-shrink epoxy grout:
    a. Mix in complete units. Do not vary ratio of components or add solvent to change consistency of mix.
    b. Pour hardener into resin and mix for at least 1 minute and until mixture is uniform in color. Pour epoxy into mortar mixer wheelbarrow and add aggregate. Mix until aggregate is uniformly wetted. Over mixing will cause air entrapment in mix.
5. Non-shrink grout:
    a. Add non-shrink cement grout to premeasured amount of water that does not exceed the manufacturer's maximum recommended water content.
    b. Mix in accordance with manufacturer's instructions to uniform consistency.

C. Curing:
1. Cement based grouts and mortars:
    a. Keep continuously wet for minimum of 7 days. Use wet burlap, soaker hose, sun shading, ponding, and in extreme conditions, combination of methods.
    b. Maintain above 40 degrees Fahrenheit until it has attained compressive strength of 3,000 pounds per square inch, or above 70 degrees Fahrenheit for minimum of 24 hours to avoid damage from subsequent freezing.
2. Epoxy based grouts:
    a. Cure grouts in accordance with manufacturers' recommendations.
        1) Do not water cure epoxy grouts.
    b. Do not allow any surface in contact with epoxy grout to fall below 50 degrees Fahrenheit for minimum of 48 hours after placement.

D. Grouting equipment bases, baseplates, soleplates, and skids: As specified in Section 15050 - Common Work Results for Mechanical Equipment.

E. Grouting other baseplates:
   1. General:
      a. Use non-shrink grout as specified in this Section.
      b. Baseplate grouting shall take place from one side of baseplate to other in continuous flow of grout to avoid trapping air in grout.
      c. Maintain hydrostatic head pressure by keeping level of grout in headbox above bottom of baseplate. Fill headbox to maximum level and work grout down.
      d. Vibrate, rod, or chain non-shrink grout to facilitate grout flow, consolidate grout, and remove trapped air.
   2. Forms and headboxes:
      a. Build forms using material with adequate strength to withstand placement of grouts.
      b. Use forms that are rigid and liquidtight. Caulk cracks and joints with elastomeric sealant.
      c. Line forms with polyethylene for easy grout release. Coating forms with 2 coats of heavy-duty paste wax is also acceptable.
      d. Headbox shall be 4 to 6 inches higher than baseplate and shall be located on one side of baseplate.
      e. After grout sets, remove forms and trim back grout at 45 degree angle from bottom edges of baseplate.

3.04 FIELD QUALITY CONTROL

A. Non-shrink epoxy grout:
   1. Test for 24-hour compressive strength in accordance with ASTM C579, Method B.

B. Non-shrink grout:
   1. Test for 24-hour compressive strength in accordance with ASTM C942.

END OF SECTION

SECTION 03922

PREPACKAGED SMALL AGGREGATE REPAIR CONCRETE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Prepackaged concrete for the repair of concrete.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C33 - Standard Specification for Concrete Aggregates.
   2. C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   3. C150 - Standard Specification for Portland Cement.

B. International Concrete Repair Institute (ICRI):
   1. Guideline No. 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

C. NSF International (NSF):
   1. Standard 61 - Drinking Water System Components.

1.03 SUBMITTALS

A. Product Data.

B. Manufacturer’s Instructions.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store in unopened containers in clean, dry area with temperature between 45 and 90 degrees Fahrenheit.

PART 2 PRODUCTS

2.01 PREPACKAGED CONCRETE

A. Coarse aggregate: Maximum 3/8-inch aggregate in accordance with ASTM C33.

B. Portland cement: Type I or II in accordance with ASTM C150.

C. Compressive strength: 5,000 pounds per square inch at 28 days minimum, in accordance with ASTM C39.

D. Packaged in multi-wall bags.

E. Manufacturers: One of the following or equal:
   1. Master Builders Solutions, MasterEmaco S 440.
   2. Sika, Sikacrete 211.

PART 3 EXECUTION

3.01 PREPARATION

A. In accordance with manufacturer's written instructions. If manufacturer's instructions are not available, prepare as indicated:
   1. Clean entire slab surface as required to remove dirt, oil, curing compound, laitance, dust, and other matter that may prevent proper grout bonding.
   2. Concrete substrate shall have rough texture, suitable for bonding repair concrete.
   3. Roughen concrete substrate in contact with repair concrete to ICRI Guideline No. 310.2R, CSP-6 surface profile or rougher using method suitable to the Engineer.
      a. Remove loose or broken concrete.
   4. Saturate concrete substrate with potable water for minimum of 3 days just before placing repair concrete. At time repair concrete is placed, substrate shall be saturated and surface damp with no standing water.

3.02 INSTALLATION

A. Slump range: 4 to 6 inches.

B. Mix in accordance with manufacturer’s instructions.

C. Water for mixing: As specified in Section 03300 - Cast-in-Place Concrete.

D. Water cure concrete repair area as specified in Section 03300 - Cast-in-Place Concrete.

END OF SECTION

SECTION 03931

EPOXY INJECTION SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Epoxy injection system.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C881 - Standard Test Method for Epoxy-Resin-Base Bonding Systems for Concrete.
   2. C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete by Slant Shear.
   3. D638 - Standard Test Method for Tensile Properties of Plastics.
   4. D648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
   5. D695 - Standard Test Method for Compressive Properties of Rigid Plastics.
   6. D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

1.03 SUBMITTALS

A. General: Submit as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Manufacturer's data completely describing epoxy injection system materials, and including test methods and results for strength in tension, flexure, compression and bond; flexural modulus of elasticity; coefficient of thermal expansion; and elongation.

C. Quality control submittals:
   1. Certificates of Compliance.
   2. Manufacturer's Instructions.

D. Special procedure submittals:
   1. Protection plan for surrounding areas and non-cementitious surfaces.

1.04 QUALITY ASSURANCE

A. Products:
   1. Provide materials that are new and use them within shelf life limitations set forth by manufacturer.

B. Qualifications:
   1. Installer:
      a. Minimum 5 years' experience in concrete repair, with focus on application of similar systems and products to projects of similar size and scope.

C. Pre-installation meeting:
   1. At least 1 week prior to commencing work of this Section, convene a meeting at the project site to review and discuss the following:
      a. Surface preparation.
      b. Substrate conditioning and pre-treatment.
      c. Installation procedures.
      d. Environmental conditions (including weather forecast) and curing requirements.
      e. Testing and inspection procedures.
      f. Protection of surrounding surfaces and equipment.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact. Labels shall include product identification, batch numbers, and shelf life information.

B. Store materials off the ground and away from moisture and direct sunlight, and at temperatures within manufacturer's recommended range.

C. Pre-condition materials to manufacturer's recommended temperatures before mixing and using.

1.06 PROJECT CONDITIONS

A. Take precautions to protect surfaces and equipment in the work area from damage and staining.

PART 2 PRODUCTS

2.01 MATERIALS

A. General:
   1. Repair materials shall be free of chlorides or alkalis (except for those attributed to water).
   2. To ensure compatibility of materials and methods, a single manufacturer shall produce and provide all products used together in a single area of concrete repair.

B. Manufacturers: One of the following or equal:
   1. Master Builders Solutions, MasterInject 1500.
   2. Sika Chemical Corp., Sikadur 35 Hi-Mod LV.

C. Epoxy:
   1. In accordance with ASTM C881, Types I, II and IV, Grade 1, Class C.
   2. Water-insensitive 2-component low viscosity, epoxy adhesive material containing 100 percent solids and meeting or exceeding following characteristics when tested in accordance with standards specified:

Table 1 - Epoxy, Physical Properties		
Characteristic	**Test Method**	**Required Results, minimum(1,2)**
Viscosity (Mixed)	--	250 - 375 centipoise
Tensile Strength	ASTM D638	7,500 pounds per square inch
Tensile Elongation at Break	ASTM D638	1 percent
Compressive Strength	ASTM D695	11,000 pounds per square inch
Compressive Modulus	ASTM D695	2.5 x 10^5 pounds per square inch.
Bond Strength, Slant Shear, Hardened Concrete to Hardened Concrete	ASTM C882	1500 pounds per square inch at 2 days at minimum 73 degrees Fahrenheit. Concrete shall fail before failure of epoxy.
Heat Deflection Temperature	ASTM D648	124 degrees Fahrenheit
Notes:		
1)	Properties for mixes with neat epoxy.	
2)	Results after 7-day cure at temperature between 72 and 78 degrees Fahrenheit, unless otherwise noted.	

2.02 EQUIPMENT

A. Injection pump:
   1. Use positive displacement injection pump with interlock to provide in-line mixing and metering system for 2 component epoxy.
   2. Use pressure hoses and injection nozzle designed to properly mix of 2 components of epoxy.
   3. Standby injection unit may be required.

PART 3 EXECUTION

3.01 PREPARATION

A. Surface preparation:
   1. Confirm that surface temperature and moisture conditions are within manufacturer's recommended limits. Condition surfaces to within those limits before commencing epoxy injection.
   2. Sweep or clean area in vicinity of cracks that will be injected with epoxy. Leave area in generally clean condition after epoxy injection is complete.
   3. Clean cracks so they are free from dirt, laitance, and other loose matter.

3.02 INSTALLATION

A. Install and cure epoxy materials in accordance with manufacturer's installation instructions.

B. Mixing:
   1. Mix epoxy in accordance with manufacturer's installation instructions.
   2. Do not use solvents to thin epoxy system materials introduced into cracks or joints.

C. Injection:
   1. Apply adequate surface seal to crack to prevent leakage of epoxy.
   2. Establish injection points at distance along crack not less than thickness of cracked member.
   3. Crack injection sequence:
      a. Inject epoxy into crack or joint at first port with sufficient pressure to advance epoxy to adjacent port. Start at lowest port along the injection line and work upwards.
      b. Seal original port and shift injection to next adjacent port where epoxy appears.
      c. Continue port-to-port injection until crack has been injected for its entire length.
      d. For small amounts of epoxy, or where excessive pressure developed by injection pump might further damage structure, premixed epoxy and use hand caulking gun to inject epoxy if acceptable to the Engineer.
      e. Seal ports, including adjacent locations where epoxy seepage occurs, as necessary to prevent drips or run out.
      f. After epoxy injection is complete, remove surface seal material, and refinish concrete in area where epoxy was injected to match existing concrete. Leave finished work and work area in a neat, clean condition.

3.03 FIELD QUALITY ASSURANCE

A. Provide Contractor quality control as specified in Section 01450 - Quality Control.

B. Field inspections and testing:
   1. Submit records of inspections and tests to Engineer within 24 hours after completion.

C. Manufacturer's services.
   1. Pre-installation meeting: Provide manufacturer's technical representative to attend pre-installation meeting specified in this Section.

3.04 FIELD QUALITY CONTROL

A. Provide Owner's quality assurance for the Work of this Section as specified in Section 01450 - Quality Control.

B. Special inspections special tests, and structural observation:
   1. Not required.

C. Field inspections:
    1. Preparation.
        a. Review manufacturer's product data and installation instructions.
    2. Required inspections.
        a. Observe surfaces to be injected for temperature and moisture conditions and for surface preparation.
        b. Observe conditioning and mixing of epoxy resin components.
        c. Observe injection procedures for filling cracks.
    3. Records of inspections:
        a. Provide record of each inspection.
        b. Submit to Engineer upon request.

3.05 NON-CONFORMING WORK

A. Rework surface finishes that do not match surrounding concrete to the satisfaction of Engineer at no additional cost to Owner.

END OF SECTION

SECTION 04055

ADHESIVE BONDING REINFORCING BARS AND ALL THREAD RODS IN MASONRY

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Bonding reinforcing bars and all thread rods in masonry using injectable, 2-component adhesive.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. Standard B212.15 - Carbide Tipped Masonry Drills and Blanks for Carbide Tipped Masonry Drills.

B. ICC Evaluation Service, Inc. (ICC-ES):
   1. AC58 - Acceptance Criteria for Adhesive Anchors in Masonry Elements.

C. Society for Protective Coatings (SSPC):
   1. Surface Preparation Standards (SP).
      a. SP-1 - Solvent Cleaning.

1.03 DEFINITIONS

A. Evaluation Report: Report prepared by ICC-ES, or by other testing agency acceptable to the Engineer and to the Authority Having Jurisdiction, that documents testing and review of the adhesive product to confirm that it conforms to the requirements of ICC-ES AC58.

1.04 SUBMITTALS

A. Product data: Furnish technical data for adhesives, including:
   1. Independent testing laboratory results indicating allowable loads in tension and shear for masonry walls of the types included in the Work, with load modification factors for temperature, spacing, edge distance, and other installation variables.
   2. Handling and storage instructions.
   3. Installation instructions.

B. Quality control submittals:
   1. Special inspection: Detailed instructions for special inspection to comply with the building code specified in Section 01410 - Regulatory Requirements.
   2. Evaluation Report confirming that the product complies with the requirements of ICC-ES AC58.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store and protect as follows, unless manufacturer has more stringent requirements:
   1. Store adhesive components on pallets or shelving in a covered-storage area protected from weather.
   2. Control temperature to maintain storage within manufacturer's recommended temperature range.
      a. If products are stored at temperatures outside manufacturer's recommended range, test components prior to use by methods acceptable to the Engineer to determine if the products still meet specified requirements.
   3. Dispose of products that have passed their expiration date.

1.06 PROJECT CONDITIONS

A. As specified in Section 01850 – Design Criteria.

B. Seismic design category (SDC) for structures: As specified in Section 01850 - Design Criteria.

PART 2 PRODUCTS

2.01 GENERAL

A. Like items of materials: Use end products of one manufacturer to achieve structural compatibility and single-source responsibility.

2.02 ADHESIVE FOR SELF-CONTAINED CARTRIDGE SYSTEM

A. Adhesive shall have a current Evaluation Report demonstrating compliance with the requirements of ICC-ES AC58.

B. Materials:
   1. 2-component structural adhesive, insensitive to moisture, and gray in color.
   2. Cure temperature, pot life, and workability: Compatible with intended use and environmental conditions.

C. Packaging:
   1. Furnished in disposable, side-by-side cartridges with resin and hardener components isolated until mixing through manufacturer's static mixing nozzle.
      a. Nozzle designed to thoroughly blend the components, in the proper mixing ratio, for injection from the nozzle directly into prepared hole.
      b. Provide nozzle extensions as required to allow full-depth insertion and filling from the bottom of the hole.
   2. Container markings: Include manufacturer's name, product name, batch number, mix ratio by volume, product expiration date, ANSI hazard classification, and appropriate ANSI handling precautions.

D. For installation in solid masonry and solid-grouted masonry (concrete or brick):
   1. Manufacturers: One of the following or equal:
      a. Hilti, Inc., HY-270 Adhesive Anchor System.
      b. Simpson Strong-Tie Co., Inc., ET-HP Anchoring Adhesive.
      c. USP Structural Connectors, CIA-GEL 7000 Masonry Epoxy Adhesive.

2.03 ALL THREAD RODS

A. Materials: As specified in Section 05120 - Structural Steel Framing.

2.04 REINFORCING BARS

A. As specified in Section 04090 - Masonry Accessories.

PART 3 EXECUTION

3.01 GENERAL

A. Unless otherwise required for “conditions of use” in the Evaluation Report submitted, prepare and install holes, adhesive, and inserts (all thread rods or reinforcing bars) in accordance with the manufacturer’s recommendations and this Section.
   1. In the event of conflicts, the more restrictive provisions shall govern.

B. Do not install adhesive-bonded all-thread rods or reinforcing bars in upwardly inclined and overhead applications.

3.02 PREPARATION

A. Prior to completing manufacturer’s on-site training specified in this Section, do not:
   1. Drill holes for reinforcing bars or all thread rods.
   2. Mix or install adhesive in holes.

B. Review manufacturer’s installation instructions and “conditions of use” stipulated in the Evaluation Report before beginning work.

C. Confirm that adhesive and substrate receiving adhesive are within manufacturer’s recommended temperature range and will remain so during the cure time for the product.

3.03 HOLE LAYOUT AND INSTALLATION

A. Drilling holes:
   1. Determine location of reinforcing bars or other obstructions with a non-destructive indicator device. Mark locations with on the surface of the masonry using removable construction crayon, or other method acceptable to the Engineer.
   2. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the masonry without prior acceptance by Engineer.

B. Hole drilling equipment:
   1. Electric or pneumatic rotary impact type.
      a. Set drill to “rotation only” mode, or to “rotation plus hammer” mode in accordance with manufacturer’s installation instructions and the requirements of the Evaluation Report.
   2. Where edge distances are less than 2 inches and “rotation plus hammer” mode is permitted, use lighter impact equipment to prevent micro-cracking and spalling from drilling.
   3. Drill bits: Carbide-tipped in accordance with ANSI B212-15.
   4. Hollow drill bits with flushing air systems are preferred. Air supplied to hollow drill bits shall be free of oil, water, or other contaminants that will reduce bond.

C. Hole diameter: As recommend in the manufacturer’s installation instructions and the Evaluation Report.

D. Hole depth: As recommended by the manufacturer’s installation instructions to provide minimum effective embedment indicated on the Drawings.

E. Obstructions in drill path:
   1. If an existing reinforcing bar or other obstruction is hit while drilling hole, stop drilling and fill the hole with dry-pack mortar. Relocate the hole to miss the obstruction and drill to the required depth.
      a. Allow dry-pack mortar to cure to strength equal to that of the surrounding masonry before resuming drilling in that area.
      b. Epoxy grout may be substituted for dry-pack mortar when acceptable to the Engineer.
   2. Avoid drilling an excessive number of adjacent holes that would weaken the structural member and endanger the stability of the structure. Obtain Engineer’s acceptance of distance between abandoned and relocated holes.
   3. When existing reinforcing steel is encountered during drilling and when acceptable to Engineer, enlarge the hole by 1/8 inch, core through the existing reinforcing steel at the larger diameter, and resume drilling at original hole diameter.
   4. Bent bar reinforcing bars: Where edge distances are critical and interference with existing reinforcing steel is likely, and if acceptable to Engineer, drill hole at 10 degree angle (or less) from axis of reinforcing bar or all thread rod being installed.

F. Cleaning holes:
   1. Insert air nozzle to bottom of hole and blow out loose dust.
      a. Use compressed air that is free of oil, water, or other contaminants.
      b. Provide minimum air pressure of 90 pounds per square inch for not less than 4 seconds.
   2. Using a stiff bristle brush of diameter that provides contact around the full perimeter of the hole, vigorously brush the hole to dislodge compacted drilling dust.
      a. Insert brush to the bottom of the hole and withdraw using a simultaneous twisting motion.
      b. Repeat at least 4 times.

3. Repeat the preceding steps as required to remove drilling dust or other material that will reduce bond, and as required by the manufacturer and the Evaluation Report.
4. Leave prepared hole clean and dry.

3.04 INSTALLATION OF ADHESIVE AND INSERTS

A. Clean and prepare inserts:
   1. Prepare embedded length of reinforcing bars and all thread rods by cleaning to bare metal. The inserts shall be free of oil, grease, paint, dirt, mill scale, rust, or other coatings that will reduce bond.
   2. Solvent-clean prepared reinforcing bars and all thread rods over their embedment length in accordance with SSPC SP-1. Provide an oil and grease-free surface for bonding of adhesive to steel.

B. Fill holes with adhesive: Solid or solid-grouted masonry:
   1. Starting at the bottom of the hole, fill hole with adhesive before inserting the reinforcing bar or all thread rod.
   2. Fill hole without creating air voids as nozzle is withdrawn.
   3. Fill hole with sufficient adhesive so that excess is extruded out of the hole when the reinforcing bar or all thread rod is inserted into the hole.
   4. Where metal or plastic screens are required for use in masonry (units with hollow cells or holes, and multi-wythe brick walls), fill screen with adhesive and insert into hole in accordance with manufacturer’s recommendations.

C. Fill holes with adhesive: Masonry with holes or un-grouted cells.
   1. Provide manufacturer’s mesh screen tubes (steel or plastic mesh), fill with adhesive, and install in compliance with manufacturer’s instructions.

D. Install reinforcing bars and all thread rods:
   1. Install to depth, spacing, and locations as indicated on the Drawings.
   2. Insert bars and all thread rods into hole in accordance with manufacturer’s recommended procedures. Confirm that insert has reached the designated embedment in the hole and that adhesive completely surrounds the embedded portion.
   3. Clean excess adhesive from the mouth of the hole.

E. Curing and loading:
   1. Provide curing conditions recommended by the adhesive manufacturer for the period required to fully cure the adhesive at the actual temperature of the masonry.
   2. Do not disturb or load anchors until manufacturer’s recommended cure time has elapsed.

3.05 FIELD QUALITY CONTROL

A. Contractor shall provide field quality control as specified in Section 01450 - Quality Control.

B. Manufacturers' services:
   1. Before beginning installation, furnish adhesive manufacturer's representative to conduct on-site training in proper storage and handling of adhesive, drilling and cleaning of holes, and preparation and installation of reinforcing bars and all thread rods.
      a. Provide notice of training to Engineer and Special Inspector not less than 10 working days before training occurs. Engineer and Special Inspector may attend training sessions.
   2. Submit record, signed by the Engineer, listing Contractor’s personnel who completed the training. Only qualified personnel who have completed manufacturer’s on-site training shall perform installations.
   3. Do not install holes or adhesive until training is complete.

3.06 FIELD QUALITY ASSURANCE

A. Engineer will provide on-site inspection and field quality assurance.

B. Special inspection:
   1. As specified in Section 01455 - Regulatory Quality Assurance.
   2. Unless otherwise indicated on the Drawings or in this Section, provide periodic special inspection as required by the “Conditions of Use” in the Evaluation Report for the product installed.
      a. Provide continuous inspection of placement of adhesive and insertion of reinforcing bars and all thread rods into adhesive.
   3. Provide a written record of each inspection using form acceptable to the Engineer and the Authority Having Jurisdiction.
   4. Preparation:
      a. Review drawings and specifications for the Work being observed.
      b. Review adhesive manufacturer’s recommended installation and evaluation report’s special inspection procedures.
   5. Provide an initial inspection by for each combination of masonry type and reinforcing bar or all thread rod being installed. During initial inspection, observe the following for compliance with installation requirements. Furnish report of inspection that includes the following items.
      a. Masonry construction: Type and thickness; whether fully or partially grouted; locations and types of voids and holes in units.
      b. Environment: Temperature and moisture conditions of masonry base material and work area.
      c. Holes: Locations, spacing, edge distances; verification of drill bit compliance with ANSI B212.15; cleaning equipment and procedures; cleanliness of hole. Before placing adhesive, confirm that depth and preparation of holes conforms to requirements of the Contract Documents, installation recommendations of the manufacturer, and “conditions of use” specified in the Evaluation Report.

d. Adhesive: Product manufacturer and name; lot number and expiration date; temperature of product at installation; installation procedures. Note initial set times observed during installation.
e. Embedded reinforcing bars and all thread rods: Material diameter and length; steel grade and/or strength; cleaning and preparation; cleanliness at insertion; minimum effective embedment.

6. Subsequent installations of the same reinforcing bars or threaded rods in the same masonry may be performed without the presence of the special inspector, provided that:
   a. There is no change in the personnel performing the installation, the type or details of the masonry receiving the insert, the adhesive or the reinforcing bars and all thread rods being used. Changes in any of these items shall require a new initial inspection.
   b. For ongoing installations over a period of time, the special inspector visits the site at least once per day during each day of installation to observe the work for compliance with material requirements and installation procedures.

END OF SECTION

SECTION 04090

MASONRY ACCESSORIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Adjustable veneer anchors.
   2. Adjustable wall ties.
   3. Control joint filler.
   4. Foamed-in place insulation.
   5. Loose fill insulation.
   6. Reinforcing bars.
   7. Sheet metal ties.
   8. Wall tie screws.
   9. Wire joint reinforcement, single Wythe type.
   10. Weep holes.

1.02 REFERENCES

A. American Welding Society (AWS):
   1. D1.4 - Structural Welding Code - Reinforcing Steel.

B. ASTM International (ASTM):
   1. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   2. A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
   3. A951 - Standard Specification for Masonry Joint Reinforcement.
   4. A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
   5. C549 - Standard Specification for Perlite Loose Fill Insulation.
   6. D2000 - Standard Classification System for Rubber Products in Automotive Applications.
   7. D2287 - Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.

1.03 SUBMITTALS

A. Reinforcing bars:
   1. Changes to reinforcing steel contract drawing requirements:
      a. Indicate in separate letter submitted with shop drawings any changes of requirements indicated on the Drawings for reinforcing steel.
      b. Such changes will not be acceptable unless the Engineer has accepted such changes in writing.

c. Reinforcement detail drawings:
   1) Review of reinforcement shop drawings by the Engineer will be limited to general compliance with the Contract Documents.
d. Welding procedures.

B. Product data.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping:
   1. Deliver bars bundled and tagged with identifying tags.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. The Drawings contain general notes concerning amount of reinforcement and placing, details of reinforcement at wall corners and intersections, and details of extra reinforcement around openings in masonry.

2.02 MANUFACTURED UNITS

A. Adjustable veneer anchors: 2-piece zinc coated fabrications, minimum 12-gauge, 3/4-inch wide by minimum 6-inch long, hat channel shaped base, capable of being mechanically fastened or welded to stud framing, and receiving minimum 3/16-inch diameter triangular steel wire tie.
   1. Manufacturers: One of the following or equal:
      a. Hohmann & Barnard, 359-FH Weld-On Ties and VBT, Vee Byna Tie.
      b. Heckmann Building Products, No. 315-B: Weld-On Anchor Straps and No. 316: Triangle Ties.
      c. Wire-Bond, Type II, 1001 and 1100.

B. Adjustable wall ties: 2-piece zinc coated fabrications, minimum 3/16-inch diameter steel wire formed into hook or pin and eye pieces, capable of restraining compression and tension forces from veneer.
   1. Manufacturers: One of the following or equal:
      a. Hohmann & Barnard, Adjustable Wall Ties.
      b. Heckmann Building Products, No. 262 and 263.
      c. Wire-Bond, 1800 Hook and 1801 Eye.

C. Anchor bolts:
   1. Cast-in/built-in steel anchors: As specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
      a. Includes: anchor bolts, anchor rods, deformed bar anchors, and welded studs).
   2. Post-installed steel anchors: As specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
      a. Includes concrete anchors for concrete masonry, and screw anchors for concrete masonry.

D. Control joint filler: The key shall be of the width and shape as indicated on the Drawings. In accordance with ASTM D2000 or ASTM D2287.
   1. Manufacturers: One of the following or equal:
      a. Hohmann & Barnard, VS Standard.
      b. Wire-Bond, No. 2901.
      c. Southern Metals and Plastics, No. CJ1.

E. Dovetail anchors: As specified in Section 03102 - Concrete Formwork.

F. Loose fill insulation:
   1. Perlite: In accordance with ASTM C549, Type IV, surface-treated for water repellency and to limit dust generation during installation.

G. Foamed-in-place masonry insulation:
   1. Manufacturers: The following or equal:
      a. Tailored Chemical Products: Core-Fill 500™.

H. Reinforcing bars:
   1. Deformed bars in accordance with ASTM A615, Grade 60.
   2. Provide reinforcing steel that is of quality specified, free from excessive rust or scale or any defects affecting its usefulness.

I. Sheet metal ties: Minimum 22 gauge corrosion resistant corrugated sheet metal, minimum 7/8 inch wide by 7 inches long, pre-punched for wire ties to wire joint reinforcement.

J. Wall tie screws.

K. Wire joint reinforcement, single Wythe type: In accordance with ASTM A951 with ASTM A1064, 3/16-inch wire side rails and 9-gauge cross ties, sized to suit application, and galvanized in accordance with ASTM A153, Class B (minimum 1.5 ounces zinc per square foot.
   1. Manufacturers: One of the following or equal:
      a. Heckmann Building Products, No. 1100 Ladder Type Wall Reinforcement (9 gauge standard, other diameters special order).
      b. Hohmann & Barnard, 220 Ladder Mesh Reinforcement.
      c. Wire-Bond, Ladder Type, Series 200.

L. Weep holes: 3/8 inch cellular drainage structure to fit in head joint of veneer units to promote drainage of the air space cavity.
   1. Manufacturers: One of the following or equal:
      a. Hohmann & Barnard, Quadro-Vent.
      b. Wire-Bond, No. 3601 Cell-Vent.
   2. Weep holes shall be manufactured of ultraviolet-light resistant polypropylene cellular 3/8 inch thick.
   3. Color shall be selected from manufacturer’s standard colors to most closely match the selected mortar color.
   4. Size shall match the depth and height of the veneer units selected.

2.03 FABRICATION

A. Reinforcing bars:
   1. Cut and bend bars in accordance with building code as specified in Section 01410 - Regulatory Requirements.
   2. Bend bars cold.
   3. Provide bars free from defects and kinks and from bends not indicated on the Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
   1. Reinforcing bars:
      a. Verify that bars are new stock free from rust scale, loose mill scale, excessive rust, dirt, oil, and other coatings which adversely affect bonding capacity when placed in the work.

3.02 PREPARATION

A. Reinforcing bars:
   1. Thin coating of red rust resulting from short exposure will not be considered objectionable. Thoroughly clean any bars that have rust scale, loose mill scale, or thick rust coat.
   2. Remove concrete or other deleterious coatings from dowels and other projecting bars by wire brushing or sandblasting before bars are embedded in subsequent masonry placement.

3.03 INSTALLATION

A. Reinforcing bars:
   1. No field bending of bars will be allowed.
   2. Welding:
      a. Weld reinforcing bars where indicated on the Drawings or acceptable to the Engineer.
      b. Perform welding in accordance with AWS D1.4.
      c. Submit welding procedures.
      d. Do not tack weld reinforcing bars.

B. Placing reinforcing bars:
   1. Accurately place bars and adequately secure them in position.
   2. Overlap bars at splices as indicated on the Drawings or specified.
   3. If not indicated on the Drawings, lap splice bars in masonry in accordance with the building code as specified in Section 01410 - Regulatory Requirements.

END OF SECTION

SECTION 04100

MORTAR AND MASONRY GROUT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Mortar and grout for masonry construction.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C144 - Standard Specification for Aggregate for Masonry Mortar.
   2. C150 - Standard Specification for Portland Cement.
   3. C207 - Standard Specification for Hydrated Lime for Masonry Purposes.
   4. C270 - Standard Specification for Mortar for Unit Masonry.
   5. C404 - Standard Specification for Aggregates for Masonry Grout.
   6. C476 - Standard Specification for Grout for Masonry.
   7. C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
   8. C1019 - Standard Test Method for Sampling and Testing Grout.

1.03 DEFINITIONS

A. Alkali: Sum of sodium oxide and potassium oxide calculated as sodium oxide.

1.04 SUBMITTALS

A. Product data.

B. Shop drawings.

C. Design Mixes for mortar and grout.

D. Test reports:
   1. Mortar Strength Test Results.
   2. Grout Strength Test Results.

1.05 QUALITY ASSURANCE

A. Materials for mortar and grout: Do not change source of materials which will affect the appearance of finished work after the work has started unless acceptable to Engineer.

1.06 PROJECT CONDITIONS

A. Environmental requirements:
   1. Cold weather requirements:
      a. Cold Weather Construction: In accordance with the building code as specified in Section 01410 - Regulatory Requirements.
      b. Provide adequate equipment for heating mortar and grout materials when air temperature is below 40 degrees Fahrenheit.
         1) Temperatures of separate materials, including water, shall not exceed 140 degrees Fahrenheit when placed in mixer.
         2) Maintain mortar temperature on boards above freezing.
   2. Hot weather requirements:
      a. Wet mortar board before loading and cover mortar to retard drying when not being used.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Compressive strength:
   1. Mortar: Minimum 1,800 pounds per square inch at 28 days.
   2. Grout: Minimum at 28 days.

2.02 MATERIALS

A. Portland cement:
   1. Type II, low alkali, containing maximum 0.6 percent total alkali in accordance with ASTM C150.

B. Hydrated lime:
   1. Type S in accordance with ASTM C207.

C. Aggregate for mortar:
   1. Fine aggregate: Sand in accordance with ASTM C144.

D. Aggregate for grout:
   1. Fine aggregate: Size Number 2 in accordance with ASTM C404.
   2. Coarse aggregate: Size Number 8 in accordance with ASTM C404.

E. Admixtures:
   1. Grout admixture:
      a. Manufacturers: The following or equal:
         1) Sika Corp., Sika Grout Aid, Type II.
   2. Mortar water repellent admixture:
      a. Manufacturers: One of the following or equal:
         1) Sika Corp., Sikaproof A.
         2) W.R. Grace, Dry Block Mortar.
         3) Master Builder Solutions, MasterPel 240MA.
   3. Other admixtures:
      a. Prohibited, unless accepted by the Engineer.

F. Water: Clean, clear, potable, free of oil, soluble salts, chemicals, and other deleterious substances.

G. Other materials:
   1. Prohibited, unless acceptable to Engineer.

2.03 MIXES

A. Mortar mix:
   1. Portland cement-lime mortar.
   2. Mortar mix proportions by volume: As indicated in the following table:

Mortar Type	Parts by Volume of Portland Cement	Parts by Volume of Hydrated Lime	Aggregate Measured in a Damp Loose Condition
S	1	Greater than 1/4 to 1/2	Not less than 2-1/4 and not more than 3 times the sum of the separate volumes of cementitious materials
N	1	Greater than 1/2 to 1 1/4	Not less than 2-1/4 and not more than 3 times the sum of the separate volumes of cementitious materials

   3. Mortar mixing:
      a. Mix on jobsite in accordance with ASTM C270.
      b. Mix in mechanical mixer and only in quantities needed for immediate use.
      c. Mix for minimum 3 minutes, and maximum of 5 minutes after materials have been added to mixer.
   4. Measurement by volume: Measurement of constituents shall be accomplished by the use of a container of known capacity.
   5. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units.
      a. Use no mortar which has been standing for more than 1 hour after being mixed.
   6. Whenever 90 minutes has elapsed since last batch was mixed, completely empty mixer drum of materials and wash down before placing next batch of materials.

B. Grout mix:
1. Grout mix proportions by volume: As indicated in the following table:

Type of Grout	Parts by Volume of Portland Cement	Parts by Volume of Hydrated Lime	Aggregate Measured in a Damp Loose Condition	
			Fine Aggregate	Coarse Aggregate
Fine grout	1	0-1/10	2-1/4 to 3 times the sum of the volumes of the cementitious materials	-
Coarse grout	1	0-1/10	2-1/4 to 3 times the sum of the volumes of the cementitious materials	1 to 2 times the sum of the volumes of the cementitious materials

2. Grout mixing:
   a. Mix on jobsite or in a transit mix in accordance with ASTM C476
   b. Slump: 8 to 11 inches, unless otherwise accepted by the Engineer.
   c. Use within 90 minutes after addition of mixing water.
   d. Mix for minimum of 5 minutes after ingredients are added and until uniform mix is attained. Grout shall have sufficient water added to produce pouring consistency without segregation.
3. Use coarse grout for hollow cell masonry units with minimum 4-inch cell dimensions in both horizontal directions.
   a. Calculate cell dimension for this criterion by subtracting diameter(s) of any horizontal reinforcement crossing the cell from clear cell dimensions of the masonry unit.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. Testing of grout and mortar:
1. During progress of construction, the Owner will have tests made to determine whether the grout and mortar, as being produced, complies with Specifications.
2. Compressive strength test for grout: In accordance with ASTM C1019.
3. Owner’s Representative will make and deliver test specimens to the laboratory and testing expense will be boprne by the Owner.
4. Required number of tests:
   a. At least 2 test specimens of grout and mortar will be made per week.
5. Do not use grout and mortar that does not meet specification.
   a. Remove such mortar and grout from Project site.

6. Make provisions for and furnish grout and mortar for test specimens, and provide manual assistance to the Engineer in preparing test specimens.
7. Assume responsibility for care of and providing proper curing conditions for test specimens.

3.02 ADJUSTING

A. Repair of defective masonry:
   1. Remove and replace or repair defective work.
   2. Do not patch, repair, or cover defective work without inspection by the Engineer.
   3. Provide repairs having strength equal to or greater than specified strength for areas involved.

END OF SECTION

SECTION 04220

CONCRETE UNIT MASONRY

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Concrete masonry units and accessories.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C90 - Standard Specification for Loadbearing Concrete Masonry Units.
   2. C140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
   3. C426 - Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.

B. The Masonry Society (TMS):
   1. TMS 602 - Specification for Masonry Structures.

1.03 TERMINOLOGY

A. The words and terms listed below, are not defined terms that require initial capital letters, but, when used in this Section have the indicated meaning.
   1. Grout Lift Height: The height of grout placed in a single continuous operation within the grout pour height.
   2. Grout Pour Height: Entire height of the masonry to be grouted prior to the construction of additional masonry.
   3. Mortar Smears: Mortar paste smeared across the permanent masonry construction during construction and absorbed into the masonry pores.
   4. Mortar Splash: Mortar dropped splashed onto the permanent masonry construction at the base of the wall or off the scaffolding.
   5. Mortar Stains: Mortar paste left after mortar tags are removed.
   6. Mortar Tag: Excess mortar between masonry units worked out of the joints during tooling or striking.

1.04 SUBMITTALS

A. Product data:
   1. Submit manufacturer’s product data for proposed cleaning agent.

B. Shop drawings: Include elevations of each wall indicating type and layout of units, including type of mortar joints, bond pattern, reinforcing steel, connecting dowels, joint reinforcement, grouted cells, and control joints.

C. Samples: Include samples of stretcher units in sufficient quantity to illustrate color range.

D. Test reports:
   1. Compressive strength.
   2. Linear shrinkage.
   3. Moisture content as a percentage of total absorption.
   4. Total absorption.
   5. Unit weight.

E. Manufacturer's instructions:
   1. Submit printed or written recommendations from the masonry unit manufacturer of the cleaning procedures and cleaning agents appropriate for each type of masonry unit included in the work.

F. Quality assurance submittals:
   1. If requested by the Engineer, submit a record of the Installer's evidence of qualifications.
   2. If requested by the Engineer, submit a record of the Masonry Cleaner's evidence of qualifications.

1.05 QUALITY ASSURANCE

A. Qualifications:
   1. Installer qualifications:
      a. The mason shall hold an appropriate contractor's license in the State where the work will be constructed.
      b. The mason shall have not less than 5 years' experience and completed a minimum of 20 projects and at least 5 of which included the type of masonry units specified for this Work.
   2. Masonry cleaner qualifications:
      a. The masonry cleaner shall have not less than 5 years' experience and completed a minimum of 20 projects and at least 5 of which included the type of masonry units specified for this Work.

B. Pre-installation conference: Conduct as specified in Section 01312 - Project Meetings.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Transport and handle concrete masonry units as required to prevent discoloration, chipping, and breakage.

B. Store masonry units off the ground in a dry location, covered and protected from absorbing moisture.
   1. Locate storage piles, stacks, and bins to protect materials from heavy traffic.
   2. If masonry units are delivered in shrink-wrapped packaging and condensation develops, remove shrink-wrap packaging.

C. Remove chipped, cracked, and otherwise defective units from jobsite upon discovery.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Cold weather requirements:
   1. In accordance with building code as specified in Section 01410 - Regulatory Requirements, provide adequate equipment for heating masonry materials when air temperature is below 40 degrees Fahrenheit.

B. Hot weather requirements:
   1. In accordance with building code as specified in Section 01410 - Regulatory Requirements, when ambient air temperature exceeds 100 degrees Fahrenheit, or when ambient air temperature exceeds 90 degrees Fahrenheit and wind velocity is greater than 8 miles per hour, implement hot weather protection procedures.
   2. Wet mortarboard before loading and cover mortar to retard drying when not being used.
   3. Do not spread mortar beds more than 48 inches ahead of placing masonry units.
   4. Place masonry units within one minute of spreading mortar.

1.08 SEQUENCING AND SCHEDULING

A. Order concrete masonry units well before start of installation to ensure adequate time for manufacturing and minimum 28 days for curing and drying before start of installation. Protect from weather after curing period to avoid moisture increase.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Hollow load bearing concrete masonry units:
   1. Class: In accordance with ASTM C90, Standard Level of Quality with minimum compressive strength of 2000 pounds per square inch.
   2. Surface texture: Standard and split face.
   3. Color: Integral, Natural gray of concrete.
   4. Typical size: 8 inches wide by 8 inches high by 16 inches long, unless otherwise indicated on the Drawings, or other sizes as needed to minimize cutting.
   5. Special sizes and shapes: As required for window and door openings, bond beams, piers, lintels, control joints, and other special applications to minimize cutting.

B. Anchor bolts: As specified in Section 05120 - Structural Steel Framing.

C. Steel reinforcement: As specified in Section 04090 - Masonry Accessories.

D. Wall ties: As specified in Section 04090 - Masonry Accessories.

E. Wire joint reinforcement: As specified in Section 04090 - Masonry Accessories.

F. Loose fill insulation: As specified in Section 04090 - Masonry Accessories.

PART 3 EXECUTION

3.01 PREPARATION

A. Protection:
   1. Protect adjacent construction with appropriate means from mortar droppings and other effects of laying of concrete masonry units.

B. Surface preparation:
   1. Thoroughly clean foundations of laitance, grease, oil, mud, dirt, mortar droppings, and other matter that will reduce bond.

3.02 INSTALLATION

A. Forms and shores:
   1. Where required, construct forms to the shapes indicated on the Drawings:
      a. Construct forms sufficiently rigid to prevent deflection which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout.
      b. Do not remove supporting forms or shores until the supported masonry has acquired sufficient strength to support safely its weight and any construction loads to which it may be subjected.
         1) Wait at least 24 hours after grouting masonry columns or walls before applying uniform loads.
   2. Wait at least 72 hours before applying concentrated loads.

B. Concrete masonry units:
   1. Lay concrete masonry units dry.
   2. Lay units in uniform and true courses, level, plumb, and without projections or offset of adjacent units.
   3. Lay units to preserve unobstructed vertical continuity of cells to be filled with grout or insulation.
   4. Align vertical cells to be filled with grout to maintain clear, unobstructed continuous vertical cell measuring not less than 2.5 inches by 3 inches.
   5. Place mortar with full coverage of joints at webs of all cells and face shells.
   6. Butter vertical head joints for thickness equal to face shell thickness of units, and shove joints tightly together so that mortar bonds to both masonry units.
   7. Solidly fill joints from face of units to inside face of cells.
   8. Lay units to desired height with joints of uniform thickness.
   9. Bond shall be plumb throughout.
   10. Lay units to avoid formation of cracks when units are placed.
   11. Keep cells of units as free of mortar as possible as masonry wall height increases.
   12. When positions of units shift after mortar has stiffened, bond is broken, or cracks are formed, relay units in new mortar.
   13. Remove mortar, mortar droppings, debris, and other obstructions and materials from inside of cell walls.
   14. Remove mortar tags and smears daily with a non-metallic tool.
      a. Mortar tags and smears shall be removed after they initially set but shall not be permitted to remain more than 24 hours.

15. Where practical, protect completed work from mortar splash by placing thin plastic sheeting around the base of walls.
    a. Place sand, straw, sawdust or other similar material on the floor around the base of walls to protect floors and walls.
16. Turn scaffold planks over at the end of the workday to avoid mortar splashes from wet weather.
    a. Cover tops of walls at the end of the workday and other work stoppages to prevent entry of water into the partially completed masonry.
17. Seal cleanouts after inspection and before grouting or placing insulation.

C. Bond pattern:
    1. Lay concrete masonry units in running bond pattern, unless otherwise indicated on the Drawings.

D. Mortar joints:
    1. Make joints straight, clean, smooth, and uniform in thickness.
    2. Tool exposed joints, slightly concave. Strike concealed joints flush.
    3. Make vertical and horizontal joints 3/8-inch thick.
    4. Where fresh masonry joins totally or partially set masonry, clean, and roughen set masonry before laying new units.

E. Wire joint reinforcement:
    1. Lap splice longitudinal wire joint reinforcement minimum 75 wire diameters.
    2. Place longitudinal wires in approximate centers of mortar beds with minimum 5/8-inch mortar cover on exposed faces.
    3. Provide intersecting masonry walls with prefabricated wire joint reinforcement tees.
    4. Rake intersecting joints 1/2 inch and caulk joints.

F. Grouting and reinforcement:
    1. Where horizontal and vertical bars are spliced and adjacent lap splices are separated by more than 3 inches, the lap splice length shall be 72 bar diameters.
        a. Where adjacent lap splices are separated by 3 inches or less, the lap splice length shall be increased by 1.3 times or the lap splices shall be staggered at least 24 bar diameters with no increase in length.
    2. Hold vertical reinforcing bars in position at top and bottom and at intervals not exceeding 200 bar diameters.
        a. Use steel wire bar positioners to position bars.
        b. Tie reinforcing bars to dowels with wire ties.
    3. Obtain acceptance of reinforcement placement before grouting.
        a. Grouting:
            1) Grout pour height shall be limited to a maximum of 5.33 feet, unless the Contractor submits sufficient evidence to the Engineer for review and acceptance that the requirements of TMS 602 as it relates to grout pour height can be met.
            2) Grout lift height shall be limited to a maximum of 5.33 feet, unless the Contractor submits sufficient evidence to the Engineer for review and acceptance that the requirements of TMS 602 as it relates to grout lift height can be met.
            3) Slushing with mortar will not be permitted.

4) Allow hollow unit masonry to cure at least 24 hours prior to grouting.
5) Each lift shall be allowed to set for 10 minutes after initial consolidation of grout before successive lift is placed.
6) The full height of each section of wall shall be grouted in 1 day.

4. Placement:
   a. Use a hand bucket, concrete hopper, or grout pump.
   b. Place grout so as to completely fill the grout spaces without segregation of the aggregates.
   c. Remove grout spills immediately by hand washing with a bucket and brush.
   d. Fill all spaces and cells solidly with grout. Grout in cells shall have full contact with surface of concrete footings.
   e. Time constraints:
      1) When grouting stops for 1 hour or longer, form horizontal construction joints by stopping grout placement 1-1/2 inches below top of uppermost unit containing grout.
      2) Place grout in final position within 1-1/2 hours after mixing. Place grout so as to completely fill the grout spaces without segregation of the aggregates.
   f. Consolidation:
      1) Do not insert vibrators into lower grout placements that are in a semi-solidified state.
      2) After placement, consolidate grout using mechanical immersion vibrators designed for consolidating grout.

G. Bond beams:
1. Starting courses at bottom of walls shall be bond beams.
2. Place horizontal reinforcement and solidly grout bond beam units in place.
3. Provide wire mesh at openings in bottom of bond beams to support grout where walls are not grouted solid.

H. Cutting concrete masonry units:
1. When possible, use full units of the proper size in lieu of cut units. Cut units as required to form chases, openings, for anchorage, and for other appurtenances.
2. Cut and fit units with power-driven carborundum or diamond disc blade saw.

I. Control joints:
1. Provide in masonry walls at locations indicated on the Drawings.
2. Make full height and continuous in appearance.
3. Run bond beams and bond beam reinforcing bars continuously through control joints.
4. Insert control joint filler in joints as wall is constructed.
5. Apply sealant as specified in Section 07900 - Joint Sealants.

J. Openings and lintels:
1. Place horizontal reinforcement in fully grouted bond beam units.
2. Use lintel block units where underside of lintel will be exposed.
3. Provide minimum of 8-inch bearing at each end of lintel.

4. Embed reinforcing bars minimum 24 inches or 48 bar diameters, whichever is longer, into wall past edges of openings or as indicated on the Drawings:
    a. At corners, provide 90-degree bend with equivalent total embedment.

K. Steel door frames:
1. Anchor and fully grout jambs and head of steel doorframes connected to concrete unit masonry.
2. Fill frames with grout as each 2 feet of concrete unit masonry is laid.

L. Bearing plates:
1. Provide minimum of 12 inches of grouted concrete unit masonry below steel bearing plates and beams bearing on masonry walls.

M. Anchor bolts:
1. Hold anchor bolts in place with template during grouting to ensure precise alignment.
2. Do not cut or ream members being anchored or use other means to accommodate misaligned anchor bolts in roof deck support angles.
3. Provide minimum 6-inch wide grouted concrete unit masonry entirely around anchor bolts and other attachment devices.

N. Enclosures:
1. Where concrete masonry units enclose conduit, pipes, stacks, ducts, and similar items, construct chases, cavities, and similar spaces as required, whether or not such spaces are indicated on the Drawings.
2. Point openings around flush mounted electrical outlet boxes with mortar, including flush joints above boxes.
3. Do not cover enclosures until inspected and when appropriate, tested.

O. Other embedded items:
1. Build in wall plugs, accessories, flashings, pipe sleeves, and other items required to be built-in as the masonry work progresses.

P. Patching:
1. Patch exposed concrete masonry units at completion of the Work and in such manner that patching will be indistinguishable from similar surroundings and adjoining construction.

Q. Water curing:
1. Protect concrete masonry units from drying too rapidly by frequently fogging or sprinkling so walls will always be visibly damp for minimum 3 days.

R. Miscellaneous:
1. Build in required items, such as anchors, flashings, sleeves, frames, structural steel, lintels, anchor bolts, and metal fabrications, as required for complete installation.

S. Water repellent:
1. Apply water repellent as specified in Section 07190 - Water Repellents.

T. Anti-graffiti coating:
    1. Apply anti-graffiti coating as specified in Section 07190 - Water Repellents.

U. Grouting equipment:
    1. Grout pumps:
        a. Do not pump grout through aluminum tubes.
        b. Operate pumps to produce a continuous stream of grout without air pockets.
        c. Upon completion of each days pumping, eject grout from pipeline without contamination or segregation of the grout:
            1) Remove waste materials and debris from the equipment.
            2) Dispose of waste materials, debris, and all flushing water outside the masonry.
    2. Vibrators:
        a. Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout.
        b. Maintain at least 1 spare vibrator, at the site at all times.
        c. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine.
        d. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation.

3.03 CONSTRUCTION

A. Site tolerances: Lay masonry plumb, true to line, and with courses level. Keep bond pattern plumb throughout. Lay masonry within the following tolerances:
    1. Maximum variation from the plumb in the lines and surfaces of columns, walls, and in the flutes and surfaces of fluted or split faced blocks:
        a. In adjacent masonry units: 1/8 inch.
        b. In 10 feet: 1/4 inch.
        c. In any story or 20 feet maximum: 3/8 inch.
        d. In 40 feet or more: 1/2 inch.
    2. Maximum variations from the plumb for external corners, expansion joints, and other conspicuous lines:
        a. In any story or 20 feet maximum: 1/4 inch.
        b. In 40 feet or more: 1/2 inch.
    3. Maximum variations from the level or grades indicated on the Drawings for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:
        a. In any bay or 20 feet maximum: 1/4 inch.
        b. In 40 feet or more: 1/2 inch.
    4. Maximum variations of the linear building lines from established position in plan and related portion of columns, walls, and partitions:
        a. In any bay or 20 feet maximum: 1/2 inch.
        b. In 40 feet or more: 3/4 inch.
    5. Maximum variation in cross sectional dimensions of columns and in thickness of walls:
        a. Minus: 1/4 inch.
        b. Plus: 1/2 inch.

3.04 FIELD QUALITY CONTROL

A. Site tests:
   1. Owner will have tests performed by an independent laboratory.
   2. Have minimum 3 concrete masonry units of each type proposed for Project tested in accordance with ASTM C90, C140, and C426 to verify conformance to Specifications.
   3. Tests shall include compressive strength, linear shrinkage, moisture content as percent of total absorption, total absorption, and unit weight.

B. Special inspection:
   1. Special inspection shall be as specified in Section 01455 - Regulatory Quality Assurance.
   2. Owner will employ a qualified masonry special inspector for continuous special inspection of the masonry work. Acceptance by a state or municipality having a program of examining and certifying masonry inspectors will be considered adequate qualifications. The masonry inspector shall be at the site during all masonry construction and perform the following duties:
      a. Review Drawings and Specifications and meet with the Contractor to discuss requirements before work commences.
      b. Before masonry work commences, Contractor and the Contractor's Quality Control Representative shall attend meeting with Engineer to review the requirements for surveillance and quality control of the masonry work.
      c. Check brand and type of cement, lime (if used), and source of sand.
      d. Verify that foundation is clean, rough, and ready to receive units.
      e. Check reinforcing steel dowels for correct location, straightness, proper alignment, spacing, size, and length.
      f. Observe field proportioning of mortar. Visually check aggregate to determine uniformity of grading, cleanliness, and moisture.
      g. Verify that joints are full of mortar and kept tight during work. Inspect grout cells to verify that fins will not interfere with grouting. Verify that masons keep grout cells clean of mortar droppings and inspect to determine compliance.
      h. Continuously observe placing of grout.
      i. Perform or supervise performance of required sampling and testing.
   3. Keep complete record of inspections. Report daily to the Building Official, Contractor's Quality Control Representative, Engineer, and Owner the progress of the masonry inspection.

3.05 FINAL CLEANING

A. General:
   1. Final cleaning shall be performed within 7 to 14 days after construction of masonry work.
   2. Protect adjacent materials and equipment that may be damaged by cleaning.
   3. Pre-wet masonry before applying cleaning agent, but do not saturate masonry.
   4. Remove mortar stains, smears, and splash, efflorescence, and grout stains on exposed surfaces with the submitted cleaning agent as directed by the masonry unit manufacturer’s recommendations.
   5. Do not use muriatic acid as cleaning agent.

6. Cleaning agents shall be applied when the masonry surface and air temperatures are at least 50 degrees Fahrenheit.
    a. Dilute cleaning agents in accordance with manufacturer's recommendations.
    b. Do not allow cleaning agents to dry on the masonry.
7. Clean wall from the top to the bottom, without overlapping areas being cleaned for consistency.
8. If pressure cleaning equipment is used, the following limitations shall be observed:
    a. Apply cleaning agent to pre-wetted wall with low pressure (less than 50 pounds per square inch).
    b. Use a 25° to 50° flared-tip nozzle (not a pointed tip).
    c. Maintain a consistent distance from the spray nozzle to the masonry surface no closer than 12 inches.
        1) Masonry cleaner shall use a combination of pressure, nozzle, and distance from tip to masonry that does not damage the masonry surface.
9. Rinse cleaning agents off the wall with potable water.
10. Dispose of debris, refuse, and surplus material offsite legally.

3.06 PROTECTION

A. Provide temporary protection for exposed masonry corners subject to damage.

B. Bracing:
    1. Unless wall is adequately supported by permanent supporting elements so wall will not overturn or collapse, adequately brace masonry walls over 8 feet in height to prevent overturning and to prevent collapse.
    2. Keep bracing in place until permanent supporting elements of structure are in place.

C. Limited access zone:
    1. Establish limited access zone prior to start of masonry wall construction.
    2. Zone shall be immediately adjacent to wall and equal to height of wall to be constructed plus 4 feet by entire length of wall on unscaffolded side of wall.
    3. Limit access to zone to workers actively engaged in constructing wall. Do not permit other persons to enter zone.
    4. Keep zone in place until wall is adequately supported or braced by permanent supporting elements to prevent overturning and collapse.

END OF SECTION

SECTION 04221

BRICK MASONRY

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Brick masonry units.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. C62 - Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale).
   2. C67 - Standard Test Methods of Sampling and Testing Brick and Structural Clay Tile.
   3. C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
   4. C652 - Standard specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale).

1.03 SUBMITTALS

A. Product data.

B. Shop drawings: Include elevations of each wall indicating type and layout of units.

C. Samples: Include samples of stretcher units in sufficient quantity to illustrate color range.

D. Test reports.

1.04 QUALITY ASSURANCE

A. Continuous inspection:
   1. Employ a qualified masonry inspector for continuous inspection of the masonry work.
      a. Acceptance by a state or municipality having a program of examining and certifying masonry inspectors will be considered adequate qualifications.
      b. The masonry inspector shall be at the site during all masonry construction and perform the following duties:
         1) Review drawings and specifications and meet with the Contractor to discuss requirements before work commences.
         2) Before masonry work commences, Contractor and the Contractor's Quality Control Representative shall attend meeting with Engineer to review the requirements for surveillance and quality control of the masonry work.
         3) Check brand and type of cement, lime (if used), and source of sand.

4) Ensure that foundation is clean, rough, and ready to receive units.
5) Check reinforcing steel dowels for straightness, proper alignment, spacing, size, and length.
6) Observe field proportioning of mortar. Visually check aggregate to determine uniformity of grading, cleanliness, and moisture.
7) Ensure that joints are full of mortar and kept tight during work.
    a) Inspect grout cells to ensure that fins will not interfere with grouting.
    b) Ensure that masons keep grout cells clean of mortar droppings and inspect to determine compliance.
8) Continuously observe placing of grout.
9) Perform or supervise performance of required sampling and testing.

2. Keep complete record of inspections. Report daily to the Contractor's Quality Control Representative the progress of the masonry inspection.

B. Mock-up:
1. Prior to starting construction of masonry, construct minimum 4-foot square mock-up.
2. Use accepted materials, containing each different kind and color of brick masonry units to illustrate wall design.
3. When not accepted, construct another mock-up.
4. When accepted, mock-up will be standard of comparison for remainder of masonry work.
5. Upon completion of Project, dispose of mock-ups in legal manner at offsite location.

C. Pre-installation conference: Conduct as specified in Section 01312 - Project Meetings.

D. Masonry prism testing: Perform masonry prism testing in accordance with building code.

E. A letter of certification from the supplier of the materials used to verify in accordance with building code, shall be provided at the time of, or prior to, delivery of the materials to the jobsite.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Transport and handle brick masonry units as required to prevent discoloration, chipping, and breakage.

B. Locate storage piles, stacks, and bins to protect materials from heavy traffic.

C. Remove chipped, cracked, and otherwise defective units from jobsite upon discovery.

1.06 PROJECT CONDITIONS

A. Cold weather requirements:
   1. In accordance with the building code as specified in Section 01410 - Regulatory Requirements.
   2. Provide adequate equipment for heating masonry materials when air temperature is below 40 degrees Fahrenheit.

B. Hot weather requirements:
   1. When ambient air temperature exceeds 100 degrees Fahrenheit, or when ambient air temperature exceeds 90 degrees Fahrenheit and wind velocity is greater than 8 miles per hour, implement hot weather protection procedures.
   2. Wet mortarboard before loading and cover mortar to retard drying when not being used.
   3. Do not spread mortar beds more than 48 inches ahead of placing masonry units.
   4. Place masonry units within 1 minute of spreading mortar.

1.07 SEQUENCING AND SCHEDULING

A. Order brick masonry units (8 weeks minimum) well before start of installation to ensure adequate time for manufacturing.

PART 2 PRODUCTS

2.01 HOLLOW LOAD BEARING BRICK MASONRY UNITS

A. Manufacturers: One of the following or equal:
   1. Interstate Brick Co.
   2. General Shale Brick Co.

B. Type: ASTM C652, Grade SW, Type HBS with minimum compressive strength of 2,500 pounds per square inch.

C. Surface texture: To be selected by Engineer from manufacturer’s full range of available textures.

D. Colors:
   1. Soldier coursing: “Copperstone,” soldier coursing over windows and doors to be contrasting color as selected by Engineer from standard colors.

E. Size: 8 inches wide, by 4 inches high, by 12 inches long, unless otherwise indicated on the Drawings.

F. Coursing: 4 inches wide, by 8 inches high, by 8 inches deep.

G. Special sizes and shapes: As required for window and door soldier coursing and custom sills where indicated; bond beams, piers, lintels, control joints, and other special applications to minimize cutting.

PART 3 EXECUTION

3.01 PREPARATION

A. Protect adjacent construction with appropriate means from mortar droppings and other effects of laying of brick masonry units.

B. Thoroughly clean foundations of laitance, grease, oil, mud, dirt, mortar droppings, and other objectionable matter.

3.02 BRICK MASONRY UNITS

A. Provide custom level of quality in accordance with ASTM C62 and C 216.

B. Lay masonry units damp. (Wet bricks with fine spray about 4 hours prior to their use).

C. Lay units in uniform and true courses, level, plumb, and without projections or offset of adjacent units.

D. Lay units to preserve unobstructed vertical continuity of cells to be filled with grout or insulation.

E. Align vertical cells to be filled with grout to maintain clear, unobstructed continuous vertical cell measuring not less than 2 by 3 inches.

F. Place mortar with full coverage of joints at webs of all cells and face shells.

G. Butter vertical head joints for thickness equal to face shell thickness of units, and shove joints tightly together so that mortar bonds to both masonry units.

H. Solidly fill joints from face of units to inside face of cells.

I. Lay units to desired height with joints of uniform thickness.

J. Bond shall be plumb throughout.

K. Lay units to avoid formation of cracks when units are placed. Keep cells of units as free of mortar as possible as masonry wall height increases.

L. Lay masonry plumb, true to line, with courses level. Keep bond pattern plumb throughout. Lay masonry within the following tolerances:
   1. Maximum variation from the plumb in the lines and surfaces of columns, walls, and in the flutes and surfaces of fluted or split faced blocks:
      a. In adjacent masonry units: 1/8 inch.
      b. In 10 feet: 1/4 inch.
      c. In any story or 20 feet maximum: 3/8 inch.
      d. In 40 feet or more: 1/2 inch.
   2. Maximum variations from the plumb for external corners, expansion joints, and other conspicuous lines:
      a. In any story or 20 feet maximum: 1/4 inch.
      b. In 40 Feet or More: 1/2 inch.

3. Maximum variations form the level or grades indicated on the Drawings for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines:
    a. In any bay or 20 feet maximum: 1/4 inch.
    b. In 40 feet or more: 1/2 inch.
4. Maximum variations of the linear building lines from established position in plan and related portion of columns, walls, and partitions:
    a. In any bay or 20 feet maximum: 1/2 inch.
    b. In 40 feet or more: 3/4 inch.
5. Maximum variation in cross sectional dimensions of columns and in thickness of walls:
    a. Minus: 1/4 inch.
    b. Plus: 1/2 inch.
6. When positions of units shift after mortar has stiffened, bond is broken, or cracks are formed, relay units in new mortar.

M. Remove mortar, mortar droppings, debris, and other obstructions and materials from inside of cell walls.

N. Seal cleanouts after inspection and before grouting or placing insulation.

3.03 LOOSE FILL INSULATION

A. Fill all brick masonry unit cells solidly with grout.

B. Place in lifts of 4 feet maximum when filling brick masonry unit cells.

C. Do not lay units more than 4 feet vertically ahead of units filled with loose insulation.

D. Ensure that no insulation gets into cells which are to be filled with grout.

3.04 MORTAR JOINTS

A. Make joints straight, clean, smooth, and uniform in thickness.

B. Pointing: Tool exposed joints, slightly concave. Strike concealed joints flush.

C. Joint thickness: Make vertical and horizontal joints 3/8-inch thick.

D. Where fresh masonry joins totally or partially set masonry, clean and roughen set masonry before laying new units.

3.05 BOND PATTERN

A. Lay brick masonry units in running bond pattern, unless otherwise indicated on the Drawings.

3.06 GROUTING AND REINFORCEMENT

A. Where horizontal and vertical bars are spliced and adjacent lap splices are separated by more than 3 inches, the lap splice length shall be 72 bar diameters.

B. Where adjacent lap splices are separated by 3 inches or less, the lap splice length shall be increased by 1.3 times or the lap splices shall be staggered at least 24 bar diameters with no increase in length.

C. Hold vertical reinforcing bars in position at top and bottom and at intervals not exceeding 200 bar diameters. Use steel wire bar positioners to position bars and tie reinforcing bars to dowels with wire ties.

D. Obtain acceptance of reinforcement placement before grouting.

E. Fill all spaces and cells solidly with grout.

F. Low-lift grouting:
   1. Hollow unit masonry to be grouted by the low lift method shall be constructed and grouted in lifts not exceeding 4 feet.
      a. Double wythe masonry which will be grouted by the low-lift method shall be constructed and grouted in lifts not exceeding 8 inches.
      b. Slushing with mortar will not be permitted.

G. High-lift grouting:
   1. If grouting is accomplished by the high-lift method, double wythe masonry shall be allowed to cure at least 72 hours and hollow unit masonry shall be allowed to cure at least 24 hours before grouting.
   2. In double wythe construction, vertical grout barriers shall be built across the grout space to the height of the grout lift.
   3. Grout barriers shall not be spaced more than 30 feet apart.
      a. Grout shall be placed in lifts not to exceed 5 feet in depth.
   4. Each lift shall be allowed to set for 10 minutes after initial consolidation of grout before successive lift is placed.
   5. The full height of each section of wall shall be grouted in 1 day.

H. Grout in cells shall have full contact with surface of concrete footings.

I. When grouting stops for 1 hour or longer, form horizontal construction joints by stopping grout placement 1-1/2 inches below top of uppermost unit containing grout.

J. After placement, consolidate grout using mechanical immersion vibrators designed for consolidating grout.

K. Placement:
   1. Use a hand bucket, concrete hopper, or grout pump.
   2. Place grout in final position within 1-1/2 hours after mixing.
   3. Place grout so as to completely fill the grout spaces without segregation of the aggregates.
   4. Do not insert vibrators into lower grout placements that are in a semi-solidified state.

3.07 BOND BEAMS

A. Place horizontal reinforcement and solidly grout bond beam units in place.

B. Provide wire mesh at openings in bottom of bond beams to support grout where walls are not grouted solid.

3.08 CUTTING BRICK MASONRY UNITS

A. When possible, use full units of the proper size in-lieu of cut units. Cut units as required to form chases, openings, for anchorage, and for other appurtenances.

B. Cut and fit units with power-driven carborundum or diamond disc blade saw.

3.09 CONTROL JOINTS

A. Provide in masonry walls where indicated on the Drawings.

B. Make full height and continuous in appearance.

C. Run bond beams and bond beam-reinforcing bars continuously through control joints.

D. Insert control joint filler in joints as wall is constructed.

E. Apply sealant as specified in Section 07900 - Joint Sealants.

3.10 OPENINGS AND LINTELS

A. Place horizontal reinforcement in fully grouted bond beam units.

B. Use lintel block units where underside of lintel will be exposed.

C. Provide minimum of 8-inch bearing at each end of lintel.

D. Embed reinforcing bars minimum 24 inches or 40 bar diameters, whichever is longer, into wall past edges of openings or as indicated on the Drawings:
   1. At corners, provide 90-degree bend with equivalent total embedment.

3.11 STEEL DOOR FRAMES

A. Anchor and fully grout jambs and head of steel doorframes connected to brick unit masonry.

B. Fill frames with grout as each 2 feet of brick unit masonry is laid.

3.12 BEARING PLATES

A. Provide minimum of 12 inches of grouted brick unit masonry below steel bearing plates and beams bearing on masonry walls.

3.13 ANCHOR BOLTS

A. Hold anchor bolts in place with template during grouting to ensure precise alignment.

B. Do not cut or ream members being anchored or use other means to accommodate misaligned anchor bolts in roof deck support angles.

C. Provide minimum 6-inch wide grouted brick unit masonry entirely around anchor bolts and other attachment devices.

3.14 ENCLOSURES

A. Where brick masonry units enclose conduit, pipes, stacks, ducts, and similar items, construct chases, cavities, and similar spaces as required, whether or not such spaces are indicated on the Drawings.

B. Point openings around flush mounted electrical outlet boxes with mortar, including flush joints above boxes.

C. Do not cover enclosures until inspected and when appropriate, tested.

3.15 OTHER EMBEDDED ITEMS

A. Build in wall plugs, accessories, flashings, pipe sleeves, and other items required to be built-in as the masonry work progresses.

3.16 PATCHING

A. Patch exposed brick masonry units at completion of the Work and in such manner that patching will be indistinguishable from similar surroundings and adjoining construction.

3.17 WATER CURING

A. Protect brick masonry units from drying too rapidly by frequently fogging or sprinkling for minimum 3 days.

3.18 MISCELLANEOUS

A. Build in required items such as anchors, flashings, sleeves, frames, structural steel, lintels, anchor bolts, and metal fabrications as required for complete installation.

3.19 WATER REPELLENT

A. Apply water repellent as specified in Section 07190 - Water Repellents.

3.20 FIELD QUALITY CONTROL

A. Have minimum 3 masonry units of each type proposed for Project tested in accordance with ASTM C67 to verify conformance to specifications.

B. Tests shall include compressive strength, linear shrinkage, total absorption, moisture content as percent of total absorption, and unit weight.

C. Employ and pay acceptable independent testing laboratory to perform testing.

3.21 CLEANING

A. Exercise extreme care to prevent mortar splotches.

B. Do not attach construction supports to masonry walls.

C. Wash off brick scum and grout spills before scum and grout set.

D. Remove grout stains from walls.

E. Clean exposed masonry. Remove scaffolding and equipment. Dispose of debris, refuse, and surplus material offsite legally.

F. Correct efflorescence on exposed surfaces with commercially-prepared cleaning solution acceptable to masonry unit manufacturer:
   1. Apply cleaning solution in accordance with cleaning solution manufacturer's printed instructions.
   2. Do not use muriatic acid as cleaning solution.
   3. Do not use sandblast cleaning equipment.

3.22 FORMS AND SHORES

A. Where required, construct forms to the shapes indicated on the Drawings:
   1. Construct forms sufficiently rigid to prevent deflection which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout.
   2. Do not remove supporting forms or shores until the supported masonry has acquired sufficient strength to support safely its weight and any construction loads to which it may be subjected:
      a. Wait at least 16 hours after grouting masonry columns or walls before applying uniform loads.
      b. Wait at least 64 hours before applying concentrated loads.

3.23 PROTECTION

A. Provide temporary protection for exposed masonry corners subject to damage.

B. Bracing:
   1. Adequately brace masonry walls over 8 feet in height to prevent overturning and to prevent collapse unless wall is adequately supported by permanent supporting elements so wall will not overturn or collapse.
   2. Keep bracing in place until permanent supporting elements of structure are in place.

C. Limited access zone:
   1. Establish limited access zone prior to start of masonry wall construction.
   2. Zone shall be immediately adjacent to wall and equal to height of wall to be constructed plus 4 feet by entire length of wall on unscaffolded side of wall.
   3. Limit access to zone to workers actively engaged in constructing wall. Do not permit other persons to enter zone.
   4. Keep zone in place until wall is adequately supported or braced by permanent supporting elements to prevent overturning and collapse.

3.24 GROUTING EQUIPMENT

A. Grout pumps:
   1. Do not pump grout through aluminum tubes.
   2. Operate pumps to produce a continuous stream of grout without air pockets.
   3. Upon completion of each day's pumping, eject grout from pipeline without contamination or segregation of the grout:
      a. Remove waste materials and debris from the equipment.
      b. Dispose of waste materials, debris, and all flushing water outside the masonry.

B. Vibrators:
   1. Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout.
   2. Maintain at least 1 spare vibrator, at the site at all times.
   3. Apply vibrators at uniformly spaced points no further apart than the visible effectiveness of the machine.
   4. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation.

3.25 EFFLORESCENCE TESTS

A. Perform efflorescence tests on mortar which will be exposed to weathering. Tests shall be scheduled far enough in advance of starting masonry work to permit retesting if necessary.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Structural steel shapes and plate.
   2. Fasteners and structural hardware:
      a. All thread rods.
      b. High-strength bolts.
   3. Welding.
   4. Bolting.

1.02 REFERENCES

A. American Institute of Steel Construction (AISC):
   1. 303 - Code of Standard Practice for Steel Buildings and Bridges.
   2. 360 - Specification for Structural Steel Buildings.

B. American Iron and Steel Institute (AISI):
   1. Steel and stainless steel alloys (“types”) as indicated.

C. American Welding Society (AWS):
   1. A5.1 - Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
   2. A5.17 - Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding.
   3. A5.20 - Specification for Carbon Steel Electrodes for Flux Cored Arc Welding.
   4. D1.1 - Structural Welding Code - Steel.
   5. D1.6 - Structural Welding Code - Stainless Steel.

D. ASTM International (ASTM):
   1. A6 - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
   2. A36 - Standard Specification for Carbon Structural Steel.
   3. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   4. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   5. A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   6. A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   7. A276 - Standard Specification for Stainless Steel Bars and Shapes.

8. A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
9. A489 - Standard Specification for Carbon Steel Lifting Eyes.
10. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
11. A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
12. A563 - Standard Specification for Carbon and Alloy Steel Nuts.
13. A992 - Standard Specification for Structural Steel Shapes.
14. F436 - Standard Specification for Hardened Steel Washers.
15. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
16. F594 - Standard Specification for Stainless Steel Nuts.
17. F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
18. F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength.
19. F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.
20. F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength.

E. Research Council on Structural Connections (RCSC):
1. Specification for Structural Joints Using High-Strength Bolts (RCSC Specification).

1.03 DEFINITIONS

A. Snug-tight: At bolted joints, the tightness attained with a few impacts of an impact wrench, or by the full effort of an ironworker using a spud wrench to bring the connected plies into firm contact.

B. Stainless steel related terms:
1. Descaling: Removal of heavy, tightly adherent oxide films resulting from hot-forming, heat-treatment, welding, and other high-temperature operations.
2. Pickling: Chemical descaling of stainless steel using aqueous solutions of nitric and hydrofluoric acid, or various proprietary formulations as specified.
3. Passivation: Chemical treatment of stainless steel with a mild oxidant for the purpose of enhancing the spontaneous formation of the steel’s protective passive film.

1.04 SUBMITTALS

A. Product data:
1. Stainless steel: Fabricator name and qualifications, member dimensions and structural section properties, and specifications and procedures used for pickling and passivating members.

B. Shop drawings:
1. Fabrication and erection drawings.

C. Quality control submittals:
   1. Welding procedure specifications (WPS) in accordance with AWS D1.1 and D1.6:
      a. Submit WPS for each type of welded joint used, whether prequalified or qualified by testing:
         1) State electrode manufacturer and specific electrodes used.
         2) Indicate required AWS qualification for joint.
      b. Submit WPS with shop drawings that indicate those welds.
      c. Submit Procedure Qualification Record (PQR) in accordance with AWS D1.1 and D1.6 for welding procedures qualified by testing.
   2. Welder qualifications: For each welding process and position:
      a. Welder's qualification certificates.
      b. Contractor's statement that certificate will be "in effect" at the time(s) welding will be performed based on the "Period of Effectiveness" provisions of AWS D1.1 and D1.6.
   3. Steel fabricator's AISC certification.

D. Test reports:
   1. Certified copies of mill tests and analyses made in accordance with applicable ASTM standards, or reports from a recognized commercial laboratory, including chemical and tensile properties of each shipment of structural steel or part thereof having common properties.

1.05 QUALITY ASSURANCE

A. Certification:
   1. Steel fabricators shall be certified by the AISC or other certification acceptable to the Engineer and the building official having jurisdiction.

B. Welding:
   1. Perform welding of structural metals in accordance with AWS D1.1 and D1.6 using welders who have current AWS qualification certificate for the process, position, and joint configuration to be welded.
   2. Make Welding Procedure Specifications available at the locations where welding is performed.
   3. Notify Engineer at least 24 hours before starting shop or field welding.
   4. Engineer may check materials, equipment, and qualifications of welders.
   5. Remove welders performing unsatisfactory Work, or require requalification.
   6. Engineer may use gamma ray, magnetic particle, dye penetrant, trepanning, or other aids to visual inspection to examine any part of welds or all welds.
   7. Contractor shall bear costs of retests on defective welds.
   8. Contractor shall also bear costs in connection with qualifying welders.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing and shipping: Deliver structural steel free from mill scale, rust, and pitting.

B. Storage and protection: Until erection and painting, protect from weather items not galvanized or protected by a shop coat of paint.

PART 2 PRODUCTS

2.01 MATERIALS

A. Unless otherwise specified or indicated on the Drawings, materials shall conform to the following:

Item	ASTM Standard	Class, Grade, Type, or Alloy Number
Carbon Steel		
Plate, bars, rolled shapes (except W and WT shapes), and miscellaneous items	A36	--
Rolled W and WT shapes	A992	Grade 50
Hollow structural sections/HSS: Round, square, or rectangular (including “pipe” where indicated for structural members and supports)	A500	Grade C
Stainless Steel		
Plate, sheet, and strip	A240	Type 304* or 316**
Bars and shapes	A276	Type 304* or 316**
* Use Type 304L (low-carbon stainless steel) if material will be welded.		
** Use Type 316L (low carbon stainless steel) if material will be welded.		

2.02 FASTENERS AND STRUCTURAL HARDWARE

A. General:
   1. Materials: Of domestic manufacture.
   2. Where fasteners and hardware are specified to be galvanized, hot-dip galvanize in accordance with ASTM A153 or ASTM F2329, unless otherwise specified.

B. All thread rods:
   1. Carbon steel:
      a. In accordance with ASTM A36 unless otherwise indicated on the Drawings.
      b. Nuts: ASTM A194.
      c. Washers: ASTM F436.
   2. Galvanized carbon steel:
      a. In accordance with ASTM A36 unless otherwise indicated on the Drawings, and hot dip galvanized in accordance with ASTM A153.
      b. Nuts: ASTM A194, hot-dip galvanized in accordance with ASTM A153.
      c. Washers: ASTM F436, hot-dip galvanized in accordance with ASTM A153.
   3. Stainless steel:
      a. Units descaled, pickled, and passivated as specified in “Fabrication” in this Section.

b. Threaded rods and nuts to be the products of a single manufacturer/fabricator to ensure proper fit without galling. Ship all thread rods with properly fitting nuts attached.
c. Alloy Type 304 or Type 316 as indicated on the Drawings.
d. Type 304:
1) Rod: ASTM F593, Group 1, Condition CW, coarse threads.
2) Nuts: ASTM F594. Match alloy of rod (group and UNS designation).
3) Washers: Type 304 stainless steel.
e. Type 316:
1) Rod: ASTM F593, Group 2, Condition CW, coarse threads.
2) Nuts: ASTM F594. Match alloy of rod (group and UNS designation).
3) Washers: Type 316 stainless steel.

C. Anchor bolts, anchor rods, and post-installed steel anchors: As indicated on the Drawings and as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

D. Forged steel structural hardware - carbon steel:
1. Clevises and turnbuckles: Forged steel in accordance with AISI C-1035.
2. Eye nuts / Eye bolts: Forged steel in accordance with AISI C-1030.
a. Having geometric and strength characteristics (including proof load, breaking strength, tensile strength, bend test, and impact strength) of eyebolts in accordance with ASTM A489, Type 1.

E. High-strength bolts:
1. Provide high-strength bolt assembly, with nuts, hardened flat washers, and compressible-washer-type direct tension indicators. Provide uncoated components unless galvanized coating is indicated on the Drawings.
2. Carbon steel - Uncoated:
a. Bolts: Plain heavy hex structural bolts in accordance with ASTM F3125, Grade A325, Type 1.
b. Nuts: Heavy hex nuts in accordance with ASTM A563, Grade C.
c. Washers:
1) Adjacent to normal, oversized, and short-slotted holes: Circular, square, or rectangular beveled, clipped, or extra thick washers in accordance with ASTM F436, Type 1. Flat circular washers unless otherwise indicated on the Drawings.
2) Adjacent to long slotted holes: Fabricated from 5/16-inch-thick plate conforming to ASTM A36.
3. Carbon steel - Galvanized:
a. Bolt and nut assemblies fabricated, galvanized, tested for rotational capacity, and shipped accordance with the provisions ASTM F3125, Grade A325and the RCSC Specification.
b. Bolts, nuts, and washers: Hot-dip galvanized in accordance with ASTM F2329.
c. Bolts: Plain heavy hex structural bolts in accordance with ASTM F3125, Grade A325, Type 1 and galvanized as specified.
d. Nuts: Heavy hex nuts in accordance with ASTM A563, Grade DH, galvanized as specified, and lubricated in accordance with ASTM A563, Supplementary Requirement S1 to minimize galling.

e. Washers:
    1) Adjacent to normal, oversized, and short-slotted holes: Circular, square, or rectangular beveled, clipped, or extra thick washers in accordance with ASTM F436, Type 1 and galvanized as specified. Flat circular washers unless otherwise indicated on the Drawings.
    2) Adjacent to long slotted holes: 5/16-inch thick plate washer fabricated from steel conforming to ASTM A36, and galvanized in accordance with ASTM A123.
f. Load indicator devices: At slip critical connections, provide one of the following devices at each bolt:
    1) Compressible washer type direct tension indicators (“DTI”): In accordance with ASTM F959, Type 325-1, with mechanically deposited zinc coating conforming to ASTM B695, Class 55.
    2) Twist-off type tension-control bolt assemblies: ASTM F3125, Grade F1852 with mechanically deposited zinc coating conforming to ASTM B695, Class 55.

F. Stainless steel bolts (for use in stainless steel structures):
1. General:
    a. Bolts and nuts shall be the products of a single manufacturer/fabricator to ensure proper fit without galling. Ship bolts with properly fitting nuts attached.
    b. Units descaled, pickled, and passivated as specified in “Fabrication."
2. Alloy: Type 304 or Type 316 to match alloy of structural members being connected.
3. Type 304:
    a. Bolts: ASTM F593, Group 1, Condition CW, coarse threads.
    b. Nuts: ASTM F594. Match alloy (group and UNS designation) and threads of bolts.
    c. Washers: Type 304 stainless steel.
4. Type 316:
    a. Bolts: ASTM F593, Group 2, Condition CW, coarse threads.
    b. Nuts: ASTM F594. Match alloy (group and UNS designation) and threads of bolts.
    c. Washers: Type 316 stainless steel.
5. Welded studs: As indicated on the Drawings and as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

2.03 ISOLATING SLEEVES AND WASHERS

A. As indicated on the Drawings and as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

2.04 GALVANIZED SURFACE REPAIR

A. Manufacturers: The following or equal:
1. Jelt, Galvinox.

2.05 THREAD COATING

A. Manufacturers: One of the following or equal:
   1. Bostik, Never-Seez.
   2. Oil Research, Inc., WLR No. 111.

2.06 SUPPLEMENTARY PARTS

A. Furnish as required for complete structural steel erection, whether or not such parts and Work are specified or indicated on the Drawings.

2.07 FABRICATION

A. Shop assembly:
   1. Fabricate structural steel in accordance with AISC 360 and AISC 303 unless otherwise specified or modified by applicable regulatory requirements.
   2. Where anchors, connections, or other details of structural steel are not specifically indicated on the Drawings or specified, their material, size and form shall be equivalent in quality and workmanship to items specified.
   3. Round off sharp and hazardous projections and grind smooth.
   4. Take measurements necessary to properly fit work in the field. Take responsibility for and be governed by the measurements and proper working out of all the details.
   5. Take responsibility for correct fitting of metalwork.
   6. Welded connections:
      a. Comply with AWS requirements for the metals to be welded.
      b. Weld only in accordance with approved Welding Procedure Specifications.
      c. Keep Welding Procedure Specifications readily available for welders and inspectors during fabrication processes.

B. Stainless steel shapes and assemblies:
   1. For structural members such as W shapes, S shapes, channels, angles, and similar rolled shapes not available in quantity, size, and type of stainless steel specified or indicated on the Drawings:
      a. Fabricate shapes using laser-fused, full penetration welds between pieces of plate to attain same or higher section modulus and moment of inertia as that of members indicated on the Drawings.
      b. Fabricate shapes from dual grade stainless steel.
      c. Fabricate beams and channels to ASTM A6 tolerances.
      d. Manufacturers: The following or equal:
         1) Stainless Structural, LLC.
   2. Cleaning and passivation:
      a. Following shop fabrication of stainless steel members and bolts, clean and passivate fabrications at point of manufacture.
      b. Finish requirements: Remove free iron, heat tint oxides, weld scale and other impurities, and obtain a bright passive finished surface with no etching, pitting, frosting, or discoloration.

c. Provide quality control testing to verify effectiveness of cleaning agents and procedures and to confirm that finished surfaces are clean and passivated.
    1) Conduct sample runs using test specimens with proposed cleaning agents and procedures as required to avoid adverse effects on surface finishes and base materials.
d. Pre-clean, chemically de-scale ("pickle"), passivate, and final-clean fabrications in accordance with the requirements of ASTM A380.
    1) If degreasing is required before cleaning (pickling) to remove scale or iron oxide, cleaning with citric acid treatments is permissible; however, such treatments shall be followed inorganic cleaners.
    2) Pickle and passivate stainless steel using a nitric acid solution in accordance with ASTM A380, Annex A2, Table A2.1, Part II.
    3) Pickling by citric acid treatment or sulfuric acid treatment is not considered to satisfy the requirements of this Section.
e. Inspect after cleaning using methods specified for "gross inspection" in ASTM A380.
f. Improperly or poorly cleaned and passivated materials shall not be shipped and will not be accepted at the site.

C. Galvanized carbon steel:
    1. Where galvanizing is required, hot-dip structural steel after fabrication in accordance with ASTM A123:
    2. Do not electro-galvanize or mechanically-galvanize unless specified or accepted by Engineer.
    3. Re-straighten galvanized items that bend or twist during galvanizing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 ERECTION

A. General:
    1. Fabricate structural and foundry items to true dimensions without warp or twist.
    2. Form welded closures neatly, and grind off smooth where weld material interferes with fit or is unsightly.
    3. Install structural items accurately and securely, true to level, plumb, in correct alignment and grade, with all parts bearing or fitting structure or equipment for which intended.
    4. Do not shift out of alignment, re-drill, re-shape, or force fit fabricated items.
    5. Place anchor bolts or other anchoring devices accurately and make surfaces that bear against structural items smooth and level.
    6. Rigidly support and brace structural items needing special alignment to preserve straight, level, even, and smooth lines. Keep structural items braced until concrete, grout, or dry pack mortar has hardened for 48 hours minimum.

7. Erect structural steel in accordance with AISC 303 unless otherwise specified or modified by applicable regulatory requirements.
8. Where anchors, connections, and other details of structural steel erection are not specifically indicated on the Drawings or specified, form, locate, and attach with equivalent in quality and workmanship to items specified.
9. Round off sharp or hazardous projections and grind smooth.
10. Paint or coat steel items as specified in Sections 09910 - Painting and 09960 - High-Performance Coatings.

B. Stainless steel: Take all necessary precautions to avoid iron contamination of stainless steel during delivery, storage, and handling.
   1. Segregate stainless steel from iron.
   2. Tools and handling devices:
      a. Do not use iron tools clamps, chokes, working surfaces, or brushes when fabricating, handling, and erecting stainless steel.
      b. Do not use tools that have been contaminated by contact with iron.
      c. Use stainless steel, polymer coated, or wood tools and handling equipment. Do not use tools that have been contaminated by contact with iron or steel.

C. Welding: General:
   1. Make welds full penetration type, unless otherwise indicated on the Drawings.
   2. Remove backing bars and weld tabs after completion of weld. Repair defective welds observed after removal of backing bars and weld tabs.

D. Welding: Carbon steel:
   1. General: In accordance with AWS D1.1:
      a. Weld ASTM A36 and A992 structural steel, and ASTM A500 and A501 structural tubing with electrodes in accordance with AWS A5.1, using E70XX electrodes; AWS A5.17, using F7X-EXXX electrodes; or AWS A5.20, using E7XT-X electrodes:
      b. Field repair cut or otherwise damaged galvanized surfaces to equivalent original condition using a galvanized surface repair.

E. Welding - stainless steel:
   1. General: In accordance with AWS D1.6.
   2. Field welding of stainless steel will not be permitted.
   3. Passivation of field-welded surfaces:
      a. Provide cleaning, pickling, and passivating as specified under “Fabrications” of this Section. Clean using Derustit Stainless Steel Cleaner, or equal.

F. Interface with other products:
   1. Where steel members and fasteners come in contact with dissimilar metals (aluminum, stainless steel, etc.), separate or isolate the dissimilar metals with isolating sleeves and washers as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

G. Fasteners: General:
   1. Install bolts to project 2 threads minimum, but 1/2 inch maximum beyond nut.
   2. Anchor bolts and anchor rods: Install as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
      a. Unless otherwise specified, tighten nuts on anchor bolts and anchor rods specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry to the "snug-tight" condition.

H. Fasteners: High-strength carbon steel bolts:
   1. Connections with high-strength bolts shall in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts.
   2. Provide pre-tensioned joints at bolted connections, except where slip-critical or snug-tight connections are indicated on the Drawings.
   3. Joints: Snug-tight:
      a. Install bolts with washers where required in accordance with RCSC Specification.
      b. Tighten bolts to bring the connected plies into firm contact. Tightening shall progress systematically beginning with the most rigid part of the joint. More than 1 cycle through the bolt pattern may be required to achieve this condition.
      c. Verify adequate tightening of bolts by visual observation to confirm that washers have been installed at locations required in accordance with RCSC Specification, and that the plies of the connected parts have been brought into firm contact.

I. Fasteners: High-strength carbon steel bolts:
   1. Connections with high-strength bolts shall in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts.
   2. Provide pre-tensioned joints at bolted connections, except where slip-critical or snug-tight connections are indicated on the Drawings.
   3. Joints: Slip-critical.
      a. Confirm that faying surfaces at connections are free of dirt and other foreign material, have been blast cleaned, and are free of coatings and inadvertent overspray in accordance with RCSC Specification.
      b. Furnish hardened flat washers in accordance with ASTM F436:
         1) On outer plies with slotted holes.
         2) When 1 or more plies of the connected material has a yield strength less than 40 ksi.
         3) Under element, nut, or bolt head, turned in tightening.
      c. Install tension indicator washers, placed in accordance with ASTM F959 Figure X1, to confirm adequate tightening of bolts.
      d. Tighten bolts to full pretension.
   4. Joints: Pre-tensioned.
      a. Joint preparation, assembly, and tightening shall be as specified for slip-critical connections, except that the requirements for un-coated faying surfaces shall not apply.
   5. Joints: Snug-tight:
      a. Install bolts with washers where required in accordance with RCSC Specification.
      b. Tighten bolts to bring the connected plies into firm contact. Tightening shall progress systematically beginning with the most rigid part of the joint.

More than 1 cycle through the bolt pattern may be required to achieve this condition.

c. Verify adequate tightening of bolts by visual observation to confirm that washers have been installed at locations required in accordance with RCSC Specification, and that the plies of the connected parts have been brought into firm contact.

J. Fasteners: Stainless steel bolts:
   1. Connections shall be snug-tight joints unless otherwise indicated on the Drawings.
   2. Prior to installing nuts, coat threads of stainless steel fasteners with thread coating to prevent galling of threads.
   3. Rotate nuts using a slow, smooth action without interruptions. Avoid over-tightening.

3.03 FIELD QUALITY CONTROL

A. Provide quality control as specified in Section 01450 - Quality Control.

3.04 FIELD QUALITY ASSURANCE

A. Provide quality assurance as specified in Section 01450 - Quality Control.

B. Special inspections, special tests, and structural observation:
   1. Provide as specified in Section 01455 - Regulatory Quality Assurance.

END OF SECTION

SECTION 05140

STRUCTURAL ALUMINUM

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Structural aluminum products, including sheet, pipe, extrusions, and associated accessories.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   2. B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
   3. B308 - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.

B. American Welding Society (AWS):
   1. A5.10 - Specification for Bare Aluminum and Aluminum-Alloy Welding Electrodes and Rods.
   2. D1.2 - Structural Welding Code - Aluminum.

1.03 SUBMITTALS

A. Quality control submittals:
   1. Test Reports: Certified copies of mill tests or reports from a recognized commercial laboratory including chemical and tensile properties of each shipment of structural metal or part thereof having common properties. Tests and analyses shall be made in accordance with applicable ASTM Standards.
   2. Welder’s certificates.

1.04 QUALITY ASSURANCE

A. Qualifications:
   1. Perform welding of structural metals with welders who have current AWS certificate for the type of welding to be performed.
   2. Notify Engineer 24 hours minimum before starting shop or field welding.
   3. Engineer may check materials, equipment, and qualifications of welders.
   4. Remove welders performing unsatisfactory work, or require to requalify.
   5. Engineer may use gamma ray, magnetic particle dye penetrant, or other aids to visual inspection to examine any part of welds or all welds.
   6. Contractor shall bear costs of retests on defective welds.
   7. Contractor shall bear costs in connection with qualifying welders.

PART 2 PRODUCTS

2.01 MATERIALS

A. Structural sheet aluminum: ASTM B209, Alloy 6061-T6.

B. Structural aluminum: ASTM B308, Alloy 6061-T6.

C. Extruded aluminum: ASTM B221, Alloy 6063-T42.

D. Isolating sleeves and washers:
   1. As indicated on the Drawings and as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

E. Miscellaneous materials:
   1. Furnish supplementary parts necessary to complete each item even where such work is neither definitely indicated on the Drawings nor specified.
   2. Size, form, attachment, and location shall conform to the best of current practice.
   3. Conform to applicable ASTM Standards for materials not otherwise specified.

2.02 FABRICATION

A. Aluminum layout:
   1. Center punch hole centers, and punch or scribe cutoff lines, except where marks would remain on fabricated material.
   2. Apply temperature correction where necessary in layout of critical dimensions. Use a coefficient of expansion of 0.000013 per degree of Fahrenheit.

B. Cutting aluminum:
   1. Material 1/2-inch thick or less: Shear, saw, or cut with a router.
   2. Material more than 1/2-inch thick: Saw or rout.
   3. Make cut edges true and smooth, free from excessive burrs or ragged breaks.
   4. Avoid reentrant cuts wherever possible. Where used, fillet by drilling prior to cutting.
   5. Do not flame cut aluminum alloys.
   6. Punch or drill rivet or bolt holes to finished size before assembly:
      a. Make finished diameter of holes for bolts 1/16-inch maximum larger than nominal bolt diameter.
      b. Make holes cylindrical and perpendicular to principal surface.
      c. Do not permit holes to drift in a manner to distort metal.

C. Aluminum forming and assembly:
   1. Do not heat structural aluminum, except as follows:
      a. Heat aluminum to 400 degrees Fahrenheit for 30 minutes maximum, to facilitate bending or welding.
      b. Heat only when proper temperature controls and supervision can ensure that limitations on temperature and time are observed.

D. Before assembly, remove chips lodged between contacting surfaces.

E. Welding aluminum:
   1. Perform welding of aluminum in accordance with AWS D1.2.
   2. Weld aluminum in accordance with the following:
      a. Preparation:
         1) Remove dirt, grease, forming or machining lubricants, and organic materials from areas to be welded by cleaning with a suitable solvent or by vapor degreasing.
         2) Additionally, etch or scratch brush to remove oxide coating just prior to welding when inert gas tungsten arc welding method is used.
         3) Oxide coating may not need to be removed if welding is performed by automatic or semi-automatic inert gas shielded metal arc.
         4) Suitably prepare edges to ensure 100 percent penetration in butt welds by sawing, chipping, machining, or shearing. Do not cut with oxygen.
      b. Filler metal: Aluminum alloys conforming to the requirements of AWS A5.10 and AWS classification ER 4043, ER 5654, ER 5554, ER 5183, ER 5356, or ER 5556.
      c. Perform welding of structures which are to be anodized using filler alloys which will not discolor when anodized, AWS ER 5654, ER 5554, ER 5183, ER 5356, or ER 5556.
      d. Perform welding by using a non-consumable tungsten electrode with filler metal in an inert gas atmosphere (TIG) or using a consumable filler metal electrode in an inert gas atmosphere (MIG).
      e. Do not use welding process that requires use of a welding flux.
      f. Neatly make welded closures.
      g. Where weld material interferes with fit or is unsightly in appearance, grind it smooth.
      h. Make welds full penetration welds unless otherwise indicated on the Drawings.

2.03 FINISHES

A. Coating for Aluminum in contact with concrete or masonry:
   1. Epoxy mastic.
      a. Manufacturers: One of the following or equal:
         1) Carboline, Carbomastic 15.
         2) International Paint, Bar-Rust 231.
         3) Tnemec, Series 135.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 INSTALLATION

A. Install structural aluminum products as indicated on the Drawings and specified.

B. Install structural aluminum products accurately and securely, true to level, plumb, in correct alignment and grade, with all parts bearing or fitting structure or equipment for which intended.

C. Do not cock out of alignment, redrill, reshape, or force fit fabricated items.

D. Place anchor bolts or other anchoring devices accurately and make surfaces that bear against structural items smooth and true to level.

E. Rigidly support and brace structural products needing special alignment to preserve straight, level, even, smooth lines, and keep braced until concrete, grout, or dry pack mortar has hardened for a minimum 48-hour period.

F. Interface with other products:
   1. Where aluminum comes in contact with dissimilar metals, use stainless steel bolts or anchors and separate or isolate the dissimilar metals with isolating sleeves and washers as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
   2. Coat those parts of aluminum that will be cast into concrete or that will be in contact with concrete, grout, masonry, wood, or other materials that will cause the aluminum to corrode, as specified in Section 09960 - High-Performance Coatings.

END OF SECTION

SECTION 05190

MECHANICAL ANCHORING AND FASTENING TO CONCRETE AND MASONRY

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Cast-in anchors and fasteners:
      a. Anchor bolts.
      b. Anchor rods.
      c. Concrete inserts.
      d. Welded studs.
   2. Post-installed steel anchors and fasteners:
      a. Concrete anchors.

1.02 REFERENCES

A. American Concrete Institute (ACI):
   1. 355.2 - Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary.

B. American National Standards Institute (ANSI):
   1. B212.15 - Cutting Tools - Carbide-tipped Masonry Drills and Blanks for Carbide-tipped Masonry Drills.

C. American Welding Society (AWS):
   1. D1.1 - Structural Welding Code - Steel.
   2. D1.6 - Structural Welding Code - Stainless Steel.

D. ASTM International (ASTM):
   1. A36 - Standard Specification for Carbon Structural Steel.
   2. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   3. A108 - Standard Specification for Steel Bars, Carbon and Alloy, Cold Finished.
   4. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   5. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   6. A240 - Standard Specification for Chromium and Chromium Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   7. A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
   8. A563 - Standard Specification for Carbon and Alloy Steel Nuts.
   9. B633 - Standard Specification for *Electrodeposited* Coatings of Zinc on Iron and Steel.

10. B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
11. E488 - Standard Test Methods for Strength of Anchors in Concrete Elements.
12. F436 - Standard Specification for Hardened Steel Washers.
13. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
14. F594 - Standard Specification for Stainless Steel Nuts.
15. F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength.
16. F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

E. International Code Council Evaluation Service, Inc. (ICC-ES):
1. AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements.

1.03 DEFINITIONS

A. Built-In Anchor: Headed bolt or assembly installed in position before filling surrounding masonry units with grout.

B. Cast-In Anchor: Headed bolt or assembly installed in position before placing plastic concrete around.

C. Overhead Installations: Fasteners installed on overhead surfaces where the longitudinal axis of the fastener is more than 60 degrees above a horizontal line so that the fastener resists sustained tension loads.

D. Passivation: Chemical treatment of stainless steel with a mild oxidant for the purpose of enhancing the spontaneous formation of the steel's protective passive film.

E. Post-Installed Anchor: Fastener or assembly installed in hardened concrete or finished masonry construction, typically by drilling into the structure and inserting a steel anchor assembly.

F. Terms relating to structures or building environments as used with reference to anchors and fasteners:
1. Corrosive locations: Describes interior and exterior locations as follows:
    a. Locations used for delivery, storage, transfer, or containment (including spill containment) of chemicals used for plant treatment processes.
2. Wet and moist locations: Describes locations, other than "corrosive locations," that are submerged, are immediately above liquid containment structures, or are subject to frequent wetting, splashing, or wash down. Includes:
    a. Exterior portions of buildings and structures.
    b. Liquid-containing structures:
        1) Locations at and below the maximum operating liquid surface elevation.

2) Locations above the maximum operating liquid surface elevation and:
a) Below the top of the walls containing the liquid.
b) At the inside faces and underside surfaces of a structure enclosing or spanning over the liquid (including walls, roofs, slabs, beams, or walkways enclosing the open top of the structure).

c. Liquid handling equipment:
1) Bases of pumps and other equipment that handles liquids.

d. Indoor locations exposed to moisture, splashing, or routine wash down during normal operations, including floors with slopes toward drains or gutters.

e. Other locations indicated on the Drawings.

3. Other locations:
a. Interior dry areas where the surfaces are not exposed to moisture or humidity in excess of typical local environmental conditions.

1.04 SUBMITTALS

A. General:
1. Submit as specified in Section 01330 - Submittal Procedures.
2. Submit information listed for each type of anchor or fastener to be used.

B. Action submittals:
1. Product data:
a. Cast-in anchors:
1) Manufacturer's data including catalog cuts showing anchor sizes and configuration, materials, and finishes.

b. Post-installed anchors:
1) For each anchor type, manufacturer's data including catalog cuts showing anchor sizes and construction, materials and finishes, and load ratings.

2. Samples:
a. Samples of each type of anchor, including representative diameters and lengths, if requested by the Engineer.

3. Certificates:
a. Cast-in anchors:
1) Mill certificates for steel anchors that will be supplied to the site.

b. Post-installed anchors:
1) Manufacturer's statement or certified test reports demonstrating that anchors that will be supplied to the site comply with the materials properties specified.

4. Test reports:
a. Post-installed anchors: For each anchor type used for the Work:
1) Current ICC-ES Report (ESR) demonstrating:
a) Acceptance of that anchor for use under the building code specified in Section 01410 - Regulatory Requirements.
b) That testing of the concrete anchor included the simulated seismic tension and shear tests of AC193, and that the anchor is accepted for use in Seismic Design Categories C, D, E, or F and with cracked concrete.

b. Concrete anchor pre-installation test report.

5. Manufacturer's instructions:
    a. Requirements for storage and handling.
    b. Recommended installation procedures including details on drilling, hole size (diameter and depth), hole cleaning and preparation procedures, anchor insertion, and anchor tightening.
    c. Requirements for inspection or observation during installation.
6. Qualification statements:
    a. Post-installed anchors: Installer qualifications:
        1) Submit list of personnel performing installations and include date of manufacturer's training for each.

1.05 QUALITY ASSURANCE

A. Qualifications:
    1. Post installed anchors shall be in accordance with building code specified in Section 01410 - Regulatory Requirements.

B. Special inspection:
    1. Provide special inspection of post-installed anchors as specified in Section 01455 - Regulatory Quality Assurance and this Section.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver post-installed anchors in manufacturer's standard packaging with labels visible and intact. Include manufacturer's installation instructions.

B. Handle and store anchors and fasteners in accordance with manufacturer's recommendations and as required to prevent damage.

C. Protect anchors from weather and moisture until installation.

1.07 PROJECT CONDITIONS

A. Seismic Design Category (SDC) for structures is indicated on the Drawings.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. General:
    1. Furnish threaded fasteners with flat washers and hex nuts fabricated from materials corresponding to the material used for threaded portion of the anchor.
        a. Cast-in anchors: Provide flat washers and nuts as listed in the ASTM standard for the anchor materials specified.
        b. Post-installed anchors: Provide flat washers and nuts supplied for that product by the manufacturer of each anchor.

2. Size of anchors and fasteners, including diameter and length or minimum effective embedment depth: As indicated on the Drawings or as specified in this Section. In the event of conflicts, contact Engineer for clarification.
3. Where anchors and connections are not specifically indicated on the Drawings or specified, their material, size and form shall be equivalent in quality and workmanship to items specified.

B. Materials:
1. Provide and install anchors of materials as in this Section.

2.02 CAST-IN ANCHORS AND FASTENERS

A. Anchor bolts:
1. Description:
a. Straight steel rod having one end with an integrally forged head, and one threaded end. Embedded into concrete with the headed end cast into concrete at the effective embedment depth indicated on the Drawings or specified, and with the threaded end left to project clear of concrete face as required for the connection to be made.
b. Furnish anchor bolts with heavy hex forged head or equivalent acceptable to Engineer.
1) Rods or bars with angle bend for embedment in concrete (i.e., “L” or “J” shaped anchor bolts) are not permitted in the Work.
2. Materials:
a. Ship anchor bolts with properly fitting nuts attached.
b. Type 316 stainless steel:
1) Surfaces descaled, pickled, and passivated in accordance with ASTM A380.
2) Bolts: ASTM F593, Group 2, Condition CW, coarse threads.
3) Nuts: ASTM F594. Match alloy (group and UNS designation) and threads of bolts.
4) Washers: Type 316 stainless steel.
c. Galvanized steel:
1) Hot-dip galvanized coating in accordance with ASTM F2329.
2) Bolt: ASTM F1554, Grade 36, heavy hex, coarse thread.
3) Nuts: ASTM A563, Grade A, heavy hex, threads to match bolt.
4) Washers: ASTM F436, Type 1.

B. Anchor rods:
1. Description: Straight steel rod having threads on each end. One threaded end is fitted with nuts or plates and embedded in concrete to the effective depth indicated on the Drawings, leaving the opposite threaded end to project clear of the concrete face as required for the connection to be made at that location.
2. Materials:
a. Stainless steel: Type 316:
1) Surfaces descaled, pickled, and passivated in accordance with ASTM A380.
2) Rod: ASTM F593, Group 2, Condition CW, coarse threads.
3) Nuts: ASTM F594. Match alloy (group and UNS designation) and threads of rods.

4) Washers: Type 316 stainless steel.
5) Plates (embedded): ASTM A240.

b. Galvanized: steel:
1) Hot-dip galvanized with coating in accordance with ASTM F2329.
2) Rod: ASTM F1554, Grade 36, coarse thread.
3) Nuts: ASTM A563, Grade A, threads to match rod.
4) Washers: ASTM F436, Type 1.
5) Plates (embedded): ASTM A36.

C. Welded studs:
1. Description: Anchor with forged head for embedment into concrete on one end, and welding ferrule for attachment to steel on the other. Welded to steel members or plates to provide anchorage for steel connections to concrete.
2. Acceptance criteria:
a. Welded studs in accordance with AWS D1.1, Type B.
3. Manufacturers: One of the following or equal:
a. Nelson Stud Welding Co., H4L Concrete Anchors or S3L Shear Connectors as indicated on the Drawings.
b. Stud Welding Products, Headed Concrete Anchors (HCA) or Headed Shear Connectors (HSC) as indicated on the Drawings.
4. Materials:
a. Galvanized steel:
1) Hot-dip galvanized after fabrication with coating in accordance with ASTM A123.
2) Steel: Carbon steel in accordance with ASTM A108 with 50,000 pounds per square inch minimum yield strength, and 60,000 pounds per square inch minimum tensile strength.

D. Steel plates or shapes for fabrications including assemblies with welded studs or deformed bar anchors:
1. Stainless steel: Type 316L or Type 304L:
a. Plates (embedded): ASTM A240.
2. Galvanized steel:
a. Hot dip galvanized in accordance with ASTM A123.
b. Steel: ASTM A36.

2.03 POST-INSTALLED ANCHORS AND FASTENERS - ADHESIVE

A. Epoxy bonding of reinforcing bars, all thread rods, and threaded inserts in concrete: As specified in Section 03055 - Adhesive-Bonded Reinforcing Bars and All Thread Rods in Concrete.

B. Epoxy bonding of reinforcing bars, all thread rods, and threaded inserts in masonry: As specified in Section 04055 - Adhesive Bonding Reinforcing Bars and All Thread Rods in Masonry.

2.04 POST-INSTALLED ANCHORS AND FASTENERS - MECHANICAL

A. General:
1. Post-installed anchors used for the Work shall hold a current ICC Evaluation Service Report demonstrating acceptance for use under the building code

specified in Section 01410 - Regulatory Requirements. Reports prepared by other recognized evaluation agencies may be submitted for consideration if acceptable to the Engineer and to the authority having jurisdiction.

a. Conditions of use: The acceptance report shall indicate acceptance of the product for use under the following conditions:
    1) In regions of concrete where cracking has occurred or may occur.
    2) To resist short-term loads due to wind forces.
    3) To resist short-term loading due to seismic forces for the Seismic Design Category of the structure where the product will be used.

2. Substitutions: When requesting product substitutions, submit calculations, indicating the diameter, effective embedment depth and spacing of the proposed anchors, and demonstrating that the substituted product will provide load resistance that is equal to or greater than that provided by the anchors listed in this Section.
    a. Calculations shall be prepared by and shall bear the signature and seal of a Professional Engineer licensed in the State of California.
    b. Decisions regarding the acceptability of proposed substitutions shall be at the discretion of the Engineer.

B. Concrete anchors:
1. Description. Post-installed anchor assembly consisting of a threaded stud and a surrounding wedge expansion sleeve that is forced outward by torquing the center stud to transfer loads from the stud to the concrete through bearing, friction, or both. (Sometimes referred to as “expansion anchors” or “wedge anchors.”)
    a. Do not use slug-in, lead cinch, and similar systems relying on deformation of lead alloy or similar materials to develop holding power.
2. Concrete anchors for anchorage to concrete:
    a. Acceptance criteria:
        1) Concrete anchors shall have a current ICC-ES Report demonstrating that the anchors have been tested and qualified for performance in both cracked and un-cracked concrete, and for short-term loading due to wind and seismic forces for Seismic Design Categories A through F in accordance with ACI 355.2 and with ICC-ES AC193 (including all mandatory tests and optional tests for seismic tension and shear in cracked concrete).
        2) Concrete anchor performance in the current ICC-ES Report shall be “Category 1” as defined in ACI 355.2.
    b. Manufacturers: One of the following or equal:
        1) Hilti, Kwik Bolt TZ Expansion Anchor.
        2) DEWALT/Powers, PowerStud.
        3) Simpson Strong-Tie, Strong Bolt 2 Wedge Anchor.
    c. Materials. Integrally threaded stud, wedge, washer, and nut:
        1) Stainless steel: Type 316.
        2) Galvanized: Carbon steel, zinc plated in accordance with ASTM B633, minimum 5 microns (Fe/Zn 5).
3. Concrete anchors for anchorage to concrete masonry (fully grouted cells):
    a. Acceptance criteria: Concrete anchors shall have a current ICC-ES Report demonstrating that the anchors have been tested and qualified in accordance with ICC-ES AC01, including all mandatory tests and optional seismic tests.

b. Manufacturers: One of the following or equal:
   1) Hilti, Kwik Bolt 3 Expansion Anchor.
   2) DEWALT/Powers, Power-Stud+ SD1.
   3) Simpson Strong-Tie, Wedge-All Anchor.
c. Materials. Integrally threaded stud, wedge, washer, and nut:
   1) Stainless steel: Type 316.
   2) Galvanized: Carbon steel, zinc plated in accordance with ASTM B633, minimum 5 microns (Fe/Zn 5) or mechanically galvanized in accordance with ASTM B695, Class 55, Type 1.

C. Flush shells:
1. Description: Post-installed anchor assembly consisting of an internally threaded mandrel that is forced into a pre-drilled concrete hole with a setting tool until the top of the anchor is flush with the face of the concrete. Once installed, a removable threaded bolt is installed in the mandrel.
2. Flush shell anchors are not permitted in the Work.

2.05 APPURTENANCES FOR ANCHORING AND FASTENING

A. Anchor bolt sleeves:
1. Having inside diameter approximately 2 inches greater than bolt diameter and minimum 10-bolt diameters long.
2. Plastic sleeves:
   a. High-density polyethylene, corrugated sleeve, threaded to provide adjustment of location on the anchor bolt.
   b. Manufacturers: The following or equal:
      1) Portland Bolt & Manufacturing Co.

B. Isolating sleeves and washers:
1. Manufacturers: One of the following or equal:
   a. Central Plastics Co.
   b. Allied Corrosion Industries.
2. Sleeves: Mylar, 1/32-inch thick, 4,000 volts per mil dielectric strength, of proper size to fit bolts and extending half way into both steel washers.
3. One sleeve required for each bolt.
4. Washers: The inside diameter of all washers shall fit over the isolating sleeve, and both the steel and isolating washers shall have the same inside diameter and outside diameter.
   a. Proper size to fit bolts.
   b. Two 1/8-inch thick steel washers for each bolt.
   c. G3 Phenolic: 2 insulating washers are required for each bolt:
      1) Thickness: 1/8 inch.
      2) Base material: Glass.
      3) Resin: Phenolic.
      4) Water absorption: 2 percent.
      5) Hardness (Rockwell): 100.
      6) Dielectric strength: 450 volts per mil.
      7) Compression strength: 50,000 pounds per square inch.
      8) Tensile strength: 20,000 pounds per square inch.
      9) Maximum operating temperature: 350 degrees Fahrenheit.

C. Coating for repair of galvanized surfaces:
   1. Manufacturers: The following or equal:
      a. Jelt, Galvinox.

D. Thread coating: For use with threaded stainless steel fasteners:
   1. Manufacturers: One of the following or equal:
      a. Bostik, Never-Seez.
      b. Oil Research, Inc., WLR No. 111.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine Work in place to verify that it is satisfactory to receive the Work of this Section. If unsatisfactory conditions exist, do not begin this Work until such conditions have been corrected.

3.02 INSTALLATION: GENERAL

A. Where anchors and fasteners are not specifically indicated on the Drawings or specified, make attachments with materials specified in this Section.

B. Substitution of anchor types:
   1. Post-installed anchors may not be used as an alternative to cast-in/built-in anchors at locations where the latter are indicated on the Drawings.
   2. Cast-in/built-in anchors may be used as an alternative to post-installed mechanical anchors at locations where the latter are indicated on the Drawings.

C. Protect products from damage during installation. Take special care to protect threads and threaded ends.

D. Accurately locate and position anchors and fasteners:
   1. Unless otherwise indicated on the Drawings, install anchors perpendicular to the surfaces from which they project.
   2. Install anchors so that at least 2 threads, but not more than 1/2 inch of threaded rod, projects past the top nut.

E. Interface with other products:
   1. Where steel anchors come in contact with dissimilar metals (aluminum, stainless steel, etc.), use stainless steel anchors and separate or isolate dissimilar metals using isolating sleeves and washers.
   2. Prior to installing nuts, coat threads of stainless steel fasteners with thread coating to prevent galling of threads.

3.03 INSTALLATION: CAST-IN ANCHORS

A. General:
   1. Accurately locate cast-in and built-in anchors.
      a. Provide anchor setting templates to locate anchor bolts and anchor rods. Secure templates to formwork.
      b. Brace or tie off embedments as necessary to prevent displacement during placement of plastic concrete or of surrounding masonry construction.
      c. Position and tie cast-in and built-in anchors in place before beginning placement of concrete or grout. Do not “stab” anchors into plastic concrete, mortar, or grout.
      d. Do not allow cast-in anchors to touch reinforcing steel. Where cast-in anchors are within 1/4 inch of reinforcing steel, isolate the metals by wrapping the anchors with a minimum of 4 wraps of 10-mil polyvinyl chloride tape in area adjacent to reinforcing steel.
   2. For anchoring at machinery bases subject to vibration, use 2 nuts, with 1 serving as a locknut.
   3. Where anchor bolts or anchor rods are indicated on the Drawings as being for future use, thoroughly coat exposed surfaces that project from concrete or masonry with non-oxidizing wax. Turn nuts down full length of the threads, and neatly wrap the exposed thread and nut with a minimum of 4 wraps of 10-mil waterproof polyvinyl tape.

B. Anchor bolts:
   1. Minimum effective embedment: 10-bolt diameters, unless a longer embedment is indicated on the Drawings.
   2. Where indicated on the Drawings, set anchor bolts in plastic, galvanized steel or stainless steel sleeves to allow for adjustment.

C. Welded studs:
   1. Butt weld to steel fabrications with automatic stud welding gun as recommended by the manufacturer.
   2. Ensure that butt weld develops full strength of the stud.

3.04 INSTALLATION: POST-INSTALLED ADHESIVE ANCHORS

A. Epoxy and acrylic adhesive bonding of reinforcing bars, all thread rods, and internally threaded inserts in concrete: As specified in Section 03055 - Adhesive-Bonded Reinforcing Bars and All Thread Rods in Concrete.

B. Epoxy and acrylic adhesive bonding of reinforcing bars, all thread rods, and internally threaded inserts in masonry: As specified in Section 04055 - Adhesive Bonding Reinforcing Bars and All Thread Rods in Masonry.

3.05 INSTALLATION: POST-INSTALLED MECHANICAL ANCHORS

A. General:
   1. Install anchors in accordance with the manufacturer’s instructions, ACI 355.2, the anchor’s ICC-ES Report. Where conflict exists between the ICC-ES Report and the requirements in this Section, the requirements of the ICC-ES Report shall control.

2. Where anchor manufacturer recommends the use of special tools and/or specific drill bits for installation, provide and use such tools.
3. After anchors have been positioned and inserted into concrete or masonry, do not:
    a. Remove and reuse/reinstall anchors.
    b. Loosen or remove bolts or studs.

B. Holes drilled into concrete and masonry:
1. Do not drill holes in concrete or masonry until the material has achieved its minimum specified compression strength (f'c or f'm).
2. Accurately locate holes:
    a. Before drilling holes, use a reinforcing bar locator to identify the position of all reinforcing steel, conduit, and other embedded items within a 6-inch radius of each proposed hole.
    b. If the hole depth exceeds the range of detection for the rebar locator, the Engineer may require radiographs of the area designated for investigation before drilling commences.
3. Exercise care to avoid damaging existing reinforcement and other items embedded in concrete and masonry.
    a. If embedments are encountered during drilling, immediately stop work and notify the Engineer. Await Engineer's instructions before proceeding.
4. Unless otherwise indicated on the Drawings, drill holes perpendicular to the concrete surface into which they are placed.
5. Drill using anchor manufacturer's recommended equipment and procedures:
    a. Unless otherwise recommended by the manufacturer, drill in accordance with the following:
        1) Drilling equipment: Electric or pneumatic rotary type with light or medium impact. Where edge distances are less than 2 inches, use lighter impact equipment to prevent micro-cracking and concrete spalling during drilling process.
        2) Drill bits: Carbide-tipped in accordance with ANSI B212-15. Hollow drills with flushing air systems are preferred.
6. Drill holes at manufacturer's recommended diameter and to depth required to provide the effective embedment indicated.
7. Clean and prepare holes as recommended by the manufacturer and as required by the ICC-ES Report for that anchor.
    a. Unless otherwise recommended by anchor manufacturer, remove dust and debris using brushes and clean compressed air.
    b. Repeat cleaning process as required by the manufacturer's installation instructions.
    c. When cleaning holes for stainless steel anchors, use only stainless steel or non-metallic brushes.

C. Insert and tighten (or torque) anchors in full compliance with the manufacturer's installation instructions.
1. Once anchor is tightened (torque), do not attempt to loosen or remove its bolt or stud.

D. Concrete anchors: Minimum effective embedment lengths unless otherwise indicated on the Drawings:

Concrete Anchors			
Nominal Diameter	Minimum Effective Embedment Length		Minimum Member Thickness
	In Concrete	In Grouted Masonry	
3/8 inch	2 1/2 inch	2 5/8 inch	8 inch
1/2 inch	3 1/2 inch	3 1/2 inch	8 inch
5/8 inch	4 1/2 inch	4 1/2 inch	10 inch
3/4 inch	5 inch	5 1/4 inch	12 inch

E. Flush shell anchors:
1. Flush shell anchors are not permitted in the Work.
2. If equipment manufacturer's installation instructions recommend the use of flush shell anchors, contact Engineer for instructions before proceeding.

F. Sleeve anchors:
1. Minimum effective embedment lengths unless otherwise indicated on the Drawings:

Sleeve Anchors			
Nominal Diameter	Minimum Effective Embedment Length		Minimum Member Thickness
	In Concrete	In Grouted Masonry	
M8 (1/2 inch)	70 mm (2 3/4 inch)	Not accepted	100 mm (8 inch)
M10 (5/8 inch)	76 mm (3 inch)	Not accepted	250 mm (10 inch)
M12 (3/4 inch)	80 mm (3 1/4 inch)	Not accepted	300 mm (12 inch)

2. Install with the sleeve fully engaged in the base material.

G. Screw anchors:
1. Minimum effective embedment lengths unless otherwise indicated on the Drawings:

Screw Anchors			
Nominal Diameter	Minimum Effective Embedment Length		Minimum Member Thickness
	In Concrete	In Grouted Masonry	
3/8 inch	2 1/2 inch	3 1/4 inch	8 inch
1/2 inch	3 1/4 inch	4 1/2 inch	8 inch
5/8 inch	4 inch	5 inch	10 inch
3/4 inch	5 1/2 inch	6 1/4 inch	12 inch

2. Install screw anchors using equipment and methods recommended by the manufacturer. Continue driving into hole until the washer head is flush against the item being fastened.

H. Undercut concrete anchors:
1. Minimum effective embedment lengths unless otherwise indicated on the Drawings:

Undercut Anchors			
Nominal Diameter (bolt)	**Minimum Effective Embedment Length**		**Minimum Member Thickness(1)**
	In Concrete	**In Grouted Masonry**	
M10 (3/8 inch)	100 mm (4 inch)	Not accepted	200 mm (8 inch)
M12 (1/2 inch)	125 mm (5 inch)	Not accepted	350 mm (14 inch)
M16 (5/8 inch)	190 mm (7 1/2 inch)	Not accepted	460 mm (18 inch)
M20 (7/8 inch)	250 mm (10 inch)	Not accepted	510 mm (20 inch)
Notes: (1) Thickness indicated is for pre-set units. If through-set units are accepted, obtain minimum member thickness requirements from the Engineer.			

2. Installations of undercut anchors shall not be allowed where edge distances are less than 12 times the nominal diameter of the anchor stud.
3. Undercut bottom of hole using cutting tools manufactured for this purpose by the manufacturer of the undercut anchors being placed.

3.06 FIELD QUALITY CONTROL

A. Contractor shall provide quality control over the Work of this Section as specified in Section 01450 - Quality Control.
1. Expenses associated with work described by the following paragraphs shall be paid by the Contractor.

B. Post-installed anchors:
1. Review anchor manufacturer's installation instructions and requirements of the Evaluation Service Report (hereafter referred to as "installation documents") for each anchor type and material.
2. Observe hole-drilling and cleaning operations for conformance with the installation documents.
3. Certify in writing to the Engineer that the depth and location of anchor holes, and the torque applied for setting the anchors conforms to the requirements of the installation documents.

3.07 FIELD QUALITY ASSURANCE

A. Owner's Representative will provide on-site observation and field quality assurance for the Work of this Section.
1. Expenses associated with work described by the following paragraphs shall be paid by the Owner.

B. Field inspections and special inspections:
   1. Required inspections: Observe construction for conformance to the approved Contract Documents, the accepted submittals, and manufacturer's installation instructions for the products used.
   2. Record of inspections:
      a. Maintain record of each inspection.
      b. Submit copies to Engineer upon request.
   3. Statement of special inspections: At the end of the project, prepare and submit to the Engineer and the authority having jurisdiction inspector's statement that the Work was constructed in general conformance with the approved Contract Documents, and that deficiencies observed during construction were resolved.

C. Special inspections: Anchors cast into concrete and built into masonry.
   1. Provide special inspection during positioning of anchors and placement of concrete or masonry (including mortar and grout) around the following anchors:
      a. Anchor bolts.
   2. During placement, provide continuous special inspection at each anchor location to verify that the following elements of the installation conform to the requirements of the Contract Documents.
      a. Anchor:
         1) Type and dimensions.
         2) Material: Galvanized steel, Type 304 stainless steel, or Type 316 stainless steel as specified in this Section or indicated on the Drawings.
         3) Positioning: Spacing, edge distances, effective embedment, and projection beyond the surface of the construction.
         4) Reinforcement at anchor: Presence, positioning, and size of additional reinforcement at anchors indicated on the Drawings.
   3. Following hardening and curing of the concrete or masonry surrounding the anchors, provide periodic special inspection to observe and confirm the following:
      a. Base material (concrete or grouted masonry):
         1) Solid and dense concrete or grouted masonry material within required distances surrounding anchor.
         2) Material encapsulating embedment is dense and well-consolidated.

D. Special Inspections: Post-installed mechanical anchors placed in hardened concrete and in grouted masonry.
   1. Provide special inspection during installation of the following anchors:
      a. Concrete anchors.
   2. Unless otherwise noted, provide periodic special inspection during positioning, drilling, placing, and torquing of anchors.
      a. Provide continuous special inspection for post-installed anchors in "overhead installations" as defined in this Section.
   3. Requirements for periodic special inspection:
      a. Verify items listed in the following paragraphs for conformance to the requirements of the Contract Documents and the Evaluation Report for the anchor being used. Observe the initial installation of each type and

size of anchor, and subsequent installation of the same anchor at intervals of not more than 4 hours.
1) Any change in the anchors used, in the personnel performing the installation, or in procedures used to install a given type of anchor shall require a new “initial inspection.”

b. Substrate: Concrete or masonry surfaces receiving the anchor are sound and of a condition that will develop the anchor’s rated strength.

c. Anchor:
1) Manufacturer, type, and dimensions (diameter and length).
2) Material (galvanized, Type 304 stainless steel, or Type 316 stainless steel).

d. Hole:
1) Positioning: Spacing and edge distances.
2) Drill bit type and diameter.
3) Diameter, and depth.
4) Hole cleaned in accordance with manufacturer’s required procedures. Confirm multiple repetitions of cleaning when recommended by the manufacturer.
5) Anchor’s minimum effective embedment.
6) Anchor tightening/installation torque.

4. Requirements for continuous special inspection:
a. The special inspector shall observe all aspects of anchor installation, except that holes may be drilled in his/her absence provided that he/she confirms the use of acceptable drill bits before drilling, and later confirms the diameter, depth, and cleaning of drilled holes.

E. Field tests:
1. Engineer may, at any time, request testing to confirm that materials being delivered and installed conform to the requirements of the Specifications.
a. If such additional testing shows that the materials do not conform to the specified requirements, the Contractor shall pay the costs of these tests.
b. If such additional testing shows that the materials do conform to the specified requirements, the Owner shall pay the costs of these tests.

3.08 NON-CONFORMING WORK

A. Remove misaligned or non-performing anchors.

B. Fill empty anchor holes and repair failed anchor locations as specified in Section 03600 using high-strength, non-shrink, non-metallic grout.

C. If more than 10 percent of all tested anchors of a given diameter and type fail to achieve their specified torque or proof load, the Engineer will provide directions for required modifications. Make such modifications, up to and including replacement of all anchors, at no additional cost to the Owner.

3.09 SCHEDULES

A. Stainless steel. Provide and install stainless steel anchors at the following locations:
1. “Corrosive locations” as defined in this Section: Type 316 stainless steel.
2. “Wet and moist locations” as defined in this Section: Type 316 stainless steel.

3. "Other locations:"
    a. For connecting stainless steel members to concrete or masonry: Type 304 stainless steel.
    b. For connecting aluminum members to concrete or masonry.
    c. For connecting fiber-reinforced plastic (FRP) members to concrete or masonry.
4. At locations indicated on the Drawings.

B. Galvanized: Provide and install galvanized carbon steel anchors at the following locations:
    1. Locations not requiring stainless steel.
    2. At locations indicated on the Drawings.

C. Provide and install anchor materials as scheduled in the following Table.

Table - Required Anchoring Materials by Location

Location/Exposure		Materials	Notes
1.	**Anchors into concrete and grouted masonry for attachment of carbon steel, including structural steel and other steel fabrications:**		
a)	Interior dry areas	Carbon steel - galvanized	
b)	Locations with galvanized steel structures or fabrications	Stainless steel - Type 304 or 316	1
c)	Exterior and interior wet and moist locations	Stainless steel - Type 316	1
d)	Corrosive locations	Stainless steel - Type 316	1
2.	**Anchors into concrete and grouted masonry for attachment of aluminum, stainless steel, or fiber-reinforced plastic (FRP) shapes and fabrications:**		
a)	Interior dry areas	Stainless steel - Type 304 or 316	1
b)	Exterior and interior wet and moist locations	Stainless steel - Type 316	1
c)	Corrosive locations	Stainless steel - Type 316	1
3.	**Anchors for attaching equipment and its appurtenances:**		
a)	All locations	Stainless steel - Type 316 (unless Type 304 is specifically indicated in the specifications for the equipment.)	1

Notes:
(1) Where anchors are in contact with a metal that differs from that of the anchor, provide isolation sleeves and washers.

END OF SECTION

SECTION 05310

STEEL DECKING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Steel deck for floors and roofs, and associated accessories.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

B. American Welding Society (AWS):
   1. D1.3 - Structural Welding Code - Sheet Steel.

1.03 SUBMITTALS

A. Product data.

B. Shop drawings.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Storage and protection:
   1. Store steel deck at the site stacked on platforms or pallets and covered with tarpaulins or other suitable weathertight covering.
   2. Do not use steel deck for storage or working platform.
   3. Remove damaged, unlabeled, untagged, rusty, and deteriorated steel deck material from the job site.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. ASC Profiles.
   2. Verco Manufacturing Co.
   3. Canam Steel Corp.

2.02 MATERIALS

A. Sheet steel: ASTM A653, G 90 minimum coating designation.

2.03 FABRICATION

A. Steel deck shall be formed:
   1. So every sheet is identical and will register perfectly with adjacent sheets.
   2. In accordance with building code as specified in Section 01410- Regulatory Requirements.

B. Decking used with concrete fill shall be deformed to develop composite action between the deck and the concrete.

C. Furnish minimum gauge, deck thickness, section modulus, moment of inertia, and allowable diaphragm shear per foot of deck width that is not less than for type deck sections indicated on the Drawings.

D. Treat exposed roof deck with phosphate.

E. Furnish roof deck ready to receive field painting without further pretreatment. Paint exposed roof deck in accordance with Contract Documents.

F. Accessories:
   1. Furnish all accessories indicated on the Drawings or needed to completed work.
   2. Minimum required gauges:
      a. Sump pans: 14 gauge.
      b. All other accessories: 20 gauge unless otherwise indicated on the Drawings.

G. Welding and electrodes: In accordance with AWS D1.3.

H. Furnish roof decking in lengths to minimize number of splices.

I. Furnish steel deck complete, including cutting, shaping, fitting, drilling, welding, ridge plates, valley plates, reinforcing plates for openings, and miscellaneous pieces necessary for proper installation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions: Examine work in place to verify that it is satisfactory to receive the work of this Section. If unsatisfactory conditions exist, do not begin this work until such conditions have been corrected.

3.02 INSTALLATION

A. Decking shall span over at least 3 spans wherever possible.

B. Do not damage or overload roof deck during installation.

C. Do not use steel deck for storage or as a working platform until sheets have been welded in position.

D. Do not exceed maximum uniformly distributed load of 20 pounds per square foot.

E. Install decking in straight and continuous rows as far as practicable, with ribs at right angles to supporting members.

F. For each end of deck section, provide 3 inches minimum bearing on supports. For sections that abut each other, each piece shall bear a minimum of 3 inches on the support. This requires a 6 inch minimum flange width. For cases where the minimum bearing cannot be obtained, notify the Engineer.

G. Electric arc weld deck sections to bearing plates, supports at butt joints, at intermediate supports, side supports, and at end supports as indicated on the Drawings. Do not burn through the deck. Remove all slag.

H. Fasten the longitudinal joints between deck sections together by the method indicated on the Drawings.

I. Neatly cut and fit openings in roof deck, and reinforce with structural steel members as indicated on the Drawings.

J. Paint welds as specified.

K. Install roof deck free of dents and bent members.

L. Reinforce all holes and openings in steel deck as indicated on the Drawings.

M. Piping, conduit, equipment, and other services: Do not hang from decking.

N. Install all accessories required to complete work.

O. Suspended items:
   1. Ceilings and ductwork:
      a. Do not attach hangers to deck within the center 1/3 of span.
      b. Only 1 hanger may be attached to any 1 rib within 1 span.
      c. Attach wire hangers to decking with clips through hanger tabs.

3.03 REPAIR OF GALVANIZING AND COATING

A. Touch-up damage to galvanized surfaces, including cut edges and holes, with zinc rich primer.

B. Repair damage to factory-applied coating system in accordance with the manufacturer's printed recommendations.

3.04 CLEANUP

A. After erection, remove weld spatter, grease, and oil from decking.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Ladders.
   2. Manhole frames and covers.
   3. Miscellaneous metals.
   4. Associated accessories to the above items.

1.02 REFERENCES

A. Aluminum Association (AA):
   1. DAF-45: Designations from Start to Finish.
      a. M12-C22-A41.

B. American Association of State Highway and Transportation Officials (AASHTO):
   1. Standard Specifications for Highway Bridges.

C. ASTM International (ASTM):
   1. A36 - Standard Specification for Carbon Structural Steel.
   2. A48 - Standard Specification for Gray Iron Castings.
   3. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless.
   4. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   5. A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels for General Applications.
   6. A276 - Standard Specification for Stainless Steel Bars and Shapes.
   7. A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
   8. A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
   9. A489 - Standard Specification for Carbon Steel Lifting Eyes.
   10. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
   11. A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
   12. A635 - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Alloy, Carbon, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, General Requirements for.
   13. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   14. A992 - Standard Specification for Structural Steel Shapes.

15. B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
16. B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
17. B308 - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
18. B429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
19. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
20. F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength.

D. American Welding Society (AWS):
   1. A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.

E. Occupational Safety and Health Administration (OSHA).

1.03 DEFINITIONS

A. Passivation: Removal of exogenous iron or iron compounds from the surface of a stainless steel by means of chemical dissolution resulting from treatment with an acid solution that removes the surface contamination but does not significantly affect the stainless steel itself.

1.04 SUBMITTALS

A. Shop drawings:
   1. Ladders.
   2. Manhole frames and covers.
   3. Miscellaneous metals.
   4. Associated accessories to the above items.

B. Quality control submittals:
   1. Design data.

PART 2 PRODUCTS

2.01 MATERIALS

A. General: Unless otherwise specified or indicated on the Drawings, structural and miscellaneous metals in accordance with the standards of the ASTM, including the following:

Item	ASTM Standard No.	Class, Grade Type or Alloy No.
Cast Iron		
Cast Iron	A48	Class 40B
Steel		
Galvanized sheet iron or steel	A653	Coating G90
Coil (plate)	A635	--
Structural plate, bars, rolled shapes, and miscellaneous items (except W shapes).	A36	--
Rolled W shapes	A992	Grade 50
Standard bolts, nuts, and washers	A307	--
High strength bolts, nuts, and hardened flat washers	F3125, Grade A325	--
Eyebolts	A489	Type 1
Tubing, cold-formed	A500	--
Tubing, hot-formed	A501	--
Steel pipe	A53	Grade B
Stainless Steel		
Plate, sheet, and strip	A240	Type 304* or 316**
Bars and shapes	A276	Type 304* or 316**
Bolts (Type 304)	F593	Group 1 Condition CW
Bolts (Type 316)	F593	Group 2 Condition CW
Aluminum		
Flashing sheet aluminum	B209	Alloy 5005-H14, 0.032 inches minimum thickness
Structural sheet aluminum-	B209	Alloy 6061-T6

Item	ASTM Standard No.	Class, Grade Type or Alloy No.
Structural aluminum	B209 B308	Alloy 6061-T6
Extruded aluminum	B221	Alloy 6063-T42
* Use Type 304L if material will be welded. ** Use Type 316L if material will be welded.		

1. Stainless steels are designated by type or series defined by ASTM.
2. Where stainless steel is welded, use low-carbon stainless steel.

2.02 MANUFACTURED UNITS

A. Ladders:
   1. General:
      a. Type: Safety type conforming to local, State, and OSHA standards as minimum. Furnish guards for ladder wells.
      b. Size: 18 inches wide between side rails of length, size, shape, detail, and location indicated on the Drawings.
   2. Aluminum ladders:
      a. Materials: 6063-T5 aluminum alloy.
      b. Rungs:
         1) 1-inch minimum solid square bar with 1/8-inch grooves in top and deeply serrated on all sides.
         2) Capable of withstanding 1,000 pound load without failure.
      c. Side rails: Minimum 4-inch by 1/2-inch flat bars.
      d. Finish of aluminum components:
         1) Anodized finish, 0.7 mil thick, applied to exposed surfaces after cutting. Aluminum Association Specification M12-C22-A41, mechanical finish non specular as fabricated, chemical finish-medium matte, anodic coating-clear Class I Architectural.
         2) Pretreat aluminum for cleaning and removing markings before anodizing.
      e. Fabrication:
         1) Welded construction, of size, shape, location, and details indicated on the Drawings.
         2) For ladders over 20 feet high, furnish standard ladder cages or fall prevention system designed in accordance with State and OSHA requirements.
      f. Fall prevention system: Include but not limit to railing, brackets, clamps, 2 sleeves, and 2 belts, satisfying OSHA safe climbing requirements:
         1) Manufacturers: One of the following or equal:
            a) North Consumer Products, Saf-T-Climb.
            b) Swager Communications, Climbers Buddy System.

B. Manhole frames and covers:
   1. Material: Gray iron castings, in accordance with ASTM A48, Class 30-B.
   2. Type: Heavy-duty traffic type, with combined minimum set weight of 265 pounds.

3. Machine horizontal and vertical bearing surfaces to fit neatly, with easily removable cover bearing firmly in frame without rocking.
4. Frame:
    a. Bottom flange type.
    b. Approximately 4-1/2 inches frame height.
    c. Dimensions as indicated on the Drawings.
        1) Minimum inside clear dimension may not be smaller than nominal diameter minus 2 inches.
5. Cover:
    a. Skid-resistant grid pattern design stamped with name of utility service provided by manhole, such as "ELECTRICAL," "SEWER," "TELEPHONE," or "WATER."
    b. Solid type without ventilation holes.
6. Finish: Unpainted.

C. Miscellaneous aluminum:
1. Fabricate aluminum products, not covered separately in this Section, in accordance with the best practices of the trade and field assemble by riveting or bolting.
2. Do not weld or flame cut.

D. Miscellaneous cast iron:
1. General:
    a. Tough, gray iron, free from cracks, holes, swells, and cold shuts.
    b. Quality such that hammer blow will produce indentation on rectangular edge of casting without flaking metal.
    c. Before leaving the foundry, clean castings and apply 16-mil dry film thickness coating of coal-tar epoxy, unless otherwise specified or indicated on the Drawings.

E. Miscellaneous stainless steel:
1. Provide miscellaneous stainless steel items not specified in this Section as indicated on the Drawings or specified elsewhere.
    a. Fabricate and install in accordance with the best practices of the trade.
2. Cleaning and passivation:
    a. Following shop fabrication of stainless steel members, clean and passivate fabrications.
    b. Finish requirements: Remove free iron, heat tint oxides, weld scale and other impurities, and obtain a passive finished surface.
    c. Provide quality control testing to verify effectiveness of cleaning agents and procedures and to confirm that finished surfaces are clean and passivated.
        1) Conduct sample runs using test specimens with proposed cleaning agents and procedures as required to avoid adverse effects on surface finishes and base materials.
    d. Pre-clean, chemically descale (pickle), and final clean fabrications in accordance with the requirements of ASTM A380 to remove deposited contaminants before shipping.
        1) Passivation by citric acid treatment is not allowed.
            a) If degreasing is required before cleaning to remove scale or iron oxide, cleaning (pickling) treatments with citric acid are

permissible; however, these treatments shall be followed by inorganic cleaners such as nitric-hydrofluoric acid.
2) Provide acid descaling (pickling) in accordance with Table A1.1 of Annex A1 of ASTM A380.
3) After pickling, final cleaning of stainless steel shall conform to Part II of Table A2.1 of Annex A2 of ASTM A380.
e. After cleaning, inspect using methods specified for “gross inspection” in ASTM A380.
f. Improperly or poorly cleaned and passivated materials shall not be shipped and will not be accepted at the job site.

F. Miscellaneous structural steel:
1. Provide miscellaneous steel items not specified in this Section as indicated on the Drawings or specified elsewhere.
a. Fabricate and install in accordance with the best practices of the trade.

G. Isolating sleeves and washers:
1. As indicated on the Drawings and as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification of conditions:
1. Examine work in place to verify that it is satisfactory to receive the work of this Section.
2. If unsatisfactory conditions exist, do not begin this work until such conditions have been corrected.

3.02 INSTALLATION

A. General:
1. Install products as indicated on the Drawings, and in accordance with shop drawings and manufacturer's printed instructions, as applicable except where specified otherwise.
2. Interface between materials:
a. Dissimilar metals: Where steel comes in contact with dissimilar metals (aluminum, stainless steel, etc.), separate or isolate the dissimilar metals.
1) Make application so that the isolating or protective barrier is not visible in the completed construction.
2) Isolating sleeves and washers: As specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
b. Aluminum in contact with concrete or masonry: Coat aluminum surfaces as specified in Section 09960 - High Performance Coatings.
c. Aluminum in contact with concrete or masonry.

B. Ladders:
1. Secure to supporting surface with bent plate clips providing minimum 8 inches between supporting surface and center of rungs.

2. Where exit from ladder is forward over top rung, extend side rails 3 feet 3 inches minimum above landing, and return the rails with a radius bend to the landing.
3. Where exit from ladder is to side, extend ladder 5 feet 6 inches minimum above landing and rigidly secure at top.
4. Erect rail straight, level, plumb, and true to position indicated on the Drawings:
    a. Correct deviations from true line or grade which are visible to the eye.

C. Stainless Steel:
1. Welding:
    a. Passivate field-welded surfaces:
        1) Provide cleaning, pickling, and passivating as specified in this Section.
        2) Clean using Derustit Stainless Steel Cleaner, or equal.

END OF SECTION

SECTION 07110

DAMPPROOFING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Dampproofing.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D1227 - Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.

B. California Air Resources Board (ARB):
   1. Architectural Coatings Suggested Control Measure.

1.03 SUBMITTALS

A. Product data.

B. Shop drawings.

C. Manufacturer's Installation Instructions.

D. Warranty.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store materials in original, unopened containers in compliance with manufacturer's printed instructions.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Conform to volatile organic compound limits specified in Table 1 of the California ARB Architectural Coatings Suggested Control Measure.

B. Do not apply bituminous dampproofing when temperatures are 40 degrees Fahrenheit or lower or when rain is forecast for the 24 hours following application.

PART 2 PRODUCTS

2.01 MATERIALS

A. Dampproofing: ASTM D1227, Asbestos Free, Emulsified Asphalt Coatings:
   1. Manufacturers: One of the following or equal:
      a. Karnak Corp., Karnak 220 AF.
      b. W.R. Meadows, Inc., Sealmastic Type 2 Asphalt Emulsion Dampproofing.

B. Sealing mastic: Type compatible with dampproofing and free of toxic solvents with thick mastic consistency and smooth and uniform in composition product as recommended by dampproofing manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that conditions are satisfactory for application of products in accordance with manufacturer's recommendations.

B. Verify that surfaces to receive dampproofing are clean, dry, reasonably smooth, free of dust, dirt, voids, cracks, or sharp projections.

3.02 APPLICATION

A. Completely cover surfaces to receive dampproofing with 2 coats:
   1. Applied by brush or spray.
   2. Apply dampproofing at manufacturer's recommended rate of application or minimum 2 gallons per 100 square feet, whichever is greater.

B. Extend dampproofing to 6 inches above finish grade.

C. Apply each coat evenly so surfaces have uniform black appearance.

D. Apply second coat at right angles to first, allowing not less than 24 hours between coats.

E. Seal around items and services projecting through dampproofing surfaces in accordance with manufacturer's recommendations.

F. Ensure sealed areas are moisture tight.

G. Backfill completely against dampproofing application within time recommended by manufacturer.

END OF SECTION

SECTION 07190

WATER REPELLENTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Water repellent for concrete masonry.

1.02 REFERENCES

A. International Union of Testing and Research Laboratories for Materials and Structures:
   1. RILEM Test Method No. 11.4 - Measurement of Water Absorption Under Low Pressure.

B. South Coast Air Quality Management District (SCAQMD):
   1. Rule 1168 - Adhesive and Sealant Applications.

1.03 DEFINITIONS

A. Water Repellent: Resistance to penetration of water from rainfall.

1.04 SUBMITTALS

A. Product Data.

B. Samples: Water repellent applied on 8-inch by 8-inch substrates to receive water repellent, marked with application date and application rate.

C. Manufacturer's Application Instructions.

1.05 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer of water repellents for minimum of 5 years with satisfactory performance record.

B. Applicator qualifications: Trained, approved, and accepted by water repellent manufacturer.

C. Spray personnel qualifications: Minimum 2 years of experience spraying exotic coatings.

D. Regulatory requirements: Comply with volatile organic compound regulations.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer's original containers with seals unbroken and labeled with manufacturer's batch number.

B. Store materials in original, unopened containers in compliance with manufacturer's printed instructions.

1.07 ENVIRONMENTAL REQUIREMENTS

A. Sealants in compliance with SCAQMD Rule 1168.

B. Apply water repellent under temperature and relative humidity conditions before, during, and after application in accordance with manufacturer's instructions.

C. Allow surfaces to dry for minimum 5 days after rains.

1.08 PROJECT CONDITIONS

A. Make proper material allowance based upon substrate material and surface configuration when determining quantities of material.

1.09 WARRANTY

A. Warrant to furnish and apply water repellent on walls that experience water penetration because of failure of water repellent for minimum 5 years.

1.10 MAINTENANCE

A. Extra materials: Deliver water repellent in manufacturer's original unopened containers to Owner that equals minimum 1 percent of material supplied.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Water repellent sealer:
   1. One of the following or equal:
      a. Rainguard Products.
      b. ProSoCo, Inc.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Performance requirements: Surfaces with water repellent shall be uniform in color with unaltered texture.

2.03 MATERIALS

A. Water repellent sealer for concrete and concrete masonry: Silane/siloxane; volatile organic compound compliant; free of silicone oils, paraffin wax, or urethanes.
   1. Manufacturers: The following or equal:
      a. Rainguard, Blok-Lok™.

2.04 EQUIPMENT

A. Spray equipment: High-volume, low-pressure, airless, with maximum 60 pounds per square inch pressure:
   1. Pump: Non-atomizing, able to flow material on walls at minimum 1 to 1-1/2 gallons per minute.
   2. Orifice size for concrete, slump block, exposed concrete aggregate, and cement plaster: 0.060 to 0.110 inches.
   3. Orifice size for brick, clay brick tile, brick veneer, stone, and wood: 0.060 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Carefully inspect installed construction. Verify that construction is ready for repellent application.

B. Require manufacturer's representative to verify that water repellent may be installed.

3.02 PREPARATION

A. Allow concrete or masonry walls to cure at least 30 days before applying water repellent.

B. Clean wall surfaces of soil, mud, efflorescence, or other detrimental materials.

C. Tuck-point or caulk cracks, other than hairline cracks.

D. Route out defective mortar joints, point with mortar and tool.

E. Moisture content: Apply water repellent sealer when moisture content of substrate is 15 percent or less.

3.03 APPLICATION ON CONCRETE, CONCRETE MASONRY, EXPOSED CONCRETE AGGREGATE, AND CEMENT PLASTER

A. Apply water repellent in accordance with manufacturer's printed instructions.

B. Apply flood coat using low-pressure spray equipment.

C. Start at top of wall and work down using overlapping horizontal passes.

D. Hold spray head 8 to 10 inches from surface so saturation coat runs freely down wall 6 to 10 inches below point of application on most substrates.

E. Spray by traveling horizontally to ensure uniform coverage.

F. Overlap each following pass by centering spray head on bottom line of the previous pass.

G. Trigger gun off at end of each pass to avoid applying excessive amount of material. Do not over apply.

H. Avoid application in hot or windy weather as premature drying can cause whitish residue on walls.

3.04 APPLICATION ON BRICK, CLAY BRICK TILE, BRICK VENEER, STONE, AND WOOD

A. Apply water repellent in accordance with manufacturer's printed instructions.

B. Apply wet coat in horizontal passes using low-pressure spray equipment with or without rundown.

C. Overlap each following pass by approximately 50 percent.

D. Trigger gun off at the end of each pass to avoid an excessive amount of material being applied.

E. Keep surface wet for 5 to 10 minutes and damp for over 1 hour.

F. Do not apply in hot or windy weather. Over-application can result in whitish residue on surface.

3.05 FIELD QUALITY CONTROL

A. 20 days after application, test water repellent on CMU surfaces using RILEM Test Method No. 11.4:
   1. Contractor shall perform a 20-minute RILEM baseline test on dry untreated CMU units of each type to receive water repellent. Test results (water loss in milliliter) shall be compared to CMU units in walls after water repellent application.
   2. On water repellant coated CMU, a RILEM tube test resulting in 5 milliliter or less after 20 minutes is necessary to qualify for 5-year warranty.

B. Notify the Engineer and manufacturer at least 72 hours in advance of test.

C. Where tested wall areas fail to pass RILEM tube test, apply additional coat of water repellent on entire wall from corner to corner.

D. Test all locations where directed by the Engineer.

3.06 CLEANING

A. Concrete, concrete masonry, exposed concrete aggregate, and cement plaster: Clean drips, runs, and overspray residue while still wet, using detergent and water. Clean application and spray equipment with detergent and water immediately following use.

B. Brick, clay brick tile, brick veneer, stone, and wood: Clean drips, runs, and overspray residue with petroleum type thinner following application.

C. Clean application and spray equipment according to the manufacturer's recommendations.

D. Remove excess materials, equipment, and debris incidental to water repellent application upon completion.

3.07 PROTECTION

A. During application, protect water repellent treated and adjacent surfaces from damage.

B. Protect glass, aluminum, and other surfaces from overspray.

C. Protect concrete sidewalks from runoff. Soak with water immediately prior to application on adjacent walls.

D. Repair damaged areas promptly.

END OF SECTION

SECTION 07220

ROOF AND DECK INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Roof and deck insulation and associated accessories.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   2. D41- Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
   3. D312 - Standard Specification for Asphalt Used in Roofing.

B. National Roofing Contractors Association (NRCA).

C. Underwriters Laboratories, Inc. (UL).

1.03 SUBMITTALS

A. Product data.

B. Samples. Include 6-inch square samples of each type and thickness of insulation required.

C. State thickness and R-value of insulation to be provided at each building.

D. Manufacturer's installation instructions: Include the following:
   1. Indicate special environmental conditions required for installation.
   2. Indicate adhesive recommendations.
   3. Indicate fastener recommendations and attachment pattern to meet specified FM 1-90 requirements.
   4. Indicate installation techniques.

E. Certificates:
   1. Certify that products meet or exceed specified requirements.
   2. Certify that insulation is approved by manufacturer for use with specified roofing materials.

F. Manufacturer's field reports.

G. Warranty.

1.04 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer of proposed product for minimum 5 years with satisfactory performance record.

B. Installer qualifications:
   1. Manufacturer-approved installer of products similar to specified products on minimum 5 projects of similar scope as Project with satisfactory performance record.
   2. Committed to complying with manufacturer's specifications and NRCA recommendations.
   3. Committed to assuming undivided responsibility for roof insulation, roofing membrane and sheet metal flashing, and trim associated with roofing.

C. Product compatibility: Provide roofing manufacturer approved roof insulation.

D. Pre-installation conference: Conduct as specified in Section 01312 - Project Meetings.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products in accordance with manufacturer's instructions.

B. Label asphalt containers with certification of full compliance with requirements of ASTM D312, Table 1, and indicating equiviscous temperature, finished flowing temperature, and flash point.

C. Store roof system materials on pallets or dunnage at least 4 inches above ground and suitably covered to protect from weather.

1.06 SEQUENCING AND SCHEDULING

A. Apply no more insulation than can be completely covered with roofing membrane on the same day.

B. When installation of insulation and roof membrane cannot be completed within same day, install temporary water cutoffs at end of day's work and remove cutoffs prior to resumption of work.

1.07 WARRANTY

A. Furnished by roof membrane manufacturer, as specified in Section 07540 - Thermoplastic Polyolefin Roofing

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Roof insulation system: As follows with UL Class A and FM Class 1A fire classification and meeting FM 1-90 wind up-lift requirements.
   1. Where tapered rigid foam insulation is indicated on the Drawings, insulation shall be as follows:
      a. Multiple layer insulation, comprised of layers of flat and tapered rigid foam roof insulation, built up to provide a taper, sloped to drains, of 1/4-inch per foot minimum.
      b. Minimum insulation thickness at roof drains shall be 1-1/2 inches.
      c. Provide drainage pattern as indicated on the Drawings.

2.02 MATERIALS

A. Tapered foam roof insulation:
   1. Closed cell polyisocyanurate foam core bonded to universal fiberglass reinforced facers.
   2. Utilizing environmentally compliant blowing agent.
   3. Manufacturers: One of the following or equal:
      a. Johns Manville, Inc., Tapered ENRGY 3.
      b. Atlas Roofing Corp., Tapered ACFoam II.

B. Roof crickets and saddles: Tapered Perlite Roof Insulation or as otherwise recommended by roofing manufacturer to meet warranty requirements.

C. Primer: ASTM D41, asphalt primer.

D. Bitumen: ASTM D312, Type II, III, or IV petroleum asphalt, free from inorganic matter; as recommended by manufacturer for interply moppings to suit particular slope limitations.

2.03 ACCESSORIES

A. Screw fastener system for steel decks:
   1. Self-drilling and self-tapping, zinc plated or stainless steel screws, sized for 1/2- to 3/4-inch exposure on exposed to view underside of deck, with minimum 3-inch square or diameter ribbed steel stress plates, hot-dip galvanized with minimum G-60 coating in accordance with ASTM A123.
   2. Manufacturers: One of the following or equal:
      a. Tru Fast.
      b. TW Buildex.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that deck is properly graded to outlets.

B. Verify that deck surfaces are clean, dry, and where required, coated with primer.

3.02 PREPARATION

A. Embed 1 ply of roofing felt over roof drains and minimum 6 inches over adjacent surface in solid uniform layer of plastic cement.

3.03 HEATING OF ASPHALT AND APPLICATION TEMPERATURES

A. Equip kettles and tankers with accurate, fully readable thermometers.

B. Do not heat asphalt to or above their flash points.

C. Avoid heating at or above finished flowing temperature.

D. When accepted, heat above finished flowing temperature for no more than 4 hours.

E. Apply asphalt at maximum 25 degrees Fahrenheit below finished flowing temperature or above equiviscous temperature.

F. Do not cut or alter bitumens.

3.04 INSTALLATION OVER STEEL DECK

A. Install roof insulation in accordance with manufacturer's specifications.

B. Secure wood nailers to roof deck adjoining eaves, at roof curbs for attachment of flashing and counterflashing, and at other locations indicated on the Drawings.
   1. Nailers shall be built up of pressure treated wood to match the thickness of the insulation.

C. Apply first layer of roof insulation with long joints continuous, either parallel or at right angles to ribs of deck.

D. Form joints parallel to ribs over solid bearing.

E. Stagger end joints.

F. Secure with approved mechanical fasteners in FM I-90 pattern:
   1. Space fasteners as recommended by insulation manufacturer.
   2. Drive fasteners through tin caps or plastic fastener/cap assemblies, unless they are provided with integral flat cap not less than 1 inch across.
   3. Install screw fastener system in top rib of steel deck in accordance with manufacturer's instructions. Where underside of metal deck is exposed to view, size fasteners to penetrate deck from 1/2- to 3/4-inch, unless otherwise recommended by fastener manufacturer.

G. Install cant strips at curbs, parapets, and intersections of roofs and vertical walls, when recommended by membrane manufacturer. Place on top of insulation and set in solid mopping of asphalt.

H. Roof crickets:
   1. Install as required to achieve drainage pattern indicated on the Drawings, and as otherwise required to obtain roof warranty. Set in full mopping of hot asphalt. Feathered edges of crickets and tapered insulation shall be formed of perlite or fiber board.
   2. Mop 12-inch wide felt strip into solid asphalt at valley formed by installation of roof crickets to provide additional membrane reinforcement.

I. Before application of roofing, turn over and solidly mop projecting felt to insulation at vertical surfaces and edges.

J. Do not leave insulation exposed to weather.

3.05 FIELD QUALITY CONTROL

A. Roof insulation which becomes wet or damaged shall be removed and replaced with solid, dry insulation, unless installer provides written acceptance of the damaged insulation from the roofing manufacturer, whose warranty shall cover the system.

B. Inspections: Roof membrane manufacturer, whose warranty shall cover complete roof assembly, shall provide supervision and inspection necessary to secure warranty.

END OF SECTION

SECTION 07530

ELASTOMERIC MEMBRANE ROOFING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Single-ply elastomeric membrane roofing system.

1.02 REFERENCES

A. American Society of Civil Engineers (ASCE):
   1. 7 - Hazard Tool.

B. ASTM International (ASTM):
   1. D751 - Standard Test Methods for Coated Fabrics.
   2. D573 - Standard Test Method for Rubber-Deterioration in an Air Oven.
   3. D1149 - Standard Test Method for Rubber Deterioration-Surface Ozone Cracking in an Ozone Controlled Environment.
   4. D2136 - Standard Test Method for Coated Fabrics-Low-Temperature Bend Test.
   5. D2240 - Standard Test Method for Rubber Property-Durometer Hardness.
   6. E108 - Standard Test Methods for Fire Tests of Roof Coverings.

C. California Air Resources Board (ARB):
   1. Architectural Coatings Suggested Control Measure.

D. Underwriters Laboratories, Inc. (UL).

1.03 SUBMITTALS

A. Product data: Include specifications and flashing details.

B. Detail drawings: Provide roofing system plans, elevations, sections, details, and details of attachment to other Work, including:
   1. Base flashings and membrane terminations.
   2. Tapered insulation, including slopes.
   3. Crickets, saddles, and tapered edge strips, including slopes.
   4. Insulation fastening and adhesive patterns.
   5. Mechanical equipment, skylights, conduit, and other penetrations.

C. Samples:
   1. For each product specified.
   2. Each type of felt: 8 inches square.

D. Manufacturer's Installation Instructions.

E. Certificates: UL listings.

F. Installer Authorization: Letter or certificate signed by roofing system manufacturer certifying that installer is approved, authorized, or licensed by manufacturer to install roofing system.

G. Maintenance manual: Include repair instructions.

H. Prior to beginning the Work of this Section:
   1. Submit sample warranties.
   2. Submit the final System Assembly Letter issued by manufacturer indicating that the products and system to be installed shall be eligible to receive the specified manufacturer's guarantee when installed by a certified contractor in accordance with manufacturer application requirements, inspected and approved by an authorized manufacturer representative.
   3. Submit the Guarantee Application Confirmation document issued by manufacturer indicating that the project has been reviewed for eligibility to receive the specified guarantee/warranty and that the project is registered.

I. Upon substantial completion:
   1. Submit final warranties.

1.04 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer of proposed product for minimum 5 years with satisfactory performance record.

B. Installer qualifications: Qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer’s product and that is eligible to receive the specified manufacturer’s guarantee/warranty.

C. Source Limitations:
   1. Obtain all components from the single source roofing manufacturer guaranteeing the roofing system.
   2. All products used in the system shall be labeled by the single source roofing manufacturer issuing the guarantee.

D. Pre-installation conference: Conduct as specified in Section 01312 - Project Meetings.

E. Verify roof and deck insulation in Section 07220 - Roof and Deck Insulation, and flashing and sheet metal in Section 07600 - Flashing and Sheet Metal are compatible with membrane roofing.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products in accordance with manufacturer's recommendations.

B. Deliver materials with appropriate labels indicating warnings, storage conditions, lot numbers, and usage instructions.

C. Deliver materials in original unopened containers.

D. Label containers with manufacturer's name, brand name, installation instructions, and identification of items.

E. Each container or bulk shipping ticket for asphalt shall indicate the equiviscous temperature, finished blowing temperature, and the flash point.

F. Store materials out of direct exposure to the elements.

G. Store roll goods on end on a clean flat surface.

H. Protect materials against moisture.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Conform to volatile organic compound (VOC) limits specified in Table 1 of the California ARB Architectural Coatings Suggested Control Measure.

B. Do not apply roofing membrane during inclement weather or when air temperature may fall below 40 degrees Fahrenheit.

C. Do not apply roofing membrane to damp or frozen deck surface.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

1.07 WARRANTIES

A. As specified in Section 01783 - Warranties and Bonds.

B. Special warranty:
   1. Manufacturer's warranty: Minimum 10 years to correct defective roofing materials, including installation.
   2. Roofer's warranty: Minimum 2 years to correct defective workmanship.
   3. Warranty rider for hail enhancement:
      a. Hail: For hail up to 1 inches.
      b. Moderate hail: 1.5.
      c. Severe hail: For hail up to 2 inches.
   4. Warranty rider for punctures:
      a. Provides 8 hours per year for repair of punctures.
      b. Provides 16 hours per year for repair of punctures.
      c. Provides 32 hours per year for repair of punctures.
   5. Warranty rider for ponding water.
   6. Warranty rider for overburden.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. General: Installed roofing membrane system shall remain watertight; and resist specified wind uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material compatibility: Roofing materials shall be compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.

C. Installer shall comply with current code requirements based on authority having jurisdiction.

D. Wind uplift performance: As specified in Section 01850 - Wind Design Criteria.
   1. Roofing system shall be identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist wind uplift pressure calculated in accordance with ASCE 7.

E. Roof live load, roof dead loads and snow load: As indicated on the structural Drawings.

F. Fire-test-response characteristics:
   1. Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction.
   2. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

G. Fire hazard classification:
   1. UL Class C.

H. Exterior fire-test exposure:
   1. ASTM E108, Class C for application and roof slopes indicated.

2.02 ROOFING SYSTEMS

A. Type: Mechanically attached**,** 60-mil reinforced membrane assemblies.

B. Membrane color: Black.

2.03 MANUFACTURERS

A. One of the following or equal:
   1. Carlisle Corp., Sure-Weld.
   2. Johns Manville, EPDM R.

2.04 COMPONENTS

A. Membrane: 60 mil, scrim-reinforced, white, uncured polyolefin based rubber sheet approximately 75 inches wide by appropriate length conforming to following minimum physical properties:
   1. Breaking strength: Minimum 225 pounds when tested in accordance with ASTM D751, Grab Method.
   2. Tear strength: Minimum 55 pounds when tested in accordance with ASTM D751, Tongue Tear.

3. Brittleness: Passes bending around 1.8 inch mandrel at minus 45 degrees Celsius in accordance with ASTM D2136.
4. Shore A hardness: From 75 to 85 when tested in accordance with ASTM D2240.
5. Heat aging: Maintains 100 percent of original breaking strength after 28 days at 212 degrees Fahrenheit in accordance with ASTM D573.
6. Ozone resistance: No effect when subjected in 3 parts per million ozone and 30 percent strain at 104 degrees Fahrenheit for 72 hours and 25,000 hours in accordance with ASTM D1149.
7. Puncture resistance: Minimum 250 pounds when tested in accordance with FTM 191 B, Method 2031.

B. Roof walkway:
1. Provide roofing system manufacturer standard roof walkway.
2. Placement location requirements:
   a. Traffic concentration points.
   b. Regular maintenance access areas.
   c. Coordinate roof access landing to connect with traffic concentration points and regular maintenance access areas.

C. Flashing, bonding adhesive, sealant, primer, seam caulk, and mechanical fasteners: Membrane manufacturer approved.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification the following:
1. Proper installation of treated curbs, wood nailers, insulation, cants, and crickets.
2. Deck is properly graded to outlets. Build up potential birdbaths.
3. Deck surfaces are dry, clean, smooth, and free of sharp edges and debris.

3.02 PREPARATION

A. Prepare substrate to receive roofing system in accordance with roofing manufacturer's instructions.

B. Install flashings and similar accessory items in accordance with manufacturer's instructions.

C. Sweep surface to be covered clean of debris, dirt, or other sharp objects.

D. Prime metal flanges, concrete and masonry surface, and concrete roof deck to receive membrane roofing with a uniform coating of asphalt primer.

3.03 INSTALLATION

A. Install roofing in accordance with manufacturer's instructions and warranty.

B. Install perimeter sheets.

C. Lay field sheets with long edges perpendicular to roof slope, with edge of roll aligned with perimeter sheets.

D. Install screw fasteners, spaced in accordance with manufacturer's recommendations, along leading edge of membrane, through insulation, and into roof deck.

E. Overlap fastened edges of installed membrane by approximately 4-1/2 inches. Hot air weld edges with manufacture approved automatic hot air welder.

F. Prime cured material as required before hot air welding.

G. Seal cut edges with seam caulk.

H. Install metal flashing as specified in Section 07600 - Flashing and Sheet Metal and as indicated on the Drawings.

I. Fasten and finish perimeter in accordance with membrane manufacturer's standard details.

J. Where underside of metal deck is exposed to view, size fasteners to penetrate deck not more than 3/4 inch.

K. Cut walkway material into sections (maximum 36 inch). Heat weld in place with 6-inch gap between sections to allow proper drainage.

3.04 FIELD QUALITY CONTROL

A. Arrange for manufacturer's inspection of completed installation in the presence of the Engineer and the Owner.

3.05 PROTECTION

A. Before the end of each working day or before application is interrupted by precipitation, seal exposed sheet edges along laps and around drains, projections, and upstands.

B. Build cutoffs using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Completely remove cutoffs prior to the resumption of roofing.

END OF SECTION

SECTION 07540

THERMOPLASTIC POLYOLEFIN (TPO) MEMBRANE ROOFING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Fully-adhered, 60 mil thermoplastic polyolefin membrane, white, scrim-reinforced roofing system.

1.02 REFERENCES

A. American Society of Civil Engineers (ASCE):
   1. 7 – Hazard Tool.

B. ASTM International (ASTM):
   1. D751 – Standard Test Methods for Coated Fabrics.
   2. E108 – Standard Test Methods for Fire Tests of Roof Coverings.

C. California Air Resources Board (ARB):
   1. Architectural Coatings Suggested Control Measure.

D. Single Ply Roofing Industry (SPRI):
   1. SPRI WD-1 - Wind Design Standard Practice for Roofing Assemblies.

E. Underwriters Laboratories, Inc.(UL).

1.03 SUBMITTALS

A. Product data: Include specifications and flashing details.

B. Detail drawings: Provide roofing system plans, elevations, sections, details, and details of attachment to other Work, including:
   1. Base flashings and membrane terminations.
   2. Tapered insulation, including slopes.
   3. Crickets, saddles, and tapered edge strips, including slopes.
   4. Insulation fastening and adhesive patterns.
   5. Mechanical equipment, skylights, conduit, and other penetrations.

C. Samples:
   1. For each product specified.
   2. Each type of felt: 8 inches square.

D. Manufacturer's Installation Instructions.

E. Certificates:
   1. UL listings.
   2. Letter of certification from the manufacturer certifying the roofing contractor is authorized to install the manufacturer's roofing system, include certified foreman and training dates.
   3. Indicating membrane thickness from the membrane manufacturer.

F. Installer Authorization: Letter or certificate signed by roofing system manufacturer certifying that installer is approved, authorized, or licensed by manufacturer to install roofing system.

G. Maintenance manual: Include repair instructions.

H. Prior to beginning the Work of this Section:
   1. Submit sample warranties.
   2. Submit the final System Assembly Letter issued by manufacturer indicating that the products and system to be installed shall be eligible to receive the specified manufacturer's guarantee when installed by a certified contractor in accordance with manufacturer application requirements, inspected and approved by an authorized manufacturer representative.
   3. Submit the Guarantee Application Confirmation document issued by manufacturer indicating that the project has been reviewed for eligibility to receive the specified guarantee/warranty and that the project is registered.

I. Upon substantial completion:
   1. Submit final warranties.

1.04 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer of proposed product for minimum 5 years with satisfactory performance record.

B. Installer qualifications: Qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer’s product and that is eligible to receive the specified manufacturer’s guarantee/warranty.

C. Source Limitations:
   1. Obtain all components from the single source roofing manufacturer guaranteeing the roofing system.
   2. All products used in the system shall be labeled by the single source roofing manufacturer issuing the guarantee.

D. Pre-installation conference: Conduct as specified in Section 01312 - Project Meetings.

E. Verify existing roof, deck insulation, and roof specialties and accessories in Section 07700 - Roof Specialties are compatible with membrane roofing.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original unopened containers.

B. Label containers with manufacturer's name, brand name, installation instructions, and identification of items.

C. Each container or bulk shipping ticket for asphalt shall indicate the equiviscous temperature, finished blowing temperature, and the flash point.

D. Store materials out of direct exposure to the elements.

E. Store roll goods on end on a clean flat surface.

F. Protect materials against moisture.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Conform to volatile organic compound (VOC) limits specified in Table 1 of the California ARB Architectural Coatings Suggested Control Measure.

B. Do not apply roofing membrane during inclement weather or when air temperature may fall below 40 degrees Fahrenheit.

C. Do not apply roofing membrane to damp or frozen deck surface.

D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

1.07 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

B. Special warranty:
   1. Manufacturer's warranty:
      a. Minimum 20 years to correct defective roofing materials, including installation.
   2. Roof Installer's warranty: Minimum 2 years to correct defective workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Carlisle Corp., Sure-Weld Roofing System.
   2. Johns Manville, JM TPO Roofing Systems.

2.02 D TYPE

A. Type: Fully-adhered, 60 mil, reinforced thermoplastic polyolefin (TPO) membrane assemblies.

B. Membrane color: White.

2.03 DESIGN AND PERFORMANCE CRITERIA

A. General: Installed roofing membrane system shall remain watertight; and resist specified wind uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material compatibility: Roofing materials shall be compatible with one another under conditions of service and application required, as demonstrated by roofing system manufacturer based on testing and field experience.

C. Installer shall comply with current code requirements based on authority having jurisdiction.

D. Design uplift pressures:
   1. In accordance with building code: As specified in Section 01410 - Regulatory Requirements.
   2. In accordance with SPRI WD-1.
   3. In accordance with ASCE 7 – Minimum Design Loads and Associated Criteria for Buildings and Other Structures (ASCE.SEI 7-16).

E. Wind uplift performance:
   1. As specified in Section 01850 - Design Criteria.
   2. Roofing system shall be identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist wind uplift pressure calculated in accordance with ASCE 7.

F. Wind pressure at each element: As indicated on the structural Drawings.

G. Roof live load, roof dead loads and snow load: As indicated on the structural Drawings.

H. Fire-test-response characteristics:
   1. Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction.
   2. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

I. Fire hazard classification:
   1. UL Class C.

J. Exterior fire-test exposure:
   1. ASTM E108, Class C for application and roof slopes indicated.

2.04 COMPONENTS

A. Scrim-Reinforced Thermoplastic Polyolefin (TPO) Sheet: 60 mil, scrim-reinforced, white, membrane 10-feet wide maximum by appropriate length conforming to following minimum physical properties:
   1. Tensile strength: Minimum of 300 pounds per foot as tested in accordance with ASTM D751.
   2. Tear strength: Minimum 45-60 pounds when tested in accordance with ASTM D751.

B. Flashing, bonding adhesive, sealant, primer, seam caulk, insulation replacement, and fasteners: Membrane manufacturer approved.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verification the following:
   1. Proper installation of treated curbs, wood nailers, insulation, cants, and crickets.
   2. Deck is properly graded to outlets. Build up potential birdbaths.
   3. Deck surfaces are dry, clean, smooth, and free of sharp edges and debris.

3.02 PREPARATION

A. Prepare substrate to receive roofing system in accordance with roofing manufacturer's instructions.

B. Install flashings and similar accessory items in accordance with manufacturer's instructions.

C. Sweep surface to be covered clean of debris, dirt, or other sharp objects.

D. Prime metal flanges, concrete and masonry surface, and concrete roof deck to receive membrane roofing with a uniform coating of asphalt primer.

3.03 INSTALLATION

A. Install roofing in accordance with manufacturer's instructions and warranty.

B. Install perimeter sheets.

C. Lay field sheets with long edges perpendicular to roof slope, with edge of roll aligned with perimeter sheets.

D. Fully adhered membrane shall be bonded to the substrate with manufacturer's approved adhesives. Overlap fastened edges of installed membrane by approximately 5-1/2 inches at fastening plates and 2 inches at end roll sections.

E. Seal non-factory cut edges with seam caulk.

F. Fasten and finish perimeter in accordance with membrane manufacturer's standard termination details.

3.04 FIELD QUALITY CONTROL

A. Arrange for manufacturer's inspection of completed installation in the presence of the Engineer and the Owner.

3.05 PROTECTION

A. Before the end of each working day or before application is interrupted by precipitation, seal exposed sheet edges along laps and around drains, projections, and upstands.

B. Build cutoffs using asphalt or plastic cement and roofing felts, constructed to withstand protracted periods of service. Completely remove cutoffs prior to the resumption of roofing.

END OF SECTION

SECTION 07600

FLASHING AND SHEET METAL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: flashing, sheet metal, and associated accessories.

1.02 REFERENCES

A. Aluminum Association (AA).

B. ASTM International (ASTM):
1. A240 - Standard Specification for Chromium and Chromium-nickel Stainless Steel Plate, Sheet, and Strip For Pressure Vessels and General Applications.
2. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
3. B32 - Standard Specification for Solder Metal.
4. B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
5. B221 - Standard Specification for Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
6. B224 - Standard Classification of Coppers.
7. B370 - Standard Specification for Copper Sheet and Strip for Building Construction.
8. B749 - Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
9. D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
10. D4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free.

C. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).

1.03 SUBMITTALS

A. Product data.

B. Shop drawings: Show fabrication details, material profiles, connections, jointing pattern, jointing details, fastening methods, isolation methods, and installation details.

C. Manufacturer's Installation Instructions.

1.04 SEQUENCING AND SCHEDULING

A. Coordinate sheet metal installation with installation of materials specified in Sections 07530 - Elastomeric Membrane Roofing, 07700 - Roof Specialties, 07900 - Joint Sealants, 15050 - Common Work Results for Mechanical Equipment.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Stack preformed material to prevent twisting, bending, or abrasion, and to provide ventilation.

B. Prevent contact with materials during storage which may cause discoloration, staining, or damage.

PART 2 PRODUCTS

2.01 MATERIALS

A. Aluminum extrusions: ASTM B221, alloy 6063-T42.

B. Aluminum sheet: ASTM B209, 5005-H14 alloy and temper; minimum 32 mils thick.

2.02 ACCESSORIES

A. Fasteners and metal washers: Types best suited for purpose, of same material as sheet metal being fastened or of composition that will not support electrolysis, such as Type 18-8 stainless steel for fastening aluminum.

B. Sealer washers: Rubber type, minimum 0.040 inch thick.

C. Underlayment: ASTM D226; Number 30 asphalt saturated roofing felt. Polyethylene, 6 mil thick.

D. Protective backing paint: Bituminous.

E. Slip sheet: Rosin sized building paper.

F. Bedding compound: Rubber-asphalt type.

G. Roof cement: ASTM D4586, plastic asphaltic cement.

H. Solder: ASTM B32.

2.03 FABRICATION

A. Form sheet metal true to shape, accurate in size, square, and free from distortion or defects.

B. Form rises and angles into flashing true and straight, with exposed surfaces free from waves and buckles.

C. Fabricate cleats and starter strips of same material as sheet, minimum 3 inches wide, interlockable with sheet.

D. Form pieces in longest practical lengths. Size and space joints to provide adequate movement for thermal expansion and contraction.

E. Hem exposed edges on underside 1/2 inch; miter and seam corners.

F. Form material with standing seams.

G. Solder and seal metal joints. After soldering, remove flux. Wipe and wash solder joints clean.

H. Fabricate corners from 1 piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.

I. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.

J. Fabricate flashings to allow toe to extend a minimum 2 inches over roofing. Return and break edges.

2.04 FINISH

A. Backpaint concealed metal surfaces with protective backing paint to minimum dry film thickness of 15 mil.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets in place, and nailing strips located.

B. Verify membrane termination and base flashings are in place, sealed, and secure.

3.02 INSTALLATION

A. Install flashing and sheet metal in accordance with AA and SMACNA references, and when in connection with roofing, roofing manufacturer's specifications.

B. Install sheet metal to even smooth, sound, thoroughly clean and dry surfaces, free from defects that could affect installation.

C. Install flashings where necessary to provide leakproof conditions.

D. Isolate dissimilar metals from direct contact with protective backing paint.

E. Install starter, edge strips, and cleats before starting installation.

F. Perform cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate work of other sections.

G. Install sealer washers under metal washers or fastener heads where weathertightness is required.

H. Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.

I. Insert counterflashings into reglets to form tight fit.

J. Secure flashings in place using concealed fasteners. Use exposed fasteners only in locations acceptable to the Engineer.

K. Lap and seal joints. Make connections watertight and weathertight.

L. Apply roof cement compound between metal flashings and felt flashings.
   1. Fit flashings tight in place.
   2. Make corners square, surfaces true and straight in planes, and line accurate to profiles.

M. Seal metal joints watertight.

END OF SECTION

SECTION 07700

ROOF SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Manufactured roof specialties and accessories, including the following:
   1. Metal coping.
   2. Metal gravel stop fascia.
   3. Expansion joint covers.
   4. Equipment curbs and supports, and associated accessories.
   5. Reglet and counterflashing systems.

1.02 REFERENCES

A. Single Ply Roofing Industry (SPRI):
   1. ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems.

1.03 SUBMITTALS

A. Product data: Include finish and color options.

B. Shop drawings. Include equipment curbs and supports details.

C. Certifications: Certify that curbs are capable of supporting the specified equipment including loads specified in Section 01850 - Design Criteria.

D. Samples: Include finish and color samples.

E. Manufacturer's Installation Instructions.

F. Warranties.

1.04 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer of proposed product for minimum 5 years with satisfactory performance record.

B. Installer qualifications: Installer of products similar to specified products on minimum 5 projects of similar scope as Project with satisfactory performance record.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products in accordance with manufacturer's recommendations.

1.06 WARRANTY

A. Provide manufacturers' standard warranties that warranty against defects for longer than 1 year.

PART 2 PRODUCTS

2.01 METAL COPINGS

A. Manufacturers: One of following or equal:
   1. Peterson Aluminum Corp., Pac-Lok.
   2. MM Systems Corp., Snap-Lok.
   3. OMG Roofing Products, Permasnap.

B. Characteristics:
   1. Capable of direct attachment to top of masonry walls.
   2. In accordance with SPRI ES-1.
   3. In accordance with codes as specified in Section 01410 - Regulatory Requirements.
   4. Capable of counterflashing roofing.

C. Copings:
   1. Material: Aluminum, minimum 0.063 inch thick.
   2. Width: To suit wall thickness.
   3. Length: 144 inches.
   4. Face heights: Sufficient to conceal nailers or roof decking.
   5. Corners: Mitered and welded with minimum 24-inch legs.
   6. Finish: Kynar® 500, resin-base color coating. Color as selected from manufacturer's standard color line.

D. Splice plates: Same materials, width, face heights, and finish as coping, 6 inches long.

E. Seal strips: Extruded Butyl with protective paper.

F. Anchor plate: Galvanized steel. Same width, face height as coping, approximately 12 inches long.

G. Fasteners and anchors: Manufacturer's recommendation.

2.02 GRAVEL STOPS FASCIA FOR SINGLE PLY ROOFING

A. Manufacturers: One of the following or equal:
   1. Peterson Aluminum Corp., Pac-1-Ply.
   2. MM Systems Corp., SLF- Series II.
   3. OMG Roofing Products, TerminEdge.

B. Fascia up to 8 inches high:
   1. Material: Aluminum, minimum 0.040-inch thick.
   2. Length: Maximum practical.

3. Face height: Sufficient to conceal edges of nailers or roof decking.
4. Corners: Mitered and welded with minimum 24-inch legs.
5. Finish: Kynar® 500, resin-base color coating. Color as selected from manufacturer's standard color line.

C. Splice plates: Same materials, width, face heights, and finish as coping.

D. Cant dams and hold-down clips: Galvanized steel, minimum 24 gauge, continuous.

E. Screws: Stainless steel.

2.03 EQUIPMENT CURBS

A. Definition:
1. 4-sided curb supporting the footprint (outline) of the roof-mounted equipment.
2. It may surround a full deck opening as at a duct or skylight, a partial deck opening as at supply and return ducts below an A/C unit, or there may be no deck opening within the curb as at a side discharge A/C unit.

B. Manufacturers: One of following or equal:
1. Equipment curbs provided by the equipment manufacturer as specified in the equipment sections.

C. Design requirements:
1. Capable of supporting equipment loads.
2. Size: Curb width as indicated on the Drawings or as otherwise recommended by the equipment manufacturer.
3. Curb manufacturer to coordinate curb capacity and width with the equipment supplier.

D. Material and fabrication:
1. Metal: Galvanized steel; gauge as required to suit equipment loads, minimum 18 gauge.
2. Rail profile: Straight, without cant.
3. Rail height: Minimum 12 inches at uniform thickness insulation and 15 inches at tapered insulation, including nailer.
4. Rail top: Level within 1/8 inch in 10 feet (adjust for roof slope).
5. Rail width: Width of nailer.
6. Rail reinforcement: Rolled tee bar at 24 inches on center.
7. Rail infill: Insulation, 3-pound density.
8. Nailer: Nominal 2 inch by width to suit equipment supported, pressure preservative treated wood, and manufacturer recommended species.
9. Base: Adequately sized to ensure proper anchoring.
10. Corners: Mitered and continuously welded with minimum 24-inch legs.

E. Accessories:
1. Curb liner: Minimum 22 gauge galvanized steel, spot welded to curb, to finish inside of curbs exposed to view from below.
2. Curb platform: Minimum 3/4-inch thick plywood platform over top of curb, capped with 20-gauge galvanized metal welded watertight to support open

sled-based roof equipment, or as watertight closure over curbed opening for future equipment.

3. Metal roofing adapters: Fabricated to conform to exposed metal roofing profile, overlapping deck by minimum 3 inches, with water diverters on flat area; watertight, continuous welds.

2.04 EQUIPMENT SUPPORTS

A. Definition: A linear rail or rails for mounting horizontal piping across the top of roof or for supporting roof equipment on legs.

B. Linear rails:
   1. Manufacturers: One of the following or equal:
      a. Pate Co., Model ES-2.
      b. ThyCurb, Model TEMS.
      c. Roof Products, Inc., Model RPES-3.

C. Material and fabrication:
   1. Material: 14 gauge galvanized.
   2. Rail profile: Straight, without cant profile.
   3. Rail height: Minimum 12 inches including nailer at uniform thickness insulation and 15 inches at tapered insulation, including nailer.
   4. Rail top: Level within 1/8 inch in 10 feet (adjust for slope of roof).
   5. Rail width: Width of nailer.
   6. Rail reinforcement: Rolled tee bar at 24 inches on center.
   7. Rail infill: None.
   8. Nailer: Nominal 2- by 4-inch pressure preservative treated wood, manufacturer recommended species.
   9. Base: Adequately sized to ensure proper anchoring.

2.05 REGLET AND COUNTERFLASHING SYSTEMS

A. Manufacturers: One of the following or equal:
   1. Fry Corp.
   2. Cheney Flashing Co.

B. Metal reglet and counterflashing system:
   1. Material: Aluminum, minimum 0.025-inch thick.
   2. Reglet: Type for embedding in masonry with 1-1/2-inch wide top flange.
   3. Counterflashing: Formed with snap lock flange to engage reglet receive and to provide spring action at bottom edge against roofing base flashing.
   4. Hold-down clips: Type 302 stainless steel, with fasteners.
   5. Sealant: As specified in Section 07900.

C. Retainer system for flexible counterflashing:
   1. Retainer: Type for embedding in masonry.
   2. Locking gasket: Vinyl rope capable of locking into reglet and firmly holding flashing.
   3. Flashing: As specified in Section 07530 - Elastomeric Membrane Roofing.
   4. Sealant: As specified in Section 07900 - Joint Sealants.

D. Reglet system for non-proprietary counterflashing:
   1. Reglet: Original with spacer channel and vinyl rope.
   2. Flashing: As specified in Section 07600 - Flashing and Sheet Metal.
   3. Sealant: As specified in Section 07900 - Joint Sealants.

E. Lengths: Longest possible.

F. Joints: With alignment splines.

G. Corners: Prefabricated, watertight.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install roof accessories and specialties accordance with manufacturers' instructions.

3.02 INSTALLATION OF METAL COPINGS

A. Accurately align and install metal copings with uniformly smooth vertical faces.

B. Attach anchor plate to top of wall at 72 inches on center.

C. Install splice plates on anchor plates at splice joints of coping. Install seal strips on top of plate and down face approximately 1/2 inch. Apply slight pressure on sealant to incur adherence to clean, dry splice plate. Remove protective paper from sealant.

D. Fully engage hook on front face of coping with front leg of anchor plates, pivot coping into position pressing firmly at rear over each anchor plate until hook on rear face of coping snaps into place.

E. Leave 1/4-inch joint between abutting ends at splice plates.

3.03 INSTALLATION OF GRAVEL STOPS

A. Locate joints in balanced pattern along each run, from end to end.

B. Overlap cant dams 1 inch. Nail to top of nailer at maximum 12 inches on center and face of nailer at maximum 24 inches on center, unless otherwise specified by roofing manufacturer.

C. Accurately align and install gravel stops with uniformly smooth vertical faces.

3.04 INSTALLATION OF EXPANSION JOINT COVERS

A. Nail longitudinal nailing strips to wood nailer at 2 inch centers.

B. Strip flanges as specified in Section 07540 - Thermoplastic Polyolefin (TPO) Membrane Roofing.

3.05 INSTALLATION OF EQUIPMENT CURBS AND SUPPORTS

A. Curbs: Install at roof mounted equipment where specified or indicated.

B. Supports: Install where indicated on the Drawings.

3.06 INSTALLATION OF METAL REGLET AND COUNTERFLASHING SYSTEM

A. Verify that reglets have been installed properly with minimum 3-inch overlaps.

B. Apply sealant on back of surface mounted reglets. Fasten reglets to wall with minimum 3-inch overlaps.

C. Install hold-down clips at minimum 30 inches on center. Insert counterflashings in reglets. Ensure spring action of counterflashing over roofing base flashings. Turn hold-down clips over counterflashings.

D. Apply sealant on tops of surface mounted reglets in accordance with Section 07900 - Joint Sealants.

END OF SECTION

SECTION 07722

ROOF HATCHES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Roof hatches.

1.02 REFERENCES

A. American National Standards Institute (ANSI).

1.03 SUBMITTALS

A. Product data: Indicate general construction, configurations, and jointing methods.

B. Shop drawings: Show locations, sizes, fastening methods, and installation details.

C. Manufacturer's Installation Instructions.

1.04 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

B. Special warranty:
   1. Duration: 5 years warranty on product defects.

PART 2 PRODUCTS

2.01 ROOF HATCHES

A. Manufacturers: One of the following or equal:
   1. The Bilco Co.
   2. Nystrom.

2.02 SINGLE LEAF FOR LADDER ACCESS

A. Size:
   1. Ladder applications:
      a. Nominal size: 42-inches by 30-inches.
      b. Cover opening angle minimum: 70 degrees.

B. Cover and curb:
   1. Material:
      a. Exterior surface and curb material:
         1) Minimum 14-gauge galvanized galvanneal steel.

b. Interior surface material:
1) Minimum 22-gauge galvanized steel liner.
2) Fully covering cover insulation.

2. Cover:
a. Corners:
1) 3-inch beaded flange and welded.
2) Weathertight corners.
b. Insulation:
1) Nominal 1-inch thick fiberglass.

3. Curb:
a. Height: Minimum 12 inches.
b. Insulation: 1-inch thick fiberboard on outside.
c. Flange: Minimum 3-1/2-inch with holes for fasteners, and welded, weathertight corners.

4. Safety guardrail:
a. Manufacturers: One of the following or equal:
1) The Bilco Co., Model RL2.
2) Nystrom, SRCAY.
b. Rail material: Aluminum or galvanized steel.
c. Finish: Safety yellow powder coating.
d. Gate: Spring hinged and latched.

5. Curb and roofing interface:
a. Non-metal roofing:
1) Integral metal cap flashing.

C. Finish:
1. Steel hatches: Red oxide primer paint.

D. Hardware:
1. Heavy pintle hinges.
2. Compression spring operators enclosed in telescopic tubes.
3. Positive snap latch with turn handles, both inside and outside.
4. Padlock hasps, both inside and outside.
5. Gasket:
a. EPDM rubber gasket adhered to the liner.
6. Automatic hold-open arm with red vinyl grip handle capable of 1-hand release.
7. Enclosed 2-point spring latch as recommended by manufacturer.

E. Latch hardware:
1. Hardware including latch assembly, inside and outside padlock hasps, arm guide bracket, lifting mechanism bracket, hinges, hinge pins, hold open arm, lock strike casting, springs, spring tubes, shoe castings, and fasteners.
2. Zinc chromate plated.

F. Fall prevention system:
1. As specified in Section 05500 - Metal Fabrications.

2.03 SINGLE LEAF

A. Size:
   1. Equipment access applications:
      a. Nominal size: 42-inches by 38-inches.
      b. Cover opening angle minimum: 90 degrees.

B. Cover and curb:
   1. Material:
      a. Exterior surface and curb material:
         1) Minimum 14-gauge galvanized galvanneal steel.
      b. Interior surface material:
         1) Minimum 22-gauge galvanized steel liner.
         2) Fully covering cover insulation.
   2. Cover:
      a. Corners:
         1) 3-inch beaded flange and welded.
         2) Weathertight corners.
      b. Insulation:
         1) Nominal 1-inch thick fiberglass. Nominal 2-inch polyiso in cover.
   3. Curb:
      a. Height: Minimum 12 inches.
      b. Insulation: 1-inch thick fiberboard on outside.
      c. Flange: Minimum 3-1/2-inch with holes for fasteners, and welded, weathertight corners.
   4. Safety guardrail:
      a. Rail material: Aluminum or galvanized steel.
      b. Finish: Safety yellow powder coating.
      c. Gate: Spring hinged and latched.
   5. Curb and roofing interface:
      a. Non-metal roofing:
         1) Integral metal cap flashing.

C. Finish:
   1. Steel hatches: Red oxide primer paint.

D. Hardware:
   1. Heavy pintle hinges.
   2. Compression spring operators enclosed in telescopic tubes.
   3. Positive snap latch with turn handles, both inside and outside.
   4. Padlock hasps, both inside and outside.
   5. Gasket:
      a. EPDM rubber gasket adhered to the liner.
   6. Automatic hold-open arm with red vinyl grip handle capable of 1-hand release.
   7. Enclosed 2-point spring latch as recommended by manufacturer.

E. Latch hardware:
   1. Hardware including latch assembly, inside and outside padlock hasps, arm guide bracket, lifting mechanism bracket, hinges, hinge pins, hold open arm, lock strike casting, springs, spring tubes, shoe castings, and fasteners.
   2. Zinc chromate plated.

2.04 DOUBLE LEAF FOR EQUIPMENT ACCESS

A. Size:
   1. Equipment access applications:
      a. Nominal size: 42-inches by 38-inches.
      b. Cover opening angle minimum: 90 degrees.
      c. Cover and curb:
   2. Material:
      a. Exterior surface and curb material:
         1) Minimum 14-gauge galvanized galvanneal steel.
      b. Interior surface material:
         1) Minimum 22-gauge galvanized steel liner.
         2) Fully covering cover insulation.
   3. Cover:
      a. Corners:
         1) 3-inch beaded flange and welded.
         2) Weathertight corners.
      b. Insulation:
         1) Nominal 1-inch thick fiberglass.
   4. Curb:
      a. Height: Minimum 12 inches.
      b. Insulation: 1-inch thick fiberboard on outside.
      c. Flange: Minimum 3-1/2-inch with holes for fasteners, and welded, weathertight corners.
   5. Safety guardrail:
      a. Rail material: Aluminum or galvanized steel.
      b. Finish: Safety yellow powder coating.
      c. Gate: Spring hinged and latched.
   6. Curb and roofing interface:
      a. Non-metal roofing:
         1) Integral metal cap flashing.

B. Finish:
   1. Steel hatches: Red oxide primer paint.

C. Hardware:
   1. Heavy pintle hinges.
   2. Compression spring operators enclosed in telescopic tubes.
   3. Positive snap latch with turn handles, both inside and outside.
   4. Padlock hasps, both inside and outside.
   5. Gasket:
      a. EPDM rubber gasket adhered to the liner.
   6. Automatic hold-open arm with red vinyl grip handle capable of 1-hand release.
   7. Enclosed 2-point spring latch as recommended by manufacturer.

D. Latch hardware:
   1. Hardware including latch assembly, inside and outside padlock hasps, arm guide bracket, lifting mechanism bracket, hinges, hinge pins, hold open arm, lock strike casting, springs, spring tubes, shoe castings, and fasteners.
   2. Zinc chromate plated.

PART 3 EXECUTION

3.01 INSTALLATION

A. Hatch quantities and locations shall be as indicated on the Drawings.

B. Install roof hatches in accordance with manufacturer's instructions.
   1. Coordinate with installation of roofing system and related flashing.
   2. Provide weathertight installation.

C. Paint hatch as specified in Section 09960 - High-Performance Coatings.

END OF SECTION

SECTION 07723

STEEL ROOFING WALKWAYS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Galvanized steel, roof-mounted walkway.

1.02 REFERENCES

A. American Iron and Steel Institute (AISI):
   1. Cold-Formed Steel Design Manual.

B. ASTM International (ASTM):
   1. A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

1.03 DEFINITIONS

A. Clips: Attachments between planks, support plates, and roof deck ribs.

B. Planks: The walkway surface elements which may span parallel or perpendicular to the ribs of the roof deck.

C. Support Plates: Plates that span between roof deck ribs to support planks that are parallel to the roof deck ribs.

1.04 SUBMITTALS

A. Product data.

B. Shop drawings and calculations:
   1. Shop drawings: For roof walkway system, including details on connections to roof.
   2. Calculations:
      a. Complete test reports indicating maximum allowable loading, both uniform and concentrated, and the associated deflections.
      b. Use methods outlined in the AISI Cold-Formed Steel Design Manual.
      c. Use a live load safety factor of 2.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Storage and protection:
   1. Store planks and accessories at the site stacked on platforms or pallets and covered with tarpaulins or other suitable weathertight covering.
   2. Remove damaged, unlabeled, untagged, rusty, and deteriorated material from the job site.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The following or equal:
   1. Unistrut Corp., Roofwalks.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Design requirements:
   1. Design roof walkway to support a uniform live load of 180 pounds per square foot and a concentrated load of 426 pounds per plank.
   2. Design of attachment assembly to roof shall not penetrate roof deck.

B. Performance requirements:
   1. Top of planks shall have an anti-skid surface that provides 360-degree positive traction.

2.03 MATERIALS

A. Planks, supporting plates, and clips shall have G90 coating in accordance with ASTM A653.

B. Planks shall be a minimum of 18 gauge roll-formed sheet steel:
   1. Supporting plates shall be a minimum of 14 gauge sheet steel.
   2. Clips shall be a minimum of 16 gauge sheet steel.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products as indicated on the Drawings and in accordance with shop drawings and manufacturer's printed instructions, applicable except where specified otherwise.

END OF SECTION

SECTION 07900

JOINT SEALANTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Acrylic-Latex sealant.
   2. Precast concrete joint sealant.
   3. Silicone sealant.
   4. Synthetic rubber sealing compound.
   5. Synthetic sponge rubber filler.
   6. Related materials.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. M198 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

B. ASTM International (ASTM):
   1. C920 - Standard Specification for Elastomeric Joint Sealants.
   2. C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
   3. C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
   4. C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
   5. D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
   6. D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.

1.03 SUBMITTALS

A. Product data.

B. Samples, include color selections.

C. Manufacturer's Installation Instructions.

D. Warranty.

1.04 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer of proposed product for minimum 5 years with satisfactory performance record.

B. Installer qualifications: Manufacturer approved installer of products similar to specified products on minimum 5 projects of similar scope as Project with satisfactory performance record.

1.05 PROJECT/SITE CONDITIONS

A. Environmental requirements: Do not apply sealant on wet or frosty surfaces or when surface temperature is higher than 100 degrees Fahrenheit or lower than recommended by the manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products in accordance with manufacturer's recommendations.

B. Code date packages. Do not use material older than manufacturer’s published shelf life. Store materials at temperatures lower than 80 degrees Fahrenheit. Condition materials in accordance with manufacturer’s instructions prior to installation.

1.07 SEQUENCING AND SCHEDULING

A. Caulk joints prior to painting.

1.08 WARRANTY

A. Warrant to correct defective products for minimum 1 year in accordance with manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 SEALANTS

A. General:
   1. Provide colors matching materials being sealed.
   2. Where compound is not exposed to view in finished work, provide manufacturer's color which has best performance.
   3. Nonsagging sealant for vertical and overhead horizontal joints.
   4. Sealants for horizontal joints: Self-leveling pedestrian/traffic grade.
   5. Joint cleaner, primer, bond breaker: As recommended by sealant manufacturer.
   6. Sealant backer rod and/or compressible filler made from closed cell polyethylene, polyethylene jacketed polyurethane foam, or other flexible, nonabsorbent, non-bituminous material recommended by sealant manufacturer to:
      a. Control joint depth.

b. Break bond of sealant at bottom of joint.
c. Provide proper shape of sealant bead.
d. Serve as expansion joint filler.

2.02 ACRYLIC-LATEX SEALANT

A. Permanently flexible, nonstaining, and nonbleeding latex modified acrylic sealant compound, colors as selected by Engineer from manufacturer's standard options:
1. Manufacturers: One of the following or equal:
a. Tremco, Tremflex 834.
b. Pecora Corp., Number AC-20.
c. Sonneborn, Sonolac.

2.03 PRECAST CONCRETE JOINT SEALANT

A. Preformed, cold-applied, ready-to-use, flexible joint sealant in accordance with ASTM C990 and AASHTO M 198:
1. Manufacturers: One of the following or equal.
a. Henry Corp., Ram-Nek.
b. Concrete Sealants Division, ConSeal.

2.04 SILICONE SEALANT

A. ASTM C920, Type S, Grade NS, Class 25, single component silicone sealant:
1. Manufacturers: One of the following or equal:
a. Tremco, Proglaze.
b. Pecora Corp., Number 864.
c. Dow Corning, Number 795.
d. General Electric, Number 1200 Series.

2.05 SYNTHETIC RUBBER SEALING COMPOUND

A. Manufacturer: One of the following or equal:
1. Sika Corporation, Sikaflex 2c NS or SL
2. Sika Corporation, Sikaflex 2c NS EZ Mix.
3. Pacific Polymers, Elastothane 227R.

B. Material: In accordance with ASTM C920 Type M, Grade P (pourable), Class 25 and Type M, Grade NS (non-sag), Class 25; multi-part polyurethane; able to cure at room temperature to firm, highly resilient polymer; able to perform satisfactory when continuously submerged in water or sewage and exposed to direct sunlight in dry condition; with the following properties determined at 75 degrees Fahrenheit and 50 percent relative humidity:
1. Base: Polyurethane rubber.
2. Application time: Minimum 2 hours.
3. Cure time: Maximum 3 days.
4. Tack free time: Maximum 24 hours.
5. Ultimate hardness: Non-sag 25, Pourable/SL 40, within 5 Shore A.
6. Tensile strength: Non-sag 95 pounds per square inch minimum and self-leveling minimum 170 pounds per square inch when tested in accordance with ASTM D412.

7. Ultimate elongation: Minimum 340 percent when tested in accordance with ASTM D412.
8. Tear resistance: Non-sag 45 pounds per inch minimum and self-leveling minimum 85 pounds per inch when tested in accordance with ASTM D624, Die C.
9. Service temperature range: Minus 25 degrees to 158 degrees Fahrenheit.

C. Color: Gray to match concrete, unless indicated on the Drawings.

2.06 SYNTHETIC SPONGE RUBBER FILLER

A. Closed-cell expanded sponge rubber manufactured from synthetic polymer neoprene base, or resilient polyethylene foam backer rod. In accordance with ASTM C1330, Type C:
1. Manufacturers: The following or equal:
a. Presstite, No. 750.3 Ropax Rod Stock.

B. Characteristics:
1. Suitable for application intended.
2. Strength: As necessary for supporting sealing compound during application.
3. Resiliency: Resistance to environmental conditions of installation.
4. Bonding: No bonding to the sealing compound.
5. Structure: Cellular, prevents absorption of water.
6. Compatibility with other materials in joint and acceptance by manufacturer of sealing compound.
7. Size: Minimum 25 percent greater than nominal joint width.

2.07 RELATED MATERIALS

A. Primer: Nonstaining type, recommended by sealant manufacturer to suit application.

B. Joint cleaner: Noncorrosive, nonstaining, compatible with joint forming materials and as recommended by sealant manufacturer.

C. Bond breaker tape: Pressure-sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify acceptability of joint dimensions, physical, and environmental conditions.

B. Verify that surfaces are dry, clean, and free of dirt, grease, curing compound, and other residue which might interfere with adhesion of sealants.

3.02 PREPARATION

A. Allow concrete to cure thoroughly before caulking.

B. Synthetic sponge rubber filler:
   1. Prepare surfaces designated to receive filler in accordance with manufacturer's installation instructions.
   2. Do not stretch filler beyond its normal length during installation.

C. Caulking:
   1. Verify that surfaces are dry, clean, and free of dirt, grease, curing compounds, and other residue that might interfere with adhesion of sealant.
   2. Concrete, masonry, wood, and steel surfaces: Clean and prime in accordance with manufacturer's instructions prior to caulking.

D. Synthetic rubber sealing compound:
   1. Ensure surfaces to which synthetic rubber must bond are dry and free of dust, dirt, and other foreign residue.
   2. Heavy sandblasted caulking groove to sound surface, and prime with manufacturer's recommended primer for particular surface.

E. For sidewalks, pavements, and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to depth equal to 75 percent of joint width, but neither more than 5/8 inches deep nor less than 3/8 inches deep.

F. For normal moving building joints sealed with elastomeric sealants not subject to traffic, fill joints to depth equal to 50 percent of joint width, but neither more than 1/2 inch deep nor less than 1/4 inch deep.

G. For joints sealed with acrylic-latex sealants, fill joints to depth in range of 75 percent to 125 percent of joint width.

H. Use joint filler to achieve required joint depths, to allow sealants to perform properly.

I. Prepare surfaces and install synthetic sponge rubber filler in accordance with manufacturer's recommendations.

J. Do not stretch filler beyond normal length during installation.

K. Apply bond breaker when recommended by joint sealer manufacturer.

3.03 INSTALLATION

A. Synthetic sponge rubber filler: Install filler in accordance with manufacturer's installation instructions.

B. Caulking, joints, and sealing:
   1. Construct expansion, contraction, and construction joints as indicated on the Drawings.
   2. Install pipe and conduit in structures as indicated on the Drawings.

3. Caulk doors, windows, louvers, and other items installed in or over concrete openings inside and out.
4. Use synthetic rubber sealing compound for caulking where indicated on the Drawings or as specified, except for masonry construction and where specified otherwise.
5. Complete caulking prior to painting.
6. Verify that concrete is thoroughly cured prior to caulking.
7. When filler compressible material is used, use untreated type.
8. Apply caulking with pneumatic caulking gun.
9. Use nozzles of proper shape and size for application intended.
10. Maintain continuous bond between caulking and sides of joint to eliminate gaps, bubbles, or voids and fill joint in continuous operation without layering of compound.
11. Employ experienced applicators to caulk joints and seams in neat workmanlike manner.
12. To hasten curing of compound when used on wide joints subject to movement, apply heat with infrared lamps or other convenient means.
13. Apply synthetic rubber sealing compound with pneumatic caulking tool or other acceptable method.

3.04 CLEANING

A. Clean surfaces adjacent to sealant as work progresses.

B. Remove excess uncured sealant by soaking and scrubbing with sealant cleaning solvent.

C. Remove excess cured sealant by sanding with Number 80 grit sandpaper.

D. Leave finished work in neat, clean condition.

3.05 SCHEDULE

A. Acrylic latex:
   1. Use where indicated on the Drawings.
   2. Interior joints with movement less than 7.5 percent and not subject to wet conditions.

B. Silicone:
   1. Use where indicated on the Drawings.
   2. Joints and recesses formed where window, door, louver and vent frames, and sill adjoin masonry, concrete, stucco, or metal surfaces.
   3. Door threshold bedding.
   4. Moist or wet locations, including joints around plumbing fixtures.
   5. Stainless steel doors and frames, including joints between applied stops and frames, and around anchor bolts.
   6. Plenum joints.

C. Synthetic rubber sealing compound, non-sag Type II:
   1. Use where indicated on the Drawings.
   2. Water-bearing and earth-bearing concrete structures.

3. Joints in masonry, concrete vertical surfaces, and metal-faced panels in vertical surfaces.
4. Joints between sheet metal flashing and trim.
5. Joints between sheet metal flashing and trim, and vertical wall surfaces.
6. Small voids between materials requiring filling for weathertight performance in vertical surfaces.
7. Perimeters of frames of doors, windows, louvers, and other openings where bonding is critical to airtight performance.
8. Expansion and control joints in masonry vertical surfaces.

D. Synthetic rubber sealing compound, self-leveling Type I:
1. Use where indicated on the Drawings.
2. Expansion and control joints in masonry, concrete horizontal surfaces, and metal panels in horizontal surfaces.
3. Small voids between materials requiring filling for weathertight performance in horizontal surfaces.
4. Pavement joints.
5. Perimeters of frames of doors, windows, louvers, and other openings in horizontal surfaces where bonding is critical to airtight performance.

3.06 FIELD QUALITY CONTROL

A. Adhesion testing:
1. Perform adhesion tests in accordance with ASTM C1521 per the following criteria:
a. Water bearing structures: 1 test per every 1,000 LF of joint sealed.
b. Exterior precast concrete wall panels: 1 test per every 2,000 LF of joint sealed.
c. Chemical containment areas: 1 test per every 1,000 LF of joint sealed.
d. Building expansion joints: 1 test per every 500 LF of joint sealed.
e. All other type of joints except butt glazing joints: 1 test per every 3,000 LF of joint sealed.
f. Manufacturer's authorized factory representative provide written recommendations for remedial measures on failing tests.

END OF SECTION

SECTION 08110

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Steel Fire Resistive Rated and Non-Fire Resistive Rated:
   1. Doors.
   2. Door frames.
   3. Combination door frames and window frames with mullions, muntins, and transom bars.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. A250.6 - Hardware on Steel Doors (Reinforcement Application).
   2. A250.8 - Recommended Specification for Standard Steel Doors and Frames.

B. ASTM International (ASTM):
   1. A653 - Standard Specification for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   2. A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
   3. A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy With Improved Formability, Solution Hardened, and Bake Hardenable.
   4. A1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy With Improved Formability, and Ultra-High Strength.
   5. E413 - Classification for Rating Sound Insulation.

C. National Association of Architectural Metal Manufacturers (NAAMM)/Hollow Metal Manufacturers Association (HMMA):
   1. HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames.

D. National Fire Protection Association (NFPA):
   1. 80 - Standard for Fire Doors and Other Opening Protectives.
   2. 252 - Standard Methods of Fire Tests of Door Assemblies.

E. Steel Door Institute (SDI):
   1. SDI-111 - Recommended Details for Standard Steel Doors, Frame, Accessories and Related Components.
   2. SDI-117 - Manufacturing Tolerances Standard Steel Doors and Frames.

F. Underwriters' Laboratories, Inc., (UL):
   1. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
   2. UL 102 - Sustainability Assessment for Swinging Door Leafs.

1.03 SUBMITTALS

A. Product data.

B. Shop drawings: Show the following with references to the Engineer's door marks and hardware groups:
   1. Location of door and frame types.
   2. Details of fabrication, including core construction, glass lights, louvers, weatherstripping, and factory finish for each door.
   3. Cutouts and reinforcements for hardware.
   4. Methods of installation and anchorage to adjacent construction.

C. Certificates documenting:
   1. Fire-rated units have been successfully tested as specified in this Section.

D. Manufacturer's instructions: Submit manufacturer's installation instructions.

E. Pre-Submittal Conference:
   1. Conduct conference in compliance with requirements in Section 01312 - Project Meetings with attendance by representatives of Supplier, Installer.
   2. Contractor to review proper methods and procedures for installing hollow metal doors and frames.

1.04 QUALITY ASSURANCE

A. Testing agency qualifications: Approved by ultimate enforcing authority for the Project; regularly engaged in inspection of materials and workmanship at factory.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Before delivery, identify type and size of each door and frame in such a way that markings will not damage finish.

B. Preassemble doorframes in shop and deliver to Project site with spreader bar at sill or tie them in pairs to form box.

C. Protect doors and frames with resilient packaging sealed with heat shrunk plastic. Break seal on-site to permit ventilation.

D. Protect doors and frames during shipment and storage to prevent warping, bending, and corrosion.

1.06 SEQUENCING AND SCHEDULING

A. Ensure timely delivery of reviewed hardware schedule and hardware templates such that no delay occurs in the work of the Contract.

PART 2 PRODUCTS

2.01 MATERIALS

A. Sheet steel: ASTM A1008, commercial quality, level, cold rolled steel, or ASTM A1011, hot rolled, pickled and oil rolled steel. Galvanize by hot-dip process with zinc-coating in accordance with ASTM A924 or with ASTM A653 and the coating designation A60 or G60.

B. Clips, bolts, screws, and rivets: sized as recommended by manufacturer.

C. Primer: Rust- inhibitive epoxy primer compatible with high-solids epoxy finish coating system as specified in Section 09960 - High-Performance Coatings.

D. Touch-up materials: Primer as recommended by manufacturer.

E. Door hardware: As specified in Section 08710 - Door Hardware.

F. Grout: As specified in Section 04220 - Concrete Unit Masonry.

2.02 DOOR AND FRAME TYPES

A. Interior doors: ANSI 250.8, Grade III, Model 3 or NAAMM HMMA 810 Type A and NAAMM HMMA 861, flush steel rib-stiffened, minimum 18-gauge face sheets.

B. Exterior doors: ANSI 250.8, Grade III, Model 3, or NAAMM HMMA 810 Type A and NAAMM HMMA 861, flush steel rib-stiffened, minimum 16-gauge face sheets.

C. Interior frames: ANSI 250.8 or NAAMM HMMA 861, fully welded frames, minimum 16-gauge, sizes and shapes as indicated on the Drawings.

D. Exterior frames: ANSI 250.8 or NAAMM HMMA 861, fully welded frames HMMA 861, except minimum 14-gauge sizes and shapes as indicated on the Drawings.

2.03 FABRICATION OF FRAMES

A. Galvanize all frames installed in exterior openings.

B. Frames: Sheet steel, integral type, welded continuous to full depth of frames with minimum 5/8-inch deep stops, unless otherwise indicated on the Drawings.

C. Hardware reinforcements: Fabricate according to SDI A250.6 with reinforcing plates from same material as door face sheets.

D. Jamb Anchors: As required for adjacent wall construction, minimum 3 per jamb, unless otherwise indicated on the Drawings.

E. Floor anchors: Fixed type, except where adjustable anchors are indicated on the Drawings, 1 per jamb, with minimum 2 holes for anchorage. Where floor fill occurs,

terminate bottom of frames at indicated finished floor level and support by adjustable extension clips resting on and anchored to structural slabs.

F. Anchors at masonry: Adjustable strap and stirrup, minimum 16-gauge corrugated or perforated steel at maximum of 30 inches on center and extending minimum 8 inches into masonry.

G. Anchors at previously placed concrete: Countersink machine screws through the frame into expansion devices spaced at maximum 30 inches on center.

H. Anchors at structural steel framing: Welded or otherwise securely fastened with stainless steel screws.

I. Anchors for fire resistive frames: Conform to requirements of labeling authority having jurisdiction.

J. Masonry angle stiffeners: Factory welded into heads of frames for installation in openings more than 48 inches wide.

K. Mullions, muntins, and transom bars: Minimum 18-gauge, tubular sheet steel matching, and butt-welded to head and jamb members.

L. Removable stops: Fasten at approximately 12 to 16 inches on center.

2.04 FABRICATION OF DOORS

A. Galvanize all doors installed in exterior openings.

B. Reinforce face sheets with steel rib stiffeners, spaced at maximum 6 inches apart, and securely attached to face sheets by spot welds at maximum 5 inches on center.

C. Fill voids between face sheets and stiffeners with fiberglass insulation having a minimum density of 0.8 pounds per cubic foot.

D. Edges: Full weld without visible joints. Bevel striking edge 1/8 inch in 2 inches.

E. Door cores:
   1. Stiffeners: Vertical steel ribs formed from minimum 22-gauge plain sheet steel, spaced at maximum 6 inches apart and securely attached to face sheets by spot welds at maximum 5 inches on center.
   2. Core fillers: Insulation, minimum 0.60 pound density noncombustible type, installed in spaces between stiffeners for full height of door; labeled door core material shall conform to requirements of labeling authority.

F. Tops and bottoms of doors: Close with continuous recess steel channel of minimum 16-gauge, extending full width of door and spot welded to both faces.

G. Tops and bottoms of exterior doors: Flush closing channels welded to make tops and bottoms waterproof with weep holes for escape of moisture.

H. Hardware reinforcements: Fabricate according to SDI A250.6 with reinforcing plates from same material as door face sheets.

I. Astragals:
   1. Install on active leaf of double doors in accordance with UL listing requirements for fire resistive ratings as indicated on the Drawings, and for exterior pairs of doors.
   2. Do not install on doors swinging in pairs with rating of 90 minutes or less in means of egress where both leaves are required to provide building code required exiting widths.
   3. Do not provide astragal cutouts for hardware operations.

J. Astragal clearances for fire resistive rated doors:
   1. Door bottoms at doors designated to receive non-combustible threshold: Not to exceed 3/8 inch between threshold and door bottom.
   2. Door bottoms where there is no threshold: Maximum clearance between door and floor not to exceed 1/2 inch.
   3. Door bottoms at doors designated to receive combustible floor coverings: Not to exceed 1/2 inch between floor covering and door bottom.
   4. Clearance between door and frame and between meeting edges of pairs of doors: Not to exceed 1/8 inch.

K. Astragal clearances for non-fire resistive rated doors: Same as fire resistive rated doors, unless otherwise indicated on the Drawings.

2.05 FABRICATION OF FIRE RATED DOORS AND FRAMES

A. Fabricate to meet requirements of the building code as specified in Section 01410 - Regulatory Requirements, UL 10C, UL 102, and NFPA 252, except hose stream test shall not be required for opposite swing double egress exit doors and for doors of fire endurance rating of less than 45 minutes with or without approved glass lites.

B. Temperature rise requirements of doors at exit enclosures and exit passageways: Maximum transmitted temperature end point of less than 450 degrees Fahrenheit above ambient at end of 30 minutes when tested in accordance with the building code as specified in Section 01410 - Regulatory Requirements.

C. Apply approved testing agency labels on fire rated doors and frames.

D. Fabricate oversized fire rated doors in accordance with requirements for ratings indicated on the Drawings.

2.06 ACCESSORIES

A. Mullions and transom bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout guards: Formed from same material as frames, not less than 0.016 inches thick.

C. Silencers:
   1. Drill single leaf doorframe jamb stops for minimum 3 silencers.
   2. Drill double-leaf doorframe head stops for minimum 2 silencers.
   3. Do not drill doorframes for silencers when weatherstripping is to be installed.

2.07 FINISHING

A. Thoroughly clean surfaces of oil, grease, and other impurities; touch-up abraded galvanizing; and chemically etch.

B. Fill irregularities and sand smooth finish surface. Apply 1 coat of manufacturer's standard rust inhibitive baked-on primer.

C. Finish painting: High solids epoxy polyurethane system:
   1. Interior doors in non-corrosive environment: As specified in Section 09910 - Painting.
   2. Exterior doors and interior doors in corrosive environments: As specified in Section 09960 - High-Performance Coatings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine reviewed hardware schedules and verify proper coordination of hardware and doors and frames.

B. Examine opening locations and verify the following:
   1. Correctness of dimensions, backing, or support conditions.
   2. Absence of defects that would adversely affect frame or door installation.

3.02 INSTALLATION

A. Install doors and frames in accordance with approved shop drawings and manufacturer's instructions.

B. Frames:
   1. Set accurately in position, plumb, align, and attach securely to structure.
   2. Set in place before construction of adjacent masonry or framed walls.
   3. Anchor frames to previously placed concrete.
   4. Set frames before removing spreader bars.
   5. Fully grout frames in masonry as the Work progresses.
   6. Grout frames at concrete through keyways provided at head and jambs.

C. Doors:
   1. Install at correct openings, ensure smooth swing and proper closure with frame.

D. Fire resistive frames and doors:
   1. Install to conform to NFPA 80 for fire resistive rated class as indicated on the Drawings.

E. Door hardware:
   1. Install in accordance with Section 08710 - Door Hardware.
   2. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

F. Separate or isolate dissimilar metals with neoprene gaskets, sleeves, and washers, or with coatings acceptable to the Engineer.

3.03 TOLERANCES

A. Manufacturing and installation tolerances: As indicated on the Drawings or in conformance to SDI 117 as minimum.

3.04 ADJUSTING AND CLEANING

A. Prime coat touch-up: Immediately after installation, sand smooth and touch-up rust areas, and other areas where primer has been damaged, with prime touch-up paint.

B. Make adjustments as required for correct, proper, and free function and smooth operation without binding of hardware or doors and frames.

C. Protect doors and frames from damage to surface or profile.

END OF SECTION

SECTION 08320

FLOOR ACCESS DOORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Non-fire-rated floor access doors.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. Standard Specifications for Highway Bridges.

B. Occupational Safety and Health Administration (OSHA):
   1. 29 CFR 1910-Occupational Safety and Health Standards.

1.03 SUBMITTALS

A. Product data.

B. Shop drawings that include the following:
   1. Floor access door installation recommendations.
   2. Locations of floor access doors.
   3. Door size and configuration.
   4. Live load capacity.
   5. Materials of construction and finishes provided.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Identify type and size of each floor access door in way not to damage finish prior to delivery.

B. Deliver products only after proper facilities are available.

C. Deliver and store packaged products in original containers with seals unbroken and labels intact until time of use.

D. Handle carefully to prevent damage and store on clean concrete surface or raised platform in safe, dry area.
   1. Do not dump onto ground.

E. Protect floor access doors during shipment and storage to prevent warping, bending, and corrosion.

1.05 WARRANTY

A. Provide manufacturer’s warranty against defects in material and workmanship for a period of 5 years.

1.06 MAINTENANCE

A. Deliver 2 keys for each cylinder lock to Owner.

PART 2 PRODUCTS

2.01 MEDIUM-DUTY FLOOR ACCESS DOORS

A. Manufacturers: One of the following or equal:
   1. The Bilco Co., Model J or JD (double leaf).
   2. Babcock Davis Associates, Inc., Model BFDDP-SAL or BFDDP-DAL (double leaf).

B. Style: Single leaf or double leaf as indicated on the Drawings, steel, capable of withstanding minimum live load of 300 pounds per square foot, channel frame, with drainage couplings.

C. Door leaf: Minimum 1/4-inch, diamond-pattern plate reinforced with stiffeners as required to meet specified live load.

D. Frame: 1/4-inch channel with anchor flange around perimeter.

E. Hardware:
   1. Hinges: Each leaf equipped with a minimum of 2 heavy forged-brass hinges with stainless steel pins.
   2. Lock: Snap lock with removable handle mounted on door leaf.
   3. Grip handle: Provide vinyl grip handle designed to release cover for closing.
   4. Operating mechanism: Spring operators designed for ease of operation and automatic hold-open arm with release handle.
   5. Drainage assembly: Provide 1-1/2-inch drainage coupling located in corner of the channel frame.

2.02 FINISHES

A. Floor access door finishes:
   1. Aluminum: Manufacturer's standard mill finish.
   2. Aluminum in contact with dissimilar metals and concrete: Manufacturer's standard bituminous coating.
   3. Steel: Manufacturer's standard red oxide primer.

B. Hardware finishes:
   1. Provide optional Type 316 stainless steel hardware throughout, including parts of the latch and lifting mechanism assemblies, hold-open arms, and all brackets, hinges, pins, and fasteners.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine construction to receive floor access door and verify correctness of dimensions and other supporting or adjoining conditions.

3.02 PREPARATION

A. Coordinate details with other work supporting, adjoining, or requiring floor access doors.

B. Verify dimensions and profiles for each opening.

C. Verify that location will serve portion of work to which access is required.
   1. Where proposed functional location conflicts with other work, notify the Engineer before installation.

D. Apply coating to aluminum surfaces that will be in contact with dissimilar metals or concrete when there is none.

3.03 INSTALLATION

A. Install floor access doors in accordance with manufacturer's instructions.

B. Ensure correct types and adequate sizes at proper locations.

C. Securely attach frames to supporting work and ensure doors, frames, and hardware operate smoothly and are free from warp, twist, and distortion.

3.04 ADJUSTING

A. Adjust doors, frames, and hardware to operate smoothly, freely, and properly without binding.

3.05 CLEANING

A. Thoroughly clean surfaces of grease, oil, or other impurities; touch up abraded prime coat where applicable.

END OF SECTION

SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Door hardware.

1.02 REFERENCES

A. Builders Hardware Manufacturers Association (BHMA):
   1. A156.1 - Butts and Hinges.156.2 - Bored and Preassembled Locks and Latches.
   2. A156.3 - Exit Devices.
   3. A156.4 - Door Controls.
   4. A156.13 - Mortise Locks and Latches.
   5. A156.14 - Sliding and Folding Door Hardware.
   6. A156.16 - Auxiliary Hardware.
   7. A156.18 - Materials and Finishes.
   8. A156.23 - Electromagnetic Locks.
   9. A156.26 - Continuous Hinges.
   10. A156.31 - Electric Strikes and Frame Mounted Actuators.
   11. A156.36 - Auxiliary Locks.

B. International Building Code (ICC):
   1. A117.1 - Accessible and Usable Buildings and Facilities.

C. National Fire Protection Association (NFPA):
   1. 80 - Fire Doors and Windows.
   2. 105 - Installation of Smoke Door Assemblies.
   3. 252 - Standard Methods of Fire Tests of Door Assemblies.

D. Underwriters Laboratories, Inc. (UL):
   1. 10C - Positive Pressure Fire Tests of Door Assemblies.
   2. 1784 - Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives.

1.03 SUBMITTALS

A. Product data:
   1. Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
   2. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

B. Hardware schedule:
   1. Include references to Engineer's hardware group number, door type designations, locations, other pertinent data, and manufacturer names or suitable abbreviation opposite items scheduled.
   2. Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
      a. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
      b. Organization:
         1) Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening.
         2) Organize door hardware sets in same order as in the Door Hardware Sets at the end of this Section.
         3) Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
      c. Content: Include the following information:
         1) Type, style, function, size, label, hand, and finish of each door hardware item.
         2) Manufacturer of each item.
         3) Fastenings and other pertinent information.
         4) Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
         5) Explanation of abbreviations, symbols, and codes contained in schedule.
         6) Mounting locations for door hardware.
         7) Door and frame sizes and materials.
         8) Warranty information for each product.
      d. Submittal Sequence:
         1) Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule.
         2) Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying schedule:
   1. After a keying meeting with the owner has taken place prepare a separate keying schedule detailing the final instructions.
   2. Submit the keying schedule in electronic format.
   3. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions.
   4. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

D. Samples: Include for each different type and manufacturer for review of finish.

E. Construction key distribution list: Submit upon Owner's request.

F. Templates:
   1. Furnish hardware templates to fabricators of doors, frames, and other work to be factory-prepared for hardware.
   2. Check shop drawings of other work to confirm that adequate hardware backing is available.

G. Project record documents: Include corrected hardware schedule.

H. Operating and Maintenance Manuals:
   1. Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation.
   2. As specified in Section 01782 - Operation and Maintenance Manuals.

1.04 REGULATORY REQUIREMENTS

A. Provide hardware for fire-resistive rated openings that complies with UL and listed by UL.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver hardware where directed in unopened packages with items packed separately, complete and ready for installation with necessary fittings, trim, fasteners, and accessories.

B. Provide packages bearing the manufacturers' labels with each item or group of items identified according to the accepted hardware schedule.

1.06 QUALITY ASSURANCE

A. Certified products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

B. Installer qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door hardware supplier qualifications:
   1. Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project.
   2. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity.
   3. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

D. Source limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.
   1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

F. Pre-submittal conference:
   1. Conduct coordination conference in compliance with requirements in Section 01312 - Project Meetings with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
   2. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products.
   3. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
   4. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
   5. Review sequence of operation narratives for each unique access controlled opening.
   6. Review and finalize construction schedule and verify availability of materials.
   7. Review the required inspecting, testing, commissioning, and demonstration procedures.

1.07 MAINTENANCE

A. Require lockset manufacturers to deliver permanent removable cylinder cores and keys and minimum 2 extractor keys to Owner directly.

1.08 SCHEDULING AND SEQUENCING

A. Upon receipt of accepted hardware schedule, coordinate accepted hardware schedule, templates, reinforcing units, and template instructions to door and frame sections.

B. Restrict distribution of construction keys to superintendents and foremen. Maintain record of persons who have received keys on construction distribution list.

1.09 MAINTENANCE TOOLS AND INSTRUCTIONS

A. Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

1.10 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.
   1. Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:
      a. Structural failures including excessive deflection, cracking, or breakage.
      b. Faulty operation of the hardware.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      d. Electrical component defects and failures within the systems operation.

B. Special warranty:
   1. Duration for electromechanical door hardware: 2 years.
   2. Duration for standard duty cylindrical (bored) locks and latches: 5 years.
   3. Duration for exit hardware: 5 years.
   4. Duration for mortise locks and latches: 10 years.
   5. Duration for manual overhead door closer bodies: 10 years.
   6. Duration for heavy duty floor closers: 10 years.

PART 2 PRODUCTS

2.01 GENERAL

A. Door hardware includes, but is not necessarily limited to, the following:
   1. Mechanical door hardware.
   2. Electromechanical door hardware.
   3. Automatic operators.
   4. Cylinders.

2.02 FASTENERS

A. Types:
   1. To concrete, marble, or masonry: Machine screws and flush shells.
   2. To wood: Wood screws.
   3. On gypsum board or plaster: Screws of sufficient length to provide solid connection to framing or backing behind gypsum board or plaster.
   4. To mineral and hollow core doors: Hex bolts.
   5. Of exit devices to doors: Thru-bolts, unless otherwise specified.

B. Screws exposed: Phillips-head type, full-threaded screws, not combination type.

C. Sizes: Suitable for heavy use.

D. Finish: Stainless steel, unless otherwise required to match material and hardware finish.

2.03 HANGING DEVICES

A. Hinges: BHMA A156.1 certified butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.
   1. Quantity: Provide the following hinge quantity:
      a. 2 Hinges: For doors with heights up to 60 inches.
      b. 3 Hinges: For doors with heights 61 to 90 inches.
      c. 4 Hinges: For doors with heights 91 to 120 inches.
      d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
      e. Hinge size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
         1) Widths up to 3 feet 0 inches: 4-1/2 inches standard or heavy weight as specified.
         2) Sizes from 3 feet 1inch to 4 feet 0 inches: 5 inches standard or heavy weight as specified.
      f. Hinge weight and base material: Unless otherwise indicated, provide the following:
         1) Exterior doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
         2) Interior doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.
      g. Hinge options: Comply with the following:
         1) Non-removable pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.
      h. Manufacturers: One of the following or equal:
         1) Hager Companies (HA).
         2) Ives (IV).
         3) McKinney Products; ASSA ABLOY Architectural Door Accessories (MK).

2.04 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed. Locksets are to be manufactured with a corrosion resistant steel case and be field-reversible for handing without disassembly of the lock body.
   1. Manufacturers: One of the following or equal:
      a. Corbin Russwin Hardware (RU) – ML2000 Series.
      b. Sargent Manufacturing (SA) – 8200 Series.
      c. Schlage (SC) – L9000 Series.

B. Cylindrical Locksets, Grade 1 (Heavy Duty): BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed.
   1. Furnish with solid cast levers, standard 2-3/4 inch backset, and 1/2 inch (3/4 inch at rated paired openings) throw brass or stainless steel latchbolt.
   2. Locks are to be non-handed and fully field reversible.

3. Manufacturers: One of the following or equal:
    a. Corbin Russwin Hardware (RU) - CL3300 Series.
    b. Sargent Manufacturing (SA) - 10 Line.
    c. Schlage (SC) - ND Series.

2.05 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
    1. Flat-lip strikes: For locks with 3-piece antifriction latch-bolts, as recommended by manufacturer.
    2. Extra-long-lip strikes: For locks used on frames with applied wood casing trim.
    3. Aluminum-frame strike box: Provide manufacturer's special strike box fabricated for aluminum framing.
    4. Double-lipped strikes:
        a. For locks at double acting doors.
        b. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:
    1. Strikes for Mortise Locks and Latches: BHMA A156.13.
    2. Strikes for Bored Locks and Latches: BHMA A156.2.
    3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
    4. Dustproof Strikes: BHMA A156.16.

2.06 CONSTRUCTION KEYING

A. Type: Removable core system.

2.07 PERMANENT CYLINDERS AND KEYING

A. Manufacturers: One of the following or equal:
    1. Corbin Russwin Hardware (RU).
    2. Sargent Manufacturing (SA).
    3. Schlage (SC).

B. Cylinders: Original manufacturer cylinders complying with the following:
    1. Mortise type: Threaded cylinders with rings and cams to suit hardware application.
    2. Rim type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
    3. Bored-lock type: Cylinders with tailpieces to suit locks.
    4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
    5. Keyway: Manufacturer’s Standard. Match Facility Standard.

C. Removable cores: Provide removable cores as specified, core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware.

D. Keying system: Each type of lock and cylinders to be factory keyed.
   1. Supplier shall conduct a "Keying Conference" to define and document keying system instructions and requirements.
   2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner.
   3. New system: Key locks to a new key system as directed by the Owner.

E. Key quantity: Provide the following minimum number of keys:
   1. Change keys per cylinder: 2.
   2. Master keys (per master key level/group): 5.
   3. Construction control keys (where required): 2.
   4. Permanent control keys (where required): 2.

F. Construction keying: Provide temporary keyed construction cores.

G. Key registration list (biting list):
   1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
   2. Provide transcript list in writing or electronic file as directed by the Owner.

2.08 PUSH/PULL PLATES

A. Manufacturers: One of the following or equal:
   1. Ives.
   2. Trimco.
   3. Rockwood.

B. Pulls:
   1. Material: As scheduled.
   2. Size: Minimum 8 inches center to center, minimum grip diameter of 3/4 inch, minimum projection of 2-1/4 inch.

C. Pull plates:
   1. Material: As scheduled.
   2. Plate size: Minimum 3 by 12 inches by 0.050-inch thick, with beveled edges on 4 sides with pull.
   3. Pull size: Minimum 8 inches center to center, minimum grip diameter of 3/4 inch, minimum projection of 2-1/4 inch.

D. Push plates:
   1. Material: As scheduled.
   2. Size: Minimum 3 by 12 inches by 0.050-inch thick, with beveled edges on 4 sides.

2.09 CLOSERS

A. Manufacturers:
   1. Features:
      a. Heavy-duty.
      b. Non-handed and non-sized.
      c. Adjustable spring power from size 1 through 4.

2. One of the following or equal:
    a. Sargent, 351 Series.
    b. LCN, Super Smoothee Model 4041 Series.
    c. Norton Door Controls, Multi-Size Door Closers Model 7500BF Series.

B. Type: Full rack and pinion type with steel spring and non-gumming, non-freezing hydraulic fluid.

C. Controls: Separate set for regulating sweep speed, latch speed, backcheck and backcheck positioning, or where schedules, spring power.

D. Sizes: As recommended by accepted manufacturer.

E. Covers: Metal, capable of receiving finishes to match adjacent hardware finishes, unless otherwise specified.

F. Narrow frame provisions: Drop plates.

G. Effort to operate: As follows:
1. Exterior: Maximum 8-1/2 pounds.
2. Interior: Maximum 5 pounds.
3. Fire-resistive rated doors: Maximum 15 pounds.

H. Adjust closers in accordance with manufacturer's directions for size of door.

2.10 EXIT DEVICES

A. Lever design:
1. Manufacturers: The following or equal:
    a. Von Duprin, Lever Model 06.

B. Rim device, non-fire resistive rated:
1. Manufacturers: One of the following or equal:
    a. Von Duprin Inc., Model Series 98.
    b. Sargent Essex Ind., Model Series 8800.

C. Rim device, fire-resistive rated:
1. Manufacturers: One of the following or equal:
    a. Von Duprin Inc., Model Series 98-F.
    b. Sargent Essex Ind., Model Series 12-8800.

D. Mortise lock device, non-fire-resistive rated:
1. Manufacturers: The following or equal:
    a. Von Duprin Inc., Model Series 9875L.

E. Mortise lock device, fire-resistive rated:
1. Manufacturers: The following or equal:
    a. Von Duprin Inc., Model Series 9875L-F.

F. Material: As scheduled.

G. Corrosive environment provisions: Zinc dichromate coated internal parts.

2.11 MISCELLANEOUS DOOR HARDWARE

A. Wall stops: As scheduled.
   1. Manufacturers: One of the following or equal:
      a. Ives.
      b. Trimco.
      c. Rockwood.

B. Floor stops: As scheduled with strike of suitable height to compensate for clearance between door and floor.
   1. Manufacturers: One of the following or equal:
      a. Ives.
      b. Trimco.
      c. Rockwood.

C. Mechanical holders: Foot-operated plunger with instant release by touch of toe and integral spring to keep constant shoe pressure against floor; brass.
   1. Manufacturers: The following or equal:
      a. Glynn-Johnson.

D. Electromagnetic holders: Electromagnetic hold open device; able to be connected to smoke alarm system; UL BHMA listed; consisting of completely flush wall-mounted electro-magnetic holder and door thru-bolted contact plate; depth as required; with minimum holding force of 25 and maximum of 40 pounds; voltage and mounting height as indicated on the Drawings; steel.
   1. Manufacturers: One of the following or equal:
      a. Rixson-Firemark Inc., Electromagnetic Door Release Model 990 Series.
      b. LCN Electromagnetic Door Release Model SEM 7800 Series.
      c. Dorma Door Controls Inc., Electromagnetic Door Holder Model Series EM.

E. Flush bolts and surface bolts:
   1. BHMA A156.3 and A156.16, Grade 1, certified.
      a. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately 6 feet from the floor.
      b. Furnish dust proof strikes for bottom bolts.
      c. Surface bolts to be minimum 8 inches in length, UL listed for labeled fire doors, and UL listed for windstorm components where applicable.
      d. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
      e. Manufacturers: One of the following or equal:
         1) Ives (IV).
         2) Rockwood Products; ASSA ABLOY Architectural Door Accessories (RO).
         3) Trimco (TC).

F. Kick plates:
   1. As scheduled, 0.050-inch thick, beveled edges, 10 inches high, 1-1/2 inches narrower than single doors, 1 inch narrower than leaf of door pairs.
   2. Manufacturers: One of the following or equal:
      a. Ives.
      b. Trimco.

G. Architectural seals:
   1. General:
      a. Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets.
      b. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated.
      c. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
   2. Smoke labeled gasketing:
      a. Assemblies in accordance with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing in accordance with UL 1784.
      b. Provide smoke labeled perimeter gasketing at all smoke labeled openings.
   3. Fire labeled gasketing:
      a. Assemblies in accordance with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing in accordance with UL 10C.
      b. Provide intumescent seals as indicated to meet UL 10C, and NFPA 252.
   4. Sound-rated gasketing:
      a. Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.
   5. Replaceable seal strips:
      a. Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
   6. Manufacturers: One of the following or equal:
      a. National Guard Products (NG).
      b. Pemko Products; ASSA ABLOY Architectural Door Accessories (PE).
      c. Zero (ZE).

H. Thresholds:
   1. As scheduled, extruded aluminum, maximum 1/2-inch high, maximum slope of 1 foot in 2 feet.
   2. Manufacturers: One of the following or equal:
      a. National Guard Products Inc.
      b. Pemko Mfg. Co.

I. Dustproof strike:
   1. As scheduled.
   2. Manufacturers: One of the following or equal:
      a. Ives.
      b. Trimco.

J. Coordinator with filler bar:
   1. As scheduled, non-handed, series type length as required for door sizes indicated, complete with filer lengths as required, with mounting brackets and carry bars when required for proper operation; steel with manufacturer's standard prime finish capable of receiving painted finish.
   2. Manufacturers: One of the following or equal:
      a. Glynn-Johnson Coordinators, Model COR Series.
      b. Ives, Door Co-Ordinator, Model 900 Series.

K. Door bottoms:
   1. As scheduled, extruded aluminum with vinyl insert, surface mounted, length equal to door width minus 2 inches, automatic, recessed in bottom of door.
   2. Manufacturers: One of the following or equal:
      a. Pemko.
      b. Reese.

L. Astragals:
   1. As specified in Sections 08110 - Hollow Metal Doors and Frames.

M. Silencers:
   1. As scheduled, pneumatic gray rubber.
   2. Manufacturers: One of the following or equal:
      a. Trimco.
      b. Ives.
      c. Rockwood.

2.12 FINISHES

A. Brass and bronze: BHMA A156.18 626 (US26D), satin chrome.

B. Steel: BHMA A156.18 652 (US26D), satin chrome.

C. Stainless steel: BHMA A156.18 630 (US32D), satin stainless steel.

D. Aluminum: BHMA A156.18 628 (US28).

E. Plastic closer covers: Spray paint to match typical door hardware finish.

F. Metal closer covers: Plate covers to match typical door hardware finish.

G. Electromagnetic hold open devices: Manufacturer's standard brushed zinc finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect doors and door frames for damage or defects and examine hardware for compatibility with receiving conditions and suitable to intended use.

B. Verify that required wall backing has been installed.

3.02 INSTALLATION

A. Install finish hardware in accordance with manufacturer's templates and instructions.
   1. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
   2. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: Hanging devices; locking devices; closing devices; and seals.

B. Accurately and properly fit hardware.

C. Securely fasten fixed parts for smooth, trouble-free, non-binding operation.

D. Fit faces of mortise parts snug and flush.

E. Ensure that operating parts move freely and smoothly without binding, sticking, or excessive clearance.

F. Mounting heights:
   1. Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:
   2. Standard steel doors and frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
   3. Wood doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
   4. Where indicated to comply with accessibility requirements, in accordance with ICC A117.1 "Accessibility Guidelines for Buildings and Facilities."
   5. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

G. Retrofitting:
   1. Install door hardware to comply with manufacturer's published templates and written instructions.
   2. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Section 09910 - Painting.
   3. Do not install surface-mounted items until finishes have been completed on substrates involved.

H. Protection:
   1. Protect door hardware from damage or marring of finish during construction, use strippable coatings, removable tapes, or other acceptable means.
   2. Ensure door hardware displays no evidence of finish paint after final building cleanup.

I. Latch guard and dead bolts: Install so that bolts automatically engage in keeper, whether activated by closer or by manual pressure.

J. Closers:
   1. Mount on opposite sides of corridors or vestibules, except at exterior doors.
   2. Mount for 180-degree swing wherever possible.
   3. Mount with drop plates at narrow top rail doors.
   4. Adjust to operate noiselessly and evenly.
   5. Have closer manufacturer regulate closers prior to final acceptance of project.

K. Kick plates: Screw on push side of doors, unless otherwise indicated on the Drawings.

L. Gasketing: Mount to provide complete contact between door and frame, finished floor, or both; and weathertight enclosure.

M. Thresholds:
   1. Install immediately before inspection for Substantial Completion or protect from heavy traffic damage during construction.
   2. Cope to fit door frame profile and drill to suit required flush bolts and panic bolts.
   3. Unless indicated on the Drawings to be set in grout, set in double bead of sealant, tightly fit at jambs, and make waterproof.
   4. Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Section 07900 - Joint Sealants.
   5. Fasten to concrete slab with 5/16-inch stainless steel flat head countersunk machine screws and concrete anchors at 8-inch centers.

N. Silencers:
   1. Insert into predrilled holes in frames.

O. Storage:
   1. Provide a secure lock up for hardware delivered to the project but not yet installed.
   2. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.03 DOOR HARDWARE SETS

A. They are a guideline only and should not be considered a detailed hardware schedule.

B. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

C. Quantities listed are for each pair of doors, or for each single door.

D. The Supplier is responsible for handing and sizing all products.

E. Where multiple options for a piece of hardware are given in a single line item, the Supplier shall provide the appropriate application for the opening.

F. Provide a list of Manufacturer’s Abbreviations.

3.04 CONSTRUCTION KEYING

A. Insert construction inserts in cylinder cores of exterior doors, and doors requiring security and access for workman, unless otherwise directed by the Engineer.

3.05 ADJUSTING

A. Examine hardware in place for complete and proper installation. Lubricate bearing surfaces for proper function.

B. Replace, rework, or otherwise correct defective door hardware, including incorrect hand or function.

3.06 CLEANING

A. Remove protective materials and devices and thoroughly clean exposed surfaces of hardware.

B. Check for surface damage prior to final cleaning for acceptance of project.

END OF SECTION

SECTION 09910

PAINTING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Field applied paints and coatings for normal exposures.
   2. Painting Accessories.

1.02 DEFINITIONS

A. Paints: Manufacturer's best ready-mixed coatings, except when field catalyzed, with fully ground pigments having soft paste consistency and capable of being readily and uniformly dispersed to complete homogeneous mixture, having good flowing and brushing properties, and capable of drying or curing free of streaks or sags.

B. Volatile Organic Compound (VOC): Content of air polluting hydrocarbons in uncured coating product measured in units of grams per liter or pounds per gallon.

1.03 SUBMITTALS

A. General: Submit as specified in Section 01330 - Submittal Procedures.

B. Shop drawings: Include schedule of where and for what use coating materials are proposed in accordance with requirements for Product Data.

C. Product data: Include description of physical properties of coatings including solids content and ingredient analysis, VOC content, temperature resistance, typical exposures and limitations, and manufacturer's standard color chips.

D. Samples: Include 8-inch square draw-downs or brush-outs of topcoat finish when requested. Identify each sample as to finish, formula, color name and number and sheen name and gloss units.

E. Manufacturer's instructions: Submit in accordance with requirements for Product Data. Include:
   1. Special requirements for transportation and storage.
   2. Mixing instructions.
   3. Shelf life.
   4. Pot life of material.
   5. Precautions for applications free of defects.
   6. Surface preparation.
   7. Method of application.
   8. Recommended number of coats.
   9. Recommended thickness of each coat.
   10. Recommended total thickness.

11. Drying time of each coat, including prime coat.
12. Required prime coat.
13. Compatible and non-compatible prime coats.
14. Recommended thinners, when recommended.
15. Limits of ambient conditions during and after application.
16. Time allowed between coats.
17. Required protection from sun, wind, and other conditions.
18. Touch-up requirements and limitations.

F. Submit notarized certificate that:
   1. All paints and coatings to be used on this project comply with the State of California Air Resources Board Rule 1113 VOC Regulations effective as of January 1, 2004; and that
   2. All paints and coatings to be used on this project comply with the VOC regulations of the State of California Air Management District in which the coatings will be used, effective January 1, 2004.

1.04 QUALITY ASSURANCE

A. Products: First line or best grade.

B. Materials for each paint system: By single manufacturer.

C. Applicator qualifications: Applicator of products similar to specified products with minimum 3 years of experience.

D. Regulatory requirements: Comply with by using paints that do not exceed governing agency's VOC limits or do not contain lead.

E. Field samples:
   1. Paint 1 complete surface of each color scheme to show colors, finish texture, materials, and workmanship.
   2. Obtain approval before painting other surfaces.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products as specified in Section 01600 - Product Requirements.

B. Remove unspecified and unapproved paints from Project site immediately.

C. Deliver containers with labels identifying:
   1. Manufacturer's name.
   2. Brand name.
   3. Product type.
   4. Batch number.
   5. Date of manufacturer.
   6. Expiration date or shelf life.
   7. Color.
   8. Mixing and reducing instructions.

D. Store coatings in well-ventilated facility that provides protection from the sun weather, and fire hazards.
   1. Maintain ambient storage temperature between 45 and 90 degrees Fahrenheit, unless otherwise recommended by the manufacturer.

E. Take precautions to prevent fire and spontaneous combustion.

1.06 ENVIRONMENTAL CONDITIONS

A. Surface moisture contents: Do not paint surfaces that exceed manufacturer specified moisture contents, or when not specified by the manufacturer, the following moisture contents:
   1. Plaster and gypsum wallboard: 12 percent.
   2. Masonry, concrete, and concrete block: 12 percent.
   3. Interior located wood: 15 percent.
   4. Concrete floors: 7 percent.

B. Do not paint or coat:
   1. Under dusty conditions.
   2. When light on surfaces measures less than 15 foot-candles.
   3. When ambient or surface temperature is less than 50 degrees Fahrenheit or unless manufacturer allow a lower temperature.
   4. When relative humidity is higher than 85 percent, unless manufacturer allows a higher relative humidity.
   5. When surface temperature is less than 5 degrees Fahrenheit above dew point.
   6. When surface temperature exceeds the manufacturer's recommendation.
   7. When ambient temperature exceeds 90 degrees Fahrenheit, unless manufacturer allows a higher temperature.
   8. Apply clear finishes at minimum 65 degrees Fahrenheit.

C. Provide fans, heating devices, or other means recommended by coating manufacturer to prevent formation of condensate or dew on surface of substrate, coating between coats and within curing time following application of last coat.

D. Provide adequate continuous ventilation and sufficient heating facilities to maintain minimum 50 degrees Fahrenheit for 24 hours before, during and 48 hours after application of finishes.

1.07 PROTECTION

A. Protect adjacent surfaces from paint and damage. Repair damage resulting from inadequate or unsuitable protection.

B. Furnish sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling surfaces not being painted and in particular, surfaces within storage and preparation area.

C. Place cotton waste, cloths, and material that may constitute fire hazard in closed metal containers and remove daily from site.

D. Remove electrical plates, surface hardware, fittings and fastenings, prior to painting operations.
   1. Carefully store, clean and replace on completion of painting in each area.
   2. Do not use solvent or degreasers to clean hardware that may remove permanent lacquer finish.

1.08 EXTRA MATERIALS

A. Extra materials: Deliver as specified in Section 01770 - Closeout Procedures. Include minimum 1 gallon of each type and color of coating applied:
   1. When manufacturer packages material in gallon cans, deliver unopened labeled cans as comes from factory.
   2. When manufacturer does not package material in gallon cans, deliver material in new gallon containers, properly sealed and identified with typed labels indicating brand, type, and color.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Paints: One of the following or equal:
   1. Carboline: Carboline.
   2. PPG Paints/PMC.
   3. S/W: Sherwin-Williams Co.
   4. Tnemec: Tnemec Co.

B. Submit requests for substitutions as specified in Section 01600 - Product Requirements:
   1. Include certified ingredient analyses.
   2. Provide colors that match specified colors.

2.02 PRETREATMENT, PRIMERS, PRIMER-SEALERS, AND WOOD STAIN

A. Aluminum primer:
   1. Manufacturers: One of following or equal:
      a. Carboline Co.: Carbocrylic 120.
      b. PPG: Pitt-Tech® Plus 4020 PF Interior/Exterior Primer/Finish, 4020PF.
      c. Sherwin-Williams Co.: DTM Wash Primer.

B. Concrete masonry filler/primer:
   1. Manufacturers: One of following or equal:
      a. Carboline Co.: Sanitile 100.
      b. PPG: Perma-Crete® Interior/Exterior Block and Masonry Surfacer/Filler, 4-100XI.
      c. Sherwin-Williams Co.: HD Block Filler, B42W46.
      d. Tnemec:
         1) Series 130, Envirofill.
         2) Series 180, Tneme-crete.

C. Concrete, porous, filler/primer:
   1. Manufacturers: One of following or equal:
      a. Carboline Co.: Sanitile 100.
      b. PPG: Perma-Crete® Interior/Exterior Block and Masonry Surfacer/Filler, 4-100XI.
      c. Sherwin-Williams Co.: HD Block Filler, B42W46.
      d. Tnemec:
         1) Series 130, Envirofill.
         2) Series 180, Tneme-crete.

D. Concrete, smooth, filler/primer:
   1. Manufacturers: One of following or equal:
      a. Carboline Co.: Sanitile 100.
      b. Carboline Co.: Carbocrylic 120.
      c. PPG:
         1) Perma-Crete® Interior/Exterior Block and Masonry Surfacer/Filler, 4-100XI.
         2) Seal Grip® Hydrosealer Exterior Bonding Primer/Sealer, 17-6001.
      d. Sherwin-Williams Co.:
         1) HD Block Filler, B42W46.
         2) Epoxy Masonry Tilt Primer White B42WW49.
      e. Tnemec: Series 180, Tneme-Crete.

E. Ferrous metal primer:
   1. Manufacturers: One of following or equal:
      a. Carboline Co.: Carboguard 890.
      b. PPG: PITT-GUARD® Rapid-Coat Direct-to-Rust Epoxy Mastic Coating, 95-245 Series.
      c. Sherwin-Williams Co.: Macropoxy 646.
      d. Tnemec: Series 104.

F. Galvanized metal surface pretreatment materials:
   1. Manufacturers: One of following or equal:
      a. Carboline Co.: Surface Cleaner 3.
      b. PPG: Duraprep® Concentrated Degreaser, Prep125.

G. Galvanized metal surface primer:
   1. Manufacturers: One of following or equal:
      a. Carboline Co.: Carboguard 890.
      b. PPG: PITT-GUARD® Rapid-Coat Direct-to-Rust Epoxy Mastic Coating, 95-245 Series Sherwin-Williams Co.: Macropoxy 646.
      c. Tnemec: Series 104.

H. Plaster sealer:
   1. Manufacturers: One of following or equal:
      a. Carboline Co.: Sanitile 120.
      b. PPG: Seal Grip® Gripper® Universal Interior/Exterior Primer/Sealer, 17-921XI.
      c. Sherwin-Williams Co.:
         1) Promar 200 Primer B28W8200.
         2) Loxon Masonry Primer A24W300.

I. Plywood, latex finishes:
   1. Manufacturers: One of following or equal:
      a. Carboline Co.: Sanitile 120.
      b. PPG:
         1) Exterior: Seal Grip® Hydrosealer Exterior Bonding Primer/Sealer, 17-6001.
         2) Interior: PPG Seal Grip Gripper Interior/Exterior 100 percent Acrylic Latex Primer, 17-921XI Series.
      c. Sherwin-Williams Co.: A100 Latex Primer B42W8041.

J. Wood primer for opaque finish paint, interior exposure:
   1. Manufacturers: One of following or equal:
      a. Carboline Co.: Sanitile 120.
      b. PPG: PPG Seal Grip Gripper Interior/Exterior 100 percent Acrylic Latex Primer, 17-921XI Series.
      c. Sherwin-Williams Co.: PrepRite Latex Primer B28W111.

K. Wood primer for opaque finish paint, exterior exposure:
   1. Manufacturers: One of following or equal:
      a. Carboline Co.: Sanitile 120.
      b. Sherwin-Williams Co.: A-100 Primer B42W.
      c. PPG: Seal Grip® Hydrosealer Exterior Bonding Primer/Sealer, 17-6001.

L. Wood stain:
   1. Manufacturers: One of following or equal:
      a. Sherwin-Williams Co.:
         1) Interior: Wood Classic.
         2) Exterior: Woodscapes.
      b. PPG:
         1) Interior: DEFT.
         2) Exterior: PROLUXE.

2.03 PAINTS, INTERIOR EXPOSURE

A. Latex, flat:
   1. Manufacturers: One of following or equal:
      a. Carboline Co.: Carbocrylic 3359 MC flat.
      b. PPG:
         1) Speedhide® Zero Interior Flat, 6-5110 Series.
         2) Ultralast Interior Matte, 13-210 Series.
      c. Sherwin-Williams Co.: Promar 200, B30W200.

B. Latex, semi-gloss:
   1. Manufacturers: One of following or equal:
      a. Carboline Co.: Carbocrylic 3359 MC.
      b. PPG:
         1) Speedhide® Zero Interior Semi-Gloss, 6-5510 Series.
         2) Copper Armor Interior Latex Paint + Primer Semi-Gloss, 29-1510.
      c. Sherwin-Williams Co.: Promar 200, B77W3402D.

C. Acrylic, semi-gloss:
    1. Manufacturers: One of following or equal:
        a. Carboline Co.: Carbocrylic 3359 MC.
        b. PPG:
            1) Speedhide® Zero Interior Semi-Gloss, 6-5510 Series.
            2) Copper Armor Interior Latex Paint + Primer Semi-Gloss, 29-1510.
        c. Sherwin-Williams Co.: Promar 200, B77W3402D.
        d. Tnemec: Series 1029, Enduratone.

2.04 PAINTS, EXTERIOR EXPOSURE

A. Latex, flat:
    1. Manufacturers: One of following or equal:
        a. Carboline Co.: Carbocrylic 3359 MC flat.
        b. PPG:
            1) Speedhide® Exterior Flat, 6-6510XI.
        c. Sherwin-Williams Co.: A-100, Flat Exterior Latex A6-100.
        d. Tnemec: 1028 Enduratone.

B. Acrylic latex, semi-gloss:
    1. Manufacturers: One of following or equal:
        a. Carboline Co.: Carbocrylic 3359 MC flat.
        b. PPG:
            1) Speedhide® Exterior Semi-Gloss, 6-901XI.Sherwin-Williams Co.: A-100, Flat Exterior Latex A6-100.
        c. Tnemec: 1028 Enduratone.

PART 3 EXECUTION

3.01 INSPECTION

A. Thoroughly examine surfaces scheduled to be painted before starting work.

B. Start painting when unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

A. Prepare surfaces in accordance with paint manufacturer's instructions or when none, the following:
    1. Aluminum:
        a. Remove surface contamination by steam, high-pressure water, or degreasers.
        b. Abrade surface by abrasive blasting, power tool cleaning or hand tool cleaning.
        c. Apply etching primer.
    2. Reinforced concrete panels:
        a. Remove dirt, powdery residue, and foreign matter.
        b. Paint immediately; both sides when applicable.
    3. Canvas and cotton insulation coverings: Remove dirt, grease, and oil.

4. Concrete floors:
    a. Remove contamination, abrasive blast or acid etch and rinse with clear water.
    b. Ensure required acid-alkali balance is achieved. Allow to dry thoroughly.
5. Copper for paint finish:
    a. Remove contamination by steam, high-pressure water, or degreasers.
    b. Abrade surface by abrasive blasting, power tool cleaning or hand tool cleaning.
    c. Apply vinyl etch primer.
6. Copper for oxidized finish:
    a. Remove contamination.
    b. Apply oxidizing solution of copper acetate and ammonium chloride in acetic acid.
    c. Rub on repeatedly for correct effect.
    d. Once attained rinse surfaces well with clear water and allow to dry.
7. Gypsum wallboard:
    a. Remove contamination and prime to show defects.
    b. Repair and prime defects.
8. Galvanized surfaces:
    a. Remove surface contamination and oils and wash with degreasers.
    b. Apply coat of etching type primer.
9. Zinc coated surfaces: Remove surface contamination and oils and prepare for priming in accordance with metal manufacturer's recommendations.
10. Concrete and concrete masonry:
    a. Remove dirt, loose mortar, scale, powder, and other foreign matter.
    b. Remove oil and grease with solution of tri-sodium phosphate.
    c. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate.
    d. Rinse well and allow to thoroughly dry.
    e. Spot prime exposed metal with alkyd primer.
11. Plaster:
    a. Fill hairline cracks, small holes and imperfections with patching plaster.
    b. Smooth off to match adjacent surfaces.
    c. Wash and neutralize high alkali surfaces where they occur.
12. Unprimed steel and iron: Remove grease, rust, scale, dirt, and dust by wire brushing, sandblasting or other necessary method.
13. Shop primed steel:
    a. Sand and scrape to remove loose primer and rust.
    b. Feather out edges to make touch-up patches inconspicuous.
    c. Clean surfaces.
    d. Prime bare steel surfaces.
14. Wood and millwork:
    a. Sandpaper to smooth even surface.
    b. Wipe off dust and grit prior to priming.
    c. Spot coat knots, pitch streaks, and sappy sections with sealer.
    d. Fill nail holes and cracks after primer has dried and sand between coats.
15. Exterior wood siding:
    a. Remove dust, grit, and foreign matter.
    b. Seal knots, pitch streak, and sappy sections.
    c. Fill nail holes with exterior caulking compound after prime coat has been applied.

16. Mildew:
    a. Remove by scrubbing with solution of tri-sodium phosphate and chlorine bleach.
    b. Rinse with clean water and allow surface to dry completely.
17. Glue laminated woods:
    a. Remove grease and dirt.
    b. Wash down surfaces with degreasers.

3.03 APPLICATION

A. Apply each coat at proper consistency.

B. Tint each coat of paint slightly darker than preceding coat.

C. Sand lightly between coats to achieve required finish.

D. Do not apply finishes on surfaces that are not sufficiently dry.

E. Allow each coat of finish to dry before following coat is applied, unless directed otherwise by manufacturer.

F. Where clear finishes are required ensure tint fillers match wood.
1. Work fillers well into grain before set.
2. Wipe excess from surface.

G. Backprime exterior woodwork, which is to receive paint finish, with exterior primer paint.

H. Backprime interior woodwork, which is to receive paint or enamel finish, with enamel undercoat paint.

I. Backprime interior and exterior woodwork, which is to receive stain or varnish finish, with gloss varnish reduced 25 percent with mineral spirits.

J. Prime top and bottom edges of wood and metal doors with enamel undercoat when they are to be painted.

K. Prime top and bottom edges of wood doors with gloss varnish when they are to receive stain or clear finish.

3.04 MECHANICAL AND ELECTRICAL EQUIPMENT

A. Identify equipment, ducting, piping, and conduit in accordance with Related Sections.

B. Remove grilles, covers, and access panels for mechanical and electrical system from location and paint separately.

C. Finish paint primed equipment with color selected by the Engineer.

D. Prime and paint insulated and bare pipes, conduits, boxes, insulated and bare ducts, hangers, brackets, collars, and supports, except where items are plated or covered with prefinished coating.

E. Replace identification markings on mechanical or electrical equipment when painted over or spattered.

F. Paint interior surfaces of air ducts, convector, and baseboard heating cabinets that are visible through grilles and louvers with 1 coat of flat black paint, to limit of sight line.

G. Paint dampers exposed immediately behind louvers, grilles, convector, and baseboard cabinets to match face panels.

H. Paint exposed conduit and electrical equipment occurring in finished areas with color and texture to match adjacent surfaces.

I. Paint both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.

J. Color code equipment, piping, conduit, exposed ductwork, and apply color banding and identification, such as flow arrows, naming and numbering, in accordance with the Contract Documents.

3.05 SURFACES NOT REQUIRING FINISHING

A. Stainless steel, brass, bronze, copper, Monel®, chromium, anodized aluminum: Specially finished articles such as porcelain enamel, plastic coated fabrics, and baked enamel.

B. Finished products such as ceramic tile, windows, glass, brick, resilient flooring, acoustical tiles, board and metal tees; other architectural features, such as finish hardware, furnished in aluminum, bronze or plated ferrous metal, prefinished panels, or other items that are installed prefinished.

C. Items completely finished at factory, such as preformed metal roof and wall panels, aluminum frames, toilet compartments, sound control panels, acoustical tiles, shower compartments, folding partition, and flagpole.

3.06 CLEANING

A. As work proceeds and upon completion, promptly remove paint where spilled, splashed, or spattered.

B. During progress of work, keep premises free from unnecessary accumulation of tools, equipment, surplus materials, and debris.

C. Upon completion of work, leave premises neat and clean.

3.07 INTERIOR PAINT SCHEDULE

A. Aluminum: 2 coats of following finish paints over specified primer:
   1. Acrylic, semi-gloss:
      a. Surfaces not scheduled otherwise.

B. Concrete masonry: 2 coats of following finish paints over block filler:
   1. Latex, semi-gloss:
      a. Walls.

C. Concrete, smooth: 2 coats of following finish paints over specified sealer:
   1. Latex, flat:
      a. Surfaces not scheduled otherwise.

D. Metal, non-galvanized ferrous: 2 coats of following finish paints over specified primer:
   1. Acrylic, semi-gloss:
      a. Surfaces not scheduled otherwise.

3.08 EXTERIOR PAINT SCHEDULE

A. Aluminum: 2 coats of following finish paints over specified primer:
   1. Acrylic, semi-gloss:
      a. Surfaces not scheduled otherwise.

B. Concrete masonry: 2 coats of following finish paints over specified block filler:
   1. Latex, flat:
      a. Surface not scheduled otherwise.

C. Concrete, smooth: 2 coats of following finish paints over specified primer:
   1. Latex, flat:
      a. Surface not scheduled otherwise.

D. Metal, ferrous: Following finish coat over specified primer:
   1. Acrylic, semi-gloss:
      a. Surface not scheduled otherwise.

E. Metal, galvanized: 2 coats of following finish paints over pretreatment and specified primer:
   1. Acrylic, semi-gloss:
      a. Surface not scheduled otherwise.

END OF SECTION

SECTION 09960

HIGH-PERFORMANCE COATINGS

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ATTACHMENT A - SCHEDULE OF SURFACES TO BE COATED

ATTACHMENT B - COATING DETAIL SHEETS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Coatings, including coating systems, surface preparation, application requirements, and quality control requirements.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.
   2. D2200 - Standard Practice for Use of Pictorial Surface Preparation Standards and Guides for Painting Steel Surfaces.
   3. D3359 - Standard Test Methods for Rating Adhesion by Tape Test.
   4. D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings.
   5. D4262 - Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
   6. D4263 - Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
   7. D4285 - Standard Test Method for Indicating Oil or Water in Compressed Air.
   8. D4414 - Standard Practice for Measurement of Wet Film Thickness by Notch Gages.
   9. D4417 - Standard Test Methods for Field Measurement of Surface Profile of Blast-Cleaned Steel.
   10. D4541 - Standard Test Methods for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
   11. D4787 - Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates.
   12. D5162 - Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates.
   13. D7234 - Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
   14. E337 - Standard Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures).
   15. F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
   16. F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-situ Probes.

B. International Concrete Repair Institute (ICRI):
   1. 310.2 - Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

C. NACE International (NACE):
   1. SP0178 - Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to Be Lined for Immersion Service.
   2. SP0188 - Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.

D. National Association of Pipe Fabricators (NAPF):
   1. 500-03 - Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings.

E. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.

F. Occupational Safety and Health Administration (OSHA).

G. Society of Protective Coatings (SSPC):
   1. Glossary - SSPC Protective Coatings Glossary.
   2. Guide 6 - Guide for Containing Surface Preparation Debris Generated during Paint Removal Operations.
   3. Guide 15 - Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates.
   4. PA 1 - Shop, Field, and Maintenance Painting of Steel.
   5. PA 2 - Procedure for Determining Conformance to Dry Coating Thickness Requirements.
   6. PA 9 - Measurement of Dry Coating Thickness Using Ultrasonic Gages.
   7. QP 1 - Standard Procedure for Evaluating the Qualifications of Industrial/Marine Painting Contractors.
   8. SP 1 - Solvent Cleaning.
   9. SP 3 - Power Tool Cleaning.
   10. SP 5 - White Metal Blast Cleaning.
   11. SP 10 - Near-White Metal Blast Cleaning.
   12. SP 11 – Power Tools Cleaning to Bare Metal.
   13. SP 13 - Surface Preparation of Concrete.
   14. SP 16 - Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.
   15. SP COM - Surface Preparation Commentary.
   16. SP VIS 1 - Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning.
   17. SP WJ-1 - Waterjet Cleaning of Metals - Clean to Bare Substrate.
   18. SP WJ-2 - Waterjet Cleaning of Metals - Very Thorough Cleaning.
   19. SP WJ-3 - Waterjet Cleaning of Metals - Thorough Cleaning.
   20. SP WJ-4 - Waterjet Cleaning of Metals - Light Cleaning.

1.03 DEFINITIONS

A. Definitions used in this Section are in accordance with definitions referenced in ASTM D16, ASTM D3960, and SSPC Glossary of Definitions.

B. Specific definitions:
   1. Abrasive: Material used for blast cleaning, such as sand, grit, or shot.
   2. Abrasive Blast Cleaning: Cleaning/surface preparation by abrasive propelled at high speed.
   3. Anchor Pattern: Profile or texture of prepared surface(s).
   4. Biogenic Sulfide Corrosion: Corrosion caused by sulfuric acid formed when *Thiobacillus* bacteria metabolizes hydrogen sulfide.

5. Bug Holes: Small cavities resulting when air bubbles are entrapped in the surface of formed concrete during placement and consolidation.
6. System: Protective film with 1 or more coats applied in a predetermined order, including surface preparation and quality control requirements.
7. Coating/Paint/Lining Thickness: Total thickness of primer, intermediate, and/or finish coats after drying or curing.
8. Dew point: Temperature a given air/water vapor mixture starts to condense.
9. Drying Time: Time interval between application and material curing.
10. Dry to Recoat: Time interval between material application and its ability to receive the next coat.
11. Dry to Touch: Time interval between material application and its ability to tolerate a light ouch without coating damage.
12. Exposed Surface: Any indoor or outdoor surface not buried or encased.
13. Feather Edging: Reducing coating thickness at its edge to blend with existing surrounding coating.
14. Feathering: Tapering off a wet edge with a comparatively dry brush.
15. Ferrous: Cast iron, ductile iron, wrought iron, and all steel alloys except stainless steel.
16. Field Coat: Application of a surface coating system at the work site.
17. Finish Coat: Final coat in a paint system, including texture, color, smoothness of surface, and other properties affecting appearance.
18. Hold Point: A defined point, specified in this Section, at which work shall be halted for inspection.
19. Holiday: A discontinuity, skip, void, or pinhole in coating or coating system film that exposes the substrate.
20. Honeycomb: Segregated and porous surface of hardened concrete due to insufficient consolidation.
21. Hydroblast: High or ultra-high-pressure water jet surface preparation.
22. Incompatibility: One coating's inability to overlay another coating or surface as evidenced by bleeding, poor bonding, or lifting of old coating; inability of a coating to bond to a substrate.
23. Immersed/Immersion: A service condition in which substrate is submerged, is immediately above liquids, or is subject to frequent wetting, splashing, or washdown.
24. Laitance: A thin, weak, brittle layer of cement and aggregate fines on a concrete surface.
25. Mil: 0.001 inch.
26. Overspray: Dry spray, particularly paint bonded to an unintended surface.
27. Pinhole: A small diameter discontinuity in a coating or coating system film, created by offgassing from a void in a concrete or masonry substrate causing a void between coats or exposing the substrate. Usually caused by coating application while temperature is rising.
28. Pot Life: Time interval after components are mixed and coating can be satisfactorily applied.
29. Prime Coat: First full paint coat applied to a surface when using a multicoat system. Primers adhere to a new substrate, protect the substrate, and promote adhesion of subsequent coats of paint. The prime coat on metal surfaces is the first full coat and does not include solvent wash, grease emulsifiers, or other pretreatment applications.

30. Resurfacer/Resurfacing Material: A layer of cementitious and/or resin-based material used to fill or otherwise restore surface continuity to worn or damaged concrete surfaces.
31. Shelf Life: Maximum storage time a material may be stored without losing its usefulness.
32. Shop Coat: 1 or more coats applied in an off-site shop or plant before shipment to work site where field or finishing coat(s) are applied.
33. Spreading Rate: Area covered by a unit volume of paint at a specific thickness.
34. Stripe Coat: A separate brush coat of paint applied to all weld seams, pits, nuts/bolts/washers, and edges. This coat shall not be applied until previous coats have cured. Once applied, the coat shall be allowed to cure before subsequent coats are applied.
35. Tie Coat: An intermediate coat that bonds different types of paint material, improving succeeding coat adhesion.
36. Thick Film Coating System: A coating system applied with a minimum dry film thickness of 25 mils.
37. Touch-Up Painting: Application of paint on previously painted surfaces to repair marks, scratches, and deteriorated or damaged areas to restore the appearance and performance of the coating.
38. Water Blast: An alternative to air abrasive blast cleaning that can be used with or without abrasive injection. Water cleaning at pressures up to 5,000 pounds per square inch is called low-pressure water cleaning or power washing. High-pressure water cleaning uses water pressures between 5,000 and 10,000 pounds per square inch. Water jetting is water blasting with added abrasive at pressures between 10,000 and 25,000 pounds per square inch. Ultra-high-pressure water jetting is water blasting at pressures above 25,000 pounds per square inch.
39. Weld Splatter: Beads of non-structural weld metal that adhere to the surrounding surface, removed as part of surface preparation.

1.04 ABBREVIATIONS

A. CSM - Coating System Manufacturer.

B. CMU - Concrete Masonry Units.

C. CSA - Coating System Applicator. Specialty subcontractor retained by the Contractor to install the coating systems specified in this Section.

D. CTR - Coating System Manufacturer's Technical Representative.

E. DFT - Dry-Film Thickness. Thickness of cured film, usually expressed in mils (0.001 inch).

F. SSD - Surface Saturated Dry. Refers to concrete surface condition where the surface is saturated (damp) without the presence of standing water.

G. TPC - Technical Practice Committee.

H. VOC - Volatile Organic Compound. Portion of the coating that is a compound of carbon, is photochemically reactive, and evaporates during drying or curing; expressed in grams per liter (g/l) or pounds per gallon (lb/gal). VOC is determined by EPA Method 24.

I. WFT - Wet Film Thickness. Coating thickness as measured immediately after application. Usually expressed in mils (0.001 inch).

1.05 SUBMITTALS

A. As specified in Section 01330 - Submittal Procedures, submit the following:
   1. Schedule of proposed coating materials.
   2. Schedule of surfaces to be coated with each coating material.
   3. Dehumidification and heating plan.
   4. Product data:
      a. Physical properties of coatings, including the following:
         1) Solids content.
         2) Ingredient analysis.
         3) VOC content.
         4) Temperature resistance.
         5) Typical exposures and limitations.
         6) Manufacturer's standard color chips.
      b. Compliance with regulatory requirements:
         1) VOC limitations.
         2) Lead compounds and polychlorinated biphenyls.
         3) Abrasives and abrasive blast cleaning techniques and disposal.
         4) Methods for tenting blasting areas and methods to protect existing equipment from dust and debris.
         5) NSF certification of coatings for potable water supply systems.
      c. CSM's current printed recommendations and product data sheets for coating systems, including:
         1) Surface preparation recommendations.
         2) Primer type.
         3) Maximum dry and wet-mil thickness per coat and number of coats.
            a) Coating Coverage Worksheets.
         4) Minimum and maximum curing time between coats, including atmospheric conditions for each.
         5) Curing time before submergence in liquid.
         6) Thinner to be used for each coating.
         7) Ventilation requirements.
         8) Minimum and maximum atmospheric conditions during which the paint shall be applied.
         9) Allowable application methods.
         10) Maximum allowable substrate moisture content.
         11) Maximum shelf life.
         12) Requirements for transportation and storage.
         13) Mixing instructions.
         14) Shelf life.
         15) Material Pot life.
         16) Precautions for applications free of defects.
         17) Method of application.

18) Drying time of each coat, including prime coat.
19) Compatible prime coats.
20) Limits of ambient conditions during and after application.
21) Required protection from sun, wind, and other conditions.
22) Touch-up requirements and limitations.
23) Minimum adhesion of each system submitted in accordance with ASTM D4541 and ASTM D7234.

d. Samples: Include 8-inch square drawdowns or brushouts of topcoat finish when requested. Identify each sample as to finish, formula, color name and number, sheen name, and gloss units.
e. Affidavits signed by an officer of the CSM's corporation attesting to full compliance of each coating system component with current federal, state, and local air pollution control regulations and requirements.
f. List of cleaning and thinner solutions allowed by the CSMs.
g. Storage requirements, including temperature, humidity, and ventilation for Coating System Materials as recommended by the CSMs.
h. Thick film coating systems (greater than 25 mils):
1) CSM's detailed written instructions for coating system treatment and graphic details for coating system terminations in coated structures, including pipe penetrations, metal embedments, gate frames, and other terminations encountered.
2) Include detail treatment for coating system at concrete joints.
3) Manufacturer's Representative's (CTR) Field Reports.

5. Quality assurance submittals:
a. Quality assurance plan.
b. Qualifications of CSA, including:
1) List of Similar Projects.
a) Name and address of project.
b) Year of installation.
c) Year placed in operation.
d) Point of contact: Name and phone number.
2) Provide a minimum of 5 project references, each including contact name, address, and telephone number where similar coating work has been performed by their company in the past 5 years.
c. CSA Reports:
1) Written daily quality control inspection reports.
d. CTR Reports:
1) Reports on visits to project site to view and approve surface preparation of structures to be coated.
2) Reports on visits to project site to observe and approve coating application procedures.
3) Reports on visits to coating plants to observe and approve surface preparation and coating application on shop-coated items.

1.06 QUALITY ASSURANCE

A. CSA qualifications:
   1. Minimum of 5 years of experience applying specified type or types of coatings under conditions similar to those of the Work:
      a. Provide qualifications of applicator and references listing 5 similar projects completed in the past 5 years.
   2. SSPC-QP 1 certified.
   3. Manufacturer-approved applicator when manufacturer has approved applicator program or when required in these specifications.

B. CTR qualifications:
   1. Certification, one of the following:
      a. NACE Level 2 or 3 Certified Coating Inspector.
      b. SSPC Level 3 Protective Coatings Inspector.
   2. Minimum of 5 years of experience evaluating application of manufacturer's coatings under conditions similar to those of the Work:
      a. Provide CTR qualifications and references listing 5 similar projects completed in the past 5 years.

C. Regulatory requirements: Comply with governing agencies' regulations by using coatings conforming to their VOC limits.
   1. Lead-based coatings are not permitted.
   2. Do not use coal-tar epoxy in contact with drinking water or exposed to ultraviolet radiation.

D. Pre-installation conference: Conduct as specified in Section 01312 - Project Meetings.
   1. Coordinate Hold Point schedule.

E. Field samples:
   1. Prepare and coat a minimum 100-square-foot area of each system between corners or limits such as control or construction joints.
   2. Approved field sample may be part of the Work.

F. Obtain approval before coating other surfaces. Use products by same manufacturer for prime coats, intermediate coats, and finish coats on same surface, unless specified otherwise.

G. CSM services:
   1. CSA shall arrange for CTR to attend pre-installation conferences.
   2. Visit the project site periodically to consult on and inspect specified surface preparation and application Hold Points.
   3. Visit coating plants to observe and approve surface preparation procedures and coating application of items to be shop primed and coated.
   4. CTR shall provide written inspection reports.

H. Quality control requirements:
   1. Contractor shall be responsible for the workmanship and quality of the coating system installation.
      a. Inspections by Owner, Engineer, CSA, or CTR will not relieve or limit Contractor’s responsibilities.
   2. Conform to this specification's requirements and the standards referenced in this Section. Changes in the coating system application requirements will be allowed only with the Engineer's written acceptance.
   3. Specially trained crews with experience applying the specified coating system coating are required for:
      a. Coating application using plural component spray equipment or other specialty equipment.
      b. Coating with specialty linings for severe service conditions, including floor coatings, and with linings for corrosive headspaces or secondary containment areas.
   4. CTR shall specially train personnel for coating systems as specified in Attachment B - Coating Detail Sheets.
      a. CSM shall approve personnel in writing applying the coating system.
   5. Do not use contaminated, outdated, diluted materials, and/or materials from previously opened containers.
   6. Identify inspection access points used by Owner's or Engineer's personnel.
   7. Provide ventilation, ingress, egress, or other means as necessary for Owner's or Engineer’s personnel to safely access the work areas.
   8. Conduct and continually inspect work so the coating system is installed as specified. The CSM shall provide written directions to correct coating work not conforming to the specifications or is otherwise unacceptable.
   9. Provide written daily reports summarizing test data, work progress, surfaces covered, ambient conditions, quality control inspection test findings, and other information pertinent to the coating system application.
      a. Determine relative humidity in accordance with ASTM E337. Confirm other conditions, such as proper protective measures for surfaces not to be coated and safety requirements for personnel.
         1) Measure daily at shift's beginning and end and at intervals not to exceed 4 hours during the shift.
         2) Determine the acceptability of weather and/or environmental conditions within the structure in accordance with the CSM's requirements.
      b. Monitoring surface preparation: Spot check cleanliness, surface profile, and surface pH testing at least 3 times daily. Check each surface at least once. In accordance with:
         1) ASTM D4262.
         2) ASTM D4263.
         3) ASTM D4417.
         4) ICRI 310.2 requirements.
         5) SSPC Surface Preparation Standards.
      c. Confirm that compressed air used for surface preparation or blow-down cleaning is free of oil and moisture.
      d. Monitor surface preparation daily at shift's beginning and end and at intervals not to exceed 4 hours during the shift.
      e. Do not apply coatings when environmental conditions are outside of the CSM's published limits.

f. Monitoring coatings application: Continuously inspect, measure, and record the wet film thickness and general film quality (visual inspection) for runs, sags, pinholes, holidays, etc. during coating.
    1) Perform WFT measurements in accordance with ASTM D4414.
g. Post cure evaluation: Measure and inspect the overall dry film thickness on all surfaces. Conduct a DFT survey and perform adhesion testing, holiday detection, or cure testing as required in this Section and/or the CSM's written instructions. Perform all applicable tests in accordance with ASTM D4541, ASTM D4787, ASTM D5162, ASTM D7234, SSPC-PA 1, SSPC-PA 2, SSPC-PA 9, and other pertinent standards and recommended practices.

I. Inspection at Hold Points:
1. Conduct inspections at Hold Points during the coating system application and record the results.
2. Coordinate Hold Points with the Engineer so the Engineer can observe Contractor's inspections on a scheduled basis.
3. Provide the Engineer a minimum of 24 hours of notice before conducting Hold Point Inspections.
4. Hold Points shall be as follows:
    a. Conditions before surface preparation: Before starting surface preparation, observe, record, and confirm that oil, grease, and/or soluble salts are gone from the surface.
    b. Post surface preparation: After completing surface preparation, measure and inspect for cleanliness and proper surface profile as specified in this Section and in the CSM's written instructions.
    c. Coatings application: At the beginning of any coating system application, measure, record, and confirm acceptability of surface and ambient air temperature and humidity. Inspect applicator's equipment for serviceability and suitability for coatings application.
    d. Post application inspection: Identify defects in application work on all surfaces, including pinholes, holidays, excessive runs or sags, inadequate or excessive film thickness, and other problems.
    e. Follow-up corrective actions and final inspection: Measure and re-inspect corrective coating work performed to repair defects at prior Hold Points, and repeat until the surface condition is acceptable. Conduct final visual inspection with follow-up tests, such as holiday detection, adhesion tests, and DFT surveys.
    f. Coatings application: At the beginning of coating system application, measure, record, and confirm acceptability of surface and ambient air temperature and humidity. Inspect applicator's equipment for serviceability and suitability for coatings application.
        1) Observe conditions during the Pre-application Meeting.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products as specified in Section 01600 - Product Requirements.

B. Immediately remove unspecified and unapproved coatings from Project site.

C. Deliver new labeled, unopened containers:
   1. Do not deliver materials after manufacturer's expiration date or over 12 months from manufacturing date, whichever is more stringent. Store materials in well-ventilated enclosed structures and protect from weather and excessive heat or cold in accordance with the CSM's recommendations.
      a. Store flammable materials in accordance with federal, state, and local requirements.
      b. Store rags and cleanup materials appropriately to prevent fire and spontaneous combustion.
   2. Store and dispose of hazardous waste in accordance with federal, state, and local requirements. This requirement specifically applies to waste solvents and coatings.
   3. Container labels shall show the following:
      a. Brand name or product title.
      b. CSM's batch number.
      c. CSM's manufacture date.
      d. CSM's name.
      e. Generic material type.
      f. Application and mixing instructions.
      g. Hazardous material identification label.
      h. Shelf life expiration date.
      i. Color.
      j. Mixing and reducing instructions.
   4. Clearly mark containers to indicate safety hazards associated with the use of or exposure to materials.

1.08 PROJECT CONDITIONS

A. Apply coatings to dry surfaces.
   1. Surface moisture: Comply with manufacturer's requirements or as specified in this Section.
      a. Plaster and gypsum wallboard: 12 percent.
      b. Masonry and concrete block: 12 percent.
      c. Interior located wood: 15 percent.
      d. Concrete floors: Moisture vapor transmission rate of no more than 3.0 pounds per 1,000 square feet per 24 hours in accordance with ASTM F1869 or relative humidity no greater than 80 percent if tested in accordance with ASTM F2170 unless the CSM's recommendations are more restrictive.
      e. Concrete structures: Negative results from Plastic Sheet Test in accordance with ASTM D4263, and maximum of 80 percent relative humidity in accordance with ASTM F2170.

B. Do not apply coatings when the following conditions exist. If such conditions exist, provide containment, covers, environmental controls, and other necessary measures.
   1. During rainy, misty, or damp weather, or to surfaces with frost or condensation.
   2. When the surface temperature is below 10 degrees Fahrenheit above the dew point.

3. When ambient or surface temperature:
    a. Is less than 55 degrees Fahrenheit unless manufacturer allows a lower temperature.
    b. Is less than 65 degrees Fahrenheit for clear finishes, unless manufacturer allows a lower temperature.
    c. Exceeds 90 degrees Fahrenheit, unless manufacturer allows a higher temperature.
    d. Exceeds manufacturer's recommendation.
4. When relative humidity is higher than 85 percent.
5. Under dusty or adverse environmental conditions.
6. When light on surfaces measures less than 15 foot-candles.
7. When wind speed exceeds 15 miles per hour.

C. Apply coating only under evaporation conditions rather than condensation.
    1. Use dehumidification equipment, fans, and/or heaters inside enclosed areas to maintain required atmospheric and surface temperature requirements for proper coating application and cure.
    2. Measure and record relative humidity and air and surface temperatures at the start and end of each shift to confirm proper humidity and temperature levels inside the work area.
        a. Submit test results.

D. Continuously ventilate, dehumidify, and heat enclosed spaces with high humidity during surface preparation, coating application, and curing.
    1. Maintain minimum air temperature of 55 degrees Fahrenheit and 10 degrees Fahrenheit above the dew point.
    2. Maintain dew point of at least 10 degrees Fahrenheit less than the temperature of the coldest part of the structure where work is performed.
    3. Reduce dew point temperature in conditioned space by at least 10 degrees Fahrenheit within 20 minutes.
    4. Seal work areas and maintain positive pressure per dehumidification equipment supplier's recommendations.
    5. Maintain these conditions before, during, and after application to ensure proper adhesion and cure of coatings for no less than:
        a. Entire curing period.
        b. 8 hours after coating.

E. Systems:
    1. Site electrical power availability as specified in Section 01500 - Temporary Facilities and Controls.
    2. Internal combustion engine generators may be used.
        a. Obtain required permits and provide air pollution and noise control devices on equipment as required by permitting agencies require.
        b. Comply with state, federal, and local fire and explosion protection measures when locating and operating generator.
        c. Locate engine generator outside hazardous classified areas per NFPA 820.
        d. Provide daily fuel service for generator for duration of use.

3. Dehumidification:
    a. Provide desiccant or refrigeration drying.
    b. Use only desiccant types with a rotary desiccant wheel capable of continuous operation.
    c. Liquid, granular, or loose lithium chloride drying systems are not acceptable.
4. Heating:
    a. Use electric, indirect combustion, or steam coil.
    b. Direct-fired combustion heaters are not acceptable heat sources during abrasive blasting, coating application, or coating cure.
5. Filters:
    a. Use a filtration system for dust removal designed to not interfere with dehumidification equipment's ability to control dew point and relative humidity inside the reservoir.
    b. Do not allow air from the working area or dust filtration equipment to recirculate through thein dehumidifier during coating application or when solvent vapors are present.
6. Design and submittals:
    a. Prepare and submit dehumidification and heating plan, including all equipment and operating procedures.
    b. Suppliers of services and equipment shall have at least 3 years of experience in similar applications.

F. Provide containment and ventilation system components in accordance with SSPC-Guide 6, Level 3 and as required for hazardous materials.

1.09 MAINTENANCE

A. Provide table of products applied organized by surface type. List coating manufacturer, color, color formulation, distributor name, telephone number, and address.

B. Provide extra materials:
1. Minimum 1 gallon of each type and color of coating applied or provide additional quantities if specified in the Contract Documents:
    a. Deliver unopened factory-labeled cans when manufacturer packages material in gallon cans.
    b. Deliver material in new gallon containers, properly sealed and identified with permanently affixed, durable, printed labels indicating brand, type, and color, when manufacturer does not package material in gallon cans, deliver.

1.10 CTR RESPONSIBILITIES

A. General:
1. Attend pre-installation conference.
2. Perform onsite application training.
3. Periodically inspect coating system application.

B. Coating system installation training:
   1. Provide a minimum of 8 hours of classroom and off-site training for application personnel and supervisory personnel in one of the following ways:
      a. Train a minimum of 2 supervisory personnel and 2 application personnel.
      b. Submit a letter from the CSM stating that CSM approves the supervisory and application personnel, listed by name and responsibility, and no additional training is required.
   2. CTR can train up to 14 application personnel and 3 supervisory personnel at a time.
   3. Minimum training requirements:
      a. Explain in detail the mixing, application, curing, and termination requirements.
      b. Provide hands-on demonstration of coating system mixing.
      c. Explain in detail the ambient condition requirements for temperature and humidity.
      d. Explain in detail the surface preparation requirements.
      e. Explain in detail the re-coat times, cure times, and related ambient condition requirements.
      f. Write a letter stating that training was satisfactorily completed by the personnel, listed by name and responsibility.
   4. Provide special training as specified in the Coating Detail Sheets.

C. Coating system inspection:
   1. CTR inspection is in addition to the CSA's inspection as specified in this Section.
   2. Be on-site to oversee:
      a. Coating application at least once a week.
      b. End of surface preparation.
      c. During coating application.
      d. Post-cure inspection.
   3. Routinely inspect and verify in writing that application personnel have successfully performed surface preparation, filler/surfacer application, coating system application, and Quality Control Inspection in accordance with this Section and to warrantable quality.
   4. Perform the following activities to confirm conformance with the specifications:
      a. Inspect ambient conditions during coating system installation at Hold Points for conformance with the specified requirements.
      b. Inspect each coated surface type and coating system applied to verify the following:
         1) Cleanliness.
         2) Surface pH for concrete substrates.
         3) Confirm surface preparation of substrates where coating system will terminate or will be applied for conformance to the specified application criteria.
      c. Verify surface profile of substrates by completing the following:
         1) Inspect preparation and application of coating detail treatment at terminations, transitions, metal embedments in concrete, and joints and cracks in substrates.
         2) Inspect application of filler/surfacer materials for concrete and masonry substrates.
         3) Verify proper mixing of coating materials.

4) Inspect application of primers and finish coats, including wet and dry film thickness.
5) Inspect coating systems for proper cure times and conditions.

d. Review adhesion testing of cured coating systems.
e. Review coating system continuity testing.
f. Inspect and record representative-localized repairs.
g. Conduct final review of completed coating system installation.
h. Prepare and submit site visit reports after each site visit to document that the coating work is in accordance with the CSM's Recommendations.

D. Final report:
1. Prepare a final report, after coating work ends, summarizing each day's test data, observations, drawings, and photographs. Include substrate conditions, ambient conditions, and application procedures observed during the CTR's site visits. Include a statement that completed work was performed in accordance with the requirements of the CSM's recommendations.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Coating materials shall be formulated for environments encountered in water and wastewater treatment processes.

B. Coating materials that come in contact with water distributed as potable water shall be certified in accordance with NSF 61.

2.02 MATERIALS

A. General:
1. Product requirements as specified in Section 01600 - Product Requirements.

2.03 COATING SYSTEMS IDENTIFICATION

A. Naming Conventions: Coating Systems Identifications contain the elements defined in Table 1.

Table 1 Coating System Identification Elements

First Element	-	Second Element	-	Third Element	-	Fourth Element (optional)
3 or 4 alpha characters		1-3 alpha characters		1 number		3 or 4 alpha characters
Coating Type		Substrate		System Number		Additional Substrate or Special Condition
Example: EPX	-	C	-	6	-	BSC

1) First element identifies the coating type using the following abbreviations:
a) ACR: Acrylic.
b) CTE: Coal tar epoxy.
c) ELA: Elastomeric acrylic.
d) EPU: Epoxy-polyurethane.

e) EPX: Epoxy.
f) POL: Polyurethane.
g) SIL: Silicone.
h) SILX: Siloxane or silane.
i) VE: Vinyl ester.

2) Second element identifies the substrate using the following abbreviations:
a) C: Concrete or masonry.
b) F: Concrete flooring.
c) FRP: Fiber-reinforced plastic.
d) GM: Galvanized metal.
e) M: Metal.
f) PVC: Polyvinyl chloride, chlorinated polyvinyl chloride.

3) Third element identifies the sequential system number.
a) For example, EPX-C-2 is the second standard epoxy coating system for concrete substrates.

4) Fourth element is optional and identifies the additional substrate or special condition with the following abbreviations:
a) PWS: Potable water service applications (NSF-61 approved).
b) BSC: Biogenic sulfide corrosion-resistant applications in wastewater.
c) BG: Below grade or buried.
d) OZ: Organic zinc primer, epoxy polyurethane system.
e) SC: Secondary containment.

2.04 PRODUCTS FOR COATING SYSTEMS

A. Products: As specified in Attachment B - Coating Detail Sheets.

B. Cleaning solvents:
1. Requirements for solvent wash, solvent wipe, or cleaner used, including, but not limited to, those used for surface preparation in accordance with SSPC-SP 1:
a. Emulsifying type.
b. Containing no phosphates.
c. Biodegradable.
d. Does not damage zinc.
e. Compatible with the specified primer.
f. Complying with applicable air-quality control board requirements.
2. Use clean white cloths and clean fluids in solvent cleaning.

PART 3 EXECUTION

3.01 GENERAL PROTECTION REQUIREMENTS

A. Protect adjacent coated surfaces from coatings and damage associated with coating work. Repair damage resulting from inadequate or unsuitable protection.

B. Use drop cloths and other coverings to protect adjacent surfaces not to be coated against spatter and droppings.

C. Mask off surfaces of items not to be coated or remove items from area.

D. Furnish and deploy sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling surfaces not being coated and, in particular, surfaces within storage and preparation areas.

E. Place coating waste, cloths, and material that may pose a fire hazard in closed metal containers and remove daily from site.

F. Remove electrical plates, surface hardware, fittings, and fasteners before coating application. Carefully store, clean, and replace items after completing coating in each area. Do not use solvent or degreasers to clean hardware that may remove permanent lacquer finishes.

G. Erect and maintain protective enclosures in accordance with SSPC-Guide 6.

H. Protect the following surfaces from abrasive blasting by masking or by other means:
   1. Threaded portions of valve and gate stems, grease fittings, and identification plates.
   2. Machined surfaces for sliding contact.
   3. Surfaces to be assembled against gaskets.
   4. Surfaces of shafting where sprockets will be fit.
   5. Surfaces of shafting where bearings will be fit.
   6. Machined bronze surfaces, including slide gates.
   7. Cadmium-plated items, except cadmium-plated, zinc-plated, or sherardized fasteners used to assemble equipment requiring abrasive blasting.
   8. Galvanized items, unless scheduled to be coated.

I. Protect installed equipment, mechanical drives, and adjacent coated equipment from abrasive blasting to prevent damage caused by spent abrasive blast media, dust, or dirt entering such equipment.

J. Schedule cleaning and coating to keep dust and spray from the cleaning process from falling on wet, newly coated surfaces.
   1. Whenever possible, coordinate with other trades and complete surface preparation and coating work before installing hardware, hardware accessories, nameplates, data tags, electrical fixtures, and similar uncoated items that will be in contact with coated surfaces. Mask machined surfaces, sprinkler heads, and other small items that will not be coated.
   2. After completing coating, reinstall removed items.
   3. Disconnect and move equipment adjacent to walls to clean and coat equipment and walls. Replace and reconnect equipment after coating.

3.02 GENERAL SURFACE PREPARATION REQUIREMENTS

A. Prepare surfaces in accordance with CSM's instructions unless more stringent requirements are specified in this Section.

B. Coating detail sheets in Attachment B - Coating Detail Sheets include additional surface preparation requirements.

C. Follow more stringent requirement if information conflicts.

D. Where required by the Owner’s representative, a NACE International certified coatings inspector, provided by the Owner, will inspect and approve surfaces to be coated before applying a coating.
   1. CSA shall coordinate coating inspections.
      a. Identify coating inspection Hold Points during the pre-installation conference.
      b. Provide at least 2 days' notice before inspection.
   2. Contractor shall correct surface defects identified by the inspector at no additional cost to Owner.

3.03 MECHANICAL AND ELECTRICAL EQUIPMENT PREPARATION

A. Identify equipment, ducting, piping, and conduit as specified in Section 15050 - Common Work Results for Mechanical Equipment, Section 15076 - Pipe Identification, and Section 16075 - Identification for Electrical Systems.

B. Remove grilles, covers, and access panels for mechanical and electrical system and coat separately.

C. Prepare and finish coat equipment primed by the manufacturer using specified intermediate and top coats, as applicable, and color selected by the Owner.

D. Prepare, prime, and coat both insulated and bare pipes, conduits, boxes, insulated and bare ducts, hangers, brackets, collars, and supports, except where items are covered with material not requiring coating, or with a prefinished coating.

E. Replace identification markings on mechanical or electrical equipment when coated over or spattered.

F. Prepare and coat interior surfaces of air ducts and convector and baseboard heating cabinets visible through grilles and louvers with 1 coat of flat black paint to limit of sight line.

G. Prepare and coat dampers exposed immediately behind louvers, grilles, and convector and baseboard heating cabinets to match face panels.

H. Prepare and coat exposed conduit and appurtenances occurring in finished areas with color and texture to match adjacent surfaces.

I. Prepare and coat sides' front, back, and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.

J. Color code equipment, piping, conduit, and exposed ductwork and apply color banding and identification, such as flow arrows, naming, and numbering, in accordance with the Contract Documents.

3.04 CLEANING OF NEW AND PREVIOUSLY COATED OR NEW SURFACES

A. Utilize cleaning agent to remove soluble salts, such as chlorides, from concrete and metal surfaces:
   1. Cleaning agent: Biodegradable non-flammable and containing no VOC.

2. Manufacturers: The following or equal:
    a. CHLOR*RID International, Inc.
        1) Complete soluble salt removal with steam or warm water cleaning.
3. Steam clean and degrease surfaces to be coated to remove oils and grease.
4. Clean surfaces with decontamination agent in conjunction with abrasive blast cleaning, steam cleaning, high-pressure washing, or hand washing, as approved by the CTR and the Engineer.
5. Test cleaned surfaces to ensure removal of soluble salts. Carry out additional cleaning as needed.
6. Complete final surface preparation before applying new coating system in strict accordance with CSM's printed instructions.

3.05 BLAST CLEANING

A. Surface preparation requirements:
    1. Do not reuse spent blast abrasive.
    2. Ensure that filter compressed air used for blast cleaning is free of condensed water and oil. Clean moisture traps at least once every 4 hours or more frequently, as required, to prevent moisture from entering the abrasive blasting equipment air supply. Check blast air for moisture and oil after each cleaning in accordance with ASTM D4285.
    3. Install oil separators just downstream of compressor discharge valves and at the discharge point of blast pot discharges. Check separators on the same frequency as the moisture traps.
    4. Keep regulators, gauges, filters, and separators on compressor air lines to blasting nozzles operational at all times.
    5. Install an air dryer or desiccant filter drying unit to dry the compressed air before blast pot connections. Use and maintain the dryer throughout surface preparation work.
    6. Use a venturi-type, or other high velocity-type, abrasive blast nozzles supplied with at least 100 pounds per square inch gauge air pressure at the nozzle and enough volume to obtain appropriate blast cleaning production rates and surface cleanliness.
    7. Provide airborne particulate evacuation and filtering that meets OSHA safety standards. Maintain optimal visibility both to clean and provide the specified surface profile and to allow inspection of the substrate during surface preparation work.
    8. If prepared and cleaned metallic substrates become contaminated between final surface preparation work and coating system application, or if the prepared substrate darkens or changes color, re-clean by water blasting, or abrasive blast cleaning as appropriate until the specified degree of cleanliness is restored.

B. Water jetting or water blasting:
    1. Use water jetting or water blasting for recoating or relining where an adequate surface profile exists.
    2. Perform water jetting or water blasting in accordance with SSPC-SP 13 and SSPC-WJ-1, WJ-2, WJ-3, WJ-4.

3.06 PREPARATION REQUIREMENTS FOR CONCRETE SURFACES

A. Cure for at least 28 days before coating.

B. Remove degraded concrete using abrasive blast cleaning or high or ultra-high-pressure water jetting, chipping, or other abrading tools until achieving a sound, clean substrate. Remove all bruised or cracked concrete.

C. Prepare substrate cracks and areas requiring resurfacing; perform detail treatment, including, but not limited to, terminating edges per the CSM's recommendations and as indicated on the Drawings.
   1. Prepare concrete surfaces in accordance with SSPC-SP 13.

D. Prepare concrete surfaces in accordance with SSPC-SP 13.
   1. Inspect concrete surfaces to select appropriate surface preparation method to provide a suitable substrate for the specified coating system.
   2. Use blast cleaning or other means to expose the complete perimeter of air voids or bug holes. Do not leave shelled over, hidden air voids beneath the exposed concrete surface.
   3. Repair concrete defects and physical damage.
   4. Clean concrete surfaces of dust, mortar, formwork, fins, loose concrete particles, form release materials, oil, and grease.
   5. Fill voids to provide surface as specified in Section 03366 - Tooled Concrete Finishing.

E. Provide clean substrate visually free of calcium sulfate, loose, coarse, or fine aggregate, laitance, loose hydrated cement paste, and otherwise harmful substances.
   1. Confirm concrete surface minimum pH of 9.0 with surface pH testing.
   2. If after surface preparation the surface pH remains below 9.0, perform additional water blasting, cleaning, or abrasive blast cleaning until additional pH testing indicates an acceptable pH level.

F. Prepare concrete surface for coating in accordance with SSPC-SP 13.
   1. Provide ICRI 310.2 minimum No. 3 concrete surface profile (CSP) or as specified on Coating Detail Sheets.
   2. Evaluate profile of the prepared concrete using ICRI 310.2 surface profile replicas.

G. Blast clean cementitious repair mortars or grouts to the same profile and degree of cleanliness requirements required for concrete substrates.

H. Blast clean polymer-based surfacers or waterborne modified cementitious surfaces only if they have exceeded the CSM's recommended recoat time.

I. Vacuum all concrete surfaces before coating application, leaving a dust free, sound concrete substrate.
   1. Thoroughly clean concrete surfaces to be coated to remove loose dirt and spent abrasive.
   2. Remove debris produced by blast cleaning from the structures to be coated, and legally dispose of it off-site.

J. Test moisture content of concrete to be coated:
   1. Conduct ASTM D4263 plastic sheet test at least once for every 500 square feet of surface area to be coated.
      a. Any moisture on plastic sheet after test period constitutes a non-acceptable test, and the concrete must be dried further.
   2. Conduct ASTM F1869 test at least once for every 1,000 square feet of concrete floor surface area to be coated.
   3. Conduct ASTM F2170 one relative humidity moisture test at least once for each 500 square feet of non-floor concrete surface area where the opposite side is exposed to soil or water.
      a. Waterproof surfaces exposed to soil or water where specified in Section 07110 - Dampproofing.
   4. Comply with specified minimum moisture content and CSM's written recommendations for moisture vapor transmission rates or relative humidity values.

K. Masonry surfaces:
   1. Cure for at least 28 days before coating.
   2. Prepare masonry surfaces to remove chalk, laitance, loose dirt, dried mortar splatter, dust, peeling, or loose existing coatings, or otherwise deleterious substances to leave a clean, sound substrate.
   3. Wash and scrub masonry surfaces with clear water. Do not use muriatic acid.
   4. Seal or fill masonry surfaces with a sealer or block filler compatible with the specified primer after cleaning.
   5. Confirm that masonry surfaces are dry before coating application.
      a. If using pressure washing or low-pressure water blast cleaning for preparation, allow the masonry to dry for at least 5 days under dry weather conditions or until the minimum ambient temperature is 70 degrees Fahrenheit before coating.

3.07 GENERAL PREPARATION REQUIREMENTS FOR METALLIC SURFACES

A. Remove rust, scale, and welding slag and spatter.
   1. Remove and grind smooth all excessive weld material and weld spatter on metal surfaces before blast cleaning in accordance with NACE SP0178, Appendix C, Level C.
   2. Grind sharp edges on metal substrate to approximately 1/16-inch radius before abrasive blast cleaning.

B. Prepare metallic surfaces in accordance with applicable portions of surface preparation specifications of the SSPC specified for each coating system.
   1. Remove grease and oil in accordance with SSPC-SP 1.
   2. Use solvent as recommended by the CSM.
   3. Measure profile depth of the surface to be coated in accordance with Method C of ASTM D4417. Contractor shall select blast particle size and gradation to produce the specified surface profile.
   4. Constantly monitor and maintain ambient environmental conditions to ensure cleanliness and that no "rust back" occurs before coating material application.

C. Prepare metallic surfaces by blast cleaning in accordance with SSPC-VIS 1 (ASTM D2200). Prepare abrasive blast representative areas for the Owner's representative to inspect on the first day of cleaning.

D. Unless otherwise specified, the requirements for blast cleaning steel, ductile iron, and stainless steel substrates are as follows:
   1. Ferrous metal surfaces not to be submerged: Abrasive blast in accordance with SSPC-SP 10 unless blasting may damage adjacent surfaces, is prohibited, or is specified otherwise. Where abrasive blasting is not possible, clean surfaces to bare metal with power tools in accordance with SSPC-SP 11.
   2. Ferrous metal surfaces to be submerged: Abrasive blast in accordance with SSPC-SP 5, unless specified otherwise, to clean and provide roughened surface profile with a depth between 2 and 4 mils.
   3. Remove traces of grit, dust, dirt, rust scale, friable material, loose corrosion products, or embedded abrasive from substrate before coating application.
   4. When abrasive blasted surfaces rust or discolor before coating, abrasive blast clean surfaces again.

E. Field preparation of shop-primed surfaces:
   1. Smooth welds and prominences with power tools before applying field-applied coatings.
   2. Clean and dry shop-primed ferrous metal surfaces and fabricated assemblies before applying field coats.
   3. Prepare shop epoxy primed surfaces with light abrasive blasting or abrading and then vacuum before applying finish coats.
      a. Follow CSM instructions for surface preparation when the primer recoat limit has been exceeded.
   4. Non-immersion service: Clean in accordance with SSPC-SP 2 (Hand Tool Cleaning) or SSPC-SP 3 (Power Tool Cleaning) and uniformly roughen.
   5. Immersion, BSC, and SC service: Remove shop primer in accordance with SSPC-SP 5 (Near-White Blast Cleaning).

F. Damaged shop primer or rust bleeding:
   1. Ferrous metals: Clean in accordance with SSPC-SP 1 (Solvent Cleaning) and spot blast in accordance with SSPC-SP 10 (Near-White Metal Blast Cleaning) to achieve a uniform surface profile between 2.0 and 2.5 mils before recoating.
   2. Reject galvanized steel with rust bleeding.

G. Damaged coating: Repair by abrasive blast cleaning surfaces as specified for the coating system; feather to a smooth transition before touching up.

3.08 PREPARATION REQUIREMENTS BY SURFACE TYPE

A. Galvanized steel and non-ferrous metal surfaces:
   1. Degrease or solvent clean (SSPC-SP 1) to remove oily residue.
   2. Abrasive blast clean in accordance with SSPC-SP 16.
      a. If abrasive blast cannot be performed, abrade in accordance with SSPC-SP 3 (Power Tool Cleaning).

3. Apply metal pretreatment within 24 hours before coating galvanized surfaces that cannot be thoroughly abraded, such as bolts, nuts, or preformed channels.
4. Test surface for contaminants using copper sulfate solution.

B. Stainless-steel surfaces:
1. Abrasive blast clean in accordance with SSPC-SP 16 to leave a clean, uniform appearance with surface profile between 1.5 and 2.5 mils.

C. Ductile iron pipe and fittings to be lined or coated: Abrasive blast clean in accordance with NAPF 500-03.

D. Sherardized, aluminum, copper, and bronze surfaces:
1. Abrasive blast clean in accordance with SSPC-SP 16.
2. Prepare in accordance with CSM's instructions.

E. Cadmium-plated, zinc-plated, or sherardized fasteners:
1. Abrasive blast in the same manner as uncoated metal when assembling equipment designated for abrasive blasting.

F. PVC and FRP surfaces:
1. Lightly sand surfaces to be coated.
a. Sand to remove gloss and establish uniform surface profile.
2. Vacuum to remove loose dust, dirt, and other materials.
3. Solvent clean with clean white rags and allow solvent to evaporate completely before applying coating materials.

3.09 APPLICATION REQUIREMENTS

A. Apply coatings in accordance with manufacturer's instructions.

B. Empty aboveground piping to be coated of contents when applying coatings.

C. Mechanical equipment shop primed by the manufacturer.
1. Pumps and valves: Shop coat with manufacturer's highest quality coating system meeting the project specifications.
a. Contractor shall provide CTR shop coating reports.
2. Non-immersed equipment: Touch up shop primer, and coat in the field with specified coating system after installation.
a. If project requires equipment removal and reinstallation, complete touch-up coating after final installation.
3. Immersed equipment not shop coated: Remove shop primer before surface preparation and field apply coating.

D. Verify surface preparation immediately before applying coating in accordance with SSPC-SP COM and the SSPC visual standard for the specified surface preparation method.

E. Allow surfaces to dry, except where coating manufacturer requires surface wetting before coating.

F. Wash coat and prime sherardized, aluminum, copper, and bronze surfaces, or prime with manufacturer's recommended special primer.

G. Do not apply coatings to a surface until it has been prepared as specified.

H. Use equipment designed to apply materials specified.
   1. Use compressors with moisture traps and filters that remove water and oils from the air.
      a. Perform a paper blotter test at the Engineer's request to verify air is sufficiently free of oil and moisture. Do not allow the amount of oil and moisture to exceed CSM-recommended amount.
   2. Equip spray equipment with properly sized mechanical agitators, pressure gauges, pressure regulators, and spray nozzles.

I. Where 2 or more coats are required, tint prime coat intermediate coats as necessary to distinguish each coating and to help indicate coverage.
   1. Do not use color additives with chromium, lead or lead compounds that hydrogen sulfide, other corrosive gases, might destroy or alter. Apply the specified number of coats.

J. Apply coating by brush, roller, trowel, or spray unless a specific application method is required by coating manufacturer's instructions or these Specifications.
   1. Apply primer or first coat by brush to power tool cleaned ferrous surfaces.
   2. Brush or spray-apply coats for blast-cleaned ferrous surfaces and subsequent coats for non-blast cleaned ferrous surfaces.
   3. After prime coat dries, mark, repair, and retest pinholes and holidays before intermediate or top coats are applied.

K. Spray application:
   1. With a brush, stripe coat edges, welds, corners, nuts, bolts, and difficult-to-reach areas, as necessary, before spray application to ensure specified coating thickness along edges.
   2. When using spray application, apply each coat to thickness no greater than recommended in coating manufacturer's instructions.
   3. Use airless spray method unless air spray method is required by CSM's instruction or these Specifications.
   4. Conduct spray coating under controlled conditions. Protect adjacent construction and property from coating mist, fumes, or overspray.

L. Lightly sand and thoroughly clean surfaces to receive high-gloss finishes unless CSM instructs otherwise.

M. Remove all dust on coatings between coats.

N. Shop and field coats:
   1. Prime coat: Shop-apply or field-apply prime coats as specified. Use shop-applied primer compatible with the specified field coating system and apply at the minimum dry film thickness recommended by the finish coat CSM.
      a. Provide data sheets identifying the shop primer to on-site coating application personnel.
      b. Perform adhesion tests on the shop primer.

c. Remove and recoat damaged, deteriorated, and poorly applied shop coatings.
d. If shop primer coat meets this Section's requirements, spot prime exposed metal of shop-primed surfaces before spray applying primer over the entire surface.

2. Field coats: Apply field coats with 1 or more prime coats and finish coats to build up coating to dry film thickness specified for the coating system.
   a. Do not apply finish coats until other work in the area is complete and previous coats are inspected.
3. Adhesion confirmation: Perform adhesion tests after proper coating cure in accordance with ASTM D3359. Demonstrate that:
   a. Prime coat adheres to the substrate.
   b. Coatings adhere to the prime and intermediate coats.
      1) Coating 5 mils or more DFT: Achieve adhesion test result of 5A on immersed surfaces and 4A or better on other surfaces.
      2) Coating less than 5 mils DFT: Achieve adhesion test results of 5B on immersed surfaces and 4B or better on other surfaces.

O. Brush, roll, trowel, or spray and back roll coats for concrete and masonry.

P. Plural component coating application:
1. Premix contents of component drums if required by the CSM each day.
2. Before starting application:
   a. Verify gauges are working properly.
   b. Complete ratio checks.
   c. Sample the mix on plastic sheeting to ensure set time is appropriate and complete.
   d. Label and retain all spray samples. Submit to Engineer when requested.

Q. Drying and recoating:
1. Provide fans, heating devices, or other means to prevent condensate or dew on substrate surface or between coats and during curing after applying the last coat.
2. Allow each coat to cure or dry thoroughly, in accordance with if required in CSM’s printed instructions, before recoating.
3. Use CSM's printed instructions and the requirements specified in this Section to determine minimum required drying time.
   a. Do not allow excessive drying time or exposure, which may impair bond between coats.
   b. Recoat all coatings within time limits recommended by CSM.
   c. If time limits are exceeded, abrasive blast clean and de-gloss clean before applying another coat.
4. If limitations on time between abrasive blasting and coating are not met before attaching components to surfaces that cannot be abrasive blasted, coat components before attachment.
5. Ensure primer and intermediate coats of coating are unscarred and completely integral when applying each succeeding coat.
6. Touch up suction spots between coats and apply additional coats where required to produce finished surface of solid, even color, free of defects.

7. Leave no holidays. Repair all holidays in accordance with the requirements on pertinent Coating Detail Sheets or as recommended by the CSM.
8. Sand and feather into a smooth transition and recoat scratched, contaminated, or otherwise damaged coating surfaces so repairs are invisible to the naked eye.

R. Workmanship:
1. Ensure that coated surfaces are free from runs, drips, ridges, waves, laps, and brush marks. Coats shall be applied to produce a smooth, even film of uniform thickness completely coating corners and crevices.
2. Coat surfaces without drops, overspray, dry spray, excessive runs, ridges, waves, holidays, laps, or brush marks.
3. Remove splatter and droppings after coating work is completed.
4. Evenly apply each coat of material and sharply cut to a line created with masking tape or other suitable materials.
5. Avoid over spraying or spattering paint on surfaces not to be coated. Protect glass, hardware, floors, roofs, vehicles, and other adjacent areas and installations by taping, drop cloths, or other suitable measures.
6. When coating complex steel shapes, stripe coat welds, edges of structural steel shapes, metal cut-outs, pits in steel surfaces, or rough surfaces with the primer before overall coating system application.
    a. Brush apply stripe coat to ensure proper coverage.
    b. Do not stripe coat with spray or roller.
7. Ensure that finish coat, including repairs, has a uniform color and gloss.

S. Coating properties, mixing, and thinning:
1. Thin prime coat and apply as recommended by the CSM. Thinned coating must comply with prevailing air pollution control regulations.
2. If maximum recoat time is exceeded, prepare surface with solvent washing, light abrasive blasting, or other procedures per CSM’s instructions.
3. Allow adequate drying time between coats as instructed by the CSM, adjusted as necessary for the site conditions.
4. Ensure that coatings, when applied, provide a satisfactory film and a smooth even surface. Lightly sand glossy undercoats to provide a surface suitable for proper application and adhesion of subsequent coats. Thoroughly stir and strain coating materials during application and maintain uniform consistency.
5. Mix coatings with 2 or more components in accordance with CSM’s instructions.
6. Where necessary to suit conditions of the surface, temperature, weather, and method of application, thin the coating per CSM's recommendations.
    a. Ensure that volatile organic content (VOC) of the thinned coating complies with prevailing air pollution control regulations.
    b. Thin coatings to only what is necessary to obtain proper application characteristics.
    c. Use a thinner recommended by the CSM.

T. Film thickness and continuity:
1. Apply coating to the specified thicknesses.
    a. Apply additional coats when necessary to achieve specified thicknesses, especially at edges and corners.

2. Verify WFT of the coating system first coat and after applying each subsequent coat.
3. Do not allow the minimum thickness at any point to deviate more than 25 percent from the required average.
4. Do not allow the surface area covered per gallon of coating for various types of surfaces to exceed those recommended by the CSM.
    a. Provide coating coverage worksheets listing the maximum and minimum coverage for each unit volume of coating for concrete surfaces.
5. Apply additional coats to achieve the specified dry film thickness if brush or roller application methods cannot achieve the specified film thicknesses per coat.

U. Protecting coated surfaces:
1. Do not handle, work on, or otherwise disturb coated items until the coating is completely dry and hard.
2. After installation, recoat shop-coated surfaces with specified coating system as necessary to match surrounding surfaces, and to coordinate with the specified color identification requirements.

V. Special requirements:
1. Before erection, apply all but the final finish coat to interior surfaces of roof plates, roof rafters and supports, pipe hangers, piping in contact with hangers, and contact surfaces inaccessible after assembly. Apply final coat after erection.
2. Coat structural slip-critical connections and high strength bolts and nuts after erection.
3. Areas damaged during erection:
    a. Prepare surface for spot repairs as specified for the coating system.
    b. Recoat with prime coat before applying subsequent coats.
    c. Touch up surfaces after installation.
    d. Clean and dry surfaces to be coated at time of application.
4. Coat underside of equipment bases and supports not galvanized with at least 2 coats of primer specified before setting the equipment in place.
5. Coat aluminum in contact with concrete.

3.10 APPLICATION REQUIREMENTS FOR CONCRETE COATING SYSTEMS

A. Apply filler/surfacer as recommended by CSM to fill bug holes and air voids in concrete or block texture in CMU, leaving a uniformly filled surface that does not produce blowholes or outgassing causing the coating system to pinhole.
1. Allow filler/surfacers to cure sufficiently before applying prime coat as required by the CSM. Use the CSM-recommended drying time between coats.

B. Apply surfacer or filler and let dry before coating application.
1. Use the drying time between filler/surfacer and coating system specified by the CSM for the site conditions.
    a. Let concrete substrate dry before applying filler/surfacers or coating system materials.
2. If the maximum recoat time is exceeded, prepare surfaces by solvent washing, light abrasive blasting, and other procedures per CSM's instructions.

3. Apply a complete parge coat of the specified filler/surfacer material over the entire substrate before applying the coating system.
    a. Scrub filler/surfacer into the substrate to completely fill open air voids and bug holes.
    b. Completely cover the substrate, unless otherwise specified, above such filled voids by 1/8 inch of thickness.
    c. Provide relatively flat, uniformly even surface before coating application.
4. Secondary containment: Place surfacer or filler 1/16 inch thick above concrete plane to create a monolithic surface free of pinholes.
    a. Floor surfaces: Broadcast with aggregate to create a non-slip surface texture.
    b. Remove excess aggregates and apply base coat to encapsulate embedded non-slip aggregate.

C. Concrete substrate temperatures:
1. Apply filler/surfacers and the coating system when temperatures are falling, typically late afternoon or evening.
    a. Do not coat concrete with rising concrete substrate surface temperatures or substrates in direct sunlight, to minimize outgassing from the substrate and formation of pinholes, and/or blistering.
2. Should bubbles, pinholes, or other discontinuities form in the applied coating system material, they shall be repaired.
    a. Should discontinuities develop in the filler/surfacer material or in the first coat of the coating material, repair them before the next coat.
    b. When discontinuities occur, open the air void behind or beneath the discontinuities and completely fill with specified coating material. Then, abrade the coated area around the discontinuities repair reapply coating over that area.

D. Perform application detail work in accordance with these Specifications, the CSM's current written recommendations, and drawings, whichever is stricter.

E. Concrete coating systems application requirements:
1. Concrete coating minimum dry film thickness excludes parge coat, block filler, and sealer.

3.11 COATING SYSTEM SCHEDULE

A. Attachment A - Schedule of Surfaces to be Field Coated specifies surfaces to be coated in the field with the coating systems required.

3.12 SURFACES NOT REQUIRING COATING

A. Stainless steel piping, valves, pipe supports, instrument sunshades.

B. Sliding surfaces on expansion joints, motor and pump shafts, machined surfaces at bearings and seals, grease fittings, etc.

C. Galvanized structural steel framing, galvanized roof decking, galvanized pipe supports.

D. Copper and brass pipe, fittings, valves, etc.

E. Bronze valves, bearings, bushings, and fasteners.

F. Corrosion resistant special alloys: Inconel, Alloy 20, Hastelloy, etc.

G. Exterior Concrete.

H. Plastic surfaces except coat PVC, CPVC, and other plastic piping system exposed to sunlight.

I. Buried Piping that is encased in concrete or cement mortar.

3.13 QUALITY CONTROL

A. Owner-provided inspection or inspection by others does not limit the Contractor's or CSA's responsibilities for quality workmanship or quality control as specified or as required by the CSM's instructions. Owner inspection is in addition to any inspection required of the Contractor.

B. Owner may perform, or contract with an inspection agency to perform, quality control inspection and testing of the coating work covered by this Section. These inspections may include the following:
   1. Inspect materials upon receipt to ensure that the CSM supplied them.
   2. Verify that specified storage conditions for the coating system materials, solvents, and abrasives are provided.
   3. Inspect and record findings for substrate cleanliness.
   4. Inspect and record pH of concrete and metal substrates.
   5. Inspect and record substrate profile (anchor pattern).
   6. Measure and record ambient air and substrate temperature.
   7. Measure and record relative humidity.
   8. Check for substrate moisture in concrete.
   9. Verify that mixing of coating system materials is in accordance with CSM's instructions.
   10. Inspect, confirm, and record that coating system materials' "pot life" is not exceeded during installation. Inspect to verify that recoat limitations for coating materials are not exceeded.
   11. Perform adhesion testing.
   12. Measure and record the coating system's thickness.
   13. Verify proper curing of the coating system in accordance with the CSM's instructions.
   14. Holiday or continuity testing in accordance with NACE SP0188 for coatings that will be immersed or exposed to aggressively corrosive conditions.

C. Contractor shall perform holiday testing in accordance with NACE SP0188 to identify holidays or pinholes needing repair for coating over 100 percent of surfaces:
   1. Coated steel that will be immersed or exposed to aggressively corrosive conditions.
   2. Coated concrete.
   3. Perform holiday tests after proper application and coating system cure.

3.14 CORRECTIVE MEASURES

A. Repair pinholes or holidays identified by Holiday Testing as follows:
   1. Remove the coating system with a grinder or other suitable power tool.
   2. Remove coating system at all pinholes and holidays at least 2 inches diameter around the defect back to expose substrate.
   3. Concrete voids: chip back to expose entire cavity in all directions.
      a. Completely fill void with approved filler/surfacer material using a putty knife or other suitable tool and strike off. Cure per CSM's recommendations.
   4. Aggressively abrade or sand the intact coating system surface at least 3 inches beyond the removal area in all directions to produce a uniform 6- to 8-mil profile in the intact coating system.
   5. Vacuum the prepared area to remove all dust, dirt, etc., leaving clean, sound surfaces.
   6. Tape to mask the periphery of the prepared intact coating area to prevent coating repair application onto the prepared area.
   7. Apply the coating system with enough coats to achieve the specified finish coat thickness over the defect and coating removal area. Feather the coating onto the abraded coated surfaces around the removal area to avoid a lip and to achieve a neat repair outline.
   8. Follow curing time between coats as specified by CSM for the site conditions. Solvent wash and abrasive blast per CSM's instructions, if the maximum recoat time is exceeded.
   9. Apply coating at specified dry film thickness.

3.15 CLEANUP

A. Remove surplus materials, protective coverings, and accumulated rubbish after completing coating. Thoroughly clean surfaces and repair overspray or other coating-related damage.

3.16 FINAL INSPECTION

A. Conduct final inspection of coating system work to determine whether it meets specifications requirements.

B. Conduct subsequent final inspection with Engineer to ensure work conforms to contract documents requirements.

C. Mark any rework required.
   1. Re-clean and repair, as specified, at no additional cost to the Owner.

END OF SECTION

ATTACHMENT A - SCHEDULE OF SURFACES TO BE COATED

APPENDIX A
Schedule of Surfaces to be Coated

A. The following schedule is incomplete. Coat unlisted surfaces with same coating system as similar listed surfaces. Contact Engineer for clarification.

EPU-M-1	Metals, exterior, non-immersed
EPX-M-2	Metals, interior, non-immersed
EPX-M-3	Metals, immersed; all exterior and interior surfaces of the AWT tanks as indicated on Drawing 85S01
EPX-M-5	Aluminum surfaces in contact with concrete or masonry. Locations where Alkali-resistant bitumastic is specified.
EPX-M-6-BG	Below grade or buried pipes, valves, pits/chambers
EPX-C-7-BG	Below grade or buried pits/chambers

Notes:

1: Non-immersed ferrous metal surfaces include:
- a. Doors, doorframes, ventilators, louvers, grilles, exposed sheet metal, and flashing.
- b. Pipe, valves, pipe hangers, supports and saddles, conduit, cable tray hangers, and supports.
- c. Motors and motor accessory equipment.
- d. Drive gear, drive housing, coupling housings, and miscellaneous gear drive equipment.
- e. Valve and gate operators and stands.
- f. Structural steel.
- g. Crane and hoist rails.
- h. Exterior of tanks and other containment vessels.
- i. Mechanical equipment supports, drive units, and accessories.
- j. Bare electrical equipment: boxes, exposed conduit, and accessories.
- k. Pumps not submerged.
- l. Other miscellaneous metals.

2: Immersed ferrous metal surfaces include:
- a. Interior surfaces of ferrous metal tanks.
- b. Field priming of ferrous metal surfaces with defective shop-prime coat; including non-submerged service.
- c. Bell rings, underside of manhole covers and frames.
- d. Sump pumps, including underside of base plates and submerged suction and discharge piping.
- e. Exterior of submerged piping and valves other than stainless steel or PVC piping.
- f. Submerged pipe supports and hangers.
- g. Stem guides.
- h. Other submerged iron and steel metal unless specified otherwise.

ATTACHMENT B - COATING DETAIL SHEETS

Appendix B			
Coating Detail Sheet			
Coating System	EPU-M-1		
Coating Material	Two coats epoxy with polyurethane finish coat		
Substrate	Metal		
Products: One of the following or equal:	Primer	Intermediate Coat	Finish Coat
Carboline	Carboguard 890	Carboguard 890	Carbothane 134 VOC
International Paint	Devran 224V	Devran 224V	Devthane 379H
PPG	Amerlock 2VOC	Amerlock 2VOC	Amershield VOC
Sherwin Williams	Macropoxy 646 100	Macropoxy 646 100	Hi Solids Polyurethane 250
Tnemec	Series 69	Series 69	Series 1095
Service Condition	Interior or Exterior, subject to direct sunlight. Non-immersion.		
Surface Preparation			
General	Prepare surfaces as specified in this Section and as follows.		
Ferrous Metal	Bare surfaces: SSPC-SP10, Near-White Blast Cleaning. Shop primed surfaces: SSPC-SP2, Hand Tool Cleaning or SSPC-SP3, Power Tool Cleaning. Damaged primer or rust: SSPC-SP10, Near White Blast Cleaning and spot prime.		
Nonferrous Metal	SSPC-SP16, Brush Blast Cleaning.		
Galvanized Metal	SSPC-SP16, Brush Blast Cleaning. Test for surface contaminants.		
Surface profile			
Ferrous Metal	2.5 to 3.0 mils		
Nonferrous Metal	1.5 to 2.0 mils		
Galvanized Metal	1.5 to 2.0 mils		
System Thickness (Dry Film)			
Total	10 to 13 mils		
Primer	4 to 5 mils		
Intermediate Coat	4 to 5 mils		
Finish Coat	2 to 3 mils		
Application			
Special CTR Training	Not required.		

Appendix B			
Coating Detail Sheet			
Coating System	EPX-M-2		
Coating Material	Epoxy		
Substrate	Metal		
Products: One of the following or equal:	Primer	Intermediate Coat	Finish Coat
Carboline	Carboguard 890	Carboguard 890	Carboguard 890
International Paint	Bar-Rust 236	Bar-Rust 236	Bar-Rust 236
PPG	Amerlock 2/400 Series	Amerlock 2/400 Series	Amerlock 2/400 Series
Sherwin Williams	TankClad HS	TankClad HS	TankClad HS
Tnemec	Series 69	Series 69	Series 69
Service Condition	Immersed, non-immersed, moderately corrosive environment.		
Surface Preparation			
General	Prepare surfaces as specified in this Section and as follows.		
Ferrous Metal	Bare surfaces: SSPC-SP5, White Metal Blast Cleaning. Shop primed surfaces: SSPC-SP7, Brush-Off Blast Cleaning. Damaged primer or rust: SSPC-SP5, White Metal Blast Cleaning and spot prime.		
Nonferrous Metal	SSPC-SP16, Brush-Off Blast Cleaning.		
Galvanized Metal	SSPC-SP16, Brush-Off Blast Cleaning.		
Surface profile			
Ferrous Metal	2 to 4 mils		
Nonferrous Metal	1.0 to 1.5 mils		
Galvanized Metal	1.0 to 1.5 mils		
System Thickness (Dry Film)			
Total	12 to 16 mils		
Primer	4 to 6 mils		
Intermediate Coat	4 to 6 mils		
Finish Coat	4 to 6 mils		
Application			
Special CTR Training	Not required.		

Appendix B			
Coating Detail Sheet			
Coating System	EPX-M-3		
Coating Material	Epoxy		
Substrate	Metal		
Products: One of the following or equal:	Primer	Intermediate Coat	Finish Coat
Carboline	Carboguard 891VOC	Carboguard 891VOC	Carboguard 891VOC
International Paint	Bar-Rust 236	Bar-Rust 236	Bar-Rust 236
PPG	Amercoat 240	Amercoat 240	Amercoat 240
Sherwin Williams	Tank Clad HS	Tank Clad HS	Tank Clad HS
Tnemec	Series 104	Series 104	Series 104
Service Condition	Immersed; non-immersed, corrosive environment. Not for Biogenic Sulfide Corrosion areas in wastewater.		
Surface Preparation			
General	Prepare surfaces as specified in this Section and as follows.		
Ferrous Metal	Bare surfaces: SSPC-SP5, White Metal Blast Cleaning. Shop primed surfaces: SSPC-SP7, Brush-Off Blast Cleaning. Damaged primer or rust: SSPC-SP5, White Metal Blast Cleaning and spot prime.		
Nonferrous Metal	SSPC-SP16, Brush-Off Blast Cleaning.		
Galvanized Metal	SSPC-SP16, Brush-Off Blast Cleaning.		
Surface profile			
Ferrous Metal	2.5 to 3.0 mils		
Nonferrous Metal	1.5 to 2.0 mils		
Galvanized Metal	1.5 to 2.0 mils		
System Thickness (Dry Film)			
Total	16 to 20 mils		
Primer	4 to 8 mils		
Intermediate Coat	4 to 8 mils		
Finish Coat	4 to 8 mils		
Application			
Special CTR Training	Not required.		

Appendix B			
Coating Detail Sheet			
Coating System	EPX-M-5		
Coating Material	Epoxy mastic		
Substrate	Metal		
Products: One of the following or equal:	Primer	Intermediate Coat	Finish Coat
Carboline	CSM recommended	None applied	Carbomastic 15
International Paint	CSM recommended	Bar-Rust 231LV	Bar-Rust 231LV
PPG	No product specified	No product specified	No product specified
Sherwin Williams	CSM recommended	No product specified	No product specified
Tnemec	CSM recommended	Series 135	Series 135
Service Condition	Interior, corrosive environment, confined enclosures, where minimal surface preparation is possible.		
Surface Preparation			
General	Prepare surfaces as specified in this Section and as follows.		
Ferrous Metal	Bare surfaces: SSPC-SP11, Power to Cleaning to Bare Metal. Shop primed surfaces: SSPC-SP3, Power Tool Cleaning. Damaged primer or rust: SSPC-SP11, Power to Cleaning to Bare Metal.		
Nonferrous Metal	SSPC-SP16, Brush-Off Blast Cleaning.		
Surface profile			
Ferrous Metal	2.0 to 2.5 mils		
Nonferrous Metal	1.0 to 1.5 mils		
System Thickness (Dry Film)			
Total	15 to 19 mils		
Primer	2 to 4 mils		
Finish Coat	15 mils		
Application			
Special CTR Training	Not Required.		

Appendix B			
Coating Detail Sheet			
Coating System	EPX-M-6-BG		
Coating Material	Epoxy		
Substrate	Metal		
Products: One of the following or equal:	Primer	Intermediate Coat	Finish Coat
Carboline	Carboguard 890	Carboguard 890	Carboguard 890
International Paint	Bar-Rust 236	Bar-Rust 236	Bar-Rust 236
PPG	Amerlock 400	Amerlock 400	Amerlock 400
Sherwin Williams	No product specified	No product specified	No product specified
Tnemec	Series 69	Series 69	Series 69
Service Condition	Below grade in contact with soil.		
Surface Preparation			
General	Prepare surfaces as specified in this Section and as follows.		
Ferrous Metal	SSPC-SP10, Near White Metal Blast Cleaning.		
Nonferrous Metal	SSPC-SP16, Brush-Off Blast Cleaning.		
Galvanized Metal	SSPC-SP16, Brush-Off Blast Cleaning.		
Surface profile			
Ferrous Metal	2.5 to 3.0 mils		
Nonferrous Metal	1.5 to 2.0 mils		
Galvanized Metal	1.5 to 2.0 mils		
System Thickness (Dry Film)			
Total	16 mils		
Primer	4 to 6 mils		
Intermediate Coat	4 to 6 mils		
Finish Coat	4 to 6 mils		
Application			
General	Fill all bugholes with a filler/surfacer compatible with the coating.		
Special CTR Training	Not Required.		

Appendix B			
Coating Detail Sheet			
Coating System	EPX-C-7-BG		
Coating Material	Polyamidoamine epoxy or epoxy coating type with similar performance		
Substrate	Concrete		
Products: One of the following or equal:	Primer	Intermediate Coat	Finish Coat
Carboline	Carboguard 890	Carboguard 890	Carboguard 890
International Paint	Bar-Rust 236	Bar-Rust 236	Bar-Rust 236
PPG	Amerlock 400	Amerlock 400	Amerlock 400
Sherwin Williams	Tank Clad HS	Tank Clad HS	Tank Clad HS
Tnemec	Series 69	Series 69	Series 69
Service Condition	Below grade in contact with soil.		
Surface Preparation			
General	Prepare surfaces as specified in this Section and as follows.		
Surface profile			
Concrete	ICRI CSP 3.		
Existing Coated Concrete	ICRI CSP 3.		
System Thickness (Dry Film)			
Total	16 mils		
Primer	4 to 6 mils		
Intermediate Coat	4 to 6 mils		
Finish Coat	4 to 6 mils		
Application			
General	Fill all bugholes with a filler/surfacer compatible with the coating.		
Special CTR Training	Not Required.		

SECTION 09986

PAINTING PRESTRESSED CONCRETE WATER TANKS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Painting and coatings for prestressed concrete water tanks.

1.02 REFERENCES

A. Military Specifications (MS):
   1. MIL-P-23236 - Paint Coating Systems, Fuel and Salt Water Ballast Tanks.

B. Society for Protective Coatings (SSPC):
   1. SP-1 - Solvent Cleaning.

C. United States Navy (USN):
   1. QPL/QMLs - Qualified Products/Manufacturers Lists.

1.03 SUBMITTALS

A. Product data.

B. Quality control submittals.

1.04 QUALITY ASSURANCE

A. Qualifications of off-site applicator of coal tar epoxy: Will not be allowed unless by applicator with proven, documented, experience acceptable to Engineer in application of coal tar epoxy systems.

1.05 PROJECT CONDITIONS

A. Environmental requirements:
   1. Application of coal tar epoxy: Do not apply coal tar epoxy when ambient and/or surface temperature is less than 50 degrees Fahrenheit.

PART 2 PRODUCTS

2.01 MATERIALS

A. Prestressed Concrete Tank Shotcrete Finish Painting: Non-Cementitious, high build, 100-percent acrylic resin polymer:
   1. Tnemec: Envirocrete 156.
   2. Sherwin Williams: Loxon XP WP.

~~B. Prestressed Concrete Tank Roof Coating: Type II asphalt conforming to ASTM D449 and gravel.~~[AD3]

B. Prestressed Concrete Tank Roof Coating: Non-cementitious, high build, 100 percent acrylic resin polymer:
   1. Tnemec: Envirocrete 156.
   2. Sherwin Williams: Loxon XP WP.[AD3]

2.02 MIXES

A. Mix in accordance with manufactures instructions.

PART 3 EXECUTION

3.01 PREPARATION

A. Surface preparation: For surfaces designated to be painted:
   1. General: Prepare surfaces in accordance with manufacturer's installation instructions.

Surface Preparation Number	Surface Preparation Process
SP-1	Painting Concrete And Shotcrete: Remove form release agents from poured or precast surfaces by sandblasting or as recommended by paint manufacturer.

3.02 PRESTRESSED CONCRETE TANK SHOTCRETE FINISH PAINTING

A. Preparation: Prepare surfaces in accordance with general application requirements and in strict accordance with coating manufacturer's instructions.

B. Application:
   1. Apply primer if required by coating manufacturer.
   2. Apply 2 or more coats as recommended by coating manufacturer to receive a minimum total DFT of 12 mils; color as selected by the Owner.
   3. Apply finish paint to a depth of one foot below finish grade.

3.03 PRESTRESSED CONCRETE ROOF COATING

A. Preparation:
   1. Prepare surfaces in accordance with general application requirements and in strict accordance with coating manufacturer's instructions.

B. Application:
   1. Apply suitable concrete primer.
   2. Cover with Type II asphalt, conforming to ASTM D449, at a minimum rate of 60 lbs per 100 sqft.
   3. While the asphalt is still hot embed an approved gravel or small rock at the rate of approximately 10 psf.

3.04 FIELD QUALITY CONTROL

A. Inspection:
   1. Coal tar epoxy paints: Check film thickness after application and before coating has cured to be sure that sufficient coating thickness has been applied before coal tar epoxy coating is allowed to set overnight.

3.05 ADJUSTING

A. Remedial work for coal tar epoxy coatings:
   1. Non-conformance with application or thickness requirements:
      a. If surface coatings are not applied in accordance with following:
         1) Time limits listed in Table A in this Section or,
         2) Coatings have cured or set and,
         3) Coatings have not been applied to specified thickness, then areas that are below specified thickness requirements are to be sandblasted.
      b. Sandblasting:
         1) Sandblast as required to remove surface film from coatings.
         2) Sandblasted areas:
            a) Wash and clean with solvent as recommended by manufacturer, and then recoat within time limits specified for coating over fresh coating.
            b) Washing or cleaning surface of paint with solvents or other solutions will not be satisfactory substitute for specified sandblasting where painted surface is older than time limits listed in Table A in this Section.
   2. In event that recoating of overage coated surface occurs without sandblasting and solvent treatment specified in this article: Entire painting system, down to substrate, is to be removed by sandblasting or other means, and complete new painting system applied.

END OF SECTION

[AD3] Addendum No. 3

SECTION 10400

SIGNAGE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Plastic and metal signs for building and site use.

1.02 REFERENCES

A. National Fire Protection Association (NFPA):
   1. 704 - Standard System for the Identification of the Hazards of Materials for Emergency Response.

B. Occupational Safety and Health Administration (OSHA).

1.03 SUBMITTALS

A. Product data.

B. Shop drawings: Include lists of sign types, sizes, text, and colors; mounting details; locations; and cast metal plaque rubbings and templates.

C. Samples: Include actual materials.

D. Manufacturer's installation instructions.

1.04 QUALITY ASSURANCE

A. Manufacturer qualifications: Manufacturer of proposed products for minimum 5 years with satisfactory performance record of minimum 5 years.

B. Installer qualifications: Manufacturer approved installer of products similar to specified products on minimum 10 projects of similar scope as Project with satisfactory performance record.

C. Regulatory requirements: Provide signage in accordance with Americans with Disabilities Act as published in the Federal Register, Volume 56, No. 144, Friday, July 26, 1991.

PART 2 PRODUCTS

2.01 PLASTIC SIGNAGE SYSTEM

A. Manufacturers:
   1. One of the following or equal:
      a. Best Manufacturing Sign Systems, System 900013.
      b. Andco Industries Corp., equivalent product.
      c. Vomar Products, Inc., equivalent product.

B. Attachment:
   1. Vinyl tape, self-adhering.

C. Lettering:
   1. Helvetica medium, 3/4 inches high.

D. Material for interior use:
   1. Plastic 1/8-inch-thick raised letters.

E. Material for exterior use:
   1. Fiberglass 1/4-inch thick with high gloss finish, raised letters, blasted from single piece of fiberglass for integral letter and background.
   2. No adhesive as mechanical fastening of letters shall be allowed.

F. Colors:
   1. As selected by Engineer from manufacturer's standard colors.

G. See Attachment A - Plastic Signage System Schedule for specific sign size, location, text, pictogram, and quantity.

2.02 METAL SAFETY SIGNS

A. Manufacturer: Meeting OSHA Requirements; 40-mil thick aluminum with baked enamel finish. One of the following or equal:
   1. Seton Name Plate Co., Special Wording.
   2. Emedco.

B. Danger sign colors:
   1. Background: White.
   2. Heading: White lettering on red oval with white border in black rectangular panel.
   3. Message: Black lettering on white.
   4. Size: As scheduled.

C. Caution sign colors:
   1. Background: Yellow.
   2. Heading: Yellow lettering on black rectangular panel.
   3. Message: Black lettering on yellow.
   4. Size: As scheduled.

D. Safety instruction signs:
   1. Background: White.
   2. Heading: White lettering on green rectangular panel.
   3. Message: Black lettering.
   4. Size: As scheduled.

E. Warning sign colors:
   1. Background: Orange.
   2. Heading: Black lettering on orange diamond in black rectangular panel.
   3. Message: Flack lettering on orange.
   4. Size: As scheduled.

F. Notice information signs:
   1. Background: White.
   2. Heading: White lettering on blue rectangular panel.
   3. Message: Black lettering.
   4. Size: As scheduled.

G. Fasteners: Round head stainless steel bolts or screws.

H. See Attachment B - Metal Safety Sign Schedule for specific sign size, location, text, and quantity.

2.03 EXTERIOR INFORMATION SIGNS

A. Able to withstand 100 miles per hour wind load without damage:
   1. Manufacturers: One of the following or equal:
      a. Best Manufacturing Sign Systems; equivalent product.
      b. Andco Industries Corp., equivalent product.
      c. Vomar Products, Inc., equivalent product.

B. Sign panel: Nominal 3 inches thick, consisting of 1/8-inch-thick fiberglass material with integral returns fully encapsulating wood and foam core, 1/8-inch radius edges and corners, size as indicated on the Drawings.

C. Text: Helvetica medium, size and wording as indicated on the Drawings.

D. Posts: Nominal 3-inch square extruded aluminum sections with aluminum fillers at top and bottom, mounting hardware, and aluminum baseplates drilled for anchor bolts.

E. Fasteners: Manufacturer's standard, suitable for application.

F. Colors: As selected from manufacturer's standard colors.

2.04 CAST METAL PLAQUE

A. Manufacturers: One of the following or equal:
   1. Andco Industries Corp.
   2. Southwell Co.
   3. ARK-RAMOS Inc.

B. Material: Cast bronze.

C. Size: Approximately 28 by 34 inches by minimum 3/16 inches thick; lettering, center panel, and trim raised 1/8 inch.

D. Lettering: Text as directed by Engineer. Verify before fabrication.

E. Finishes:
   1. Lettering, center panel, and trim: Fine satin.
   2. Background: Finely pebbled, oxidized to dull black color.

F. Mounting: Concealed with fasteners.

2.05 HAZARD MATERIAL SIGNALS

A. Manufacturer: One of the following or equal:
   1. Seton Name Plate Co.
   2. Emedco.

B. Hazard material signals: In accordance with NFPA 704; 40-mil thick aluminum with baked enamel finish panels, letters, and symbols with pressure sensitive adhesive, sizes as required for viewing distances, letters and symbols in accordance with Attachment C - Hazard Material Signals.

2.06 CAST ALUMINUM LETTERS

A. Manufacturers:
   1. One of the following or equal:
      a. Metal Arts.
      b. Southwell Co.
      c. OMC Industries.

B. Material:
   1. Cast aluminum.

C. Text size and font:
   1. As indicated on the Drawings.

D. Finish:
   1. Black duranodic coating.

E. Mounting:
   1. Projected jamb nut mounting, concealed.

2.07 DECAL SIGNS ON GLASS

A. Provide decal signs of the international symbol for accessibility, in accordance with requirements of CBC 1127B.3 for entry signs. Signs to comply with CBC 1117B.5 through 1117B.5.9. Locate signs as follows:
   1. Door or sidelight of Door No.

PART 3 EXECUTION

3.01 PREPARATION

A. Protect adjacent surfaces which may be damaged by installation of signs.

B. Prepare substrates in accordance with sign manufacturer's instructions.

C. Remove scale, dirt, grease, and other contaminates from substrates.

3.02 INSTALLATION

A. Install signs in accordance with sign manufacturer's instructions.

B. Fasten signs securely in level, plumb, and true to plane positions.

C. Install signs where indicated on the Drawings.

END OF SECTION

ATTACHMENT A - PLASTIC SIGNAGE SYSTEM SCHEDULE

PLASTIC SIGNAGE SYSTEM SCHEDULE

A. Room Names:
   1. Location: On wall outside room adjacent to latch side of doors or when not enough space on latch side, on nearest adjacent wall.
   2. Height: 60 inches above floor to center or sign.
   3. Size: 6 inches square.
   4. Colors: As selected by Engineer.
   5. Text: Sign per door describing room function as indicated on the Drawings.

B. Fire Extinguishers:
   1. Location: Adjacent to fire extinguishers.
   2. Height: 60 inches above floor to center of sign.
   3. Size: 6 inches square.
   4. Colors: White letters on OSHA Red background.
   5. Text: FIRE EXTINGUISHER.

C. Nonpotable Water:
   1. Location: At impure water and nonpotable water hose valves in accordance with Typical Detail M276.
   2. Height: In accordance with Typical Detail.
   3. Size: 10 inches wide by 7 inches high.
   4. Heading: CAUTION
   5. Text: IMPURE WATER
      DO NOT DRINK

ATTACHMENT B - METAL SAFETY SIGN SCHEDULE

METAL SAFETY SIGN SCHEDULE

A. CHLORINATION AND SULFONATION EQUIPMENT:
   1. Location: Adjacent to exterior doors and gate of Chlorination-Dechlorination building.
   2. Size: 14 inches wide by 10 inches high.
   3. Heading: CAUTION
   4. Wording: CHLORINATION AND SULFONATION EQUIPMENT
      DANGEROUS GAS

B. NONPOTABLE WATER:
   1. Location: At impure water and nonpotable water hose valves in accordance with Typical Detail M276.
   2. Height: In accordance with Typical Detail.
   3. Size: 10 inches wide by 7 inches high.
   4. Heading: DANGER
   5. Wording: DO NOT DRINK THIS WATER

C. REMOTELY CONTROLLED AUTOMATIC EQUIPMENT:
   1. Location: On front and back of equipment that starts automatically by remote control.
   2. Heading: DANGER
   3. Wording: THIS EQUIPMENT STARTS AUTOMATICALLY
      BY REMOTE CONTROL

D. HIGH VOLTAGE WARNING:
   1. Location: On front and back of equipment, adjacent to doors to rooms containing devices, and devices that operate at 600 volts or greater.
   2. Heading: DANGER
   3. Wording: HIGH VOLTAGE
      KEEP OUT

E. NO SMOKING INFORMATIONAL SIGNS:
   1. Location: On exterior face of wall, adjacent to each entry point (exterior door) to all buildings.
   2. Height: 60 inches above floor to center of sign. Where metal safety signs are also located adjacent to entry points, place no smoking signs below these signs.
   3. Size: 6 inches square.
   4. Heading: None.
   5. Wording: None.
   6. Pictogram: International “No Smoking” symbol.

F. NO SMOKING WITHIN 25 FEET OF BUILDING ENTRY:
   1. Location: As indicated on the Drawings.
   2. Height: Pole mounted with top of sign at 5 feet above grade.
   3. Size: 14 inches wide by 10 inches high.
   4. Heading: NOTICE
   5. Wording: NO SMOKING WITHIN 25 FEET OF BUILDING.
   6. Pictogram: International “No Smoking” symbol.

G. ACCESSIBLE PARKING SIGN (POST MOUNTED AND REFLECTORIZED):
   1. Location: Centered on the parking space reserved for persons with disabilities in accordance with UBC 1129B5.
   2. Height: 60 inches from the bottom of sign to parking space finished grade, in accordance with UBC 1129B5.
   3. Size: Not smaller than 70 square inches.
   4. Wording: As required to suit local regulations.
   5. Pictogram: Symbol of accessibility in white on dark blue.

ATTACHMENT C - HAZARD MATERIAL SIGNALS

HAZARD MATERIAL SIGNALS

A. HAZARD SIGNAL FOR FERRIC CHLORIDE 35 - 45 PERCENT:
   1. Location: At entrances to locations where stored and on storage tanks.
   2. Health: 3
   3. Flammability: 0
   4. Reactivity: 0
   5. Special: -

SECTION 10520

FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Fire extinguishers and cabinets.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. E814-11a - Standard Test Method for Fire Tests of Penetration Firestop Systems.

B. National Fire Protection Association (NFPA):
   1. 10 - Standard for Portable Fire Extinguishers.

C. Underwriters Laboratories, Inc. (UL):
   1. 711 - Rating and Fire Testing of Fire Extinguishers.

1.03 SUBMITTALS

A. Product data.
   1. Cabinets: Materials description for fire extinguisher cabinets include roughing-in dimensions, details showing mounting methods, relationships to surrounding construction, door hardware cabinet type and materials, trim style and door construction, door style and materials.
   2. Extinguishers: Materials description for fire extinguishers; include ratings and classifications.
   3. Installation instructions for each product specified.

B. Shop drawings:
   1. Small-scale plans showing locations of fire extinguisher cabinets and individual fire extinguishers.
   2. Schedule showing each type of cabinet and extinguisher to ensure proper fit and function.
   3. Indicate installation procedures and accessories required for a complete installation.

1.04 QUALITY ASSURANCE

A. Manufacturer qualifications: Minimum 5 years with satisfactory performance record.

1.05 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The following or equal:
   1. Activar Construction Products Group – JL Industries.

2.02 FIRE EXTINGUISHERS

A. Multi-purpose chemical type:
   1. Extinguisher unit containing a fluidized and siliconized mono ammonium phosphate powder; nonconductive and nontoxic.
   2. Construction: Heavy duty steel cylinder with metal valve and siphon tube, o-ring seal, replaceable valve stem seal, visual pressure gage, pull pin and upright squeeze grip.
   3. Finish: Factory powder-coated: Red.
   4. UL Effectiveness Rating in accordance with UL 711: Class A, B, and C fires.
   5. UL Rating in accordance with UL 711: 4A-80BC.
   6. Drawing will use the symbol FE for “Fire Extinguisher”.

B. Regular dry chemical type:
   1. Extinguisher unit containing Halotron™.
   2. Size minimum: 11 pounds.
   3. Construction: Heavy duty steel cylinder with metal valve and siphon tube, o-ring seal, replaceable valve stem seal, visual pressure gage, pull pin, and upright squeeze grip.
   4. Finish: Factory powder-coated; Red.
   5. UL Effectiveness Rating in accordance with UL 711: Class B and C fires.
   6. UL Rating in accordance with UL 711: 2A-10BC.
   7. Drawing will use the symbol EFE for “Electrical Fire Extinguisher”.

2.03 WALL BRACKETS

A. Type: Standard as manufactured by fire extinguisher manufacturer.

2.04 EXTRA MATERIALS

A. Furnish a minimum 10 percent, but not less than 1, of fire extinguishers with brackets installed in addition to the number indicated on the Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance NFPA 10, Standard for Portable Fire Extinguishers.

3.02 LOCATIONS

A. Install fire extinguisher type, FE and EFE, as indicated on the Drawings.

B. Install fire extinguisher mounting in cabinets or wall brackets as indicated on the Drawings.

END OF SECTION

SECTION 10732

SHADE FABRIC

PART 1 GENERAL

1.01 SUMMARY

A. Work included: Fabricate, and install shade fabric on the structure as detailed including:
   1. Fabricated shade panels.
   2. Stainless steel cables.
   3. Clamping.
   4. Fasteners.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
   2. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Stops.
   3. F3125 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi and 150 ksi Minimum Tensile Strength.

1.03 QUALITY ASSURANCE

A. Fabrication and erection is limited to firms with proven experience in design and construction of fabric shade structures and such firms shall meet the following minimum requirements:
   1. A single Contractor shall manufacture and erect the fabric shade.
   2. The Contractor shall demonstrate to have a minimum of 10 years of experience in the engineering, fabrication, and erection of permanent fabric structures.
   3. Contractor shall demonstrate that it has a staff of experienced fabric structure installation personnel who will undertake the installation of each project.

1.04 WARRANTY

A. After final payment, the Contractor shall furnish the Owner with a written 10-year warranty, which warrants that the fabric panels (cloth, stitching, and fading), its perimeter attachment system, and the structural support systems supplied and installed by the subcontractor has been installed in accordance with the project and manufacturer's specifications and will be free from defects in materials and workmanship which will impair its normal use or service.
   1. The warranty shall extend from the date of substantial completion of the fabric panel shade structure, specifically the first date on which the entire fabric panel system is subject to design pre-stress conditions.

1.05 SUBMITTALS

A. Contractor shall submit drawings and calculations showing the design meets all code provisions.

B. Calculations shall include the fabric attachment and tensioning.

PART 2 PRODUCTS

2.01 MANUFACTURERS/FABRICATORS

A. The following or equal:
   1. Sun Ports International, Inc.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Comply with the requirements of the building code specified in Section 01410 - Regulatory Requirements.

B. Design and fabricate shade fabric and support system for resistance to the following loads as specified in Section 01850 - Design Criteria:
   1. Seismic loading
   2. Wind loading, based on the requirements for "components and cladding."

C. Shade fabric shall be flame-resistant.

D. Life safety:
   1. Fabric shade structures shall be designed so no life safety issue is created in the event of a loss of a part of the fabric.
   2. The fabric structure shall not rely on the fabric for structural stability.

2.03 MATERIALS

A. Erection hardware:
   1. Bolt and fastening hardware shall be determined based on calculated engineering loads.
   2. Specifications, based on the following load requirements are:
      a. Low strength: ASTM F593 stainless steel bolts, nuts, and washers.
      b. Medium strength: ASTM A307 zinc-plated steel bolts, nuts, and washers.
      c. High strength: ASTM F3125, Grade A325 zinc-plated steel bolts, nuts, and washers.

B. Cable:
   1. Steel cable is a determined based on calculated engineering load.
      a. For light and medium loads: 1/4-inch (nominal) galvanized 7 by 19 cable is used.
      b. For heavy loads: 3/8-inch (nominal) galvanized 7 by 19 cable is used.

C. Thread:
   1. Gore™ TENARA® sewing thread is made up of 100 percent expanded polytetrafluorethylene fiber, known as Teflon™.
      a. The sewing thread carries a 10-year warranty against deterioration from exposure to the elements.
   2. Shall be high strength and low shrinkage.
   3. Shall have a wide temperature and humidity range.
   4. Flew and abrasion resistant and ultraviolet radiation immunity.
   5. Shall be unaffected by cleaning agents, acid rain, mildew, rot, chlorine, saltwater, and pollution.
   6. Lockstitch thread: 1200 Denier or approved equal.
   7. Chainstitch thread: 2400 Denier or approved equal.

D. Edge details:
   1. Perimeter shall contain cables and be double lock stitched.
      a. The cable shall be contained in a non-tear cloth edge firmly sewed to the fabric.
   2. Brass grommets spaced at one foot centers shall be installed inside the cable and in the non-tear edge.

E. Fabric:
   1. Raw material:
      a. Shadesure® High Density Polyethylene (or equal).
      b. Special chemicals for ultraviolet stability.
   2. Construction:
      a. Monofilament tape construction.
   3. Fabric panel material:
      a. Cloth shall be made of Shadesure® high density polyethylene cloth with ultraviolet stabilizer treatment (or equal).
      b. Color shall be as selected by Engineer.
         1) Red is not acceptable.
      c. The material shall be manufactured with tensioned fabric structures in mind.

d. The fabric knit is to be made using monofilament and tape filler which has weight of 0.6 ounce per square foot.
    1) Material to be Rachel knitted so material will not unravel if cut.
e. Burst strength of 35 pounds per square inch.

Finish	Stentored
Shade Protection	80 percent
UV Protection	90 percent
Tear Tests (lbs)	Warp 200 Weft 450 pounds
Fabric Weight (oz/m2)	6.9
Life Expectancy	12 years in sun
Fading	Minimum fading after 10 years
Temperature	-22 degrees Fahrenheit
Maximum Temperature	+ 176 degrees Fahrenheit

F. Rope:
    1. Polypropylene rope: Polypropylene rope for lacing the shade to the frame shall be ultraviolet resistant and have sufficient capacity to carry the weight of the shade, tension force and any wind and live loads applied to the fabric panel.

PART 3 EXECUTION

3.01 INSTALLATION AND SAFETY PROCEDURES

A. The Contract Work to be performed shall consist of furnishing all labor, materials, equipment, parts, and supplies necessary for installation.

B. Shade shall be attached to steel pipe frame using polypropylene rope.
    1. Shade shall be taut and be sloped to drain as indicated on the Drawings.

END OF SECTION

SECTION 11242

LIQUID CHEMICAL DIAPHRAGM-TYPE METERING PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Positive displacement, diaphragm metering pumps; accessories, drives, and control panel requirements for pumping chemical solutions.

B. Tag numbers:
   1. As specified in Pump Schedule.

1.02 REFERENCES

A. Instrumentation Controls Specialty Contractor (ICSC).

B. International Society of Automation (ISA):
   1. ISA5.4 - Instrument Loop Diagrams.

C. National Electrical Code (NEC).

D. National Electrical Manufacturer's Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

E. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.

F. Underwriters Laboratories, Inc. (UL):
   1. 508 - Standard for Industrial Control Equipment.
   2. 508A - Standard for Industrial Control Panels.
   3. 698A – Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.
   4. 1283 - Standard for Electromagnetic Interference Filters.
   5. 1449 - Surge Protective Devices.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: As specified in Section 15050 - Common Work Results for Mechanical Equipment.
   1. Design data, test reports, certificates, manufacturer’s instructions, manufacturer’s field reports:
      a. Chemical feed pumps:
         1) For each pump type, submit calibration charts and tables relating flow rate to stroke length and stroke rate.

2) Submit hydraulic modeling results for each pumping system.
    a) Confirm scheduled values or recommend new pressure setpoints for the backpressure valves and pressure relief valves listed in the Pump Schedule.
3) Submit calculations for each metering pump showing the suitability of each pump for the suction and discharge conditions of each application point.
    a) Pump manufacturer shall recommend and size an accumulator to be piped to the suction side of each metering pump, when required based on calculations.
4) Submit calculations recommending dimensions of pulsation dampener indicated on the Drawings.

C. Shop drawings: As specified in Section 15050 - Common Work Results for Mechanical Equipment.
    1. Provide a list of parameters, ratings, or other characteristics where the proposed chemical feed systems deviate from the requirements.
    2. Dimensions, including anchor bolt layout, materials of construction, size, weight, and performance data.
    3. Drawings: Provide electrical and instrumentation drawings showing coordination with electrical control devices operating in conjunction with the associated feed system.
    4. Dimensioned inlet and outlet connections.
    5. Current NSF 61 Certification for components to be in contact with associated chemical or potable water.
    6. Provide data showing chemical compatibility and history of service with the associated chemical for materials in the system.
    7. Control panel views showing equipment arrangement, doors, equipment layout inside the panel and dimensional information.
    8. Internal interconnecting wiring diagrams showing terminal strips and external devices connected to the panel as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.
    9. Loop drawings for analog and discrete signals in accordance with ISA5.4.
    10. Complete schematic and diagrams including terminal block and wire identification numbers and device location symbols consistent with the Contract Documents.
    11. Panel bill of material with detailed description of components and equipment data sheets.
    12. Field cable numbers and terminations.
    13. Manufacturer’s Representative’s qualifications as specified in Section 01756 - Commissioning.
    14. Manufacturer’s certificate stating that the materials of construction are compatible with the pumped fluid.
    15. Manufacturer’s Certificate of Source Testing as specified in Section 01756 - Commissioning.
    16. Manufacturer’s Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.
    17. Calibration curves for each pump relating stroke length to flow rate shall be supplied.

18. Capacity control shall be 0 to 100 percent with delivery repeatable within plus or minus 1 percent accuracy over at least a 10 to 1 range.
19. Motor and VFD supplier shall carefully review the intended application of the VFD and certify in writing that sizes provided are adequate for continuous or intermittent operations (whichever is the most severe operating condition.

D. Calculations: As specified in Section 15050 - Common Work Results for Mechanical Equipment.

E. Vendor operation and maintenance manuals: As specified in Section 01782 - Operation and Maintenance Manuals.
1. Provide information on each piece of equipment, including instrumentation.
2. Provide all safety considerations relating to operations and handling of the associated chemical.
3. Maintenance data shall include all information and instructions required by plant personnel to keep equipment properly cleaned, lubricated, and adjusted so that it functions economically throughout its full design life.
4. Lubrication charts and tables of alternate lubricants.
5. Name, address, and phone number of manufacturer and manufacturer's local service representative.

F. Commissioning submittals:
1. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756 - Commissioning.
2. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.04 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

B. Special warranty:
1. Provide an additional 2 years manufacturer's warranty, issued in the name of the Owner, for all equipment provided under this Section.

1.05 DELIVERY, STORAGE AND HANDLING

A. Packing, shipping, handling, and unloading:
1. Pack for shipping and outdoor storage at the project site for up to 6 months.
   a. Apply temporary corrosion protective coatings to unpainted components and pack components to protect from the elements.
2. Ship pump and drive completely assembled.
   a. VFD shall be shipped unwired to the motor for field wiring.

PART 2 PRODUCTS

2.01 GENERAL

A. A single pump manufacturer shall furnish and coordinate all drives and pump components specified in this Section, including motors, gears, couplings, supports,

and other specified accessories and appurtenances to ensure compatibility and integrity of the individual components.

B. The manufacturer of the pumps shall have sole-source responsibility for furnishing the complete assemblies and meeting the specified performance requirements.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. General: Provide mechanically actuated, positive displacement, diaphragm type chemical metering pumps, accessories, and other items required for a complete and operational system. Each chemical metering pump system shall include, but not be limited to, the following items, which shall be supplied by the chemical metering pump manufacturer.
   1. Pumps.
   2. Motors.
   3. Variable frequency drive (VFD) (as applicable).
   4. DC Drive (as applicable)
   5. Control panels.
   6. Calibration columns.
   7. Pulsation dampeners.
   8. External pressure relief valves.
   9. Diaphragm back pressure valves.

B. Fluid characteristics:
   1. Ferric chloride:
      a. Dry chemical formula: $2FeCl_3$.
      b. Solution concentration: 40 percent by weight.
      c. Solution pH: < 2.
      d. Solution specific gravity: 1.4.

C. Design requirements:
   1. Pump:
      a. Dry self-priming, capable of being run dry without damaging effects to pump.
   2. Motor characteristics:
      a. As specified in this Section and in Section 16222 - Low Voltage Motors up to 500 Horsepower.
      b. Minimum acceptable motor size is 1/2 horsepower.
   3. VFD characteristics: As specified in this Section.
   4. Shafting and couplings: Design shafting and couplings to withstand a minimum of 1.5 times the maximum operating torque or other imposed loads.
   5. Supports:
      a. Provide pump and driver supported on a common base.
      b. Design anchor bolts to withstand a minimum of 1.5 times the maximum imposed operating loads or 1.0 times the imposed seismic loads, whichever is greater.

D. Performance requirements:
   1. Systems shall deliver the pressures and volumes listed for their respective services in the Pump Schedule.

E. Product requirements as specified in Section 01600 - Product Requirements and Section 15050 - Common Work Results for Mechanical Equipment.

2.03 PUMPS

A. Existing products:
   1. Existing facility has ProMinent brand pumps.
   2. New pumps must match style, material, finish, operation, and dimensions.

B. Equipment:
   1. Pump:
      a. Manufacturer, no equal:
         1) Prominent Fluid Controls, Inc.
   2. Type: Simplex chemical proportioning pumps of the positive displacement diaphragm type.
   3. Materials:
      a. The metering pumps and their components and accessories shall be suitable for the following chemical concentrations, as scheduled in this Section:
         1) Ferric chloride:
            a) Wetted parts shall be suitable for use with 23 to 43 percent ferric chloride solution.
            b) Other non-specified materials are to be manufacturer’s standard for continuous service with 23 to 43 percent ferric chloride solution.
      b. Diaphragm materials:
         1) Flat, composite, mechanically actuated diaphragms shall be Viton™, EPDM or PTFE faced as pump manufacturer deems suitable for the pumped liquid, fiber reinforced and bonded to an elastomeric support with a Type 316 stainless steel backing plate.
         2) Flat, composite, hydraulically actuated diaphragms shall be Viton™, EPDM or PTFE faced as pump manufacturer deems suitable for the pumped liquid.
         3) Tubular, hydraulically actuated diaphragms shall be Viton™, EPDM or PTFE lined, as pump manufacturer deems suitable for the pumped liquid.
      c. Other parts in contact with pumped liquid: PTFE, PVC, or other suitable thermoplastic.
   4. Characteristics:
      a. Diaphragm simplex chemical proportioning pumps of the positive displacement diaphragm type.
      b. The diaphragm shall be mechanically actuated.
      c. Liquid end:
         1) Liquid end shall be sealed by means of an O-ring of material compatible with the pumped liquid.

2) Pumps for sodium hypochlorite service shall be equipped with an off-gassing valve.
3) Liquid end of each metering pump shall be fitted with a system to detect early stage diaphragm failure. Upon actuation, the leak detector shall stop the pump, light a locally visible LED and sound a remote alarm.

5. Components:
   a. Manually controlled external stroke controllers.
   b. Suction and discharge single check valves.
   c. Built-in internal or external, adjustable pressure relief valve to relieve pressure in the event of discharge line stoppage; which shall be factory set to relieve at 100 pounds per square inch gauge.
   d. Hydraulic make-up and air bleed valves.
6. Accessories: As indicated on the Drawings, pumps shall be equipped with:
   a. Calibration column in suction piping.
   b. Diaphragm backpressure, pulsation dampener, and pressure relief valve in discharge piping.
7. Tests and inspections:
   a. As scheduled in this Section.
8. Verification of performance.

2.04 MOTOR

A. Type:
1. Each chemical metering pump shall be motor-driven through a flexible coupling, or direct-connected to the pump when manufacturer's standard.
2. Pumps and motors shall be mounted on floor-mountable base plates.
   a. Coupler:
      1) Manufacturers: One of the following or equal:
         a) Dodge, Para-flex.
         b) Falk, Type WA.
         c) Baldor.

B. Characteristics:
1. Electric motors shall be as specified in Section 16222 - Low Voltage Motors up to 500 Horsepower.

2. Motors and motor starters shall be furnished by the pump manufacturer and shall be coordinated with the requirements of the pumps and the following characteristics:

Tag Number	PMP-85183
Driver Type	DC Drive
Drive Coupling	Close-coupled, Verfical
Horsepower (Minimum)	1/2
Supply Voltage/Phase/Hertz	120/1/60
Speed (Maximum)	1,750 rpm
Service Factor	1.0
Ambient Temperature	40 degrees Centigrade
Maximum Temperature Rise	40 degrees Centigrade
Enclosure	TENV
Insulation	Class F
Bearings	6203
Fasteners	

3. PMP-85183 (Coagulant Pump): The motor shall be a permanent magnet type, having a 90-volt direct current armature rating, and horsepower not less than the minimum specified rating. If the pump and motor are replaced to match the existing system, use Baldor Motor CDP3330 with Spec No. 33-2092Z122. This is a special-order motor with longer motor leads and should also be suitable for mounting an encoder on the NDE of the motor. Use Dart Controls DC Drive MD50P with encoder for monitoring speed feedback.
4. Motor shall have a thermostat for high temperature shutdown.
5. The motor brushes shall have tinned leads.

2.05 VENDOR CONTROL PANEL

A. General:
   1. Replace existing DC drive only, all other existing components to remain in place.

B. DC drive with integrated controller:
   1. Manufacturer: The following, no equal:
      a. Dart Controls, MD50P with OPT420 module.
   2. Display: 1/2 inch LED.
   3. Ambient temperature: -10 – 45 degrees Celsius.
   4. Line input frequency: 60 Hz.
   5. Overload capacity: 200 percent for 1 minute.

C. Monitoring and control:
    1. Dry contact rating: 120 VAC at 10 A.
    2. Analog signal type: 4-20 mA.
    3. Provide optional modules as needed for inputs and outputs listed below.
    4. VCP Inputs:
        a. Control:
            1) Accept a pump speed set point (4-20 mA input).
    5. VCP Outputs:
        a. Status:
            1) Running (dry contact).
            2) ESTOP pressed (dry contact).

2.06 CONTROL STRATEGY

A. General.

B. Hardwired control functions:
    1. Provide components required so that existing dilution water solenoid valve located in non-potable water line on the discharge side of the pump will be commanded to open when the pump is running and commanded to close when the pump is stopped.
    2. With the HOA switch in HAND:
        a. The pump may be started, stopped, and speed adjusted by the DC drive controller.
    3. With the HOA switch in OFF:
        a. The pump is stopped.
    4. With the HOA switch in AUTO:
        a. The pump receives a speed setpoint from the PCS via 4 – 20 mA input. If the speed is set to 0 percent (4mA), the pump shall stop.

2.07 SPARE PARTS

A. Vendor to provide spare parts that are required to provide uninterrupted operation for a minimum of 2 years.

B. Additional spare part requirements as specified in the Contract Documents.

2.08 ACCESSORIES

A. Pulsation dampeners:
    1. Manufacturers: One of the following or equal:
        a. Kemlon Products.
        b. Blacoh Fluid Controls, Inc.
        c. Pulsafeeder.
    2. Pulsation dampeners shall be furnished and installed on each chemical metering pump’s discharge lines as indicated on the Drawings and scheduled in this Section.

3. Materials:
    a. Pulsation dampeners shall have Hypalon diaphragms and CPVC, PVC, stainless steel, or lined cast iron chamber.
        1) Materials shall be compatible with the pumped liquid at the specified concentration, and suitable for outdoor use and exposure.
4. Characteristics:
    a. Pulsation dampeners shall be gas or air charged, single diaphragm type complete with valved gas/air charge valve connection and pressure gage graduated from 0 to 150 pounds per square inch.
    b. Pulsation dampeners shall allow no more than 6 percent discharge pressure fluctuation.
5. Dampeners shall be provided with a true-union ball valve for shutoff.

B. Calibration columns:
1. Materials:
    a. Materials shall be compatible with the pumped liquid and concentration specified in this Section, and suitable for outdoor use and exposure.
2. Characteristics:
    a. Furnish and install calibration columns, 1 for each chemical metering pump, on each chemical pump's inlet line as indicated on the Drawings and specified in this Section.
        1) Columns shall be translucent.
    b. Provide top cap threaded connection with vent piped to floor to prevent entry of foreign materials and to direct spillage or overflow.
    c. End connections shall be threaded.
    d. Capacities and graduations shall be as indicated in the schedule in this Section.

C. Diaphragm backpressure and pressure relief valves:
1. As specified in Section 15118 - Pressure Reducing and Pressure Relief Valves.
2. Manufacturers: One of the following or equal:
    a. Wallace and Tiernan.
    b. Pulsafeeder.
    c. Griffco.
    d. Milton Roy Co.
3. Materials:
    a. Valves shall be of suitable materials for the pumped liquid.
4. Characteristics:
    a. Ported to serve as either a backpressure valve or a pressure relief valve.
    b. Relief valve shall be plumbed to the nearest chemical drain, or back to the pump suction on the non-pump side of the pump suction isolation valve, to avoid spillage, as indicated on the Drawings.
    c. Valves shall be furnished and installed on each chemical metering pump's discharge lines as indicated on the Drawings and scheduled in this Section.

d. Valves shall have an adjustable spring range to match existing. Valves shall be factory adjusted for the backpressure recommended by the pump manufacturer.
e. Valves shall produce a back pressure no greater than 10 pounds per square inch above valve set pressure when metering pumps are operating at full capacity, pulsating flow.

D. Additional accessories:
1. Additional accessories required for the system but not required to be supplied by the pump manufacturer include:
a. Isolation valves as specified in Section 15111 - Ball Valves for suction and discharge piping as indicated on the Drawings.

2.09 NAMEPLATES

A. Each pump, gearbox, and motor shall have, securely affixed in a conspicuous location, a stainless steel nameplate with raised letters providing the manufacturer's model, serial number, rating, range, speed and other pertinent data.

2.10 SPARE PARTS AND SPECIAL TOOLS

A. Spare parts: Furnish the following spare parts packed and labeled for warehouse storage:
1. Complete set of inlet and outlet ball check valves (balls, seats and gaskets) and a diaphragm for each pump.
2. 1 complete spare parts kit for each pump provided.
3. An initial supply of all oils, greases, and lubricants required to start operations. Supply an amount of these materials equivalent to 1 year of continuous operation for each system.

B. Special tools: Deliver 1 set for each furnished pump type and size needed to assemble and disassemble pump system.

PART 3 EXECUTION

3.01 COMMISSIONING

A. As specified in Section 01756 - Commissioning and this Section.

B. Manufacturer services:
1. Provide certificates:
a. Manufacturer's Certificate of Source Testing.
b. Manufacturer's Certificate of Installation and Functionality Compliance.
2. Manufacturer's Representative onsite requirements:
a. Installation: 1 trip, 1 day minimum.
b. Functional Testing: 1 trip,1 day minimum each.
3. Training:
a. Maintenance: 4 hours per session, 1 sessions.
b. Operation: 2 hours per session, 21 sessions.

4. Process operational period:
    a. As required by Owner or Contractor.

C. Source testing: As specified in Pump Schedule.

D. Functional testing: As specified in Pump Schedule.

3.02 SCHEDULES

A. Pumps:

Tag Number	PMP-85183
Feed Point	AWT Packaged Filter/Clarifiers No. 1 to No. 4
Service	Ferric Chloride
Pump Type	Single Diaphragm
Number of Pumps	1
Named Manufacturer	Prominent
Pump Characteristics	
Design Conditions:	
Maximum Flow, (gallons per hour)	20.4
Pump Stroke Range (strokes per hour)	144
Source Testing	
Test Witnessing	Not Witnessed
Performance Test Level	1
Vibration Test Level	None
Noise Test Level	None
Functional Testing	
Performance Test Level	1
Vibration Test Level	1
Noise Test Level	1

1. Provide pumps that deliver the maximum capacity, listed in the above table, when at full speed and maximum stroke length.

END OF SECTION

SECTION 11294B

HEAVY-DUTY FABRICATED STAINLESS STEEL SLIDE GATES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Heavy-duty fabricated stainless steel slide gates.
   1. Gate Schedule is included in the Drawings.

B. As specified in Section 01600 - Product Requirements.

1.02 REFERENCES

A. American Water Works Association (AWWA):
   1. C561 - Fabricated Stainless Steel Slide Gates.

B. American Welding Society (AWS):
   1. D1.6 - Structural Welding Code-Stainless Steel.

C. ASTM International (ASTM):
   1. A276 - Standard Specification for Stainless Steel Bars and Shapes.
   2. B584 - Standard Specifications for Copper Alloy Sand Castings for General Application.
   3. D1248 - Standard Specification for Polyurethane Plastics Extrusion Materials for Wire and Cable.
   4. D2000 - Standard Classification for Rubber Products in Automotive Applications.
   5. D4020 - Standard Specification for Ultra-High Molecular-Weight Polyethylene Molding and Extrusion Materials.

1.03 DEFINITIONS

A. Design Head: Depth from surface of water to centerline of gate. Use value specified in the gate schedule.

B. Seating Head: Pressure applied to gate slide from weight of water column above gate centerline that forces gate slide into seat.

C. Slenderness Ratio (l/r): The largest ratio obtained by dividing the unsupported length of the stem by the radius of gyration of the stem cross section.

D. Substantially Similar:
   1. Similar in size, design head, and service.
   2. Utilizes the proposed design for critical components including guides and seals.

E. Unseating Head: Pressure applied to gate slide from weight of water column above gate centerline that forces gate slide away from seat.

1.04 SUBMITTALS

A. Submit as specified in Section 01330- Submittal Procedures.

B. Product data: As specified in Section 15050 - Common Work Results for Mechanical Equipment.

C. Shop drawings: As specified in Section 15050 - Common Work Results for Mechanical Equipment.

D. Calculations: As specified in 15050 - Common Work Results for Mechanical Equipment:
   1. Calculations and design data substantiating conformance with the Drawings and specifications.
   2. For coordination purposes, gate manufacturer shall supply calculations verifying the suitability of the selected operator for the application.
      a. For all gates:
         1) The maximum torque required for operation of the gate (including breakaway from seat) with a safety factor of 1.4.
         2) Indicate thrust value and stem factor.
      b. For manually operated gates coordinate with Section 13446 - Manual Actuators.
   3. Gate opening and closing thrust forces that will be transmitted to the support structure with operator at extreme positions and load.
   4. Breakaway torque from seat. Indicate thrust value and stem factor.
   5. Guide frame in accordance with AWWA C561 stress threshold compliance for exterior guide leg and fasteners.
   6. Anchorage calculations in accordance with Section 15050 - Common Work Results for Mechanical Equipment.

E. Shop drawings:
   1. Layout and installation drawings for each gate size and type.
   2. Wall thimbles design.
   3. Complete bill of materials.

F. Vendor operation and maintenance manuals: As specified in Section 01782 - Operation and Maintenance Manuals.

G. Commissioning submittals:
   1. Provide Manufacturer’s Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.
   2. Leakage test results.

H. Manufacturer's installation instructions.

1.05 QUALITY ASSURANCE

A. Manufacturer qualifications:
   1. Minimum 10 years of experience in production of fabricated stainless steel slide gates substantially similar to the equipment specified.

2. Submit evidence of satisfactory operation in at least 20 different installations in the United States using the proposed guides and seals design.
3. Multiple gates at a plant shall be considered as one installation toward meeting the experience requirements.

B. Manufacturer's shop welds, welding procedures, and welders: Qualified and certified in accordance with the requirements of AWS D1.6.

C. Factory markings:
1. Mark gates according to the scheduled equipment tag numbers when such numbers are used.
2. For thimbles, frames, and other non-interchangeable components, match mark the entire system.

D. Assembled gates: Shop inspected, adjusted, and tested before shipment.

1.06 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: One of the following or equal.
1. H. Fontaine, Series 20.
2. Whipps, Inc., Series 900.
3. Waterman Industries, SS-250.
4. Rodney Hunt, Series A-113 or A-114.
5. Hydro Gate, Model HG-561.
6. RW Gate, Model RW1000-S.

B. Operator anchor bolts and wall thimbles: Provided by manufacturer of slide gates.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Maximum allowable leakage shall be 0.10 gallons per minute per foot of sealing perimeter, the allowable limits set forth in AWWA C561. Leakage testing shall be conducted in accordance with AWWA C561.

B. Except as modified or supplemented as specified in this Section, all gates and operators shall conform to the requirements of AWWA C561, latest edition.

C. Gate components:
1. Frames:
a. Design for the design head scheduled with a minimum safety factor of 5 with regard to ultimate tensile, compressive, and shear strength.
b. Self-contained gates: Where frames extend above the operating floor, design to be self-supporting so that no further reinforcing or support is required.

2. Stem: Select stem diameter, stem guide quantity and stem guide spacing based on following criteria:
    a. Slenderness ratio (l/r): Shall not exceed 200.
    b. Maximum diameter: Provide stem guides at a spacing to maintain stem diameter of 2 inches or less.
    c. Tensile strength: Suitable to withstand the force generated by the operator with the application of a 200-pound force applied to the crank or handwheel or a 250-foot-pound torque applied to the wrench nut.
    d. Compressive strength:
        1) Suitable to withstand buckling due to the force generated by the operator with the application of an 80-pound force applied to the crank or handwheel or a 100-foot-pound torque applied to the wrench nut.
        2) Determine buckling load using Euler Column formula in accordance with AWWA C561, where C = 2.
    e. Design force for power actuators:
        1) Hydraulic cylinder operators: 1.25 times the output thrust at maximum hydraulic fluid operating pressure.
        2) Electric motor operators: 1.25 times the output thrust in the stalled-motor condition.
    f. Gates having widths greater than 2 times the height: Provide with 2 lifting mechanisms connected by a tandem shaft.
3. Thrust nut: Suitable to withstand thrust developed by operator with the application of a 40-pound force on the crank or handwheel with safety factor of 5. Base design on ultimate strength of material used.
4. Yokes for self-contained gates:
    a. Design yoke using design loading criteria for stem with safety factor of 5 based on the ultimate strength of the material used.
    b. Maximum deflection at design load: Not to exceed 1/360th of the span.
5. Slide:
    a. Deflection shall be less than or equal to 1/1000 of the span of the gate or 1/16 inch, whichever is less, under the design head.
    b. Design for the maximum design head specified with a minimum safety factor of 5 with regard to ultimate tensile, compressive, and shear strength.

2.03 MATERIALS

A. Stainless steel: ASTM A276, Type 304:
    1. Components or structural shapes which are welded: ASTM A276, Type 304L.
        a. Manufacturer's shop welds, welding procedures, and welders:
            1) Qualified and certified in accordance with the requirements of AWS D1.6.
    2. All wetted and unwetted parts including all fasteners and hardware, except as specified in this Section, shall be stainless steel.

B. Ultra-high molecular weight polyethylene: ASTM D1248 and D4020, virgin materials only.

C. Neoprene: ASTM D2000, Grade 2 BC 510.

D. Manganese bronze: ASTM B584, UNS Number C86500 or Alloy 432.

E. Silicon bronze: ASTM B584 UNS Number C87300.

2.04 COMPONENTS

A. Slide:
   1. Type 304L stainless steel.
   2. Rectangular or square.
   3. Fabricated with a flat plate reinforced with formed plates or structural members.

B. Frame:
   1. Construct gate frame of Type 304L stainless steel structural members or formed plate welded to form a rigid 1-piece frame.
      a. Capable of providing true dimensions within tolerances and preventing binding and excessive wear of sliding parts.
   2. Mounting: As indicated on the Drawings and Slide Gate Schedule.
      a. Centerline of anchors shall be located no closer than 4-1/2 inches from the edge of concrete opening for face-mounted gates.
   3. Adjustable ultra-high molecular weight polyethylene pressure pads.
   4. Flush bottom type unless otherwise indicated on the Drawings.
   5. Allow replacement of top, side, and bottom seals without removing the gate frame from concrete or wall thimble.
   6. Machine surfaces matching with thimble. Provide seal between gate frame and thimble that will meet leakage performance requirements.
   7. Embedded gates: Extend frame to provide access to pressure pad adjusting screws (For seal design alternatives A and B only).

C. Yoke for self-contained gates:
   1. Type 304L stainless steel.
   2. Extend guides and frame so that bottom of yoke is at least 12 inches above top of slide at full open position.
   3. Bolt or weld to frame.
   4. Provide mounting plate on top of yoke to mount operator.
   5. Design yoke to allow removal of gate slide.

D. Guides:
   1. Type 304L stainless steel with ultra-high molecular weight polyethylene insert in contact with gate.
   2. Minimum face width of 1 inch.
   3. Length: To support the slide fully in the open position.
   4. Anchor bolts shall not pass through the guides and seals.

E. Seals:
   1. Designed to achieve the specified leakage requirements.
   2. Sealing and sliding surfaces shall provide a low coefficient of friction with the surface of the slide.
   3. Field replaceable without removing gate from concrete or wall thimble.
   4. Anchor bolts shall not pass through the guides and seals.
   5. J-bulb seals are not acceptable.

6. Minimum seating surface width: 3/4 inch in contact with slide.
7. Bottom seal:
    a. Resilient neoprene, minimum durometer of 45.
    b. Attached to the bottom of the slide or embedded in gate frame invert.
    c. Compressed by closing action of gate slide against plate for all standard upward opening gates.
8. Side and top seals:
    a. Provide one of the seal design alternatives listed below.
    b. Seal design alternative A:
        1) UHMWPE fixed sealing surfaces that surround the clear opening.
        2) Held in place in the guide with Type 304 stainless steel fasteners.
        3) Seal compression shall be maintained by UHMWPE field adjustable pressure pads mounted to the slide with Type 304 stainless steel fasteners.
    c. Seal design alternative B:
        1) Neoprene crown seal with UHMWPE bearing bars.
        2) Attached to the slide with Type 304 stainless steel fasteners.
        3) Crown seal shall be actuated by water pressure in either the seating or unseating direction.
        4) Primary contact with the slide shall be through the UHMWPE bearing bar. The neoprene shall not be solely relied upon for the contact seal.
        5) Seal compression may be maintained by UHMWPE field adjustable pressure pads mounted to the guide with Type 304 stainless steel fasteners.
    d. Seal design alternative C:
        1) UHMWPE self-adjusting type seals: Utilize a continuous compression cord to ensure contact between the seals and the slide.
            a) An O-ring is not acceptable in lieu of compression cord.
        2) Side seals:
            a) Attach to frame using one of the following approaches.
                (1) Held in place between the front and back angles of the guide with Type 316 stainless steel bolts passing through the guide and seal along the length of the guide.
                (2) Held in place between front and back of a formed, 1 piece, rigid channel guide. Attach seals to frame using Type 316 stainless steel bolts.
            b) Design and installation shall provide access to and removal of the bolt to allow removal of the side seal without removing the gate from the concrete.
        3) Top Seal: UHMWPE self-adjusting type seal with double compression cord.
9. Provide invert seal for all downward (weir) gates.
10. Set seals to be slightly compressed with slide in closed position.

F. Stem:
1. Type 304 stainless steel.
2. Machine cut or rolled full depth ACME threads.
3. Diameter: Capable of withstanding anticipated opening and closing thrusts under head as indicated on the Drawings. Minimum stem diameter: 1-1/2 inch at the threads.
4. Length: Capable of permitting easy installation and removal.

5. Stem couplings:
    a. Silicon bronze or Type 304 stainless steel.
    b. Threaded and keyed to stem or threaded and bolted to stem.
6. Stem guides:
    a. Type 304 stainless steel.
    b. Split collar.
    c. Adjustable in 2 directions.
    d. Ultra-high molecular weight polyethylene bushing.
7. Provide manganese bronze stop collar on stem above actuator.
8. Drill and connect stem to slide structural sections with Type 304 stainless steel bolts.
9. Coordinate the selection of the gate stem configuration with the gate operator and operating speed.
    a. The selected gate stem configuration shall provide the most efficient combination of stem diameter/pitch/lead and keep the operating temperature at the stem nut to a minimum during operation.
    b. For motorized applications, if the proposed gate stem configuration would result in any deviation from the operating rise rate specified in Section 13447 - Electric Actuators, submit proposed deviation for approval by the Engineer.

G. Operating nut:
1. Locate at operator level.
2. Material: Manganese bronze.

H. Gate operators: As scheduled and specified in Section 13446 - Manual Actuators.
1. Provide cranks and gears necessary to bring operator to height specified, or typical operator height of 3 feet 6 inches if not otherwise shown.

I. Bolts, nuts, and fittings: Type 304 stainless steel.

J. Anchor bolts: Type 316 stainless steel of sufficient quantity and length to anchor the gate.
1. Quantity, size, and location of anchor bolts shall be determined by the gate manufacturer in accordance with requirements of Section 15050 - Common Work Results for Mechanical Equipment.

2.05 WALL THIMBLES

A. Provide wall thimbles for gates where scheduled and as indicated on the Drawings.

B. F-section of a depth equal to the thickness of the structure wall upon which the gate is mounted.
1. Modify F-sections where required for F-section and pipe bell ring connections in a wall.
    a. Provide flange-by-mechanical joint or flange by push on joint wall thimble where ductile iron piping connects to the wall thimble. Ensure that joint wall thimble has sufficient embedment to resist pipe thrust.
    b. Provide flange-by-bell ring wall thimble insert where reinforced concrete piping connects to the wall thimble.

C. Fabricated Type 304L stainless steel of sufficient section to resist permanent distortion; minimum 3/8-inch-thick plate.

D. Width of mounting flange of wall thimble: 1/2 inch wider than mounting flange of gate.

E. Fully machine front flange of thimble to a plane Drill and tap to match the drilling on the flange back gate seat.

F. Clearly mark top center of each thimble for installation.

G. Provide Type 304 stainless steel studs for attaching the gate frame.

H. Seal joint between thimble and gate watertight, in accordance with AWWA C561.

I. To permit entrapped air to escape as the thimble is being cast in concrete, drill holes in each entrapment zone formed by ribs, flanges, and water stops.

J. Provide annular weep ring to control seepage and resist thrust, where needed to anchor the pipe thrust restraint system.
   1. Continuously weld weep ring to outside of the wall thimble.
   2. Weep ring shall be minimum 1/4 inch thick and minimum 2 inches deep.

2.06 FINISHES

A. Stainless steel:
   1. Surface preparation of gates and stop plates after fabrication to remove weld splatter and to polish scratches:
      a. Shot blast.
   2. Clean the entire surface to produce an even color and sheen.

B. Operators, stands, and other accessory equipment: Surface preparation, factory prime, field prime, and finish coats as specified in Section 09960 - High-Performance Coatings.

2.07 FABRICATION

A. Shop assembly:
   1. Gates shall be factory assembled, adjusted, and tested.
   2. Mount all accessories and appurtenances including, but not limited to, motor operators and limit switches so that the complete system may be tested at the factory.

PART 3 EXECUTION

3.01 EXAMINATION

A. Inspect all components for shipping damage, conformance to specifications, and proper torques and tightness of fasteners, as specified in Section 15050 - Common Work Results for Mechanical Equipment.

3.02 INSTALLATION

A. Install equipment as indicated on the Drawings and as specified in Section 15050 - Common Work Results for Mechanical Equipment and the manufacturer's written installation instructions.

B. Mount thimbles and gates plumb in both vertical planes and level in horizontal plane.

C. Coat seating surfaces between frame and wall thimble with a waterproof plastic compound or provide EPDM gasket prior to tightening frame studs.

D. Adjust wedges or other parts of the gate to the point where it will not be possible to insert a 0.004 inch feeler gauge between the gate slide and the gate frame at any point.
   1. Securely lock wedges into position after adjustment.

E. Adjust limit switches in electric and hydraulic operators in accordance with manufacturer's instructions.

F. Face mounted gates:
   1. Where wall thimbles are not provided, mount gate to wall with anchor bolts and provide a 1-inch grout pad in accordance with manufacturer’s recommendations.

G. Embedded gates:
   1. Provide blockouts in sidewalls and channel bottom for installation of gates.
   2. After gate placement, adjustment, and alignment in accordance with manufacturer’s recommendations, grout frame with non-shrink grout.

3.03 COMMISSIONING

A. As specified in Section 01756 - Commissioning and this Section.

B. Manufacturer services:
   1. Provide certificates:
      a. Manufacturer’s Certificate of Installation and Functionality Compliance.
   2. Manufacturer’s Representative onsite requirements:
      a. Installation: 1 trip, 1 day minimum.
      b. Functional Testing: 1 trip, 1 day minimum each.
   3. Training:
      a. Maintenance: 2 hours per session, 2 sessions.
      b. Operation: 2 hours per session, 2 sessions.
   4. Process operational period:
      a. As required by Owner or Contractor.

C. Functional testing:
   1. Test witnessing: Witnessed.
   2. After gate installation and checking, run gates through at least 2 full cycles from the closed position to full open position and back to the closed position.

3. Leakage tests:
    a. Conduct in accordance with AWWA C561. Comply with specified allowable leakage limits.

3.04 GATE SCHEDULE

A. The Gate Schedule is indicated on the Drawings.

B. Gate Schedule is not a take-off list.
    1. Contractor shall provide gates specified and as indicated on the Drawings.

END OF SECTION

SECTION 11312D

VERTICAL TURBINE SHORT SETTING CENTRIFUGAL PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Pump systems including vertical turbine pumps with radial, mixed flow, or axial (propeller) type impellers and drivers as scheduled.

B. Tag numbers: As specified in Pump Schedule.

1.02 REFERENCES

A. American Bearing Manufacturers Association (ABMA):
   1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, and 250.
   2. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.
   3. PTC 8.2 - Centrifugal Pumps.

C. American Water Works Association (AWWA):
   1. C205 - Standard for Cement-Mortar Protective Lining and Coating for Steel Water Pipe, 4 In. (100 mm) and Larger-Shop Applied.

D. ASTM International (ASTM):
   1. A48 - Standard Specification for Gray Iron Castings.
   2. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   3. A108 - Standard Specification for Steel Bars, Carbon and Alloy, Cold-Finished.
   4. A276 - Standard Specification for Stainless Steel Bars and Shapes.
   5. A278 - Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650°F (350°C).
   6. A283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
   7. A516- Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate-and Lower-Temperature Service.
   8. A582 - Standard Specification for Free-Machining Stainless Steel Bars.
   9. A743 - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
   10. B30 - Standard Specification for Copper Alloys in Ingot Form.
   11. B505 - Standard Specification for Copper Alloy Continuous Castings.
   12. B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

13. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
14. F594 - Standard Specification for Stainless Steel Nuts.

E. Hydraulic Institute (HI):
1. 9.1-9.5 - Pumps - General Guidelines for Types, Definitions, Application, Sound Measurement and Decontamination.
2. 14.1-14.2 – Rotodynamic Pumps for Nomenclature and Definitions.
3. 14.3 - Rotodynamic Pumps for Design and Application.
4. 14.4 - Rotodynamic Pumps for Installation Operation and Maintenance.
5. 14.6 - Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

1.03 DEFINITIONS

A. Pump head (total dynamic head, TDH), flow capacity, pump efficiency, net positive suction head available (NPSHa), and net positive suction head required (NPSHr): As defined in HI 9.1-9.5, 14.1-14.2, 14.3, 14.4, and 14.6 and as modified in the Specifications. The pump head and efficiency are evaluated at the outlet of the discharge head and include the net losses in the pump column and discharge head, and intake basket or strainer (when specified).

B. Flow, head, efficiency, and motor horsepower specified in this Section are minimums unless stated otherwise.

C. Suction head: Gauge pressure available at pump intake flange or bell in feet of fluid above atmospheric.

D. Tolerances: This Section and related sections contain tolerances that may be more stringent than Hydraulic Institute Standard tolerances. Where tolerances are not mentioned, Hydraulic Institute Standards 9.1-9.5, 14.1-14.2, 14.3, and 14.4 shall apply.

E. Allowable Operating Region (AOR): The region over which the service life of the pump is not seriously compromised by hydraulic loads, vibration, or flow separation where the pump's vibration, noise, and cavitation are within acceptable limits.

F. Preferred Operating Region (POR): The region over which the service life of the pump will not be significantly affected by hydraulic loads, vibration, or flow separation where the pump's vibration, noise, and cavitation are within acceptable limits.

1.04 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Vibration analysis: Submit as specified in Section 15050 - Common Work Results for Mechanical Equipment when scheduled.

C. Product data: As specified in Section 15050 - Common Work Results for Mechanical Equipment:
    a. Pump certification as specified in Section 01600 - Product Requirements.
    b. Weighted average lead calculations as specified in Section 01600 - Product Requirements.

D. Shop drawings: As specified in Section 15050 - Common Work Results for Mechanical Equipment.

E. Calculations: As specified in Section 15050 - Common Work Results for Mechanical Equipment:
    1. Torsional analysis: Submit as specified in Section 15050 - Common Work Results for Mechanical Equipment when scheduled.

F. Vendor operation and maintenance manuals: As specified in Section 01782 - Operation and Maintenance Manuals.

G. Commissioning submittals:
    1. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756 - Commissioning.
    2. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.05 QUALITY ASSURANCE

A. As specified in Section 15050 - Common Work Results for Mechanical Equipment.

B. Provide pumps specified in this Section from same manufacturer.

C. Vibration analysis: Provide equipment vibration analysis as specified in this Section.
    1. Vibration analysis level: As scheduled and as specified in Section 15050 - Common Work Results for Mechanical Equipment.
    2. Vibration analysis expert: Provide when scheduled.

D. Manufacture's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.06 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
    1. Flowserve; model as scheduled.
    2. Sulzer/Johnston Pumps; similar to scheduled model.
    3. Peerless Pump; similar to scheduled model.
    4. Weir/Floway; similar to scheduled model.

5. National Pump Co.; similar to scheduled model.
6. Cascade Pump Company; similar to scheduled model.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Components: Pumps, drivers, motors, variable frequency drives, and drive arrangements as specified or as scheduled with shafts, columns, barrels, intermediate bearings, seals or packing, couplings, base plates, guards, supports, anchor bolts, necessary valves, gauges, taps, lifting eyes, stands, and other items as required for a complete and operational system.

B. Design requirements:
   1. Pump performance characteristics:
      a. As specified in the Pump Schedule.
      b. All required conditions (flow/head) shall be within the pump manufacturer's Allowable Operating Range (AOR).
      c. Performance tolerances shall be the same as the test tolerances specified in Section 15958 - Mechanical Equipment Testing.
      d. Pump curve shall be continuously rising throughout the design conditions listed in the pump schedule.
   2. Motor characteristics: As specified in the Pump Schedule.

C. Product requirements as specified in Section 01600 - Product Requirements and Section 15050 - Common Work Results for Mechanical Equipment.

2.03 MATERIALS

A. General:
   1. Pump Schedule materials: As specified in this Section.

B. Cast iron: ASTM A48, Class 30 minimum.

C. Nickel cast iron: ASTM A48, minimum Class 30, cast iron with 3 percent nickel.

D. Gray iron casting: ASTM A278, Class 30.

E. Iron-chromium alloy: ASTM A743, Grade CA40; ASTM A276, Type 420 Stainless Steel may be substituted; Brinell Hardness Number of 350 to 380.

F. Lead-free bronze except for bearings that require lead for lubricity: ASTM B584.

G. Leaded tin bronze: ASTM B505, Alloy C92700.

H. Bronze or high lead tin bronze: ASTM B584, Alloy 93800.

I. Leaded red brass: ASTM B584, Alloy C83600, leaded red brass.

J. Type 416 stainless: ASTM A582, Type 416 Stainless Steel.

K. Neoprene: Polychloroprene rubber.

L. Steel: ASTM A283, Grade D or ASTM A516 Gr. 70.

M. Steel pipe: ASTM A53, Grade B.

N. Aluminum bronze meeting the requirements of Section 15050 - Common Work Results for Mechanical Equipment.

O. Lead-free aluminum bronze: ASTM B30.

2.04 GENERAL PUMP CONSTRUCTION

A. Type: Industrial, heavy duty, vertical turbine, centrifugal type pumps meeting performance requirements and features as scheduled and as specified.

B. Discharge flange: ASME B16.1 or B16.5 drilled; rated for 1.2 times the pump shutoff head at 150 degrees Fahrenheit.

C. Discharge nozzles: Provide 1/2-inch NPT taps for pressure gauges; install nipple and gauge with block valve.

D. Bearings:
   1. Design driver/motor bearings to support the line shaft assembly and rated for ABMA L10 life of 40,000 hours at Design Rated Point flow and head in accordance with ABMA 9 or ABMA 11.
   2. Design motor to withstand continuous duty full load thrust and momentary up thrust that may occur during pump on/off or other operations.

E. Fasteners: Provide Type 316 stainless steel fasteners in accordance with ASTM F593 or ASTM F594.

2.05 PUMP SUCTION ASSEMBLY

A. Pump suction assembly: Provide suction bell. Provide anti-vortex baffles and strainer when scheduled.

B. Design suction bells and provide strainers and anti-vortex baffles to minimize solids plugging and vortexing. Screens to have a flow area at least 4 times the suction pipe area.

C. Materials:
   1. Pump suction bell: As scheduled.
   2. Anti-vortex baffles: Same material as scheduled for pump suction bell.
   3. Pump suction bell bearing: As scheduled.
   4. Pump suction strainer: When strainer scheduled, provide Type 316 stainless steel.

2.06 PUMP IMPELLER BOWL ASSEMBLIES

A. Pump impeller assembly:
   1. Type: As scheduled.
   2. Maximum number of vanes: As scheduled.
   3. Number of stages: As scheduled.

4. Required balance: As specified in Section 15050 - Common Work Results for Mechanical Equipment to meet vibration criteria as specified in Section 15958 - Mechanical Equipment Testing.
5. Method of securing impellers to shafts: Keyed and secured by a bronze nut locked in place or locked by other methods acceptable to the Engineer. Provide any special tools required for removal and installation of pump impellers.
6. Provisions for adjustment of axial clearance: Make such adjustment through use of motor adjusting nut or adjustable coupling.
7. Impeller thrust: When appropriate for the specified impeller type, provide hydraulically balanced impeller to minimize down thrust.

B. Intermediate and discharge impeller cases:
1. Material: As scheduled.
2. Attached with bolting.

C. Pump impeller bowl bearings: Provide bearing for each impeller; material as scheduled.

D. Diffusion vanes: Provide vanes cast into bowl.

E. Suction bowl bearings:
1. Provide bronze sleeved bearings with self-contained lubrication system filled with graphite type non-soluble grease when grease lubrication scheduled; provide bearing with sand cap.

F. Design with smooth water passages to reduce clogging by stringy or fibrous materials on impellers or shafting.

G. Design replaceable wear rings for both the bowl and impeller on each impeller bowl.

H. Design capable of passing solids with a sphere size as scheduled or larger.

I. Design impellers capable of working on pumps that may be abnormally started against closed manual valve or normally against a closed pump control valve.

2.07 LINE SHAFTS

A. Provide line shaft type and lubrication type as scheduled and as specified in this Section.

B. Open line shaft, product lubricated:
1. Shaft and couplings:
a. Provide keyed shaft type mechanical couplings with key or set screw locking of shaft couplings.
1) Threaded shaft connections are not allowed.
2. Bearings and bearing retainers: Provide bearings and retainers spaced as scheduled, but not to exceed 10 feet; provide at least 1 bearing for each line shaft length; provide grease fitting for top bearing extended to outside any guards when grease lubrication specified.

3. Materials:
    a. Shaft and couplings: As scheduled; where hard faced steel shaft is specified, hard face at sleeve bearings to 550 Brinell minimum.
    b. Bearings and bearing retainers: As scheduled; when not scheduled, Neoprene rubber bearings with bronze retainers.

C. Enclosed line shaft, oil lubricated:
    1. Shaft and couplings: Provide flanged shaft couplings with key or set screw locking of shaft couplings.
    2. Shaft bearings and spiders: Provide bearings and retainers as scheduled, but not to exceed 10 feet and enclosing tube spiders spaced at 30 feet maximum; provide oil reservoir volume for 3 days continuous use.
    3. Enclosing tube: Pipe, thickness as scheduled.
    4. Materials: As scheduled; when not scheduled provide:
        a. Shaft and couplings: ASTM A108, Grade 1045 steel with ASTM A276, Type 316 hardened stainless steel journal or sleeve at each bearing.
        b. Shaft bearings and spiders: ASTM B584, Alloy C83600 leaded red brass bearings; Neoprene rubber spider on enclosing tube.
        c. Enclosing tube: Steel pipe, ASTM A53, Grade B unless scheduled otherwise.

D. Design strength: Able to withstand minimum 1.5 times maximum operating torque and other loads.

E. Resonant frequency: As specified in Sections 15050 - Common Work Results for Mechanical Equipment and 15958 - Mechanical Equipment Testing.

F. Sleeves: Provide shafting with Type 316 stainless steel sleeve or hardened sleeves where shafts pass through bearings or stuffing boxes as scheduled; Brinell 550 or higher for hardened shaft; when the specified mechanical seals cannot be installed on a hardened shaft, hardened shafts are not required in the area of the mechanical seal.

G. Design pump line shafting in interchangeable lengths as scheduled, but not to exceed 10 feet; shaft lengths to match scheduled pump column lengths.

H. Coupling strength: Design driver to pump line shaft coupling of sufficient length and strength to maintain line shaft alignment.

I. Adjustment:
    1. Design a means to adjust shaft position to adjust impeller position.
    2. For motor driven units with solid shaft motors, design driver to pump line shaft coupling to allow adjustment of the impeller position.
    3. For motor driven units with hollow shafts, an adjusting nut may be provided at the top of the motor shaft.

J. Spacer coupling: When mechanical seals are scheduled, provide an adjustable spacer coupling to allow removal of the seal without driver removal.

2.08 PUMP COLUMN PIPE

A. Pump column pipe: Thickness and material as scheduled.

B. Head connection: Design with flanged and bolted connection to discharge head and flanged and bolted connection to impeller assembly to permit removal of impeller bowl assembly without disturbing the column or discharge connections.

C. Design Working Pressure: Design to withstand a design working pressure not less than 1.20 times the maximum shutoff total dynamic head with the maximum diameter impeller at the maximum operating speed plus the maximum suction static head.

D. Pressure test: Design to withstand a 5-minute hydrostatic test pressure not less than 1.5 times the design working pressure; perform test at source.

E. Lengths and connections: Design with maximum 10-foot length, or less if scheduled, interchangeable column sections with flanged or threaded with registered fit screwed connections as scheduled.

F. Diameter: Design column inside diameter for no more than 4 feet of fluid friction loss per 100 feet of column length.

2.09 PUMP BARREL/CAN

A. Pump barrel/can: Pipe thickness and material as scheduled and shall be provided by manufacturer; inlet as indicated on the Drawings.

B. Mounting flange: Sufficient strength and thickness to withstand 1.5 times the imposed loads under any operating condition.

C. Can lining: When scheduled, provide cement mortar lining in accordance with AWWA C205.

D. Can diameter: Provide can diameter so that free-flow cross-sectional area in the can after lining or coating is at least 10 percent more than the can inlet nozzle flow area.

2.10 PUMP DISCHARGE HEAD ASSEMBLY

A. Design the discharge head for above or base discharge as scheduled.

B. Design the discharge vertical to horizontal flow transition as a smooth pipe elbow or from a minimum of 3 pipe pieces mitered to form the elbow.

C. Design discharge head to mate with the driver as scheduled.

D. Head and base plate construction: Sufficient strength, weight, and thickness to provide accurate alignment, prevent excessive deflection and support the drive motor.

E. Stuffing box and seal:
   1. Design the discharge head with a stuffing box to accommodate packing or mechanical seals as scheduled.
   2. Shaft seal type: As scheduled and as specified in Section 15050 - Common Work Results for Mechanical Equipment.
      a. Packing: When packing scheduled, provide stuffing box arranged for packing (sized for bronze lantern ring and 6 packing rings minimum); provide hollow shaft motor with top adjusting nut.
      b. Mechanical seal: When scheduled, provide stuffing box suitable for the specified seal and provide solid shaft motor with spacer coupling.
   3. Drain: Provide drain, minimum 3/4-inch size, for pump stuffing box leakage, together with drain line to the pump can or wet well or to nearest equipment drain as indicated on the Drawings.

F. Discharge vent: Provide 3/4-inch NPT threaded high point vent on discharge; install pipe nipple with threaded ball valve in vent.

G. Barrel/Can vent: When pump is indicated to be installed in a barrel/can, provide 1 inch NPT threaded tap on base plate to vent accumulated air at the barrel/can high point; install pipe nipple with threaded ball valve in vent.

H. Materials: As scheduled; when not scheduled, provide:
   1. Pump discharge head/driver stand: Steel, ASTM A283, Grade B and/or ASTM A53, Grade B; or cast iron, ASTM A48, Class 30 minimum.
   2. Pump discharge head sleeve bearing: Bronze.
   3. Stuffing box and seal: Container and gland, cast iron, ASTM A48, Class 30 minimum; Neoprene top shaft seal.

2.11 EQUIPMENT GUARDS

A. Provide equipment safety guards as specified in Section 15050 - Common Work Results for Mechanical Equipment.

2.12 DRIVERS

A. Horsepower:
   1. As scheduled.
   2. Listed driver horsepower is the minimum to be supplied.
      a. Increase driver horsepower if required to prevent driver overload while operating at any point of the supplied pump operating head-flow curve including runout.
      b. When scheduled driver is a motor, increase motor horsepower if required to prevent operation in the service factor.
      c. Make all structural, mechanical, and electrical changes required to accommodate increased horsepower.

B. Motors: Provide motors as specified in Section 16222 - Low Voltage Motors up to 500 Horsepower and as specified in this Section:
   1. RPM: As scheduled:
   2. Enclosure: As scheduled.
   3. Electrical characteristics: As scheduled.

4. Efficiency, service factor, insulation, and other motor characteristics: As specified in Section 16222 - Low Voltage Motors up to 500 Horsepower.
5. Motor accessories: As specified in Section 16222 - Low Voltage Motors up to 500 Horsepower and in this Section.
6. Coordinate motors with the variable frequency drive manufacturer to ensure compatibility between the motor and variable frequency drive.

C. Variable frequency drives (VFDs): As scheduled and as specified in Sections 16262 - Variable Frequency Drives 0.50 - 50 Horsepower and 16265 - Reduced Harmonic Variable Frequency Drives.
1. Contractor to coordinate with the existing pump manufacture to replace existing pump motor with new VFD duty rated motor.

D. Other drivers: As scheduled and as specified in sections listed in the Schedule.

E. Non-reverse ratchets: When scheduled, provide driver with non-reverse ratchets or pin mechanism to prevent reverse rotation of the pump and driver in the event of discharge valve failure.

2.13 SUPPORTS

A. Strength: Design pump discharge head and driver (motor or engine) supports to withstand a minimum of 1.5 times the maximum imposed operating loads or the imposed seismic loads, whichever is greater.

B. Resonant frequency: Design supports in conjunction with the pump, shafting, drivers, bearings, and other components to avoid natural resonant frequencies, either torsional, radial, or axial as specified in Section 15958 - Mechanical Equipment Testing.

C. Coordinate pump and drive system supports with the foundation designs as indicated on the Drawings.

D. Anchor bolts: As specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

2.14 SPARE PARTS AND SPECIAL TOOLS

A. Spare parts:
1. Seal packing material: 1 set of each type supplied.
2. Line shaft rubber bearings: 1 set for each type pump.
3. Line shaft bronze bearings: 1 set for each type pump.
4. Impeller and bowl wear rings: 1 set for each type of pump.
5. Mechanical seal: 1 complete seal of each type.
6. Motor/gear thrust bearing set: 1 for each type of pump.
7. Motor radial bearing set: 1 for each size of motor (if specified).
8. Pump impeller/bowl assembly: 1 of each type supplied.
9. Line shaft: 1 length of each size and type.

B. Special tools: Deliver 1 set for each furnished pump type and size needed to assemble and disassemble pump system.

PART 3 EXECUTION

3.01 PREPARATION

A. Anchoring and bracing to structures:
   1. Prepare equipment anchor setting template(s) and use to position anchors during construction of supporting structure(s).
   2. Install anchors of type and material indicated on approved anchoring designs.
   3. Install anchors with embedment indicated on approved anchoring designs.

3.02 INSTALLATION

A. Install the equipment in accordance with the accepted installation instructions and anchorage details.

B. General:
   1. Install free-standing enclosures on a raised concrete housekeeping pad:
      a. Provide structural leveling channels in accordance with the manufacturer's recommendations to provide proper alignment of the units.
      b. Weld and/or bolt the VFD frame to the leveling channels.
   2. Provide openings in top or bottom of the VFD (free-standing or within motor control center) enclosure for conduit only, no additional openings will be allowed:
      a. Improperly cut holes will require that the entire panel be replaced:
         1) No hole closers or patches will be allowed.
   3. Bundle circuits together and terminate in each unit:
      a. Tie with nylon wire ties.
      b. Label all wires at each end with wire numbers shown on the approved control drawings.
   4. Replace existing motor for the existing carousel pump(s) with new VFD duty rate motor. Motor selection shall be coordinated with the existing pump manufacturer, and specification section 16222 and 16262. The existing motors are manufactured by NIDIC Motor Corporation, Model BF48A, and Catalog No.: H040S2BLG.

3.03 COMMISSIONING

A. As specified in Section 01756 - Commissioning and this Section.

B. Manufacturer services:
   1. Provide certificates:
      a. Manufacturer's Certificate of Source Testing.
      b. Manufacturer's Certificate of Installation and Functionality Compliance.
   2. Manufacturer's Representative onsite requirements:
      a. Installation: 1 trip, 1-day minimum.
      b. Functional Testing: 1 trip, 1-day minimum each.
   3. Training:
      a. Maintenance: 4 hours per session, 2 sessions.
      b. Operation: 2 hours per session, 2 sessions.
   4. Process operational period:
      a. As required by Owner or Contractor.

C. Source testing: As specified in the Pump Schedule.

D. Functional testing: As specified in the Pump Schedule.

3.04 PUMP SCHEDULE

Tag Numbers	PMP-89100, PMP-89101	PMP-89102	PMP-91100	PMP-99411, 99412, 99413, 99414
Location	**Carousel Pump Station**		**PAU Pump Station**	**Recycled Water Pump Station**
Drawing(s)	**89D01, 89D02, 89M01, 89M02, 89E01, 89E02, 89N01**		**91M01, 91E01, 91N01**	**98M01, 99E03, 99N01, 99N02,**
General Characteristics:				
Application	Wastewater	Wastewater	Wastewater	Recycled Water
Service	Secondary Effluent	Secondary Effluent	Secondary Effluent	Reclaimed Water Pump
Quantity	Note 1	1	1	4 installed
First Named Manufacturer's Model Number	Note 1	12AF	12EQH	12RL-SS
Maximum Noise, dBA at 3 feet	Note 1	85	85	85
Minimum Pumped Fluid Degrees Fahrenheit	Note 1	50	50	50
Normal Pumped Fluid Degrees Fahrenheit	Note 1	70	70	70
Maximum Pumped Fluid Degrees Fahrenheit	Note 1	85	85	85
Vibration Analysis Level	Note 1	None	None	None
Vibration Analysis Expert	Note 1	Not Required	Not Required	Not Required
Pump Characteristics:				
Number of Stages	Note 1	Per Manufacturer	Per Manufacturer	Per Manufacturer
Impeller Type	Note 1	Enclosed	Enclosed	
Impeller, Maximum Number of Vanes	Note 1	Per Manufacturer	Per Manufacturer	Per Manufacturer
Pass Minimum Sphere Size, Inch	Note 1	1-inch	1-inch	0.75-inch

Tag Numbers	PMP-89100, PMP-89101	PMP-89102	PMP-91100	PMP-99411, 99412, 99413, 99414
Location	**Carousel Pump Station**		**PAU Pump Station**	**Recycled Water Pump Station**
Drawing(s)	**89D01, 89D02, 89M01, 89M02, 89E01, 89E02, 89N01**		**91M01, 91E01, 91N01**	**98M01, 99E03, 99N01, 99N02,**
Pump Impeller Bowl Bearing Lubrication	Note 1	Product Lubricated	Product Lubricated	Product Lubricated
Shaft Seal Type	Note 1	Type 1	Type 1	Type 1
Suction Bowl Bearing Lubrication	Note 1	Grease	Grease	Product Lubricated
Suction Strainer	Note 1	Required	Required	None
Anti-Vortex Baffle	Note 1	None Required	None Required	None
Line Shaft Type	Note 1	Open	Open	Open
Minimum Line Shaft Bearing Spacing, Feet	Note 1	10	10	10
Line Shaft Lubrication	Note 1	Product	Product	Product
Column Connection Type	Note 1	Flanged	Flanged	Threaded
Maximum Column Section Lengths, Feet	Note 1	10	10	10
Pump Barrel or Can	Note 1	None Required	None Required	Can
Discharge Arrangement	Note 1	Above Base	Above Base	Base
Coupling Type	Note 1	Spacer	Spacer	No Coupling
Speed Control	Variable Frequency Drive	Variable Frequency Drive	Variable Frequency Drive	Variable Frequency Drive
Maximum Pump rpm	1780	1780	1180	1800
Minimum Pump rpm	885	885	880	880

Tag Numbers	PMP-89100, PMP-89101	PMP-89102	PMP-91100	PMP-99411, 99412, 99413, 99414
Location	**Carousel Pump Station**		**PAU Pump Station**	**Recycled Water Pump Station**
Drawing(s)	**89D01, 89D02, 89M01, 89M02, 89E01, 89E02, 89N01**		**91M01, 91E01, 91N01**	**98M01, 99E03, 99N01, 99N02,**
Rated Design Point (at Maximum Revolutions per Minute):				
Flow, gpm	Note 1	4000	1750	900
Head, Feet	Note 1	21.9	15.00	240
Minimum Efficiency, Percent	Note 1	65	73	80
Required Condition 2 (at Maximum Revolutions per Minute):				
Flow, gpm	Note 1	2000	1000	600 to 700
Head Range, Feet	Note 1	38 to 42	18 to 20	310 to 280
Minimum Efficiency, Percent	Note 1	32	64	70
Required Condition 3 (at Maximum Revolutions per Minute):				
Flow, gpm	Note 1	4500	2000	1,000 to 1,100
Head Range, Feet	Note 1	22 to 26	11 to 13	220 to 180
Minimum Efficiency, Percent	Note 1	68	74	76
Other Conditions:				
Maximum Shut Off Head, Feet	Note 1	73	27	344
Maximum NPSHr at every Specified Flow, Feet	Note 1	Manufacture To Specify	Manufacture to Specify	25
Minimum NPSHa at every Specified Flow, Feet	Note 1	36.5	39.01	5
Minimum Suction Static Head, Feet	Note 1	2.83	2	9
Maximum Suction Static Head, Feet	Note 1	8.3	5	33

Tag Numbers	PMP-89100, PMP-89101	PMP-89102	PMP-91100	PMP-99411, 99412, 99413, 99414
Location	**Carousel Pump Station**		**PAU Pump Station**	**Recycled Water Pump Station**
Drawing(s)	**89D01, 89D02, 89M01, 89M02, 89E01, 89E02, 89N01**		**91M01, 91E01, 91N01**	**98M01, 99E03, 99N01, 99N02,**
Pump Materials:				
Suction Bell	Note 1	Cast Iron	Cast Iron	Cast Iron
Suction Bell Bearing	Note 1	Bronze	Bronze	High Lead Tin Bronze
Impeller Cases	Note 1	Bronze	Cast Iron	Leaded Tin Bronze
Impeller	Note 1	Bronze	Bronze	Leaded Tin Bronze
Impeller Bearing	Note 1	Bronze	Bronze	High Lead Tin Bronze
Impeller Shaft Key	Note 1	Steel	Steel	Steel, Gr 1045
Line Shaft and Coupling	Note 1	Type 416 Stainless Steel	Type 416 Stainless Steel	Rubber Buna-N
Line Shaft Bearings	Note 1	Neoprene	Neoprene	N/A
Shaft Enclosing Tube	Note 1	Schedule 40 Steel Pipe	Schedule 40 Steel Pipe	Hardened
Shaft Sleeve	Note 1	Hardened	Hardened	Steel Pipe, 0.25
Column Material and Thickness, Inch or Schedule	Note 1	Steel Pipe, 0.25	Steel Pipe, 0.25	Steel Pipe, 0.50
Can Material and Thickness, Inch or Schedule	Note 1	Steel Pipe, 0.50	Steel Pipe, 0.50	Epoxy
Can Lining	Note 1	Epoxy	Epoxy	Cement Mortar
Can Coating	Note 1	Painted	Painted	Cast Iron

Tag Numbers	PMP-89100, PMP-89101	PMP-89102	PMP-91100	PMP-99411, 99412, 99413, 99414
Location	**Carousel Pump Station**		**PAU Pump Station**	**Recycled Water Pump Station**
Drawing(s)	**89D01, 89D02, 89M01, 89M02, 89E01, 89E02, 89N01**		**91M01, 91E01, 91N01**	**98M01, 99E03, 99N01, 99N02,**
Discharge Head/Driver Stand	Note 1	Steel	Steel	High Lead Tin Bronze
Discharge Head Bearing	Note 1	Ductile Iron	Ductile Iron	Cast Iron
Discharge Stuffing Box	Note 1	Cast Iron	Cast Iron	
Driver Characteristics:				
Driver Type	VFD Motor	VFD Motor	VFD Motor	VFD Motor
Drive Arrangement	Vertical, Coupled	Vertical, Coupled	Vertical, Coupled	Vertical, Coupled
Non-Reverse Ratchets		None Required	None Required	Required
Minimum Driver Horsepower	40	40	10	75
Maximum Driver rpm	1800	1800	1200	1,800
Motor Characteristics (When Motor is Driver Type):				
Inverter Duty Rated	Yes	Yes	Yes	Yes
Motor Voltage/Phases/Hertz	460/3/60	460/3/60	460/3/60	460/3/60
Enclosure Type	WP1	WP1	WP1	TEFC

Tag Numbers	PMP-89100, PMP-89101	PMP-89102	PMP-91100	PMP-99411, 99412, 99413, 99414
Location	**Carousel Pump Station**		**PAU Pump Station**	**Recycled Water Pump Station**
Drawing(s)	**89D01, 89D02, 89M01, 89M02, 89E01, 89E02, 89N01**		**91M01, 91E01, 91N01**	**98M01, 99E03, 99N01, 99N02,**
Source Testing:				
Test Witnessing	Note 1	Witnessed	Witnessed	Not Witnessed
Performance Test Level	Note 1	2	2	2
Vibration Test Level	Note 1	1	1	2
Noise Test Level	Note 1	1	1	1
Functional Testing:				
Performance Test Level	Note 1	3	3	2
Vibration Test Level	Note 1	2	2	2
Noise Test Level	Note 1	2	2	1
Notes: This pump is existing. Only the motor and VFD will be replaced on the pump.				

END OF SECTION

SECTION 11312O

HORIZONTAL ANSI CENTRIFUGAL PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Frame mounted, centrifugal, horizontal end suction pumps in accordance with ASME B73.1, with drivers and features as scheduled.

B. Tag numbers: As specified in Pump Schedule.

1.02 REFERENCES

A. American Bearing Manufacturers Association (ABMA).

B. American Society of Mechanical Engineers (ASME):
   1. B73.1 - Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process.

C. ASTM International (ASTM):
   1. A48 - Standard Specification for Gray Iron Castings.
   2. A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
   3. A276 - Standard Specification for Stainless Steel Bars and Shapes.
   4. A283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
   5. A322 - Standard Specification for Steel Bars, Alloy, Standard Grades.
   6. A395 - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
   7. A494 - Standard Specification for Castings, Nickel, and Nickel Alloy.
   8. A743 - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
   9. B367 - Specification for Titanium and Titanium Alloy Castings.
   10. E10 - Standard Test Method for Brinell Hardness of Metallic Materials.

D. Hydraulic Institute (HI):
   1. 9.1-9.5 - Pumps - General Guidelines.
   2. 14.1-14.2 - Rotodynamic Pumps for Nomenclature and Definitions.
   3. 14.3 - Rotodynamic Pumps for Design and Application.
   4. 14.6 - Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

1.03 TERMINOLOGY

A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section have the indicated meaning.
   1. Allowable Operating Region (AOR): The region over which the service life of the pump is not seriously compromised by hydraulic loads, vibration, or flow

separation where the pump's vibration, noise, and cavitation are within acceptable limits.
2. Preferred Operating Region (POR): The region over which the service life of the pump will not be significantly affected by hydraulic loads, vibration, or flow separation where the pump's vibration, noise, and cavitation are within acceptable limits.
3. Pump head (total dynamic head, TDH), flow capacity, pump efficiency, net positive suction head available (NPSHa), and net positive suction head required (NPSHr): As defined in HI 9.1-9.5, 14.1-14.2, 14.3, 14.6 and as modified in this Section.
4. Suction head: Gauge pressure available at pump intake flange or bell in feet of fluid above atmospheric; average when using multiple suction pressure taps, regardless of variation in individual taps.
5. Tolerances: In accordance with HI 9.1-9.5, 14.1-14.2, 14.3, and 14.6 unless specified more restrictively.

1.04 DELEGATED DESIGN

A. As specified in Section 01357 - Delegated Design Procedures.

B. Anchoring and bracing.

C. Rotordynamic analysis.

1.05 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Delegated Design Submittals:
1. Provide project-specific calculations based on support conditions and requirements to resist loads specified in Section 01850 - Design Criteria.
2. Anchoring and bracing:
   a. Design of equipment support structures or pedestals and associated anchoring to structures.
3. Rotordynamic analysis:
4. Level as scheduled.

C. Commissioning Submittals:
1. For commissioning submittals listed below and specified in this Section and as specified in Section 01756 - Commissioning:
   a. Manufacturer's representative qualifications.
   b. Certificates.
      1) Requirements as specified in this Section.
   c. Test Plans:
      1) Test requirements as specified in this Section.
   d. Test Reports:
   e. Manufacturer's representatives field notes and data.
   f. Owner training.

D. As specified in Section 01600 - Product Requirements.
   1. Product data.
      a. Pump certification.
      b. Weighted average lead.
   2. Shop drawings.
   3. Calculations:
      a. Torsional analysis.

E. Vendor operation and maintenance manuals: As specified in Section 01782 - Operation and Maintenance Manuals.

1.06 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Pump: One of the following or equal:
   1. Flowserve Co., model as scheduled.
   2. ITT Ind., similar to scheduled model.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Horizontal, centrifugal, ASME B73.1 end suction pump, drivers, motors, seals or packing, couplings, base plates, guards, supports, anchor bolts, necessary valves, gauges, taps, lifting eyes, stands, and other items as required for a complete and operational system.

B. Design requirements:
   1. Pump performance characteristics:
      a. As specified in Pump Schedule.
      b. Rotordynamic analysis level: As scheduled and as specified in Section 15050 - Common Work Results for Mechanical Equipment.
         1) Vibration analysis expert: Provide when scheduled.
      c. All required conditions (flow/head) shall be within the pump manufacturer's Allowable Operating Range (AOR).
      d. Performance tolerances shall be the same as the test tolerances specified in Section 15958 - Mechanical Equipment Testing
   2. Motor characteristics: As specified in Pump Schedule.

C. Product requirements as specified in Section 01600 - Product Requirements and Section 15050 - Common Work Results for Mechanical Equipment.

2.03 MATERIALS

A. General:
   1. Materials in the Pump Schedule shall be the type and grade as specified in this Section.
   2. Drinking Water Pumps: Provide materials in conformance with Section 15050 - Common Work Results for Mechanical Equipment.

B. Cast iron: ASTM A48, Class 30 minimum.

C. Ductile iron: ASTM A395.

D. Steel: ASTM A108, grade as scheduled or ASTM A322, grade as scheduled.

E. Stainless steel: ASTM A276, type as scheduled.

F. Iron-chromium alloy: ASTM A743, Grade CA40.

G. Structural steel: ASTM A283, Grade D.

H. Hastelloy C: ASTM A494, Grade CW-12M-2.

I. Titanium: ASTM B367, Grade C-3.

2.04 GENERAL PUMP CONSTRUCTION

A. Type: Horizontal centrifugal, end suction pumps manufactured in accordance with ASME B73.1, except as modified in this Section.

B. Other requirements:
   1. Vibration: In accordance with ASME B73.1 or as specified in Section 15958 - Mechanical Equipment Testing, whichever is more stringent.

2.05 PUMP CASINGS

A. Type: 1-piece volute type with integral suction and discharge nozzles.

B. Material: As scheduled.

C. Design working pressure: Minimum 1.10 times maximum shutoff total dynamic head with maximum installable impeller diameter at maximum operating speed plus maximum suction static head.

D. Hydrostatic test: 10-minute hydrostatic test at minimum 1.5 times design working pressure.

2.06 IMPELLERS

A. Type: As scheduled.

B. Material: As scheduled.

C. Method of securing to shafts: Threaded impeller in accordance with ASME B73.1.

D. Balance: As specified in Section 15050 - Common Work Results for Mechanical Equipment and vibration criteria as specified in Section 15958 - Mechanical Equipment Testing.

2.07 PUMP SHAFTS

A. Material: As scheduled.

B. Strength: Able to withstand minimum 1.5 times maximum operating torque and other loads.

C. Solid shaft without sleeve.

2.08 STUFFING BOXES

A. Type: In accordance with ASME B73.1, Figure 3, with universal cover adapter.

B. Materials: As scheduled.

C. Shaft seal type: As scheduled and as specified in Section 15050 - Common Work Results for Mechanical Equipment.

D. Drain: Minimum 3/8-inch size, with drain line to nearest equipment floor drain.

2.09 BEARINGS AND BEARING FRAME

A. Bearing type: Anti-friction meeting ABMA standards; self-aligning spherical roller type radial bearings; double row ball type or tapered roller for thrust bearings.

B. Bearing lubrication: Grease or oil lubricated as scheduled:
   1. For oil lubricated, provide pressure lubricating system or separate oil reservoir type system with oil filler pipe and external level indicator gauge.
   2. For grease lubricated, provide external grease fittings with grease relief pipe.
   3. Size sufficiently to safely absorb heat energy normally generated in bearing under maximum ambient temperature of 60 degrees Celsius.

C. Bearing life: In accordance with ASME B73.1.

D. Pump bearing frames:
   1. Material: As scheduled.
   2. Provide a 1-piece rigid construction with bearing housing at outboard (pump) end, and end cover or housing at inboard (driver) end.

E. Grease seals and deflectors: Lip type seals and labyrinth type deflectors at both ends of bearing housings, able to prevent entrance of contaminants.

F. Bearing isolators: Provide bearing isolators on each end with integral locking ring to prevent leakage past the shaft.
   1. Manufacturers: The following or equal:
      a. Inpro Model VBX.

2.10 COUPLINGS

A. Types: As scheduled and as specified in Section 15050 - Common Work Results for Mechanical Equipment.

B. Design coupling to withstand a minimum of 1.5 times the maximum operating torque and other imposed loads.

2.11 SUPPORTS, PEDESTALS, AND BASEPLATES

A. Type: Provide baseplate and supports in accordance with ASME B73.1.

B. Materials: Same as pump casing or ASTM A283 steel, hot-dip galvanized after fabrication and coated as specified in Section 09960 - High-Performance Coatings.

C. Pump and driver support strength: Able to withstand minimum 1.5 times maximum imposed operating loads or imposed seismic loads, whichever is greater.

D. Anchor bolts: As specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

2.12 EQUIPMENT GUARDS

A. Provide equipment safety guards as specified in Section 15050 - Common Work Results for Mechanical Equipment.

2.13 DRIVERS

A. Horsepower:
   1. As scheduled.
   2. Listed driver horsepower is the minimum to be supplied:
      a. Increase driver horsepower if required to prevent driver overload while operating at any point of the supplied pump operating head-flow curve including runout.
      b. When scheduled driver is a motor, increase motor horsepower if required to prevent operation in the service factor.
      c. Make all structural, mechanical, and electrical changes required to accommodate increased horsepower.

B. Motors: Provide motors as specified in Section 16222 - Low Voltage Motors up to 500 Horsepower and as specified in this Section:
   1. Revolutions per minute: As scheduled.
   2. Enclosure: As scheduled.
   3. Electrical characteristics: As scheduled.
   4. Efficiency, service factor, insulation, and other motor characteristics: As specified in Section 16222 - Low Voltage Motors up to 500 Horsepower.

5. Motor accessories: As specified in Section 16222 - Low Voltage Motors up to 500 Horsepower and in this Section.
6. Coordinate motors with the variable frequency drive manufacturer to ensure compatibility between the motor and variable frequency drive.

C. Other drivers: As scheduled and as specified in sections listed in the Schedule.

2.14 SPARE PARTS AND SPECIAL TOOLS

A. Special tools: Deliver 1 set for each furnished pump type and size needed to assemble and disassemble pump system.

B. Spare parts: Deliver the following as specified in Section 01600 - Product Requirements:
1. Pump thrust bearing set.
2. Pump radial bearing set.
3. Gasket set.
4. Motor bearing set of each type.
5. Pump impeller, trimmed to match installed impeller.
6. Mechanical seal rebuild set.

PART 3 EXECUTION

3.01 PREPARATION

A. Anchoring and bracing to structures:
1. Prepare equipment anchor setting template(s) and use to position anchors during construction of supporting structure(s).
2. Install anchors of type and material indicated on approved anchoring designs.
3. Install anchors with embedment indicated on approved anchoring designs.

3.02 INSTALLATION

A. Install the equipment in accordance with the accepted installation instructions and anchorage details.

3.03 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

B. Source Testing (Factory Acceptance Tests):
1. Not witnessed.
2. Furnish test reports and Manufacturer’s Certificate of Source Testing.
3. Equipment Testing:
   a. Pump:
      1) Performance test: Test level as scheduled; test as specified in Section 15958 - Mechanical Equipment Testing.
      2) Vibration test: Test level as scheduled; test as specified in Section 15958 - Mechanical Equipment Testing.

3) Noise test: Test level as scheduled; test as specified in Section 15958 - Mechanical Equipment Testing.
4) Pump casing: Hydrostatic pressure tests if specified in this Section.

b. Motor: Test as specified in Section 16222 - Low Voltage Motors up to 500 Horsepower.

C. Installation Verification:
1. Furnish Manufacturer's Certificate of Installation Verification.

D. Functional testing:
1. Equipment testing:
a. Pump:
1) Performance test: Test level as scheduled; test as specified in Section 15958 - Mechanical Equipment Testing.
2) Vibration test: Test level as scheduled; test as specified in Section 15958 - Mechanical Equipment Testing.
3) Noise test: Test level as scheduled; test as specified in Section 15958 - Mechanical Equipment Testing.
b. Motor: Test as specified in Section 16222 - Low Voltage Motors up to 500 Horsepower.

E. Owner Training:
1. Perform Owner training as specified in Section 01756 - Commissioning.
2. Number of sessions:
a. Operations: 1.
b. Maintenance: 1.

3.04 PUMP SCHEDULE

Tag Numbers	PMP-85104
General Characteristics:	
Application	Wastewater
Service	Secondary Effluent
Quantity	1
First Named Manufacturer's Model	2K3X2-10ARV
Normal Pumped Fluid Degrees Fahrenheit	60
Rotordynamic Analysis Level	None
Vibration Analysis Expert	Not Required

Tag Numbers	PMP-85104
Pump Characteristics:	
Impeller Type	Open
Bearing Lubrication	Grease
Shaft Seal Type	Type 3
Speed Control	Fixed
Maximum Pump Revolutions per Minute	1750
Suction Flange Size, Minimum (in.)	3
Discharge Flange Size, Minimum (in.)	2
Rated Design Point (at Maximum Revolutions per Minute):	
Flow, Gallons per Minute	140
Head, Feet	75
Minimum Efficiency, Percent	50
Pump Materials:	
Pump Casing	Ductile Iron
Impeller	Ductile Iron
Impeller Wear Ring	420 Stainless
Casing or Suction Head Wear Ring	420 Stainless
Shaft	316 Stainless
Shaft Sleeve	316 Stainless
Stuffing Boxes	Ductile Iron
Driver Characteristics:	
Driver Type	Motor
Drive Arrangement	Horizontal, Coupled
Minimum Driver Horsepower	7.5
Maximum Driver Speed, Revolutions per Minute	1800
Motor Characteristics (When Motor is Driver Type):	
Inverter Duty Rated	No
Motor Voltage/Phases/Hertz	460/3/60
Enclosure Type	TEFC

Tag Numbers	PMP-85104
Source Testing:	
Performance Test Level	1
Vibration Test Level	1
Noise Test Level	1
Functional Testing:	
Performance Test Level	1
Vibration Test Level	1
Noise Test Level	1

END OF SECTION

SECTION 11313E

HORIZONTAL SELF-PRIMING SAMPLE CENTRIFUGAL PUMPS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Requirements for provision of pump systems including self-priming centrifugal motor driven pumps are included.

B. Tag numbers: As specified in Pump Schedule.

1.02 REFERENCES

A. American Welding Society (AWS):
   1. D1.1 - Structural Welding Code - Steel.

B. ASTM International (ASTM):
   1. A48 - Standard Specification for Gray Iron Castings.
   2. A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
   3. A276 - Standard Specification for Stainless Steel Bars and Shapes.
   4. A283 - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
   5. A322 - Standard Specification for Steel Bars, Alloy, Standard Grades.
   6. A536 - Standard Specification for Ductile Iron Castings.
   7. A582 - Standard Specification for Free-Machining Stainless Steel Bars.
   8. A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   9. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   10. F594 - Standard Specification for Stainless Steel Nuts.

C. Hydraulic Institute (HI):
   1. 9.1-9.5 - Pumps - General Guidelines.
   2. 14.1-14.2 - Rotodynamic Pumps for Nomenclature and Definitions.
   3. 14.3 - Rotodynamic Pumps for Design and Application.
   4. 14.6 - Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

D. National Electrical Manufacturers Association (NEMA).

1.03 DEFINITIONS

A. Allowable Operating Region (AOR): The region over which the service life of the pump is not seriously compromised by hydraulic loads, vibration, or flow separation where the pump's vibration, noise, and cavitation are within acceptable limits.

B. Flow, head, efficiency, and driver horsepower specified in this Section are minimums unless stated otherwise.

C. Preferred Operating Region (POR): The region over which the service life of the pump will not be significantly affected by hydraulic loads, vibration, or flow separation where the pump's vibration, noise, and cavitation are within acceptable limits.

D. Pump head (Total Dynamic Head, TDH), flow capacity, pump efficiency, net positive suction head available (NPSHa), and net positive suction head required (NPSHr): As defined in HI 9.1-9.5, 14.1-14.2, 14.3, 14.6 and as modified in this Section.

1.04 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Vibration analysis: Submit as specified in Section 15050 - Common Work Results for Mechanical Equipment when scheduled.

C. Product data: As specified in Section 15050 - Common Work Results for Mechanical Equipment.

D. Shop drawings: As specified in Section 15050 - Common Work Results for Mechanical Equipment.

E. Calculations: As specified in Section 15050 - Common Work Results for Mechanical Equipment.

F. Vendor operation and maintenance manuals: As specified in Section 01782 - Operation and Maintenance Manuals.

G. Commissioning submittals:
   1. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756 - Commissioning.
   2. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.05 QUALITY ASSURANCE

A. As specified in Section 15050 - Common Work Results for Mechanical Equipment.

B. Provide pumps specified in this Section from same manufacturer.

C. Vibration analysis: Provide equipment vibration analysis as specified in this Section.
   1. Vibration analysis level: As scheduled and as specified in Section 15050 - Common Work Results for Mechanical Equipment.
   2. Vibration analysis expert: Provide when scheduled.

D. Manufacture's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.06 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Pumps:
   1. One of the following or equal:
      a. Gorman-Rupp Company, AMT.
      b. Barnes Pumps, similar to series listed.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Centrifugal self-priming pump with components: Pump, close coupled driver, bearings, seals, supports, anchor bolts, necessary valves, taps, and other items as required for a complete and operational system.

B. Provide pumps, drivers, couplings, and other components capable of intermittent or continuous operation while pumping specified fluid; loss of prime and possible siphoning of liquid from the pump casing shall be considered in design of the self-priming features.

C. Design requirements:
   1. Pump performance characteristics:
      a. As specified in the Pump Schedule.
      b. All required conditions (flow/head) shall be within the pump manufacturer's Allowable Operating Range (AOR).
      c. Performance tolerances shall be the same as the test tolerances specified in Section 15958 - Mechanical Equipment Testing.
   2. Motor characteristics: As specified in Pump Schedule.

D. Product requirements as specified in Section 01600 - Product Requirements and Section 15050 - Common Work Results for Mechanical Equipment.

2.03 MATERIALS

A. General: Materials in the Pump Schedule shall be the type and grade as specified in this Section.

B. Cast iron: ASTM A48, Class 30 minimum.

C. Ductile iron: ASTM A536, Grade as scheduled.

D. 316 Stainless: ASTM A276, Type 316 stainless steel or ASTM A666, Type 316 Stainless Steel.

E. 416 Stainless: ASTM A582, Type 416 stainless steel.

F. Steel: ASTM A108, Grade as scheduled.

G. Hot-wrought alloy steel: ASTMA322, Grade 4140, UNS Alloy G41400.

H. Structural steel: ASTM A283, Grade D.

2.04 GENERAL PUMP CONSTRUCTION

A. Type: Self-priming, centrifugal, sewage type pumps meeting performance and design requirements and features as specified in this Section.

B. Fasteners: Provide Type 316 stainless steel fasteners in accordance with ASTM F593 and ASTM F594.

2.05 PUMP CASINGS

A. Type: 1 or 2-piece.

B. Material: Cast Iron.

C. Construction: Of sufficient strength, weight, and thickness to provide accurate alignment, prevent excessive deflection, and support drive motor.

D. NPT suction and discharge ports meeting design working pressure.

E. Design internal suction check valve that can be removed through the cover plate. Check valve plate shall be constructed of neoprene.

F. Hardware: Stainless steel.

G. Maximum working pressure: 75 pound per square inch.

H. Maximum temperature: 160 degrees Fahrenheit.

I. Vent and taps:
   1. Provide castings with both 3/4-inch threaded low point and initial priming fill vent on casing. Install pipe nipples with threaded gate valves in drain and priming vent.

2.06 IMPELLERS

A. Type: Self-cleaning, semi-open or open.

B. Material: Ductile iron.

C. Design with smooth water passages to prevent clogging by stringy or fibrous materials.

D. Design impeller and volute for automatic unattended self-priming and repriming with a dry suction leg and without reliance on a suction check valve to maintain prime.

E. Rotation: Clockwise looking from top, unless otherwise indicated on the Drawings.

F. Balance: As specified in Section 15050 - Common Work Results for Mechanical Equipment to meet vibration criteria as specified in Section 15958 - Mechanical Equipment Testing.

2.07 SHAFT

A. Material: Stainless steel.

B. Strength: Able to withstand minimum 1.5 times maximum operating torque and other loads.

C. Resonant frequency: As specified in Sections 15050 - Common Work Results for Mechanical Equipment and 15958 - Mechanical Equipment Testing.

D. Deflection: Maximum 0.002 inches under operating conditions.

E. Impeller attachment: Taper fitted at impeller with key and bolt for securing impeller.

F. Pump shaft seal:
   1. Silicon carbide mechanical seal.
   2. Self-lubricating.

2.08 COUPLINGS

A. Type: Close coupled.

B. Flexible coupling life: Infinite at up to 0.3-degree misalignment angle total or per disk for disk type at maximum operating loads.

C. Design coupling to withstand a minimum of 1.5 times the maximum operating torque and other imposed loads.

2.09 DRIVERS

A. Horsepower:
   1. As scheduled.
   2. Listed driver horsepower is the minimum to be supplied.
      a. Increase driver horsepower if required to prevent driver overload while operating at any point of the supplied pump operating head-flow curve including runout.
      b. However, electrical equipment is sized for scheduled horsepower.

B. Motors: Provide motors as specified in Section 16222 - Low Voltage Motors up to 500 Horsepower and as specified in this Section:
   1. Revolutions per minute: As scheduled:
   2. Enclosure: As scheduled.
   3. Electrical characteristics: As scheduled.
   4. Efficiency, service factor, insulation, and other motor characteristics: As specified in Section 16222 - Low Voltage Motors up to 500 Horsepower.
   5. Motor accessories: As specified in Section 16222 - Low Voltage Motors up to 500 Horsepower and in this Section.

2.10 ANCHOR BOLTS

A. As specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

2.11 SPARE PARTS AND SPECIAL TOOLS

A. Spare parts: None.

B. Special tools: For each type or size of pump specified, provide 1 set of all special tools required for complete assembly or disassembly of all pump system components.

PART 3 EXECUTION

3.01 COMMISSIONING

A. As specified in Section 01756 - Commissioning and this Section.

B. Manufacturer services:
   1. Provide certificates:
      a. Manufacturer's Certificate of Source Testing.
      b. Manufacturer's Certificate of Installation and Functionality Compliance.
   2. Manufacturer's Representative onsite requirements:
      a. Installation: 1 trip, 5-day minimum.
      b. Functional Testing: 2 trips, 2-day minimum each.
   3. Training:
      a. Maintenance: 4 hours per session, 2 sessions.
      b. Operation: 2 hours per session, 2 sessions.
   4. Process operational period:
      a. As required by Owner or Contractor.

C. Source testing: As specified in Pump Schedule.

D. Functional testing: As specified in Pump Schedule.

3.02 PUMP SCHEDULE

Tag Numbers	PMP-87134
General Characteristics:	
Service	Final Effluent
Quantity	1
Maximum Noise, dBA at 3 Feet	85
Minimum Pumped Fluid Degrees Fahrenheit	50
Normal Pumped Fluid Degrees Fahrenheit	70

Tag Numbers	PMP-87134
Maximum Pumped Fluid Degrees Fahrenheit	85
Vibration Analysis Level	None
Vibration Analysis Expert	Not Required
Rated Design Point (at Maximum Revolutions per Minute):	
Flow, gpm	20
Head, Feet	20
Motor Characteristics (When Motor is Driver Type):	
Motor Specification Section	16222 - Low Voltage Motors up to 500 Horsepower
Motor Horsepower	0.5
Maximum Speed, Revolutions per Minute	1750
Service Factor	1.15
Voltage/Phases/Hertz	480/3/60
NEMA Enclosure Type	TEFC
Source Testing:	
Test Witnessing	Not Witnessed
Performance Test Level	None
Vibration Test Level	None
Noise Test Level	None
Functional Testing:	
Performance Test Level	1
Vibration Test Level	None
Noise Test Level	None

END OF SECTION

SECTION 11376A

ROTARY-LOBE BLOWERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Rotary-lobe blowers to supply air to the packaged water treatment system specified in Section 11802 - Packaged Water Treatment System Rehabilitation, including the related appurtenances specified herein and as indicated on the Drawings:
   1. Automatic air supply valves and valve actuators as indicated on the Drawings and specified elsewhere.
   2. Blower piping, valving, inlet filters, silencers, and instrumentation indicated on the Drawings and specified elsewhere.

B. As specified in Section 15050 - Common Work Results for Mechanical Equipment.

C. Tag numbers:
   1. Air Wash Blower 1 (BLO-85106).
   2. Air Wash Blower 2 (BLO-85107).
   3. Air Wash Blower 3 (BLO-85108).

1.02 REFERENCES

A. American Bearing Manufacturers Association (ABMA):
   1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
   1. 52.1 - Testing for HVAC Air Filtration.

C. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

D. National Electrical Manufacturers Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1,000 V Maximum).

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. As specified in Section 15050 - Common Work Results for Mechanical Equipment.
   2. Blower information:
      a. Manufacturer.

b. Model.
c. Blower speed in revolutions per minute.
d. Blower site capacity, actual cubic feet per minute.
e. Discharge pressure, pounds per square inch absolute.
f. Horsepower required including loss in V-belt drive.
g. Weight of blower.
h. Weight of motor.
i. Free-field noise level at 3 feet from blower acoustic enclosure.

3. Motor performance and construction data.
4. Construction details of acoustic enclosure.
5. Descriptive brochures and applicable performance and construction data for each item of auxiliary equipment along with their weights.
6. Test data on equipment performance, vibration, and noise.

C. Shop drawings: As specified in Section 15050 - Common Work Results for Mechanical Equipment:
1. Blower panel device layout and material list.

D. Calculations: As specified in Section15050 - Common Work Results for Mechanical Equipment.

E. Vendor operation and maintenance manuals: As specified in Section 01782 - Operation and Maintenance Manuals.

F. Commissioning submittals:
1. Provide Manufacturer’s Certificate of Source Testing as specified in Section 01756 - Commissioning.
2. Provide Manufacturer’s Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.04 ENVIRONMENTAL CONDITIONS

A. Blower shall be suitable for continuous service and indoor installation.

1.05 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. System components: Aeration blowers, blower panel, and appurtenances.

B. General: Aeration blowers and appurtenances shall include the following items and supplied by blower manufacturer:
1. Rotary positive displacement blower and motor.
2. Air intake filters.
3. Silencers, inlet, discharge, and vent.
4. Butterfly valves and silencer in blowoff circuit.

5. Check valves.
6. Relief valves.
7. Flexible pipe connectors.
8. Pressure gauges.
9. Acoustic enclosure.
10. Discharge Temperature gauge.
11. Appurtenances as required.

C. Design criteria:

Type of Blower	Rotary lobe, positive displacement
Number of blowers	3
Rated speed	4,535 RPM
Rated inlet air flow at rated speed SCFM	447
Inlet filter/Silencer pressure loss	0.5 pounds per square inch
Rated discharge pressure	19.1 psia
Rated inlet pressure	14.1 psia
Inlet temperature	104 degrees F

1. Motor: As specified in Section 16222 - Low Voltage Motors up to 500 Horsepower, except as otherwise specified or supplemented below:

Power supply	480-volt, 3-phase, 60-hertz
Horsepower	20
Speed, maximum	4,535 RPM
Enclosure	TEFC
Service factor	1.15

2. Drive: Belt.
3. Noise control:
   a. Sound pressure levels radiated from equipment furnished shall not exceed 78 dBA (mean, A-weighted) at 3 feet (RE 2 x 10^{-5} N/m^2) for free field condition when unit is in operation at rated flow.
4. Vibration:
   a. Maximum acceptable peak vibration velocity (unfiltered) for blower equipment is 0.45 inches per second.
5. Provide instrumentation, and alarms as indicated on the P&ID Drawings and as specified in Sections 17100 - Control Strategies and 17101 - Specific Control Strategies.

D. System operation: System operation shall be as specified in Sections 17100 - Control Strategies and 17101 - Specific Control Strategies.

2.02 AERATION BLOWERS

A. Manufacturers: One of the following or equal:
   1. Kaeser Compressors, Com-paK Series.
   2. Aerzen.
   3. FPZ, Inc., MS Series.

2.03 MATERIALS

A. General:
   1. Aeration blower assembly: Complete with blower, drive, inlet and discharge silencers, valves, and appurtenances.
   2. Blower rating: As specified above.
   3. Rotation direction of blower shall match requirements of piping.

B. Blower and drive:
   1. General:
      a. Blower shall deliver oil-free air.
      b. Blower and motor mounting: On common base.
      c. Lifting provisions: Lifting eyes on blowers, motors, and base so each major component or entire unit can be lifted.
      d. Piping connections: 125 pound class flanges in accordance with ASME B16.1.
   2. Type: Positive displacement rotary blowers using 2 impellers to pressurize a trapped volume of air at a controlled rate prior to exposing it to a discharge pressure.
   3. Casing and head plates:
      a. Blower casing: 1 piece with separate head plates and end covers.
      b. Casing and head plates: Made of close-grained, machined cast iron.
      c. End covers and head plates: Reinforced with bosses at penetrations with cast, machined support feet.
   4. Impellers:
      a. Material: Ductile iron or cast iron.
      b. Design: Straight, 3-lobe, involute type.
      c. Balance: Dynamically, by removing metal from impeller body.
      d. Operation: Free of rubbing without need for liquid seals or lubrication.
      e. Timing: positively by a pair of accurately machined, heat-treated, alloy steel timing gears.
      f. Shafts: Alloy steel forgings, pressed into each end of each impeller and pinned.
      g. Impeller assembly support: Anti-friction type bearings, sized for a minimum ABMA 9 and 11 L10 life for bearings of 100,000 hours.
   5. Lubrication:
      a. Positive oil seal: Provided at each bearing.
      b. Seal design: Capable of preventing lubricant from leaking into air stream.
      c. Vent provisions: Capable of venting impeller side of oil seal to atmosphere while eliminating possible carryover of lubricant into air stream.
      d. Drive-end bearings: Grease or oil lubricated.
      e. Timing gears and gear-end bearings: Splash oil lubricated.
      f. Blower’s shipment: With openings sealed after injection of rust inhibitor.

2.04 APPURTENANCES

A. Inlet filter shall have front access for filter element access. Filter shall provide 99 percent removed efficiency of 5 micron particle size and larger.

B. Silencers:
   1. Manufacturers: The following or equal:
      a. Burgess-Manning, Model BMSI, BMSS, or equal.
   2. Construction: Welded steel.
   3. Discharge silencer: Furnished with copper wool absorption material and shall have connections for a pressure relief valve, pressure gauge, temperature gauge, and drain.
   4. Silencers sizing: For design conditions and specifically designed for use with positive displacement blowers, size as indicated on the Drawings unless a larger size is recommended by the manufacturer.
   5. Mounting of silencers: As indicated on the Drawings.
   6. Noise attenuation of silencers shall as a minimum, meet the following:

Octave Band Center Frequency, hertz	Attenuation, dBA
63	12
125	20
250	27
500	30
1,000	31
2,000	29
4,000	25
8,000	21

C. Acoustic enclosure:
   1. Galvanized sheet-metal sandwich construction.
   2. With noise attenuating walls and with ventilation openings ported, ducted, shielded, and lined with acoustic absorptive material as required to achieve specified noise levels.
   3. Design criteria:
      a. Seismic design criteria: As specified in Section 01850 - Design Criteria.
      b. Wind design criteria: As specified in Section 01850 - Design Criteria.
   4. Raintight and dusttight, suitable for outdoor unprotected installation.
   5. With ventilation system designed for not more than 15 degrees Fahrenheit air temperature rise with aeration blower operating at maximum load.
   6. With fan interlocked with blower motor to start when blower starts and to stop with an adjustable time delay after the blower motor stops.
   7. With a weather-protected ventilation air intake filter:
      a. Of disposable, dry type, pleated lofted cotton and polyester fiber media construction, securely bonded to a welded galvanized wire backing, with a frame of heavy-duty paperboard.
      b. Sized for not more than 400 feet per minute face velocity.

c. With ASHRAE Standard 52.1 cleaning efficiency of not less than 25 percent.
d. With thickness not less than 1 inches.
e. With an easily visible and resettable "replace filter" indicator with retained indication independent of blower on/off status.

8. With removable access panels located for maintenance and inspection access to the housed equipment, each weighing not more than 40 pounds, or hinged if weight exceeds 40 pounds.

D. Relief valve: High-capacity, full-nozzle type; 2 inch minimum valve inlet:
1. Manufacturers: The following or equal:
a. Kunkle Valve Co.

E. Butterfly valves:
1. Constructed as specified in Sections 13446 - Manual Actuators.
2. Lined with 10 mils of epoxy suitable for temperatures to 350 degrees Fahrenheit.
3. Sealed with seals suitable for temperatures of 350 degrees Fahrenheit.

F. Check valves: No. 8808-GAX-SSF; dual disc, wafer style with torsion spring induced closure:
1. Manufacturers: The following or equal:
a. Val-Matic.
2. Consisting of following components:
a. Valve body: ASTM A126 cast iron.
b. Disc: ASTM B148-9A, aluminum bronze.
c. Spring: ASTM A276, Type 316 stainless steel.
d. Pins and thrust bearings: ASTM A276 Type 316, stainless steel.
e. Seals, rated for minimum 350 degrees Fahrenheit.

G. Pressure gauges:
1. Provide one gauge for the discharge side of each blower and one for the discharge header.
2. Manufacturers: One of the following or equal:
a. Ashcroft:
1) Maximum pressure less than 10 pounds per square inch: Model 1188.
2) Maximum pressure greater or equal to 10 pounds per square inch: Model 1279.
b. Wika.
c. Ametek.
3. Accuracy: Grade 2A, as defined by ASME B40.100.
4. Where the maximum pressure is less than 10 pounds per square inch, provide socket and bellows; for all other pressure ranges, employ a Bourdon® tube.
5. Liquid filled case with minimum 4 1/2 inch dial face.
6. Type on discharge side of blower: Pressure gauge calibrated in pounds per square inch gauge.
7. A suitable tee handled corporation stop or ball valve and snubber shall be installed between each gauge and connection to air piping.

H. Pressure switches:
   1. Provide one differential pressure switch for each inlet filter, one direct switch for the discharge side of each blower, and one direct switch for the discharge header.
   2. Manufacturers: One of the following or equal:
      a. Ashcroft, N series.
      b. United Electric, Series One.
   3. Accuracy: Within 1.0 percent of range.
   4. Overpressure:
      a. Minimum 130 percent of maximum range pressure without damage to switch or sensing element.
      b. Minimum 400 percent of nominal range without leakage or rupture.
   5. Relay outputs: 2 Form C contacts.

I. Pressure transmitters:
   1. Provide on pressure sensor/transmitter for the discharge side of each blower.
   2. Manufacturers: One of the following or equal:
      a. Emerson, Rosemount 3051 Series.
      b. Yokogawa, EJA Series.
      c. Endress & Hauser, Cerebar S Series.
   3. Maximum ratio of total instrument range to calibrated span: 10 to 1.
   4. Accuracy:
      a. Reference accuracy: Plus or minus 0.075 percent of calibrated span, including effects of hysteresis, nonlinearity, and repeatability.
      b. Total performance accuracy: Plus or minus 0.30 percent of calibrated span, including reference accuracy effects, static pressure and ambient temperature effects.
   5. Stability: Plus or minus 0.15 percent of upper range limit over 5 years.
   6. Power supply: 24 VDC - 2 wire loop powered.
   7. Outputs: 4 – 20 mA.

J. Other safety devices and controls: As recommended by blower manufacturer.

K. Rubber expansion joints:
   1. Provided at inlet and discharge flanges of blowers.
   2. Suitable for pressures up to 15 pounds per square inch gauge and temperature up to 350 degrees Fahrenheit.
   3. At discharge joints, provided with control rods to restrict axial pipe movement.
   4. Manufacturers: The following or equal:
      a. General Rubber.

L. Discharge piping and silencer insulation: As specified in Section 15082 - Piping Insulation, and as indicated on the Drawings. Insulation inside acoustic enclosure by blower manufacturer.

M. Supports and bracing: As required to support blower, associated equipment and piping, and to prevent excessive or harmful vibration or movement of equipment or piping.

2.05 SPARE PARTS AND SPECIAL TOOLS

A. Spare parts: Provide the following:
   1. 1 complete set of bearings.
   2. 4 complete sets of ventilation and air intake filters.
   3. 4 lubrication oil filter cartridges.
   4. 2 complete sets of gaskets and o-rings.
   5. 2 sets of drive belts:
      a. Label spare parts as specified in Section 01600 - Product Requirements and box for storage.

B. Special tools: Provide the following:
   1. 1 set of special tools with equipment when required for normal operation and maintenance.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install adequate supports and bracing to support blower, associated equipment and piping, and to prevent excessive or harmful vibration or movement of equipment or piping resulting from operation of the system.

B. Mount blower on base plate: Properly align and grout base plate as required for blower and base for electric motor with sliding rails.

C. Secure silencers with hold-down bolts.

3.02 COMMISSIONING

A. As specified in Section 01756 - Commissioning, 15958 - Mechanical Equipment Testing, 11802 - Packaged Water Treatment System Rehabilitation, and this Section.

B. Manufacturer services:
   1. Provide certificates:
      a. Manufacturer’s Certificate of Source Testing.
      b. Manufacturer’s Certificate of Installation and Functionality Compliance.
   2. Manufacturer’s Representative onsite requirements:
      a. Installation: 1 trip, 2-day minimum.
      b. Functional Testing: 2 trips, 1-day minimum each.
   3. Training:
      a. Maintenance: 4 hours per session, 2 sessions.
      b. Operation: 2 hours per session, 2 sessions.
   4. Process operational period:
      a. As required by Owner or Contractor.

C. Source testing:
    1. Test as specified in Section 15958 - Mechanical Equipment Testing.
    2. Blower:
        a. Test witnessing: Not witnessed.
        b. Conduct Level 1 General Equipment Performance Test.
        c. Conduct Level 1 Vibration Test.
        d. Conduct Level 1 Noise Test.
    3. Electrical and Controls:
        a. Conduct testing as specified in Section 17950 - Commissioning for Instrumentation and Controls.

D. Functional testing:
    1. Electrical and Controls:
        a. Conduct testing as specified in Section 17950 - Commissioning for Instrumentation and Controls.
    2. Rotary Lobe Blower System:
        a. Test witnessing: Witnessed.
        b. Conduct Level 2 General Equipment Performance Test.
        c. Conduct Level 2 Vibration Test.
        d. Conduct Level 2 Noise Test.

END OF SECTION

SECTION 11802

PACKAGED WATER TREATMENT SYSTEM REHABILITATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Provisions for rehabilitation of four (4) existing packaged water treatment system units. The existing units are Microfloc Trident Model TR-840A Water Treatment units as manufactured by WesTech Engineering, Inc.

B. The Contractor shall assign responsibility of these units to WesTech Engineering, Inc., herein referred to as the manufacturer.
   1. The Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified and required to refurbish, install, and test (if applicable) the treatment equipment, to be supplied by the specified manufacturer, complete with piping, internals and appurtenances.
   2. The specified manufacturer shall assist in the installation of all required equipment, including all instrumentation and controls connections, in order to provide a complete and operational system. Any electrical and wiring components shall be provided and installed by the Contractor unless otherwise specified.

1.02 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. As specified in Section 15050 - Common Work Results for Mechanical Equipment.

C. Shop drawings: As specified in Section 15050 - Common Work Results for Mechanical Equipment:
   1. Approval Drawings: Submit six sets for approval of the following:
      a. Shop drawings showing plan, elevation and sectional views/materials of construction, tank reinforcing, and electrical and piping connections.
      b. Materials list of items proposed to be provided under this Section.
      c. Manufacturer's literature and catalog cuts of purchased items.
      d. Manufacturer’s specifications and other data needed to prove compliance with the specified requirements.
      e. Manufacturer’s installation instructions and diagrams.
      f. Control panel wiring schematics and layouts:
         1) Scaled exterior front and side elevations with dimensional information.
         2) Scaled interior panel layout showing all components coordinated with the bill of materials.
         3) Bill of materials with detailed description of components.
         4) Wiring schematics including wire numbers and terminal numbers.

5) Single-line diagram of power distribution.
6) Control wiring, control logic, and instrumentation.

g. Paint System.
h. ANAB-accredited ISO 9001 quality system certification.

D. Calculations: As specified in Section15050 - Common Work Results for Mechanical Equipment.
1. Thermal management calculations for each control panel.

E. Vendor installation, operation and maintenance manuals: As specified in Section 01782 - Operation and Maintenance Manuals.
1. This information shall be provided to the Contractor and Engineer at least two weeks prior to the shipment of the equipment.
2. Submit three copies in electronic format and three copies in hard copy format, each including the following:
a. Complete manufacturer's installation instructions with detailed installation drawings.
b. Complete manufacturer's operational instructions.
c. Complete manufacturer's maintenance instructions with complete catalog information, electric motor information, parts list, recommended spare parts list and instructions for periodic maintenance of the treatment unit.

F. Commissioning submittals:
1. Provide Manufacturer’s Certificate of Source Testing as specified in Section 01756 - Commissioning.
2. Provide Manufacturer’s Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.03 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Comply with the pertinent provisions of the delivery schedule.

B. Equipment and materials to be shipped F.O.B. shipping points, with freight prepaid to the jobsite. Fabricated parts when delivered to the site shall be stored off the ground and protected from weather and damage. Control and electrical devices shall be stored indoors.

C. Ship fabricated assemblies in largest sections permitted by carrier regulations. Match-mark all sections for ease of field installation.

D. Handle so as to prevent damage to equipment during handling and transportation.

E. Equipment supplied under this section shall not be delivered to the site until construction has progressed to the point where installation may properly commence.

PART 2 PRODUCTS

2.01 GENERAL

A. The following items, most of which are supplied by the specified manufacturer, some of which are provided by the Contractor, describe the elements required to ensure a properly designed and integrated water treatment system:
   1. Modify existing factory built steel tanks as indicated on the Drawings, including the following:
      a. Repair, replacement, and/or addition of structural support components.
      b. Addition of an air grid connection.
      c. These modifications to be done when the internals are removed and prior to repairing, sandblasting, and re-painting the tankage.
   2. Refurbishing/repair/replace various ancillaries of the factory built steel modular tanks, including but not limited to:
      a. Clarifier section:
         1) Removing and cleaning existing media retaining screens and buoyant media.
         2) Removing, inspecting, repairing, replacing influent distribution header and lateral assembly.
         3) Replacing with new air distribution header and lateral assembly to updated versions.
         4) Updating media to mixed media.
         5) Replacing pressure switch assembly and/or add pressure transducer.
      b. Filter section:
         1) Removing surface wash system.
         2) Removing existing media, gravel support, and underdrain.
         3) Removing and reusing tubular underdrains.
         4) Replacing media and gravel support.
         5) Incorporating an air grid, tank connection, air check, and control valve.
         6) Replacing automatic process valves and/or actuators.
         7) Replace headloss-pressure switch assembly and/or add pressure transducer.
         8) Replace existing filter level with radar level control.
      c. Air blowers:
         1) Contractor shall replace air wash blowers as indicated on the Drawings and as specified in Section 11376A - Rotary-Lobe Blowers. Blowers shall be provided by packaged water treatment supplier.
      d. Control panel:
         1) Remove and replace existing vendor control panel (VCP).
         2) Installing new vendor control panel.
         3) Providing all new conduit to valves and instruments from new control panel.
         4) Incorporating enhanced chemical feed control.
      e. Backwash supply system:
         1) Replace and install new backwash supply valves with electric valve actuators for each unit.
      f. Chemical feed:
         1) Replace and update the chemical treatment for remote control from the VCP PLC.

B. Painting:
   1. The contractor shall be responsible for coating the filter tank interior and complete treatment unit (filter tank and adsorption clarifier tank) exterior tankage surface and as specified in Section 09960 - High-Performance Coatings.
      a. Surface defects repaired and any tank modifications required shall be completed as suggested by the manufacturer. The surface shall then be prepared by a method defined in Section 09960 - High-Performance Coatings.
      b. All coatings shall be NSF 61 approved.

C. Technical Services: Training shall be provided to the operators for the purpose of review and understanding of any updates or modifications that have been made during the refurbishment.
   1. A competent technical service representative from the manufacturer shall be provided to instruct the Owner's personnel in the operation and maintenance of the equipment. The time listed below includes only on-site time. No travel time should be considered as part of the required training time. Comply with the requirements of Section 01756 - Commissioning.
   2. Instruction during modifications to the existing water treatment units shall happen as described in the table in Section 3.02.K. Instruction and observation shall be included for the following:
      a. Underdrain placement and clarifier influent and air assemblies of the first unit rehabilitated.
      b. Equipment inspection, media placement, start-up and Owner training for the first unit rehabilitated.
      c. Calibration of replaced or updated valves, flow meters and or pressure switches.
      d. Calibration of existing or newly supplied instrumentation.
      e. Equipment inspection and start-up of the second unit rehabilitated.
      f. The minimum days specified above do not relieve the system manufacturer of providing sufficient service to place the system in satisfactory operation.
      g. Advise and adjust chemical feed equipment to optimize process to include optimal clarifier and filter run times.

D. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

E. The water system manufacturer shall coordinate all activities, design, installation, and operation with all other suppliers of related equipment to ensure that the final water treatment system is properly designed and functions correctly.

F. Teardown/repaint/refurbish 4 tanks with Adsorption Clarifier section and integral filter, each capable of 1,400 GPM. The following pre-engineered treatment system reflects the equipment already existing on site:

	Nominal Tank	Surface Area/Tank (sq.ft.)	
Model No.	**Capacity (GPM)**	**Clarifiers**	**Filters**
TR-840A	1400	140	280

2.02 WATER TREATMENT FILTER UNIT REHABILITATION

A. Adsorption Clarifier Section:
   1. The contractor shall refurbish/repair 4 Adsorption Clarifier section(s) as shown on the contract drawings.
      a. The adsorption media retention hold-down beams, fasteners, gaskets and retaining screens shall be removed to gain access to the internal.
      b. Beams shall be recoated as set forth in this section and set aside.
      c. The media retaining screen and grating assemblies shall be cleaned by power washer.
      d. All gasket surfaces cleaned and free of old adhesive, sealants, and glues.
      e. The media hold down fasteners shall be cleaned for reuse or replace if the threads or material has been corroded or damaged.
   2. The adsorption media can be removed or floated to the filter section while clarifier repairs/refurbishments are conducted.
   3. The raw water inlet header shall be removed, cleaned, and inspected for damage. Any damage shall be repaired by replacing with new material or replacement of complete assembly. All stainless steel fasteners showing signs of corrosion or damage shall be replaced with new 18-8 SS/304 SS fasteners.
   4. All inlet air piping shall be removed and replaced after system coating. Any Flow-EZ type air nozzles shall be replaced with new media retaining, non-clog air diffusers consisting of a slotted plastic nozzle body consisting of six slot, 0.040 inch slot size, ABS-SST material.
   5. All couplings for the influent water and air headers to be fitted with new gaskets/seals.
   6. For complete repair/repainting of the interior clarifier, see section regarding interior finish coating.
   7. All openings and threaded areas shall be protected from epoxy coating.
   8. For spot repairs: All painted mounting surfaces that show signs of rust or damage shall be sandblasted, cleaned, dried and prepared for repainting per section regarding interior finish coating.
   9. A bottom media retention screen with stainless steel screen support shall be provided to prohibit mixed media from entering and coalescing with the influent and air piping. The adsorption media retention screen shall be a corrosion resistant assembly that allows free passage of water but contains the adsorption media particles.
   10. A 24-inch depth of fiber ball media shall be provided. Media shall be neutrally buoyant with specific gravity of approximately 1.0. Half of the buoyant media that currently is in use shall be reused and set aside during rehabilitation. This existing material is manufactured of recycled HDPE beads. At least one-half of the beads in the bed shall be rolled to produce an elliptical shape and shall also be scarified to place a groove on the media surface. The rolled and

scarified shape provides improved floc retention inside of the clarifier bed. Media that does not include the rolled and scarified design is not acceptable due to its lower capability of floc retention.

11. A stainless steel grating assembly shall sit above the air scour system near the bottom of the ADSORPTION CLARIFIER unit. The grating allows for free passage of water but contains the adsorption media particles.
12. Splash guards shall outline the perimeter of the ADSORPTION CLARIFIER system to prevent water from burping over the edge during the flushing process.
13. Once the AC Media is installed, new adhesive seal shall be installed for the media retaining screen and on the screens as described in the Owners' Manual. Media hold down beams replaced and torqued per specifications.
14. The clarifier check valve shall be replaced, or the seals shall be replaced with new.

B. Filter Section:
1. The floats, level controller, and other instrumentation as required shall be removed.
2. The surface wash sweep(s) and pipework shall be removed from the washtrough.
3. The coupling in the washtrough shall be plugged.
4. The filter media shall be removed as well as any support gravel.
5. The filter underdrain shall be removed.
6. The tank shall be modified with the required tank connection to allow for an air flow into the in-bed air wash grid.
7. The interior shall be cleaned, inspected, repaired or modified as shown on the drawings prior to sandblasting and repainted as noted per the interior finish coating specification.
8. All required supports shall be properly welded and/or installed into the tank(s) as required proper installation. Additional structural supports may be required to be welded to the tank walls to provide stiffening.
9. Effluent piping shall be cleaned prior to installing the new underdrain to ensure no debris in present that could cause damage to the new underdrain during a backwash process.
10. The following procedure will be followed for installation of the underdrain assembly:
    a. In-Bed Air Wash Grid:
        1) The contractor shall install the in-bed air wash grid in the filter section per the manufacturer's requirement.
        2) The gravel support layers shall be installed per the required configuration.
        3) The contractor shall install the in-bed air wash grid assembly into the filter section. The grid shall consist of a main air header pipe with laterals. The header will be flanged on one end and capped on the other end. The laterals shall have cut slots perpendicular to the length of the pipe and in predetermined sections along the length of the lateral pipes. The in-bed air wash assembly shall be placed at the interface of the gravel support and filter media. The assembly shall be supported with the required supports and hardware to ensure the header pipe and laterals are secure and allow air flow into the underdrain system for the filter backwash process.

11. Replacing filter media per specifications below:
    a. Filter mixed media:
        1) The filter media shall be a 30 inch deep mixed media separation bed composed of three materials, each of different size and specific gravity, providing uniform void distribution from coarse to fine in the direction of flow. The mixed media shall consist of the following as noted in the original equipment bills of material:
            a) 18 inches of anthracite coal, MS-4, 1.0–1.1 mm ES, ≤1.7 SG.
            b) 9 inches of silica sand, MS-18, 0.35–0.45 mm ES, ≤1.4 SG.
            c) 3 inches of high-density sand, MS-21, 0.20-0.32 mm ES, ≤1.7 SG.
        2) The filter media shall be supplied by the manufacturer and shall be shipped in bags for ease of installation.

2.03 PLANT PROCESS VALVES-ELECTRIC

A. Refer to Section 13447 for all process control valves in the sizes shown on the drawings.

B. The existing valves and actuators for influent, Adsorption Clarifier air scour, filter effluent, filter-to-waste, backwash and air assisted backwash shall be replaced with new seal kits and replacement actuators.

C. One automatic high-rate valve, one manual high-rate valve, and one manual low-rate valve is provided for backwash flow control. These valves are common to all tanks.

D. The automatic valves with motor actuator shall be provided for process valves. Valves 1-1/2-inch and smaller shall be ball type with bronze body, brass ball, and Teflon * seats. Valves 2-inch and larger shall be wafer butterfly valves with nylon coated ductile iron disc, EPDM seat, 416SS stem and cast-iron body.

E. Motor actuators shall have 480VAC, 60 Hz supply. NEMA 4 enclosure.

F. All electric operated valves will maintain position upon loss of power.

G. A manual wafer-type butterfly valve, complete with handwheel operator, shall be provided for backwash rate setting.

H. New valves with electric motor actuators shall be provided for influent, effluent, filter to waste, Adsorption Clarifier air scour, filter air scour, and backwash inlet.

2.04 PROCESS AND CONTROL EQUIPMENT

A. Filter Level Transmitter:
    1. Utilize the existing level sensor and transmitter selectively demolished from each filter unit.

B. Clarifier Headloss Transmitter and Switch:
    1. Utilize the existing pressure indicating elements, transmitters, gauges, and switches selectively demolished from each filter unit.

C. Filter Headloss Transmitter:
   1. Utilize the existing pressure indicating sensor, transmitter, and gauge selectively demolished from each filter unit.

D. Filter Backwash Switches:
   1. Provide two (2) new float level switches per filter (8 total) for backwash control.

2.05 PLANT BLOWER(S) - REPLACEMENT

A. Refer to Section 11376A - Rotary Lobe Blowers for all blowers shown in drawings.

B. The treatment plant manufacturer shall supply blowers, to provide an air flow capacity for aiding in the cleaning of the Adsorption Clarifier and Filter sections during flushing and backwashing.

C. Air flow capacity for the Adsorption Clarifier flush process shall be 475 scfm at 5 psi and 950 scfm at 5 psi for the filter backwash process.

D. The blower(s) shall be positive displacement (PD) type with a Tri-Lobe design.

E. Each blower shall be provided with an inlet filter, pressure relief valve and dirty filter indicator.

2.06 REPLACEMENT VENDOR CONTROL PANEL (VCP)

A. General:
   1. Vendor control panel components and construction shall be as specified in Section 17710 - Control Systems: Panels, Enclosures, and Panel Components.
   2. Provide components and equipment with UL 508 listing.
   3. Provide control panels with UL 508A labeled.
   4. Provide intrinsically safe circuits and equipment in accordance with UL698A.
   5. VCP shall be programmed, wired, and factory tested for proper operation prior to shipment.
      a. Factory-assemble and wire the control panel such that field wiring only requires connections to terminals.
      b. Additional testing requirements as specified in Section 17950 - Commissioning for Instrumentation and Controls.
   6. Provide surge protection on the incoming power feed.
   7. Provide necessary control hardware, software, and components as required for a fully functional and operational installation.
   8. Provide heating, cooling, and dehumidifying equipment to maintain instrumentation and control devices within their rated operational temperature range.
   9. Power supply: 120 VAC, 1-phase 60 Hz.

B. Enclosures and panel components:
   1. Manufacturers: One of the following or equal:
      a. nVent/Hoffman.
      b. Saginaw Control & Engineering.

2. Panel shall be rated as follows, unless otherwise specified:
    a. Indoor panels:
        1) Electrical/control rooms: NEMA 12, powder coated mild steel.
        2) Process floor: NEMA 4X:
            a) Non-Corrosive Areas: Type 316 stainless steel.
            b) Corrosive Areas: Polycarbonate**.**
3. Programmable logic controller (PLC):
    a. Manufacturers:
        1) Allen-Bradley:
            a) CompactLogix 5380, 5069-L3 Series.
    b. As specified in Section 17720 - Control Systems: Programmable Logic Controllers.
    c. Provide PLC programming software system from same manufacturer as the PLC hardware manufacturer.
    d. PLC Power Supply:
        1) Voltage: 120 VAC.
    e. I/O Modules:
        1) Provide external fuses mounted on the field connection terminal block for discrete input, discrete output, and analog input I/O points.
        2) Discrete modules:
            a) Voltage: 120 VAC.
        3) Individually isolated points are required.
4. Local operator interface (LOI):
    a. As specified in Section 17721 - Local Operator Interface (LOI).
    b. Manufacturers: The following, no equal:
        1) Allen-Bradley:
            a) PanelView Plus 7.
    c. General:
        1) Provide the LOI graphic software system manufactured by the LOI hardware manufacturer.
        2) NEMA rating shall match enclosure rating.
        3) Capable of stand-alone operation in conjunction with 1 PLC.
        4) Communications protocol:
            a) EtherNet/IP.
        5) Touchscreen operator input.
    d. Display:
        1) Type: TFT color.
        2) Standard aspect ratio:
            a) Screen size: 10-inch.
5. Network materials and equipment:
    a. As specified in Section 17733 - Control Systems: Network Materials and Equipment.
        1) Ethernet switches:
            a) Manufacturers: The following, no equal:
                (1) Allen-Bradley Stratix.
                (2) Cisco.
                (3) Hirschmann.
                (4) N-Tron.
            b) Properties:
                (1) Hardware:
                    (a) 100/1000 BASE-FX.

(b) 10/100/1000 BASE-TX.
(c) No fans or moving parts.
(2) Environment:
(a) Operating temperature range: 32 to 140 degrees Fahrenheit.
(b) Humidity: 5 to 95 percent, non-condensing.
(3) Provide Ethernet switch capable of performing basic switching without special programming or configurations.
(4) Connector type:
(a) Fiber: SFP.
(b) Copper: RJ-45.
(5) Mounting:
(a) DIN Rail.

6. Provide 120 VAC to 24 VDC (or other voltages as required) power supply arrangement that is configured with several modules to supply adequate power in the event of a single module failure in either a 1+1 or N+1 configuration as required:
   a. Provide automatic switchover upon module failure.
   b. Alarm contacts monitored by the PLC.
   c. Design power supplies so the either the primary or backup supply can be removed, repaired, and returned to service without disrupting the system operation.
7. Provide GFCI duplex 120 VAC convenience receptacle.
8. Provide NEC Class 2 power to devices requiring NEC Class 2 or SELV supply power.
9. Pilot devices:
   a. Controls:
      1) Power ON-OFF switch.
   b. Lights:
      1) Power ON-OFF indicator.

2.07 CONTROL STRATEGY

A. General:
1. Provide signals over network communication protocol as indicated on the Drawings.
   a. Plant PLC monitoring I/O shall be over the network connection.
2. Coordinate signal transfer with Programmer at programming meetings as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.
3. Provide access to control parameters and settings.
4. PCS shall only have visibility to Vendor’s PLC. No other vendor furnished Ethernet devices shall be visible to the PCS.
5. Provide security lock out capability for vital settings and functions.
6. Provide real time clock within the PLC to select and initiate unit start times.
   a. Include programming functions for syncing the PLC clock with the plant network time server.
7. Refer to and coordinate with Section 17101 - Specific Control Strategies and Digital I/O Tables provided in the Contract Drawings.

B. Common control functions:
   1. Alarms:
      a. Generate alarms within the PLC logic.
      b. Indicate alarms at the LOI. Enable acknowledgement from either the PCS or the LOI.
      c. Use interlocks and proving timers to prevent alarms from operating due to power loss, except for loss of power alarms.
   2. Analog magnitude checking:
      a. Provide clamps to prevent operator-entered values (setpoints, etc.) that fall outside acceptable limits.
   3. I/O filtering and processing:
      1) Monitor analog input signal quality:
         a) Generate alarms for over or under range inputs.
   4. Display the current status of operator selections (HAND/AUTO, START/STOP, etc.) on the LOI and send those signals to the Plant Control System (PCS) for display on HMI screens.
   5. PLC status:
      a. Provide an LOI screen that depicts the status of the enclosure, including but not limited to the following:
         1) PLC cabinet over-temperatures from high temperature switch.
         2) Intrusion status on enclosures equipped with intrusion switches.
         3) AC power failure.
         4) DC power supply failure.
   6. PLC system communication status:
      a. Provide a minimum of 1 screen to display communication errors and status within the control system network and generate alarms for:
         1) Communication with Plant PLC.

C. Control system requirements as specified in Sections 17100 - Control Strategies and 17101 - Specific Control Strategies.

D. Provide complete program in electronic format, unlocked, via USB drive.

2.08 SPECIFIC CONTROL STRATEGY:

A. Normal operation:
   1. Provide logic to run all clarification and filtration operations automatically.

B. Absorption Clarifier Backwashing:
   1. The control system shall provide means for automatically initiating a flush cycle for each Adsorption Clarifier section by a timeclock or preset adjustable clarifier headloss pressure switch.
   2. An interlock shall be provided so that only one unit can be flushed at a time.
   3. A selector switch shall provide override of the automatic flush initiation to allow manual flushing of each unit.
   4. During the flush cycle, collected solids shall be removed by proper sequencing of valves and the blower.
   5. Return to service shall be automatic.

C. Mixed Media Filter Backwashing and Air Scour:
   1. The control system shall provide means for automatically initiating backwash and air scouring of each Mixed Media Filter by a timeclock or a preset filter headloss pressure switch or transmitter.
   2. An interlock shall be provided so that only one filter can backwash at a time.
   3. A selector touch button shall provide override of the automatic backwash initiation to allow manual backwash of each unit.
   4. Flushing of the corresponding Adsorption Clarifier section can be initiated automatically at the PCS.
   5. The control system shall automatically sequence valves, blowers, and pumps during the backwash cycle.
   6. Return to service shall be automatic.

D. Backwashing Interlocks:
   1. On receipt of backwash pump station low level signal from the PCS, the VCP shall prevent backwashing of additional units.
   2. On receipt of backwash pump station high level signal from the PCS, the VCP shall stop production of water through all units.

E. Automatic Chemical Control:
   1. Coagulant feed shall be controlled by the Aquaritrol logic within the VCP PLC. The controller shall be capable of automatically changing chemical coagulant by pacing chemical feeder to maintain plant effluent turbidity at an established setpoint.
      a. Control inputs shall be from existing turbidimeters and pH monitors.
      b. Control output to the coagulant feed pump shall be a speed percentage output to the PCS via the EtherNet/IP connection to control the pump stroke (or pump motor speed).
   2. Operator interface:
      a. The Aquaritrol Program parameters will be accessible through the control panel LOI.

F. Communication with the PCS:
   1. The VCP shall receive the following signals from the PCS via the EtherNet/IP connection:
      a. All setpoints shall be adjustable from the PCS.
      b. Handshake signal.
      c. Unit 1 run.
      d. Unit 2 run.
      e. Unit 3 run.
      f. Unit 4 run.
      g. Backwash pump station low level.
      h. Backwash pump station high level.
      i. Blower discharge header flow.
      j. Coagulant feed pump 1 running.
      k. Coagulant feed pump 2 running.
      l. Coagulant feed pump 3 running.
   2. The VCP shall send the following signals to the PCS via the EtherNet/IP connection:
      a. Handshake signal.
      b. Unit 1 ready.

c. Unit 1 in semi-auto mode.
d. Unit 1 in auto mode.
e. Unit 1 mode status.
f. Unit 2 ready.
g. Unit 2 in semi-auto mode.
h. Unit 2 in auto mode.
i. Unit 2 mode status.
j. Unit 3 ready.
k. Unit 3 in semi-auto mode.
l. Unit 3 in auto mode.
m. Unit 3 mode status.
n. Unit 4 ready.
o. Unit 4 in semi-auto mode.
p. Unit 4 in auto mode.
q. Unit 4 mode status.
r. Backwash in progress.
s. Flush in progress.
t. Blower 1 in auto mode.
u. Blower 1 running.
v. Blower 1 stopped.
w. Blower 2 in auto mode.
x. Blower 2 running.
y. Blower 2 stopped.
z. Blower 3 in auto mode.
aa. Blower 3 running.
bb. Blower 3 stopped.
cc. Coagulant feed pump 1 speed setpoint.
dd. Coagulant feed pump 2 speed setpoint.
ee. Coagulant feed pump 3 speed setpoint.
ff. Unit 1 influent flow.
gg. Unit 2 influent flow.
hh. Unit 3 influent flow.
ii. Unit 4 influent flow.
jj. Unit 1 influent valve in auto.
kk. Unit 1 influent valve mode.
ll. Unit 1 effluent valve in auto.
mm. Unit 1 effluent valve mode.
nn. Unit 1 air valve in auto.
oo. Unit 1 air valve mode.
pp. Unit 1 air scour valve in auto.
qq. Unit 1 air scour valve mode.
rr. Unit 1 backwash valve in auto.
ss. Unit 1 backwash valve mode.
tt. Unit 1 waste gate valve in auto.
uu. Unit 1 waste gate valve mode.
vv. Unit 2 influent valve in auto.
ww. Unit 2 influent valve mode.
xx. Unit 2 effluent valve in auto.
yy. Unit 2 effluent valve mode.
zz. Unit 2 air valve in auto.
aaa. Unit 2 air valve mode.

bbb. Unit 2 air scour valve in auto.
ccc. Unit 2 air scour valve mode.
ddd. Unit 2 backwash valve in auto.
eee. Unit 2 backwash valve mode.
fff. Unit 2 waste gate valve in auto.
ggg. Unit 2 waste gate valve mode.
hhh. Unit 3 influent valve in auto.
iii. Unit 3 influent valve mode.
jjj. Unit 3 effluent valve in auto.
kkk. Unit 3 effluent valve mode.
lll. Unit 3 air valve in auto.
mmm. Unit 3 air valve mode.
nnn. Unit 3 air scour valve in auto.
ooo. Unit 3 air scour valve mode.
ppp. Unit 3 backwash valve in auto.
qqq. Unit 3 backwash valve mode.
rrr. Unit 3 waste gate valve in auto.
sss. Unit 3 waste gate valve mode.
ttt. Unit 4 influent valve in auto.
uuu. Unit 4 influent valve mode.
vvv. Unit 4 effluent valve in auto.
www. Unit 4 effluent valve mode.
xxx. Unit 4 air valve in auto.
yyy. Unit 4 air valve mode.
zzz. Unit 4 air scour valve in auto.
aaaa. Unit 4 air scour valve mode.
bbbb. Unit 4 backwash valve in auto.
cccc. Unit 4 backwash valve mode.
dddd. Unit 4 waste gate valve in auto.
eeee. Unit 4 waste gate valve mode.

2.09 CHEMICAL MIXING AND FEED SYSTEMS

A. Refer to Section 11242 - Liquid Chemical Diaphragm - Type Metering Pumps.

B. Chemical feed pumps electronically controlled by the Aquaritrol PLC Program.

NOTE: Tank and mixer for liquid chemical feed system to be provided by others.

2.10 FINISH

A. Oil, grease, dirt, rust, mill scale, and foreign matter shall be removed from the interior tankage surface by a method defined by the Steel Structures Painting Council (SSPC Spec-latest revision). Tankage interior shall receive at the factory, one coat Tnemec N140-1255 primer, or equivalent, followed by one coat of Tnemec N140-15BL, or equal. The tank exterior, except the bottom, shall be painted with one coat of Tnemec N140-1255 primer, or equal. Field finish painting shall be by the contractor. Tank bottom shall be bare, for the field placement onto a coal tar or asphaltic base mastic compound to be provided and installed on the equipment base pad by the Contractor.

2.11 SPARE PARTS

A. If needed, insert required spare parts for the project. This could include but not limited to, AC retaining screen gaskets, anthracite filter media, valves and actuators, instrumentation, control panel components, touch-up paint, etc.

B. If the PLC hardware provided for the VCP and local control panels are not the same type as the Plant's PLC system hardware, provide the following spare PLC hardware for the PLC equipment in the VCPs and LCPs.
   1. 1 spare CPU for every type of CPU in the system, with programming files preloaded.
   2. 1 spare network and/or communications card for every network or communications card in the system.

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Refurbishment of multiple units shall be coordinated with the Owner and Engineer to allow plant to continue to produce water if needed during the refurbishment phase. Refer to specific requirements in Section 01140 - Work Restrictions.

B. Coordination with plant control system and programmer:
   1. Coordinate requirements for data transfer with PCS:
      a. Include all data registers, data types, and engineering units, etc.
   2. Coordinate with the ICSC and programmer for factory testing. Vendor shall supply PLC and LOI programming file prior to the testing.
   3. Coordinate signal transfer with Owner at programming meetings as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.02 TECHNICAL SERVICES

A. The field installation shall be approved by the equipment manufacturer's personnel, who is directly employed by the equipment manufacturer, and normally engaged in the field installation of the equipment specified herein.

B. The manufacturer's authorized personnel shall be present during the placement of filter Mixed Media and underdrains to instruct and observe installation for the first unit rehabilitated.

C. The manufacturer shall inspect all equipment in this section prior to start-up to confirm that all equipment is properly installed and working, both individually and as a system.

D. The manufacturer will be responsible for calibration of equipment specified herein.

E. The Manufacturer shall be present during placement of filter Mixed Media that is not pre-installed.

F. The Manufacturer shall inspect the installation of all equipment in this section prior to start-up in order to verify that the equipment has been properly installed and operates properly as a system and individually.
   1. Submit field reports to the Engineer.
   2. The field reports should include the following items:
      a. Agenda.
      b. Contact time.
      c. Work completed.

G. The Manufacturer after the equipment has been properly installed shall calibrate the equipment with the Owner's operator present.

H. The Manufacturer's representative shall be present for installation assistance described above as listed in the table in Section 3.02.K.

I. After start-up, the Manufacturer shall furnish the service of a competent technical service representative one month after Contractor's start-up to instruct the Owner's personnel in the operation and maintenance of the equipment for a three-day period during one trip.

J. Effluent quality laboratory analysis shall be provided by the Owner.

K. Equipment manufacturer is required to provide qualified personnel to assist the Contractor as listed in the following table.

Total Trips	Total Duration (Days)	Description
1	2	Initial site visit for equipment inventory review
4	10	Mechanical Components; AC, filter air scour grid, and filter media installation inspection and startup
2	6	Instrumentation on-site assistance, inspection, and startup
4	8	Controls on-site assistance, inspection, and startup
1	3	Operator Training

3.03 TESTING AND INITIAL OPERATION

A. Place units in service utilizing services of equipment manufacturer's service personnel.

B. Fill the plant with liquid to test the hydrostatic design.
   1. Any failure or excessive deflection shall be remedied.

C. Demonstrate proper installation and operation of all equipment with a 72-hour test.
   1. Any failure is to be corrected and the system is to be retested for the specified time period.
   2. Licensed operators at the water treatment plant will be responsible for actual operation of the plant.

3. The equipment manufacturer's service technician will be available by phone during the entire test and will provide on-site service as needed.
4. All testing, including schedules, etc. will be coordinated with the Owner, Contractor, and Engineer.

3.04 WARRANTY

A. A warranty shall be provided covering all replacement parts and workmanship for twelve months after Substantial Completion.

B. It shall be the Supplier's responsibility to provide the necessary service engineers to repair and/or replace any defective components during this warranty period including any and all travel expenses incurred for same.

END OF SECTION

SECTION 13206F

HYDROPNEUMATIC BLADDER TANK

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. ASME-rated hydropneumatic bladder tank with removable bladder.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. Boiler and Pressure Vessel Code (BPVC).
      a. Section VIII-Rules for Construction of Pressure Vessels, Division 1.

B. NSF International (NSF):
   1. Standard 61 - Drinking Water System Components.

1.03 DELEGATED DESIGN

A. As specified in Section 01357 - Delegated Design Procedures.

B. Equipment anchoring and bracing to structures.

1.04 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures and Section 01600 - Product Requirements.

B. Contractor is responsible for completing the Pressure Vessel Inspection Request Form that can be found at the California Department of Industrial Relations website http://www.dir.ca.gov/dosh/pressure.html#PresureVessel.
   1. City will pay for the permit fees and should be listed as “Company Contact.” Contractor to coordinate point of contact with City.

C. Product data:
   1. List of materials and coatings used with specifications and physical properties for each.
   2. Manufacturer's standard operations and maintenance information.

D. Shop Drawings:
   1. Detailed drawings or manufacturer's literature to indicate compliance with the specified requirements.
   2. Dimensional drawings indicating vessel dimensions, wall thicknesses, and mounting, and anchorage requirements.

E. Delegated Design Submittals:
    1. Anchoring and bracing: Project-specific calculations with anchoring and bracing details based on support conditions and requirements to resist loads specified in Section 01850 - Design Criteria.
        a. To structures for tanks installed in structures designated as seismic design category C, D, E, or F.
        b. For tanks installed outdoors.
        c. For tanks installed indoors and having a height to diameter ratio greater than 1.0.Installation instructions.

F. Installation instructions.
    1. Manufacturer's installation instructions.
    2. Equipment anchor setting template.
    3. Complete details for installation of the equipment including rigging, moving, and setting into place.

G. Certifications:
    1. Certification of compliance with ASME BPVC, and data reports in accordance with the ASME BPVC and other local codes as required.

1.05 WARRANTY

A. Provide manufacturer's standard warranty.

PART 2 PRODUCTS

2.01 GENERAL

A. As specified in Section 01600 - Product Requirements and Section 15050 - Common Work Results for Mechanical Equipment.

2.02 MANUFACTURERS

A. Hydropneumatic bladder tank:
    1. One of the following or equal:
        a. John Wood Co., JOPR-22-020.
        b. Wessels Co., Model FXA 4000.
        c. AAtanks., Model FXA-4000.
        d. Elbi of America, Series WTL-2.

2.03 DESIGN AND PERFORMANCE CRITERIA

A. General:
    1. Design, fabricate, and test tanks in accordance with the requirements of:
        a. ASME BPVC.
        b. As specified in Section 01850 - Design Criteria.
        c. Applicable local codes and regulations.
    2. Where conflicts between design criteria exist, request clarification from the Engineer.

B. Hydropneumatic bladder tank:
   1. Vertically mounted tanks, designed for the operating conditions specified:

Minimum Drawdown Volume	1,000 gallons
Maximum Diameter	8 feet
Pressure Cut-In (psi)	85
Pressure Cut-Out (psi)	120
Maximum Operating Pressure	125 pounds per square inch
Temperature Range	20 to 120 degrees Fahrenheit
Minimum Bladder Lifetime Cycles(1)	50,000
Notes: (1) 1 Cycle = When hydropneumatic tank bladder experiences 1 duration of Cut-In to Cut-Out pressure.	

   2. Pressure rating: Unless otherwise indicated on the Drawings, hydropneumatic bladder tanks shall be fabricated in accordance with the ASME BPVC for unfired pressure vessels, for a design pressure rating not less than the lesser of:
      a. 150 percent of the maximum operating pressure, or
      b. 50 pounds per square inch gauge above the maximum operating pressure.
   3. Corrosion allowance: 1/8-inch at shell, heads, and attachments.
   4. Tank seal water volume shall be a minimum of 10 percent of the overall tank capacity.

2.04 MATERIALS

A. Tank:
   1. Constructed using carbon steel with interior and exterior coatings in unless otherwise indicated on the Drawings.
   2. Lifting lugs: Provide lifting lugs at top of tank.
   3. Anchor clips:
      a. Manufacturer's standard configuration, attached to tank skirt, and as required to resist design forces specified.

B. Bladder: Provide sealed bladder system to separate liquid from the steel tank and the air cushion:
   1. Heavy-duty butyl rubber bladder rated for the maximum operating temperature specified.
   2. Liquid contained inside the bladder through an exterior system fill connection.
      a. Material in direct contact with water certified under NSF-61.
   3. Bladder and system connection mounted on a tank flanged connection so that bladder is replaceable through the tank flanged connection.
   4. Tank factory pre-charged to 30 pounds per square inch gauge with minus 40-degree Fahrenheit dew point dry air.

C. Nameplates and certification stamps:
   1. Nameplate:
      a. Each tank shall bear a stainless steel ASME nameplate.
      b. Each nameplate shall bear the applicable code symbol.
   2. ASME Stamp:
      a. Stamp applied to the tank shell.
      b. Manufacturer shall be authorized by ASME to apply the applicable code symbols.

D. Fittings and attachments:
   1. Fittings as specified in Section 15120 - Piping Specialties or as indicated on the Drawings.
   2. Fittings larger than 1 inch shall be flanged.
   3. Fittings 1 inch and smaller shall be National Pipe Thread.

E. Access openings:
   1. Access openings shall be flanged and, unless otherwise indicated on the Drawings, have a nominal diameter of at least 24 inches.
   2. The coverplate and flange of access openings shall each have a net thickness, after machining, of at least 1/2-inch or as required to meet the vessel design pressure.
   3. Reinforce openings in accordance with the ASME BPVC.

F. Weld shell attachments for pipe supports, tank gauges, instruments, and other items as indicated on the Drawings before application of the tank interior coating.

2.05 APPURTENANCES

A. Air charging valve:
   1. Standard Schrader valve or approved equal industry standard.

B. Air relief valve:
   1. Air relief valve shall be sized by manufacturer in accordance with ASME BPVC for unfired pressure vessels.
      a. Drain connection located on tank air side.
      b. Manufacturer's standard size for the tank size.

C. Manual air vent valve:
   1. Screwdriver operated, low projection type vent for shallow height clearance installation; or needle valve, designed for the tank pressure rating at the maximum operating temperature with 1/8-inch male pipe thread connection.
   2. Manufactures: One of the following or equal:
      a. Armstrong, 505A.
      b. Bell and Gossett, 4V.

D. Pressure gauge:
   1. Pressure gauges shall be as specified in Section 17404 - Pressure/Vacuum Measurement: Gauges, with a 0 to 125 pounds per square inch gauge dial range.
   2. Pressure gauge shall be separated from the tank by ball valves and insulating bushings.

E. Anchors:
    1. Anchoring to structures:
        a. As indicated on the Drawings and as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

2.06 FABRICATION

A. Welding:
    1. Weld and test welding in accordance with ASME BPVC.
    2. Excessive reinforcement shall be ground down to within the ASME BPVC requirements, and as required to install the lining systems.
    3. Internal corners and edges shall be ground to a 1/8-inch radius, or a greater radius if required by the lining system.

B. Protective coating:
    1. Interior surfaces: Factory coated with high solids epoxy coating as specified in Section 09960 - High-Performance Coatings.
    2. Exterior surfaces: Factory coated with primed for field coating as specified in Section 09960 - High-Performance Coatings.

PART 3 EXECUTION

3.01 PREPARATION

A. Anchoring and bracing to structures:
    1. Prepare equipment anchor setting template(s) and use to position anchors during construction of supporting structure(s).
    2. Install anchors of type and material indicated on approved anchoring designs.
    3. Install anchors with embedment indicated on approved anchoring designs.

3.02 INSTALLATION

A. Install tanks:
    1. As indicated on the Drawings.
    2. As specified in Section 15050 - Common Work Results for Mechanical Equipment.
    3. In accordance with accepted manufacturer’s installation instructions and accepted anchorage design details.

B. Field finishes:
    1. Not required: Provide tanks with manufacturer's factory-applied coating.

3.03 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

B. Source Testing (Factory Acceptance Tests):
    1. Not witnessed.

2. Furnish: Test reports and Manufacturer's Certificate of Source Testing.
    a. Certification of compliance with ASME BPVC for design and performance criteria specified with be considered acceptable Source Testing.

C. Installation Verification:
    1. Furnish: Documentation not required.

D. Functional Testing:
    1. Equipment testing:
        a. Hydropneumatic bladder tank(s).

E. System Testing:
    1. As specified in Section 01756 - Commissioning, Attachment G.
    2. As specified in this Section.
    3. Furnish Manufacturer's Certificate of Functional Compliance.

END OF SECTION

Replace Section in its Entirety

SECTION 13207[AD3]

STRAND-WOUND CIRCULAR PRESTRESSED CONCRETE TANK WITH A TYPE I CORE WALL AND DOMED ROOF

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PART 1 GENERAL

1.01 SUMMARY

A. Work includes:
   1. This section specifies the design and construction of an AWWA D110, Type 1, strand-wrapped circular prestressed concrete tank, furnishing, installation, testing, and disinfection. The tank shall consist of: foundation, underdrain system, concrete membrane floor slab, cast-in-place concrete core wall, cast-in-place concrete domed roof, and all associated appurtenances. The core wall shall be vertically post-tensioned with thread bars, prestressed circumferentially with machine-wrapped 7-wire galvanized strand, and protected with several coats of shotcrete. The foundation shall be constructed with continuous shallow concrete spread footings below the perimeter wall. The concrete floor shall be constructed with a concrete slab below grade.
   2. In the event of a discrepancy between this section of the Specifications and any other section of the Specifications, this section shall govern.
   3. The Tank Contractor shall furnish all labor, materials, tools, and equipment necessary to design, construct, disinfect, and test the prestressed concrete tank.

B. Related sections:
   1. Section 01410 - Regulatory Requirements.
   2. Section 01759 - Water Leakage Test for Concrete Structures.
   3. Section 02300 - Earthwork.
   4. Section 03102 - Concrete Formwork.
   5. Section 03150 - Concrete Accessories.
   6. Section 03200 - Concrete Reinforcing.
   7. Section 03300 - Cast-in-Place Concrete.
   8. Section 03931 - Epoxy Injection System.
   9. Section 09960 - High-Performance Coatings.

1.02 REFERENCES

A. Abbreviations:
   1. cfm - cubic feet per minute.
   2. f'c - specified compressive strength of concrete.
   3. g - gravitational constant, equal to 32.2 feet per second squared.
   4. gpm - gallons per minute.
   5. ksi - kips per square inch.
   6. MG - million gallons.
   7. mph - miles per hour.
   8. pcf - pounds per cubic foot.
   9. psf - pounds per square foot.
   10. psi - pounds per square inch.
   11. PVC - polyvinyl chloride.
   12. sec - seconds.

B. Definitions:
   1. Core Wall - That portion of the concrete tank wall that is circumferentially post-tensioned.

2. Prestressed Concrete - Concrete in which internal compressive stresses of such magnitude and distribution have been introduced through post-tensioning to offset tensile stress development from service loads.
3. Prestressing Reinforcement - High-strength steel used to prestress the concrete tank wall.
4. Rebound - The shotcrete material that ricochets off of the receiving surface and falls.
5. Shotcrete - Pneumatically applied wet mortar or concrete used for embedment protection of the circumferential prestressed wall reinforcement.
6. Strand - A symmetrically arranged and helically twisted assembly of 7 high-strength steel wires used for prestressing reinforcement or as nonprestressed seismic cables.
7. Stressing Machine - May refer to the automated wrapping machinery used to post-tension the strand around the tank circumference or vertical post-tensioning equipment used to post-tension vertical thread bars.
8. Tank Contractor - A qualified tank manufacturer and/or contractor that specializes in the design and construction of an AWWA D110 type of tank specified herein.
9. Tank Prestressor - A contractor or sub-contractor that specializes in the design of an AWWA D110 type of tank and specializes in the construction of the prestressed elements of the tank, such as the strand/wire wrapping and the vertical post-tensioning of the wall.
10. Tendon - High-strength thread bar, including end anchorages, used to impart vertical prestressed forces to the tank wall.
11. Wire - High-strength, cold-drawn steel wire used to assemble strands.

C. Reference Standards:
1. American Concrete Institute (ACI):
   a. ACI 301-16 - Specifications for Structural Concrete, 2016.
   b. ACI 305.1-14 - Specification for Hot Weather Concreting, 2014.
   c. ACI 306.1-90 - Standard Specification for Cold Weather Concreting, 1990.
   d. ACI 350-06 - Code Requirements for Environmental Concrete Structures and Commentary, 2006.
   e. ACI 350.1-10 - Specification for Tightness Testing for Environmental Engineering Concrete Containment Structures and Commentary, 2010.
   f. ACI 350.3-06 - Seismic Design of Liquid-Containing Concrete Structures and Commentary, 2006.
   g. ACI 350.5-12 - Specifications for Environmental Concrete Structures, 2012.
   h. ACI 372R-13 - Design and Construction of Circular Wire- and Strand-Wrapped Prestressed Concrete Structures, 2013.
   i. ACI 506R-16 - Guide to Shotcrete, 2016.
   j. ACI 506.2-13 - Specification for Shotcrete, 2013.
2. ASTM International (ASTM):
   a. A 185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
   b. A 416 - Standard Specifications for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
   c. A 475 - Standard Specification for Zinc-Coated Steel Wire Strand.
   d. A 615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

e. A 706 - Standard Specification for Low-Alloy Deformed and Plain Bars for Concrete Reinforcing.
f. A 722 - Standard Specification for Uncoated High-Strength Steel Bars for Prestressed Concrete.
g. C 33 - Standard Specification for Concrete Aggregates.
h. C 150 - Standard Specification for Portland Cement.
i. C 171 - Standard Specification for Sheet Materials for Curing Concrete.
j. C 618 - Type F Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
k. D 570 - Standard Test Method for Water Absorption of Plastics.
l. D 624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
m. D 638 - Standard Test Method for Tensile Properties of Plastics.
n. D 746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
o. D 747 - Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
p. D 792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
q. D 1056 - Standard Specification for Flexible Cellular Materials- Sponge or Expanded Rubber.
r. D 2000 - Standard Classification System for Rubber Products in Automotive Applications.
s. D 2240 - Standard Test Method for Rubber Property-Durometer Hardness.

3. American Society of Civil Engineers (ASCE):
   a. 7-10 - Minimum Design Loads for Buildings and Other Structures.
4. American Water Works Association (AWWA):
   a. C652 - Standard for Disinfection of Water-Storage Facilities.
   b. D110-13 - Wire- and Strand-Wound, Circular, Prestressed Concrete Water Tanks, 2013.
5. Code of Federal Regulations (CFR):
   a. Part 1910 - Occupational Safety and Health Standards (OSHA).
6. NSF International (NSF):
   a. 61 - Drinking Water System Components - Health Effects.
7. U.S. Army Corps of Engineers (USACE):
   a. CRD C 572 - Corps of Engineers Specifications for Polyvinylchloride Waterstop.

1.03 SUBMITTALS

A. Product data:
   1. Waterstops:
      a. Submit samples, prints, and complete physical property data covering waterstops.
      b. Laboratory test reports: Submit reports indicating that average properties of polyvinyl chloride waterstops material and finish conform to requirements specified in this Section.
   2. Epoxy grouting equipment: Submit product information.
   3. Neoprene bearing pads: Submit product information.

4. Stressing machine:
    a. Submit a description of the proposed equipment.
    b. Submit calibration reports for force recording equipment used installation of vertical thread bars and circumferential prestressing.

B. Shop drawings:
1. Drawings showing all plan views, sections, and details of the tank construction, including, but not limited to, all structural elements, all appurtenances, connections, joints, waterstop, roof hatches, vents, ladders, fall arrest and protection systems, guardrails, piping, pipe penetrations, pipe supports, sub-grade preparation, base liners, tank instrumentation, and materials for roof drainage and conductance.
2. Drawings of entire prestressing operation showing vertical thread bar and circumferential strand placement with associated schedules and intermediate lock-off elevations, prestressing bar and strand size, ducts for vertical thread bars, and anchorage details.
3. Drawings for placement and detailing of all reinforcing steel.
4. Drawings showing:
    a. Neoprene bearing pads and methods of pad installation.
    b. Waterstop and methods of installation.
    c. Sponge filler pads or sleeves and methods of installation.
    d. Exterior coating system.
5. All shop drawings shall be signed and sealed by a registered California structural or civil engineer.

C. Design submittals:
1. Structural calculations for all aspects of the structural design of the tank, along with calculations for prestressing reinforcement, elongation estimates, soil capacity checks, and calculations for any other structural design aspect.
2. Concrete mix designs in accordance with Section 03300 - Cast-in-Place Concrete and additional provisions specified herein.
3. Shotcrete mix designs in accordance with the provisions specified herein.
4. Admixtures to be used in the concrete and/or shotcrete and their purpose.
5. All design submittals shall be signed and sealed by a registered California structural or civil engineer.

D. Tank responsibility statement:
1. The Tank Contractor shall submit a statement attesting that they have assumed responsibility for the tank design and construction. The statement shall be signed and sealed by the Tank Contractor’s engineer-in-responsible-charge of the tank design. No other submittal items will be reviewed until a satisfactory statement has been received.

E. Qualification Statement:
1. Failure to submit a qualifications statement package will be deemed an irregularity, which will cause bid to be rejected as nonresponsive.
2. Submit pertinent information that demonstrates conformance with Quality Assurance requirements specified herein.

3. To include:
    a. Company history, contact person(s), address, and telephone number.
    b. Project references with owner and engineer's contact information.
    c. Name and work history of the on-site project manager to be assigned to the project.

F. Quality control submittal:
    1. Certificates of Compliance:
        a. Thread Bars: Submit certified test reports that verify bars and anchorage meet specified material standards.
        b. Waterstop: Submit certificates certifying that waterstops provided on this project meet or exceed physical property requirements of current USACE CRD C 572.
        c. Circumferential prestressing: Submit certified test reports for each size, heat, and reel that verify conformance to applicable ASTM standards for materials, strength, and yield properties.

G. Test reports:
    1. Strand and vertical thread bar prestressing records.

H. Manufacturer's instructions:
    1. Tank appurtenances: Submit manufacturer's installation instructions.

1.04 NON-RESPONSIVE BID

A. Qualifications statement package:
    1. Submit a qualifications statement package with the bid. The package shall contain information as required per Section 1.03.E.
    2. Failure to submit a qualifications statement package will be deemed an irregularity that may cause bid to be rejected as non-responsive.

1.05 QUALITY ASSURANCE

A. Qualifications:
    1. Singular Responsibility:
        a. It is the intent of these Specifications to create singular responsibility for design, construction, and performance of the prestressed concrete tank. The design and construction of all aspects of the foundation, floor slab, core wall, columns, prestressing, shotcrete, and roof of the tank shall be performed by the Tank Contractor.
            1) No portion of the work on the tank shall be subcontracted unless:
                a) Prior acceptance is obtained from the Engineer; and
                b) The Tank Contractor's on-site project manager personally supervises the work of any subcontractors and their personnel.
        b. If the Tank Contractor believes that any requirement of this Section represents a departure from its normal recommendations that will affect the quality or performance of the tank, notify the Engineer in writing of such concerns. For each provision of concern, cite the relevant

paragraphs of this Section and indicate the Tank Contractor's recommended modifications or alternatives to those provisions.
1) Acceptance of Tank Contractor's alternatives shall be at the discretion of the Engineer, and the decision of the Engineer shall be final.

2. The specified tank shall be designed and constructed by the Tank Contractor. The Tank Contractor shall be experienced in the design and construction of circumferentially prestressed tanks with cast-in-place concrete core wall sections using freed neoprene bearing pad connections at the top and base of the wall, PVC waterstops, seismic cables placed between the wall and the foundation, and a domed concrete roof deck.
   a. No Tank Contractor is considered qualified unless it has designed and built the following projects in its own name:
      1) At least then circumferentially prestressed concrete tanks conforming to AWWA D110, Type I in the last 20 years.
      2) At least 5 circumferentially prestressed concrete tanks conforming to AWWA D110, Type I used for water storage that have been in successful operation for at least 5 years.
      3) At least 5 circumferentially prestressed concrete tanks with domed roofs conforming to AWWA D110, Type I that are 1.5 MG or larger in the last 10 years.
   b. The Tank Contractor shall have in its employ a design engineer with a minimum of 10 years of experience in the design of AWWA D110 Type I tanks. The design engineer shall have been the engineer of record for a minimum of 10 AWWA D110 Type I tanks designed for and constructed by the Tank Contractor in its own name. The design engineer shall be licensed as a civil or structural engineer in the state of California.
   c. The Tank Contractor shall have in its employ for this project a team consisting of an on-site project manager, concrete foreman, shotcrete foreman, shotcrete nozzleman, and prestressing foreman, each of whom shall have constructed in the last 10 years a minimum of five AWWA D110 Type I tanks having a capacity of 1.5 MG or greater.
      1) Experience gained on shotcrete pool and ditch construction will not be considered as qualifying experience for nozzleman.
      2) Skill of nozzleman:
         a) Capable of applying thin coats of even and uniform thickness.
         b) Certified shotcrete nozzleman in accordance with ACI 506R.
3. Experience in the design and construction of AWWA D110 Type II, Type III, or Type IV tanks will not be accepted as demonstrating the qualifications required by the preceding paragraphs.
4. Soil Anchors:
   a. Qualifications and Experience:
      1) The design, construction, testing and quality control of the deep foundation system shall be the responsibility of the Tank Contractor. The Tank Contractor may subcontract labor for the deep foundation installation under the Tank Contractor's direct supervision.

1.06 DESIGN CRITERIA

A. Except as modified herein, the prestressed concrete tank shall be designed and constructed in compliance with the provisions of AWWA D110 for strand-wound circular, prestressed concrete water tanks with Type I core wall.
   1. The prestressed concrete tank core wall shall be of cast-in-place concrete construction. Shotcrete or precast core walls are not permitted under the provisions of this Section.

B. Standards/Codes:
   1. The prestressed concrete tank shall be designed and constructed as specified herein, and in accordance with provisions of the following standards and codes:
      a. AWWA D110-13.
      b. ACI 350-06.
      c. ACI 350.3-06.
      d. ASCE 7-10.
   2. Where conflicts between the requirements of this Section and of these standards and codes occur, the more restrictive provisions shall apply.
      a. Exception: Requirements for concrete cover and member thickness shall be as specified in this Section.

C. Load criteria and requirements to be used by the Tank Contractor in the design calculations:
   1. Capacity: 2.0 MG usable storage below the maximum water elevation shown on the Drawings.
      a. Inside Diameter: 115 feet.
   2. Dead Load: shall be the estimated weight of all permanent imposed loads.
      a. Unit weight of concrete shall be taken as 150 pounds per cubic foot.
      b. Unit weight of steel shall be taken as 490 pounds per cubic foot.
   3. Fluid Load: shall be the lateral pressure and weight of the water when the tank is filled to a level that is 6 inches above the elevation of the top of the overflow elevation as indicated on the Drawings (to allow for overflow conditions).
      a. Unit weight of water shall be taken as 62.4 pounds per cubic foot.
   4. Roof Live Load:
      a. Uniform: 40 pounds per square foot, non-reducible.
      b. Any concentrated reactions due to the use of fall protection equipment.
      c. Application of fall protection equipment reaction loads shall be applied concurrently with uniform roof live load. However, load factors for the load case where the combination of uniform and fall protection reactions are considered simultaneously may be taken as unity.
   5. Construction Loads:
      a. Loads applied to the tank during construction shall be accounted for in the design of the tank.
   6. Geotechnical Report: See Section 00800 - Supplementary Conditions.

7. Foundation Loads: the tank foundation shall be proportioned so that the net foundation bearing pressure shall be less than the net allowable soil bearing pressure specified in the Geotechnical Report.
    a. The allowable soil bearing pressure may be increased by 33 percent for load combinations that include wind or seismic loads.
    b. Settlement Loads: the tank shall be designed to resist the effects of total and differential settlement indicated in the Geotechnical Report.
8. The final design for wind and seismic loads shall consider a reduced capacity to resist sliding due to any membranes placed between the bottom of the concrete foundation and the soil.
9. Wind Load: determined in accordance with ASCE 7-10.
    a. Exposure Category C.
    b. Basic Wind Speed = 104 mph (3-sec gust).
    c. Importance Factor, I_W = 1.00.
10. Seismic Design Criteria: seismic design shall be based on the applicable sections of AWWA D110-13, ASCE 7-10, and ACI 350.3-06. The seismic forces shall be calculated using each code separately. The total base shear used for design shall be the maximum value obtained from the three codes used.
    a. When comparing force and base shear values, those obtained from ASCE and ACI shall be based on service level loads.
    b. AWWA D110-13 Design Criteria:
        1) Occupancy Category, IV.
        2) Importance Factor, I = 1.50.
        3) Mapped Spectral Acceleration for Short Period, S_S = 1.48 g.
        4) Mapped Spectral Acceleration for 1-second Period, S_1 = 1.58 g.
        5) Site Class D.
        6) Impulsive Structure Coefficient, R_I = 3.5.
        7) Convective Structure Coefficient, R_C = 1.0.
        8) Overstrength Factor,Ω_o, 2.0.
    c. ASCE 7-10 Design Criteria:
        1) Risk Category IV.
        2) Mapped Spectral Acceleration for Short Period, S_S = 1.48 g.
        3) Mapped Spectral Acceleration for 1-second Period, S_1 = 1.58 g.
        4) Site Class D.
        5) Response Modification Factor, R = 3.25.
        6) Overstrength Factor,Ω_o, 2.0.
        7) Long-period Transition Period, T_L = 12 sec.
        8) Importance Factor, I = 1.50.
    d. ACI 350.3-06 Design Criteria:
        1) Mapped Spectral Acceleration for Short Period, S_S = 1.48 g.
        2) Mapped Spectral Acceleration for 1-second Period, S_1 = 1.58 g.
        3) Site Class D.
        4) Response Modification Factor, R = 3.25.
        5) Long-period Transition Period, T_L = 12 sec.
        6) Importance Factor, I = 1.50.
    e. The sloshing wave height shall be taken as the larger of the values calculated in accordance with AWWA D110-13, ASCE 7-10, and ACI 350.3-06.
        1) In the event that the calculated height of the “sloshing wave” exceeds the freeboard of the tank (distance from the maximum operating

water surface elevation to the bottom of the roof deck at the wall), the tank and the roof deck shall be designed to accommodate the dynamic effects as follows:

a) Any portion of the convective sloshing wave that extends above the top of the tank wall (bottom of the roof deck at the wall) shall be calculated and applied to the roof deck as an uplift pressure in accordance with section 15.7.6.1.2.c of ASCE 7-10.
b) Additionally, the mass of any confined portion of the convective sloshing wave shall be included with the impulsive mass used in the estimation of the hydrodynamic forces applied to the tank for design, also in accordance with section 15.7.6.1.2.c of ASCE 7-10.
c) Any revisions to the tank, including but not limited to, the roof elevation, water overflow level, and roof slab that are required to meet the specified provisions to resist sloshing loads and its effect on the hydrodynamic design shall not result in additional costs to the Owner.

11. Temperature and moisture gradients: effects due to changes in temperature and due to temperature and moisture gradients across structural members shall be considered in the design. Refer to Section 01850 - Design Criteria.
12. Prestressing application: forces applied to the wall shall be considered in the design of the wall, especially where wall penetrations result in locally increased prestressing force application to the wall.
13. On screen mesh size and screen open area:
    a. The vent shall be sized for a minimum rate of 750 cfm or the rate of volumetric withdrawal assuming the outlet pipe has ruptured, whichever is greater.
14. Overflow Design Capacity: 2,000 gpm with maximum 9-inch water height over the top of the overflow weir.

D. Floor Slab and Wall Footing Requirements:
    1. The floor slab shall be designed as a membrane floor slab as defined in ACI 372R, Section 3.2.2 that is not less than 18 inches thick; or the floor slab may be designed as a slab-on-ground with a thickness not less than 18 inches.
    2. Construction joint locations shall be submitted to the Engineer for review.
        a. Where construction joint spacing exceeds 50 feet, provide means for reducing shrinkage below the limit specified in Section 03300 - Cast-in-Place Concrete in proportion to the extent the spacing limit of 50 feet is exceeded.
        b. Use of construction joints in the floor slab shall be minimized.
    3. Minimum ratio of floor slab reinforcement area to concrete area shall be 0.5 percent for each orthogonal direction, with bars spaced no greater than 12 inches on center or 2 times the slab thickness, whichever is less.
    4. Minimum concrete cover over reinforcing steel shall be in accordance with Table 3.3.2.3 of ACI 350.5.

5. Wall footings shall bear below floor sub-grade and shall be placed monolithically with the floor slab.
    a. The bottom of the wall footing shall be embedded a minimum of 60 inches below the lowest finish grade elevation over the outside edge of the footing or as indicated on the Drawings, whichever is greater.
6. Design of the floor and wall footing shall consider the differential base stiffness and at concrete encasements or hard points below the floor and wall footing.

E. Wall Design Requirements:
1. The prestressed concrete tank wall shall be constructed with a cast-in-place core wall that is circumferentially wrapped with 7-wire strand prestressing reinforcement at the exterior and encapsulated within protective shotcrete layers. The core wall is to be vertically prestressed with post-tensioned thread bars.
2. The thickness of the core wall shall not be less than 10 inches thick.
3. The minimum average vertical compressive axial prestress in the core wall provided by the vertical prestressing reinforcement shall be 200 psi after deduction for all losses.
    a. Vertical prestressing reinforcement shall be spaced on average no greater than 50 inches on center or 7 times the thickness of the core wall, whichever is less.
4. The minimum average circumferential residual prestress compression in the wall shall not be less than 200 psi for the aboveground portion of the tank wall, tapering linearly to 50 psi at 6 feet below grade.
5. The connection between the base of the wall and the foundation shall be an anchored flexible connection in accordance with Section 4.2.1 and Figure 4B of AWWA D110-13.
    a. The joint at the base of the wall shall permit unrestrained radial expansion and contraction of the wall relative to the foundation.
    b. The joint at the base of the wall shall provide restraint against lateral seismic loads acting tangentially to the wall.
    c. Restraint cables shall be provided between the core wall and the foundation to resist seismic loads. The cable installation shall be detailed in a manner that does not introduce radial restraint between the wall and the foundation.
6. The joint at the wall to the roof shall allow the roof to expand and contract radially while maintaining full vertical load bearing capacity under all conditions.
7. The minimum concrete cover over non-prestressed reinforcing shall be in accordance with Table 3.3.2.3 of ACI 350.5.
8. Vertical non-prestressed reinforcing:
    a. Provide vertical non-prestressed reinforcing over the full height of the wall.
    b. The tensile stress shall be limited to a maximum of 18,000 psi.
    c. Reinforcing size shall not exceed 3/4-inch in diameter.
    d. Reinforcing spacing shall not exceed 12 inches on center.

F. Domed Rood Design Requirements:
1. The roof shall be a domed, cast-in-place concrete structure. Columns or interior supports will not be allowed.
2. The minimum thickness of the domed roof shall be 4 inches.
3. The dome shall be fixed to the tank wall.

4. Minimum concrete cover over reinforcing steel shall be in accordance with Table 3.3.2.4 of ACI 350.5.
5. The reinforcing steel for the roof structure shall be sized in accordance with ACI 350 with the environmental durability factor, S_d, applied to limit flexural stress. Reinforcing steel shall be proportioned and distributed to control cracking for normal environmental exposure.
6. The effects of thermal expansion and contraction shall be accounted for in the design of the roof structure. Appurtenances and roof connections shall be detailed to limit restraint to the thermal radial movement.
7. The Tank Contractor shall submit, for the Engineer's approval, a plan showing the roof configuration that includes construction joints. Construction joints shall incorporate 6-inch PVC waterstop.

G. Uplift:
1. Tank to resist uplift forces from design flood elevation of 604 feet, in tank empty conditions.

1.07 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Prestressing steel shall be adequately packaged for protection against corrosion and physical damage during shipping and storage.

B. Prestressing steel that has rusted or has otherwise sustained damage will be rejected.

C. Prestressing material and appurtenances delivered to project site: Store off ground on planks, supported by 4-by-4 timber. Cover with polyethylene sheeting or treated paper to prevent exposure to moisture.

1.08 PROJECT CONDITIONS

A. Environmental requirements:
1. Cold weather epoxy grouting of tendons:
a. In cold weather, and especially during frosts, take special precautions to avoid freezing of epoxy.
b. In event that grouting procedure cannot be postponed, keep wall temperature above freezing point with hot blankets or by other means acceptable to Engineer.

B. Site safety precautions:
1. Take every precaution to keep personnel and visitors outside the area of danger from breaking prestressing strands or bars.
2. At no time shall anyone stand in the line of stressed circumferential strand.
3. No work shall be performed by anyone, other than the prestressing crew within 100 feet of circumferential wrapping operation or vertical bar stressing operation.
4. Where access to the site by unauthorized persons cannot be controlled while prestressing work is in progress, or where property lines are less than 100 feet from the wrapping operation, erect protective fencing to prevent breaking strands from endangering such persons.

C. Welding:
   1. Perform no welding to anchor plates after prestressing tendons have been assembled.
   2. Do not use prestressing steel as ground for welding operations.

1.09 SEQUENCING AND SCHEDULING

A. Polyvinyl chloride waterstops:
   1. Welding of polyvinyl chloride waterstops: Prior to installing waterstops in forms, demonstrate ability to weld acceptable joints in waterstops.
   2. Quality of welded joints: Are to be subject to acceptance of the Engineer.

B. Restrictions on shotcrete operations:
   1. Abrasive Blasting:
      a. Do not commence prior to the completion date of curing period of tank corewall.
      b. Do not commence until all form tie holes have been drypacked.
   2. Wind conditions: Do not apply shotcrete under such strong wind conditions that considerable amount of cement and moisture is removed by wind from mortar spray between nozzle and surface on which shotcrete is applied.
   3. Temperature requirements:
      a. Peak temperature during day must be expected to rise to at least 55 degrees Fahrenheit.
      b. Night temperature of first night after shotcrete application must not be expected to drop below 33 degrees Fahrenheit.
   4. Cold weather conditions:
      a. Application of shotcrete under cold weather conditions is solely at the Tank Contractor's risk.
      b. Shotcrete may be applied in cold weather provided surfaces are not frozen.
      c. Damage to shotcrete: Whenever rain or frost damages shotcrete which has not had chance to take set:
         1) Remove and replace such shotcrete.
         2) Remove damaged shotcrete before applying any new layers of shotcrete.
      d. Type III Portland cement may be utilized for shotcrete for cold weather application.

C. Ultimate initial prestressing force for vertical thread bars: Do not apply until concrete compressive strength in walls reaches specified strength.

D. Wrapping of circumferential prestressing strands:
   1. May start when core wall concrete has reached a compressive strength of 3,000 pounds per square inch and intermediate layers of shotcrete coats over prestressing strands has reached a compressive strength of 250 pounds per square inch or 12 hours after the shotcrete coat was applied, whichever is greater.
   2. The compressive stress in the concrete due to wrapping shall not exceed 55 percent of f'_c at any time.

E. Backfilling of tanks:
   1. Do not backfill until and unless the Engineer has accepted leakage testing results and the concrete has reached specified strength.

1.10 GUARANTEE

A. The Tank Contractor shall guarantee the structure against defective materials or workmanship for a period of 2 years from the final date of completion. If any materials or workmanship prove to be defective within 2 years, those materials shall be replaced or repaired by the Tank Contractor at the expense of the Tank Contractor.

B. Access hatch (through-roof access) warranty:
   1. Manufacturer is to warranty proper operation and against defects in material or workmanship for a period of 5 years.

PART 2 PRODUCTS

2.01 MATERIALS

A. General:
   1. Materials of construction for the strand-wound prestressed concrete tank shall be selected by the Tank Contractor, subject to the limitations of this Section.

B. Concrete:
   1. Concrete shall conform to Section 03300 - Cast-in-Place Concrete and ACI 301, except as modified herein.
   2. Unless otherwise specified, all concrete for tank construction shall have a minimum 28-day compressive strength of 4,000 psi.
   3. The concrete for the tank floor, footings, and pipe encasement shall conform to the following requirements.
      a. Concrete shall not be air entrained.
      b. The coarse and fine aggregate shall meet the requirements of ASTM C33 and sized to meet member thickness and clearance requirements of ACI 350.
      c. Superplasticizer and water-reducing admixtures shall be incorporated into the concrete for the floor slab and wall footing.
   4. Proportioning for concrete shall be in accordance with ACI 301.
   5. All concrete shall have a maximum water-soluble chloride ion concentration of 0.06 percent by weight of cement.
   6. Cement shall conform to ASTM C 150, Type I or Type II.
   7. Accelerating and retarding admixtures shall not be incorporated into the any concrete mix without prior acceptance by the Engineer.

C. Reinforcing Steel:
   1. Reinforcing steel shall be new billet steel Grade 60 meeting the requirements of ASTM A 615.
   2. Reinforcing steel that is to be welded shall be ASTM A 706, Grade 60.
   3. Reinforcing steel shall be accurately fabricated and shall be free from loose rust, scale, and contaminants.

4. Reinforcing steel shall be accurately positioned on supports, spacers, hangers, or other reinforcement and shall be secured in place with wire ties or suitable clips. Rebar chair supports shall be provided in accordance with Section 03200 - Concrete Reinforcing.

D. Prestressing Materials:
   1. 7-wire strand:
      a. Prestressing strand shall be in accordance with ASTM A 416 prior to hot-dip galvanizing.
      b. Individually hot-dip galvanize each wire of strand before forming the wires into a strand.
      c. Hot-dip galvanized 7-wire strand shall meet following minimum requirements:

Physical Characteristics	Required Results
Nominal Strand Diameter Before Galvanizing	3/8 inch
Nominal Area After Galvanizing	0.089 square inch
Nominal Weight Per 1,000 Linear Feet	303 pounds
Pitch of Strand	12 to 16
Minimum Yield Strength At 1 Percent Extension	180,000 psi
Minimum Ultimate Strength After Galvanizing	240,000 psi
Elongation In 24 Inches At Fracture	4.5 percent
Weight Of Zinc Coating per ASTM A475	0.85 ounces per square foot

   2. High strength thread bars:
      a. Thread bars and deformations: Hot rolled.
         1) Thread bars with cold rolled threads or with quenched or tempered steels will not be permitted.
      b. Deformations of thread bars:
         1) Provide deformations that form screw-thread suitable for mechanically coupling lengths of thread bar and provide positive attachment of anchor assemblies.
         2) Provide deformations that are in accordance with ASTM A 722, Type II requirements and are uniform such that any length of bar may be cut at any point and internal threads of coupler designated for that size of bar can be freely screwed on bar.
      c. Tensile and physical properties: Bars manufactured in accordance with ASTM A 722, Type II requirements are to comply with following minimum requirements:

Physical Characteristics	Required Results
Nominal Diameter	1.25 inches or 1.375 inches
Nominal Cross-Sectional Area	1.245 square inches or 1.577 square inches

Physical Characteristics	Required Results
Nominal Bar Weight	4.39 pounds per foot or 5.56 pounds per foot
Minimum Tensile Stress	150 ksi
Minimum Yield Stress at 0.2 Percent Offset	120 ksi
Elongation At Rupture In Gauge Length of 20 Bar Diameters	4 percent minimum
Maximum Carbon Content of Bar	0.55 percent

   d. Nuts: Minimum ultimate strength shall be 95 percent of minimum ultimate strength of thread bar.

3. Anchorages for vertical post-tensioned thread bars:
   a. All post-tensioned prestressing shall be secured at the ends by means of approved permanent anchoring devices, which shall hold the prestressing steel at a force not less than 95 percent of the guaranteed minimum tensile strength of the prestressing steel.
   b. The load from the vertical prestressing anchoring device shall be distributed to the concrete through steel bearing plates and shall not exceed the values specified by the Post-Tensioning Institute (PTI), Guide Specifications, Paragraph 3.1.7.
   c. Fully threaded anchor connections shall be used at both ends of the vertical prestressing bar, which shall incorporate a spherical-shaped bearing surface to match the conical surface in the bearing plate.
   d. Wedge anchors shall not be used for permanent anchor hardware.
4. Testing of Prestressing Material:
   a. Provide mill certificates.
   b. Prior to preparation of shop drawings and installation of vertical thread bars, provide proof that the thread bar anchorage system meets the requirements specified herein.
   c. Before any prestressing operations may be started, the Tank Contractor shall calibrate all recording equipment at an approved testing laboratory to the satisfaction of the Engineer.
   d. All continuous force readings for either the vertical or the circumferential prestressing operations shall be developed with electronic (or the substantial equivalent) force (strain gauge method) sensing transducers, all having a maximum nonlinearity error of +/- 0.5 percent and a maximum hysteresis error of +/- 0.25 percent.
5. Anchor pockets for vertical thread bars:
   a. Consist of steel cans fabricated from steel tubing, hot-dip galvanized after cutting and subsequently welded to the top bearing plate.
   b. Provide adequate means for flushing of vertical ducts during concrete placement.
6. Ducts for vertical thread bars:
   a. Duct enclosures shall be standard 1.25 inch or 1.375 inch diameter PVC pipe class 160 or class 200, respectively, unless otherwise specified on the Drawings.

b. Threaded hose connections shall be provided at the top of each duct for water flushing.
c. All ducts shall be provided with expandable valves to facilitate the injection of epoxy grout after prestressing.

7. Epoxy grout for vertical thread bars:
   a. The vertical thread bar system shall offer complete 2-part epoxy protection of the prestressing steel inside ducting and anchors.
   b. Portland cement grout will not be accepted.

E. Seismic Cables and Sleeves:
1. Seismic cables:
   a. Hot-dipped galvanized 7-wire strand:
   b. Prestressing strand shall be in accordance with ASTM A 416 prior to galvanizing and ASTM A 475 after galvanizing.
   c. Individually hot-dip galvanize each wire of strand before forming the wires into a strand.
   d. The galvanized strand shall have a minimum ultimate tensile strength of 240,000 psi.
   e. The cables shall be installed to connect the wall and the foundation.
   f. The minimum weight of zinc galvanic coating shall be 0.85 ounces per square foot.
   g. Only 7-wire strand will be allowed. Single wire will not be allowed.
2. Neoprene sleeves for seismic cables shall conform to SCE-43 of ASTM D 1056 and as further modified by the following:

Physical Characteristics	Required Results
Compressive deflection	9 to 13 psi
Shore 00 durometer	60 to 80 pcf
Density	12 to 28 pcf
Water absorption by weight	5 percent
Temperature range: Low (flex without cracking) High continuous High intermittent	-40 degrees F 150 degrees F 250 degrees F
Compressive set (average): 1/2-inch sample compressed at 50 percent for 22 hours at 70 degrees F and 24 hour recovery	15 to 35 percent
Maximum linear shrinkage during heat aging (7 days at 158 degrees F)	5 percent
Minimum tensile strength	175 psi
Minimum elongation	180 percent
Resilience (bayshore - percent rebound average 1/2-inch thickness at 72 degrees F)	20 to 40 percent

F. Shotcrete:
1. General:
   a. Shotrcrete shall conform to ACI 506.2, except as modified herein.
   b. Minimum compressive strength of shotcrete shall be 4,500 psi at 28 days.

c. Shotcrete used in the tank construction shall have a maximum water soluble chloride ion concentration of 0.06 percent by weight of cement.
d. Rebound materials shall not be reused in any form for shotcrete

2. Portland cement shall meet the general requirements in Section 03300 - Cast-in-Place Concrete.
3. Fine aggregates:
   a. Fine aggregates shall meet the requirements as specified in Section 03300 - Cast-in-Place Concrete and the following paragraphs.
   b. Coarse sand:
      1) Shotcrete applications: Use well graded coarse sand, unless otherwise noted.
      2) Gradations:

Sieve Size	Percent Passing by Weight
3/8 inch	100
Number 4	95-100
Number 8	80-100
Number 16	50-85
Number 30	25-60
Number 50	10-30
Number 100	2-10

   c. Fineness modulus shall be between 2.7 and 3.0.
4. Water shall be in accordance with Section 03300 - Cast-in-Place Concrete.
5. Class F fly ash shall conform to ASTM C618 and shall not make up more than 20 percent of the cementitious material in the shotcrete mix.

G. Elastomeric Materials:
1. Bearing pads shall be natural rubber or neoprene:
   a. Natural rubber bearing pads shall contain only virgin natural polyisoprene as the raw polymer and the physical properties shall comply with ASTM D 2000 Line Call-Out M4AA414A13.
   b. Neoprene bearing pads shall have a hardness of 40 to 50 durometer, a minimum tensile strength of 1,500 psi, a minimum elongation of 500 percent, and a maximum compressive set of 50 percent. Pads shall meet the requirements of ASTM D 2000 Line Call-Out M2BC410 A14 B14 or 2 BC 415 A1 4 B14 for 40 durometer material.
2. Sponge filler shall be closed-cell neoprene or rubber conforming to ASTM D 1056, Type 2, Class A, and Grade 3. Compression deflection limited to 25 percent at 2 to 5 psi.

H. Waterstops:
1. Requirements:
   a. Material: Polyvinyl chloride.
   b. Size and type:
      1) Centered at construction joints in cast-in-place concrete: 6-inch flat ribbed type.

2) At tank walls to tank wall-footing joints: 9-inch wide with 1-inch diameter hollow bulb ribbed type.
3) Type not allowed: Dumbbell type.

c. Physical characteristics:

Physical Characteristics	Test Method	Required Results
Specific Gravity	ASTM D 792	Not less than 1.3
Hardness	ASTM D 2240	70 to 90 Type A Shore durometer
Tensile Strength	ASTM D 638	Not less than 2,000 pounds per square inch
Ultimate Elongation	ASTM D 638	Not less than 300 percent
Alkali Extraction	CRD C 572	7 day weight change between minus 0.1 percent and plus 0.25 percent. Hardness change within 5 points.
Low Temperature Brittle Point	ASTM D 746	No sign of cracking or chipping at minus 35 degrees Fahrenheit
Water Absorption	ASTM D 570	24 hours, not more than 0.15 percent
Accelerated Extraction Tensile	CRD C 527	Not less than 1,600 pounds per square inch
Stiffness in Flexure	ASTM D 747	Not less than 600 pounds per square inch
Tear Resistance	ASTM D 624	225 pounds per square inch
Weight Requirements		
Thickness		3/8 inch
Center Bulb Outside Diameter		1 inch nominal
Allowable Tolerances		
Width		Plus or minus 3/16 inch
Thickness		Plus or minus 1/32 inch

d. Manufacturers: One of the following or equal:
1) Burke Concrete Accessories, Inc.
2) Greenstreak PVC Waterstops, Sika Corporation.
3) Kirkhill Rubber Company.
4) Williams Products, Inc.
5) Vinylex Corporation.

I. Tank Appurtenances:
1. General:
a. Provide and install all appurtenances as shown on the Drawings and as specified herein.

2. Piping:
    a. Inlet: As indicated on the Drawings.
    b. Outlet: As indicated on the Drawings,
    c. Overflow piping and overflow cone: As indicated on the Drawings.
3. Pipe Supports:
    a. Provide as required to adequately support piping under all load and operating conditions.
    b. Refer to Section 15061 - Pipe Supports.
4. Ladders:
    a. Conforming to all requirements of OSHA and as indicated on the Drawings.
        1) Provide brackets and fasteners required for support and secure mounting to tank structure.
        2) Rungs: solid bar stock.
        3) Welds: fillet or full penetration as appropriate to the condition.
        4) Fasteners Ladder bolts, concrete anchors, nuts, washers, and flush steel inserts: Type 316 stainless steel.
    b. Interior:
        1) Materials: Type 304/304L stainless steel.
        2) Fall protection: Fall arrest device as specified in the following paragraphs. Material to match that of ladder. Provide removable center rail extension projecting at least 48 inches above top rung of ladder.
    c. Exterior:
        1) Materials: As indicated on the Drawings.
        2) Fall protection: “Saf-T-Climb” as indicated on the Drawings.
        3) Anti-climb door: Per ladder manufacturer. Material to match that of the exterior ladder.
    d. Horizontal lifeline fall protection system: As indicated on the Drawings.
    e. Fall arrest device consisting of sliding/locking mechanism with safety belt and belt attachment to center climbing rail.
        1) Device material: Type 304 stainless steel.
        2) Devices: To include following items, all fabricated of device material unless otherwise accepted by the Engineer:
            a) Rails: Lengths as required.
            b) Brackets: Complete with brackets necessary for attaching rail to ladders.
            c) Removable rail extension: 48-inch long.
        3) Sleeve assemblies and safety belts: 2.
        4) Manufacturers: The following or equal:
            a) Norton Company, Air Space Device Division, Cerritos, CA, Saf-T-Climb with SAF-T-NOTCH RAIL and SAF-T-LOCK SLEEVE.
5. Access hatches (through-roof access):
    a. Sizes: Nominal size(s) as indicated on the Drawings.
    b. Material and construction:
        1) Door leaf/leaves: Aluminum diamond pattern plate with reinforcement if required for spans provided.
        2) Frame: Minimum 1/4-inch thick, aluminum channel with anchor flange around perimeter.

3) Door hardware: Equip doors with following:
a) Hinges: Minimum 2 heavy forged stainless steel hinges and pins for each leaf.
b) Operators, hold-open and handle: Spring operators and automatic hold-open arm with release handle for each leaf.
c) Lock: A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of 1 cover. In addition, the lock shall be a cylinder style with a threaded security cover plug.
d) Seals: Leaf seals shall be dust and watertight.
e) Drainage coupling: 1-1/2-inch coupling located in front right corner of frame. Drain shall be installed to drain to the exterior side of the tank, adjust curb height as required.
4) Finish: Manufacturer's standard mill finish.
5) Manufacturers: One of the following or equal:
a) Bilco Co., Type JD-AL.
b) Babcock-Davis Associates, Inc., Type AM or GT.
c) Nystrom, Inc.

6. Grating, Guardrail, and Miscellaneous Fabrications:
a. Refer to Section 05500 - Metal Fabrications.
b. Materials: As indicated on the Drawings.
7. Roof Ventilator:
a. Size: As required to meet the air flow design requirements, but not less than indicated on the Drawings.
b. Materials and construction:
1) Aluminum components.
2) Stainless steel anchors.
3) Flashing shall wrap over the edge of the concrete curb and extend down a minimum of 2 inches.
4) 2-inch aluminum filters.
5) Insect screens.
6) 12-inch tall base.
7) Fiberglass hood insulation.
c. Manufacturers: The following or equal:
1) Greenheck Fabra Hood.
d. Finish: Manufacturer’s standard mill finish.

J. Form ties:
1. General: The requirements of this Section supplement the form ties requirements stated in Section 03102 - Concrete Formwork.
2. Requirements:
a. Form ties for forming system selected for concrete other than corewall: Cone-snap tie or flat bar type with waterstops.
b. Form ties for forming system selected for tank corewall: Tapered ties.

K. Wall Forms: As specified in Section 03102 - Concrete Formwork, regular plywood forms may be used for forming of circular walls, as long as there are no straight sections longer than 36 inches at any place around the outside circumference of such walls.
1. Forms shall be designed to resist the construction loads for full height wall pours.

L. Polyethylene sheeting:
   1. Minimum 6 mils thick and in accordance with ASTM C 171.

M. Granular leveling base:
   1. Material shall meet the requirements for aggregate base course specified in Section 02050 - Soils and Aggregates for Earthwork.

N. Epoxy injection materials: As specified in Section 03931 - Epoxy Injection Systems and the following products:
   1. Epoxy materials: Nontoxic to potable water.
   2. Grout injection pipes: Provide with positive mechanical shutoff valves.

O. Materials for repair of chipped out concrete areas:
   1. Epoxy bonding agent: As specified in Section 03071 - Epoxies.

P. Membrane Liner:
   1. Thickness: Minimum 30 mil.
   2. Material: Impermeable PVC.
   3. Manufacturers: One of the following or equal:
      a. York Manufacturing, Inc., Wasco Seal.
      b. Watersaver Co., Inc. equivalent product.
      c. Palco Linings, Inc. equivalent product.
      d. Install liner per manufacturer's recommendations to provide a waterproof layer below the tank foundation as indicated on the Drawings.

2.02 SOURCE QUALITY CONTROL

A. Concrete testing:
   1. As specified in Section 03300 - Cast-in-Place Concrete.

2.03 COMPLIANCE TESTING (NOT USED)

PART 3 EXECUTION

3.01 SUPERVISION

A. The Tank Contractor shall provide a full-time on-site project manager or site superintendent during all aspects of tank construction.

3.02 INSTALLATION

A. Waterstops:
   1. General: The requirements of this Section supersede the waterstop requirements stated in Section 03150 - Concrete Accessories.
   2. Requirements:
      a. Install in concrete joints where indicated on the Drawings.
      b. Connect the ends of the radial waterstop in the wall footing joints to the circumferential waterstop in the wall to wall footing joint and to the circumferential waterstops in the floor to wall-footing joints if they should exist.

c. Provide waterstop in each joint in water-bearing structures, whether indicated on the Drawings or not.
d. Provide waterstops that are continuous.
e. Set accurately to position and line indicated on the Drawings.
f. Hold and securely fix edges in position at intervals of not more than 12 inches and secure in manner that they cannot move during placing of concrete.
g. A hog-ring or nail may be driven through both ends of the waterstop to facilitate placing and tying of waterstops to reinforcing steel forms or form-ties.
h. Tank Contractor's option: One of the following:
    1) Use waterstop tie wires at not more than 12 inches on centers, near outer ribs, to tie waterstops into position.
    2) Use special clips.
i. Waterstop terminations: Terminate 3 inches from top of finished surfaces of walls and slabs unless otherwise specified or indicated on the Drawings.
j. Installation of waterstops:
    1) Install so that joints are watertight.
    2) Provide field welded polyvinyl chloride waterstop joints such as unions, crosses, ells, and tees.
    3) Make all splices to waterstop in accordance with manufacturer's recommendations.
    4) Clean waterstops of all concrete, dirt, and foreign matter.

B. Form and accessories removal:
1. General: The requirements of this Section supercede the form and accessories removal requirements stated in Section 03102 - Concrete Formwork.
2. Requirements:
    a. Other forms supporting concrete and shoring: Remain in place as follows:
        1) Sides of footings, sides of slabs, and columns: 24 hours minimum.
        2) Core walls: 12 hours minimum.

C. Neoprene bearing pads:
1. General:
    a. Secure bottom surface of pads by positive attachment to structure such that horizontal crawling is prevented.

D. Closed cell neoprene joint fillers and sleeves (“sponge filler”):
1. When joint filler pads or sponge filler sleeves are indicated on the Drawings or specified, place materials in correct position before concrete is placed against them.
2. Holes and joints in pads are to be filled with caulking to prevent passage of mortar or concrete from 1 side of the joint to the other.

3.03 FLOOR

A. Prior to placement of the floor reinforcing, a 6-mil polyethylene moisture barrier shall be placed over the leveling base material. Joints in the polyethylene shall be overlapped a minimum of 6 inches.

B. Prior to placement of the floor concrete, all piping that penetrates the floor shall be set and encased in concrete to the limits indicated on the Drawings. Provide waterstops at the joints between the encasement and the concrete floor slab where indicated on the Drawings.

C. The vertical waterstops between the wall and footing shall be placed and supported to locate the center bulb within the joint as indicated on the Drawings and as required by the Tank Contractor. The waterstop shall be spliced using a thermostatically controlled sealing iron and each splice shall be successfully spark tested prior to encasement in concrete.

D. The floor shall be poured without construction joints, except as otherwise allowed by the Engineer. There shall be no construction joints between the floor and wall footing.

3.04 CONCRETE

A. All concrete shall be conveyed, placed, finished, and cured as specified in Section 03300 - Cast-in-Place Concrete, except as modified herein.

B. Requirements:
   1. Cold joints:
      a. Cold joints in floors, roof slabs, and wall footings are not allowed.
      b. Continuously cover joints with new concrete, and thoroughly integrate through vibration, even if it means that horizontal passes of only 6 inches in width can be made until additional concrete and equipment becomes available to permit wider passes in concrete placement.
   2. Blockouts or other types of wall openings: Do not provide openings other than those indicated on the Drawings.

C. Weather Limitations:
   1. Unless specifically authorized in writing by the Engineer, concrete shall not be placed without special protection during cold weather when the ambient temperature is below 35 degrees Fahrenheit and when the concrete is likely to be subjected to freezing temperatures before initial set has occurred and the concrete strength has reached 500 psi. Concrete shall be protected in accordance with ACI 306.1. The temperature of the concrete shall be maintained in accordance with the requirements of ACI 301 and ACI 306.1. All methods and equipment for heating and for protecting concrete in place shall be subject to the approval of the Engineer.
   2. During hot weather, concreting shall be in accordance with the requirements of ACI 305.1.
   3. Placement of concrete during periods of low humidity (below 50 percent) shall be avoided when feasible and economically possible, particularly when large surface areas are to be finished. In any event, surfaces exposed to drying wind shall be covered with polyethylene sheets immediately after finishing, or flooded with water, or shall be water cured continuously from the time the concrete has taken initial set. Curing compounds may be used in conjunction with water curing, provided they are compatible with coatings that may be applied later and if they are degradable.

D. Finishes:
   1. Tank Designer to define concrete finishes in accordance with manufactures specifications.

E. Curing:
   1. Except where specified herein, concrete curing shall be as specified in Section 03300 - Cast-in-Place Concrete.
   2. Requirements:
      a. Any concrete surface that is designated to receive paint or upon which any material is to be bonded: No curing compound shall be used.
      b. Concrete designated to be painted: Water or plastic membrane cure.
      c. Tank core walls: Water curing.
      d. Floor slab:
         1) The floor shall be cured by flooding with water and shall remain saturated for a minimum of 7 days after placement.
         2) Alternatively, the floor slab may be cured with a sprayed-on curing compound and prepared as follows:
            a) After the surface is dry to the touch, a 6-mil thick polyethylene sheet shall be carefully taped and sealed to the concrete surface and kept on such surface for as long as possible, but not less than 7 days, to minimize the loss of moisture trapped between the polyethylene sheet and the concrete.
            b) Alternatively, heavy curing blankets may be used in lieu of the polyethylene sheet.
      e. Roof slab: Water or plastic membrane cure.
      f. Other concrete surfaces: Water curing.

F. Testing Cast-in-Place Concrete:
   1. All concrete testing shall be in accordance with Section 03300 - Cast-in-Place Concrete, except as noted herein.
   2. Testing shall be at the expense of the Tank Contractor, and shall be conducted by an independent testing agency approved by the Engineer.

3.05 SEISMIC CABLES

A. Requirements:
   1. Provide seismic cables to connect wall and wall footing.
   2. Quantity and spacing of seismic cables shall be as indicated on the Shop Drawings.
   3. Where necessary, seismic cables shall be pre-bent before placing units in wall and wall footing.
   4. Tie seismic cables to lower horizontal circumferential tie-bar for vertical prestress tendons as indicated on the Drawings.
   5. In wall-footing, tie seismic cables to radial footing bars.

3.06 PRESTRESSING

A. Circumferential Prestressing Equipment:
   1. The circumferential stressing system shall produce a continuously, electronically (or substantial equivalent) monitored permanent stress or force recording along its full length as it is being applied and the stress variation in

any strand at any point around the circumference shall not be greater than +/- 1.5 percent of the ultimate strength of the steel. In addition to this recording, any system which deflects the tensioned prestressing material between the tensioning device and the wall after it has left the tensioning device, shall provide a similar continuously monitored stress or force record along its full length as it is being applied to the wall. These recordings shall show that either before or after deflection that the stress variation in the prestressing material at any point around the circumference shall not be greater than +/- 1.5 percent of the ultimate strength of the steel.

2. Due to prior instances of force measurement inaccuracies and the inherent problems associated with hand-held stressometers, no manually recorded force readings will be accepted. This requirement shall be strictly followed.
3. Any wrapping that does not meet the stress tolerances specified and/or cannot meet the requirements of above will not be accepted and will be removed at the expense of the Tank Contractor. The Tank Contractor is responsible for all costs associated with meeting the specified tolerances.
4. Since intermittent force applications can result in an unequal stress distribution around the wall (due to friction losses), the prestressing system shall be capable of applying a continuous wrapped force at any point around the circumference within the specified tolerances. Circumferential stressing systems based on jack-operated cable or rod-type tendons (such as those placed inside of ducts incorporated in the corewall or placed manually around the exterior of the corewall) will not be allowed.
5. Since wrapping systems which utilize single solid prestressing material will not provide the desired bond between the prestressing material and the shotcrete and since single solid prestressing material will not provide an adequate safety factor against failure, only machine wrapping systems which utilize 7-wire prestressing strandwrapping will be allowed.

B. Circumferential Prestressing Application:
   1. All cracks in the core wall and floor slab shall be repaired as specified following the circumferential prestressing of the tank walls.
   2. Wrapped strand shall be anchored to the wall at least once for every coil or reel.
   3. Permanently anchoring 1 strand to a previously wrapped strand will not be permitted. Wrapped strand ends shall be joined by suitable splicing methods that shall develop 90 percent of the full strength of the strand.
   4. Use of different alloys in the splicing material shall not be permitted.
   5. The clear vertical spacing between any 2 wrapped strands shall be 1.5 strand diameters or 3/8-inch, whichever is larger. A 1/4-inch construction tolerance shall apply to strand spacing, as well as to this minimum spacing requirement.
   6. All wrapped strand not meeting the spacing requirements shall be spread by approved methods or shall otherwise be removed.

C. Vertical Prestressing Equipment:
   1. The Tank Contractor shall provide a continuously, electronically (or substantial equivalent), monitored permanent force elongation record from zero to full force at the final lock-off for all of the vertical prestressing work.
   2. The ordinate of the permanent recording shall show the elongation in inches and the abscissa shall show the force in pounds or kips.
   3. Manually recorded force and elongation readings will not be accepted.

4. The vertical prestressing machinery shall have automatic electronic tensioning cut-off devices or equivalent means to ensure that the specified force and elongation is not exceeded at any time during any thread bar stressing operation.
5. The force readings at the stressed bar ends, immediately after lock-off, for any stressing operation, on any thread bar, shall not fluctuate more than +/- 1.5 percent (of the minimum ultimate strength of the steel) from the desired average force setting.
6. The applied force, immediately after lock-off for the final stressing operation on any thread bar, shall be no less than 72 percent of the ultimate strength of the steel and the applied force before lock-off shall be no greater than 75 percent of the ultimate strength of the steel.

D. Vertical Prestressing Application:
1. All permanent anchor hardware shall have a ball-shaped threaded nut that can be screwed down on to a matching cone-shaped bearing surface in the bearing plate after the desired tension on the anchor hardware and/or prestressing steel has been applied.
2. The number and spacing of the thread bars shall not be altered under any condition.
3. High-strength thread bars shall be used for vertical prestressing.
4. All ducts shall be clean and free of water and deleterious materials that would impair bonding of the grout or interfere with grouting procedures.
5. Grout injection pipes shall be fitted with positive mechanical shutoff valves, which shall not be removed within the first 24 hours.
6. Grouting of thread bars shall begin at the lowest grout connection.
7. Each vertical thread bar duct shall be pumped until the entire nut at the top anchor has been covered with epoxy.
8. In cold weather, and especially during frosts, special precautions must be taken to avoid the freezing of grout. In the event that the grouting procedure cannot be postponed, the wall temperature must be kept above the freezing point with hot blankets or by other approved means.
9. Upon completion of the vertical stressing and grouting operation, all anchor pocket areas above the anchor nuts shall be dry packed with a 1 part cement to 2 parts sand mortar mix immediately after the epoxy coating on the inside can surface has become tacky, or alternatively, the metal can may be filled with concrete aggregates and epoxy.
10. The inside surfaces of any metal cans to be dry packed shall be coated with a 2 part epoxy. Dry packing shall not proceed until the epoxy coat has become tacky. The dry pack surface shall be finished flush with the adjoining concrete surface.
11. Damaged PVC tubing shall be replaced unless repairs are made and approved by the Engineer.
12. Vertical thread bar components shall be assembled off the ground and as detailed on the Shop Drawings. All vertical thread bars must be fully assembled before they are installed in the forms.
13. Vertical thread bars shall be accurately placed and fastened securely in place to reinforcing steel and form ties to prevent movement during placement of concrete.
14. All vertical thread bars must be flushed with water from the top immediately upon completion of the concrete vibrating operation. Water shall be introduced

through a taped-off hole in the wooden lids on the anchor pockets and be permitted to drain through the bottom grout tube. Flushing shall not be accomplished by introducing water through the bottom connection. Should a thread bar duct not flush properly, the Engineer shall be notified immediately.

15. Cleaning of ducts with air only (not water), or removal of water with air from the bottom connection, will not be permitted.
16. Placing of vertical thread bars shall be done to proper locations, elevations, and alignments, with a maximum tolerance of plus or minus 1/4 inch.
17. All vertical thread bars shall be properly tied at the anchor plates and shall be tied with No. 4 bars at intervals of 24 inches or less between the anchor plates. The maximum permissible misalignment of the anchor plate to the vertical thread bar is +/- 2.5 degrees.
18. Anchor plates must be installed at right angles to the thread bar alignment near the anchor. Anchor plates must be installed with long sides, aligned parallel with the wall forms and secured to prevent their rotation while concrete is placed.
19. Unless indicated otherwise on the Plans, the minimum concrete cover around steel anchor pockets and bearing plates shall be 1.5 inches.
20. The vertical clearance between bottom anchor plate and the waterstop at the base of the tank walls shall be no less than 2 inches nor more than 4 inches.

E. Circumferential and Vertical Prestressing Operations:
   1. The maximum initial electronically recorded steel stress shall not exceed 75 percent of the guaranteed minimum ultimate strength of the steel at any time during or after stressing.
   2. An automatic, continuously electronically (or substantial equivalent) monitored permanent recording of the applied force, at any point on the strand, at any point on and around the tank wall, must be made during the entire circumferential prestressing application. All such recordings must be based on a continuous sensing of the applied force on the strand between the tensioning drum and the wall when, and as, the strand is being wrapped and laid on the wall.
   3. The force setting on wrapping and vertical thread bar stressing machinery shall be such that the applied forces fall within the specified minimum or maximum stress or force limitations; the force setting shall be corrected immediately when the applied force falls outside the required force tolerance limitations.
   4. In the event that the stressing machinery is incapable of holding the applied forces within the specified stress or force limitations, the Engineer will order, at the expense of the Tank Contractor, the removal and replacement of such machinery in favor of a different unit capable of maintaining such tolerance requirements.
   5. The loss in stress in post-tensioned prestressing steel due to creep and shrinkage of concrete and sequence stressing is to be assumed as 25,000 psi. The final stress is the average initial stress reduced by the stress loss of 25,000 psi.
   6. The final force is the steel section multiplied by the final stress.
   7. The final force for the vertical thread bars shall be no less than the required final force shown on the Shop Drawings.
   8. The initial force for the circumferential wrapped strand shall be no less than the required initial force shown on the Shop Drawings.

9. The continuous, electronically produced force application chart during the wrapping application becomes the property of the Owner.
10. An automatic, continuously electronically (or substantial equivalent) monitored and simultaneously recorded force-elongation reading must be made for each vertical stressing application.
11. The force-elongation reading must represent the true relationship between the elongation at any given point of the vertical stressing operation and the applied force on the prestressing steel at that same point.
12. The force-elongation relationship must be constantly maintained from the beginning, starting with the removal of the slack to the point of lock-off and complete release of the force on the vertical prestressing steel after retraction of the stressing piston or equivalent stressing device.
13. All electronically produced force-elongation readings during the vertical thread bar stressing operations become the property of the Owner.
14. After the concrete core wall has reached the specified 28-day compressive strength, the vertical thread bars shall be stressed.
15. Circumferential wrapping shall not start until the vertical thread bars have been stressed.
16. In the event gaps between concrete core wall and wrapped strand develop that exceed 3/8 inch, discontinue wrapping. Before resuming any wrapping, either:
    a. Build-up walls with shotcrete to provide proper curvature before resuming any wrapping.
    b. If acceptable to Engineer, drypack gaps after wrapping is completed and before shotcreting is started.
17. Wrapping over intermediate shotcrete coats or built-up shotcrete areas may commence 12 hours after shotcrete has been applied, or when the shotcrete has reached a strength of 250 psi, whichever duration is longest.
18. Prestressing strand exposed to excessive temperatures greatly increases the possibility of irrevocable damage to the strand such as steel embrittlement, stress corrosion, and strand splitting. The temperature of the prestressed strand during wrapping shall not be allowed to increase by more than 50 degrees at any time during application due to stressing technique.
19. All vertical thread bar ducting and anchors (both vertical and circumferential prestressing) shall be pressure grouted with an approved 2 part water insensitive epoxy and approved epoxy grouting equipment.

3.07 ABRASIVE BLASTING

A. Exterior surfaces of concrete walls shall be prepared prior to the commencement of any shotcreting or strand wrapping, to remove all deteriorated concrete and bond-inhibiting contaminants. The surface preparation shall achieve a minimum profile of International Concrete Repair Institute (ICRI) CSP5 over a minimum of 90 percent of the surface area required to be prepared. The prestressing operator who is performing the abrasive blasting shall make available to the inspector an ICRI surface preparation sample to assist with evaluation of the surface preparation.

B. The concrete surface shall have no traces of laitance, form-oil, original surface smoothness, or surface color.

C. In order to mitigate environmental concerns, conform to environmental constraints, and achieve the desired profile, the Tank Contractor shall utilize either a self-contained mechanical etching or shot blast system, combined with a vacuum recovery system, or a high pressure water jetting system. Abrasive blasting systems which rely on sandblasting or steel shot without a vacuum recovery system, or systems that have not been used successfully in the past to prepare surfaces for shotcreting and standwrapping, will not be permitted.

3.08 SHOTCRETING

A. Shotcrete Equipment:
   1. Shotcrete mixing shall be in conformance with the requirements of Section 03300 - Cast-in-Place Concrete.
   2. The delivery equipment shall be of an approved design and size that has given satisfactory results in similar previous work.
   3. The equipment must be capable of discharging mixed materials into the hose under close control and it must be able to deliver a continuous smooth stream of uniformly mixed material at the proper velocity to the discharge nozzle, free from slugs of any kind.
   4. The nozzle shall be of a design and size that will insure a smooth and uninterrupted flow of materials.
   5. Delivery equipment shall be thoroughly cleaned at the end of each shift.
   6. Equipment parts shall be regularly inspected and replaced as required.
   7. The capacity of the compressor shall be large enough that the minimum amount of air to be available at the nozzle shall be no less than 400 cfm, irrespective of whether or not air from the same air supply is used for other purposes.

B. Placement and Testing of Shotcrete:
   1. Shotcrete shall be applied by an ACI 506 certified nozzleman.
   2. Manually applied shotcrete shall be applied with the nozzle held at a small upward angle not exceeding 5 degrees and constantly moving during application in a smooth motion with the nozzle pointing in a radial direction toward the center of the tank. The nozzle distance from the prestressing shall be such that shotcrete does not build up or cover the front face of the wire or strand until the spaces behind and between the prestressing elements are filled.
   3. Unless applied by an automated shotcrete process, total cover coat thickness shall be controlled by shooting guide wires. Vertical wires shall be installed under tension and spaced no more than 2 feet apart to establish uniform and correct coating thickness. Monofilament line (100 pound test) or 18 or 20 gauge high tensile strength steel wire shall be used. Guide wires shall be removed after placement of the cover coat.
   4. Shotcrete applied by an automated shotcrete process shall be applied using the wet mix only. Nozzles shall be kept mounted on power driven machinery enabling the nozzle to travel parallel to the surface to be sprayed at a uniform linear or bi-directional speed. The nozzle shall be kept at a uniform constant distance from the surface, always maintaining a right angle spray of the material to the surface. The high velocity impact shall be developed pneumatically by injecting compressed air at the nozzle.

5. Testing:
    a. Testing shall be by an independent testing laboratory, acceptable to Engineer, and engaged by and at the expense of the Tank Contractor.
    b. Test shotcrete in accordance with ACI 506, except as specified herein. One test panel shall be made for each of the following operations: core wall, cove, wire cover, and cover coat. Test panels shall be made from the shotcrete as it is being placed, and shall, as nearly as possible, represent the material being applied. The method of making a test sample shall be as follows: A frame of wire fabric (1 foot square, 3 inches in depth) shall be secured to a plywood panel and hung or placed in the location where shotcrete is being placed. This form shall be filled in layers simultaneously with the nearby application. After 24 hours, the fabric and plywood backup shall be removed and the sample slab placed in a safe location at the site.
    c. The sample slab shall be moist cured in a manner identical to that used for the regular surface application. The sample slab shall be sent to the testing laboratory. Nine 3-inch cubes shall be cut from the sample slab and subjected to compression tests in accordance with current ASTM Standards. Three cubes shall be tested at the age of 7 days, three shall be tested at the age of 28 days, and three shall be retained as spares.

C. Shotcrete Placing and Finishing:
1. Shotcrete shall be applied in a steady, uninterrupted flow. Should the flow become intermittent for any cause, the machine operator shall direct the nozzle away from the work until it again becomes constant, or shut off the flow of materials.
2. The nozzle shall be held at approximately right angles to the surface and shall be kept at the proper and the same distance from the surface dictated by good practice standards for the type of application, type of nozzle and air pressure employed.
3. Sufficient time shall be allowed for each layer of shotcrete to set up so it may take the next layer without sagging.
4. The shotcrete shall be started at the bottom of the wall until all wrapped strand has been covered. Subsequent shotcrete layers may be applied from the top down or from the bottom up at the discretion of the Tank Contractor.
5. While the nozzle travels around the wall, the nozzle shall be raised or lowered at a uniform rate in such a manner that an adequate overlapping of coatings and a uniform finish will develop.
6. The nozzle shall be spiraled up or down around the tank to either the top or the bottom of the wall or to the termination of the intermediate strand layer.
7. To ensure proper penetration around the strand and proper conveyance of the material through the hose, a 5- to 7-inch slump of the mortar at the pump is recommended.
8. The application of the shotcrete in the number and thickness of layers specified herein is mandatory for proper penetration of shotcrete behind prestressing material and to reduce shrinkage due to more uniform in-depth drying of the shotcrete.
9. Each layer of wrapped prestressing steel shall be covered with shotcrete until a minimum clear cover of 3/8-inch or the diameter of the strand, whichever is greater, has been placed over the prestressing steel.
10. The final cover coat, to make up for the full thickness of shotcrete over the final strand layer, shall be applied in at least 3 layers of equal thickness.

11. Each layer of shotcrete shall be completed for the full circumference of the tank and substantially the full height of that layer before the next layer of shotcrete may be applied.
12. All shotcrete coatings shall be built up in layers of approximately 3/8-inch in thickness until the final required thickness has been obtained. The Tank Contractor shall demonstrate by a reliable means that the proper thickness of shotcrete has been obtained with each layer applied.
13. Unless otherwise specified on the Drawings, the minimum shotcrete cover over all wrapped steel shall not be less than the following:
    a. For shotcrete in contact with soil: 2 inches.
    b. For other shotcrete exposures: 1.5 inches.
14. The Tank Contractor shall make provisions to protect adjacent structures, equipment, vehicles, etc., from being damaged by overshooting shotcrete and rebound materials. Overshot shotcrete deposited onto the roof slab shall be removed before it adheres to the concrete surface.
15. After the minimum shotcrete cover specified over the wrapped prestressing strand has been completed by the automated shotcrete procedure, and if such finish requirements are shown on the Drawings, the exterior surface shall be given an acceptable float finish true to line and curvature and to details shown on the Drawings.
16. If a float finish is required on the Drawings, plaster or hand-applied shotcrete may be used to build up and level the surface and to obtain the desired surface finish and projections.
17. The finish coat mix (if a smooth float finish is required on the Drawings), shall consist of a minimum of one sack of cement for each 3-1/2 cubic feet of moist plaster sand.
18. The Tank Contractor shall be responsible for all damages caused by shotcreting operations and shall bear the cost for making repairs.

D. Hand Placed Shotcrete for Repairs Only:
    1. To ensure a high quality shotcrete, the Tank Contractor shall satisfy the Engineer that the nozzleman has had sufficient and acceptable experience in the application of structural shotcrete and is a certified nozzleman in accordance with ACI 506.
    2. Experience gained on shotcrete pool and ditch construction will not be considered as experience for qualifying the nozzleman.
    3. The nozzleman shall be capable of applying thin coats of even and uniform thickness.
    4. The nozzleman's skill shall be tested and the results of such tests shall be acceptable to the Engineer before that nozzleman may start any work.

E. Restrictions on Shotcrete Operation:
    1. Shotcrete shall not be applied under such strong wind conditions that a considerable amount of cement and moisture will be removed by the wind from the mortar spray between the nozzle and the surface on which the shotcrete is applied.
    2. Shotcrete may be applied in cold weather provided the surfaces are not frozen.
    3. The temperature during the day must be expected to rise to at least 40 degrees Fahrenheit and the night temperature of the first night after the

shotcrete application must not be expected to drop below 27 degrees Fahrenheit.

4. The use of Type 3 Portland cement is required (when readily available) in the event shotcrete is applied at temperatures below 40 degrees Fahrenheit.
5. The Tank Contractor may apply shotcrete under the conditions specified herein solely at his own risk.
6. Whenever rain or frost has damaged shotcrete which has not had a chance to set up, such shotcrete must be removed and replaced.
7. The Tank Contractor shall consult with the Engineer to determine whether or not he will accept the shotcrete damaged by rain or frost before applying any new layers of shotcrete.

F. Shotcrete Curing:
   1. Intermediate layers of shotcrete shall be kept damp by hand curing or other means no sooner than 12 hours after the shotcrete has been applied.
   2. Watercuring is not required should additional shotcrete be applied on the entire wall surface within the following 12 hours.
   3. Indiscriminate use of continuous watercure for intermediate layers should be avoided.
   4. Complete shotcrete surfaces, which do not receive any additional shotcrete coatings, shall be membrane cured with plastic for a period of at least 7 days. Plastic membrane used shall contain and prevent loss of moisture from shotcrete as much as possible. Membrane curing methods utilizing curing compounds or wax-based residuals will not be permitted.
   5. Wall coatings, specified in Section 09986 - Painting Prestressed Concrete Water Tanks, shall be applied no later than 5 days after completion of the curing. If conditions make it impossible to apply coatings within the 5-day period, or if no coatings are required, shotcrete shall be membrane cured for a period of 10 days instead of the 7 days specified herein.

3.09 CLEANING

A. After construction is completed, the interior of the tank shall be completely cleaned of debris and flushed with clean water to remove all dirt and loose material.

3.10 DISINFECTING (NOT USED)

3.11 FILLING AND WATERTIGHTNESS TESTING

A. Filling:
   1. The water used for the first filling of the tank will be furnished by the Owner. If the leakage test fails, the Tank Contractor shall refill the tank and retest it. The Tank Contractor shall be responsible for the cost of refilling the tank for subsequent tests.
   2. The tank shall be filled in approximately 8-foot increments with 8 working hours between each increment for observation of possible leaks through ring drains, wall, and wall-footing.

B. Testing:
   1. If only damp spots and small puddles of water are observed during filling, the filling of tank can continue. If leaks that are large enough to potentially fail the

leakage test specified in Section 01759 - Water Leakage Test for Concrete Structures are observed, the filling process shall cease, and those leaks shall be thoroughly investigated prior to continuing to fill the tank.

2. Fill tank with water and hold water level at 3 inches below the overflow level for a period of 24 hours.
3. Test tank for leakage in accordance with the provisions of Section 01759 - Water Leakage Test for Concrete Structures.
4. Examine the tank and soil at the perimeter of the tank footings for evidence of leaks.
    a. Acceptance criteria shall be as specified in Section 01759 - Water Leakage Test for Concrete Structures.

C. Repairing tank leaks:
    1. Repair leaks to satisfaction of the Engineer.
    2. Any areas that, in the opinion of the Engineer, are exposed to contamination during repair work shall be sprayed with disinfection water mix.
    3. Leakage through joints, which may have resulted from bent over waterstops or honeycomb under or around waterstops, may require removal of concrete around waterstops in suspected areas.
    4. Repair of chipped out concrete areas:
        a. Coat chipped out concrete surface with epoxy bonding agent.
        b. Properly drypack with drypack mix for repair of concrete tank areas.
    5. Any cracks, voids, honeycomb, or cold joints showing or causing running leaks of water, shall be repaired by epoxy injection as specified in Section 03931 - Epoxy Injection System until such cracks and voids have been completely sealed.

END OF SECTION

[AD3] Addendum No. 3

SECTION 13446

MANUAL ACTUATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Valve and gate actuators.
   2. Handwheel actuators.
   3. Hand-cranked geared actuators.
   4. Floor Boxes.
   5. Floor stands.
   6. Key operated valves.
   7. Bench stands.
   8. Accessory equipment and floor boxes.

1.02 REFERENCES

A. Aluminum Association (AA):
   1. DAF-45 - Designation System for Aluminum Finishes.

B. American Water Works Association (AWWA).

C. National Electrical Manufacturers Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

D. National Electrical Code (NEC).

1.03 SUBMITTALS

A. Shop drawings: Include shop drawings and product data with associated gate or valve as an integrated unit.

1.04 QUALITY ASSURANCE

A. Provide valve actuators integral with valve or gate, except for valve actuators utilizing T-wrenches or keys, and portable gate actuators intended to operate more than 1 valve.

B. Provide similar actuators by 1 manufacturer.

C. Provide gates and hand operating lifts by 1 manufacturer.

D. Provide hydraulic gate lifts by 1 manufacturer.

E. Provide hydraulic valve actuators and motorized actuators by 1 manufacturer.

1.05 MAINTENANCE

A. Extra materials:
   1. Key operated valve keys or wrenches: Furnish a minimum 4 keys with 4-foot shafts and 3-foot pipe handles or wrenches with 4-foot shafts and 3-foot handles for operating key operated valves.

PART 2 PRODUCTS

2.01 VALVE AND GATE ACTUATORS

A. Valve actuators:
   1. Manual actuators:
      a. Material: Type 316 stainless steel.
      b. Design: Hand lever.
      c. Spring release handle: 12-inch.
      d. Notch plate: 10 position.
      e. Secure with mounting bolts.
      f. Locking device so that valve can be locked in any position with a wing nut.
   2. Stem and cover:
      a. For submerged valves, provide extension stem as indicated on the Drawings.

B. Stem covers:
   1. Aluminum pipe:
      a. Threaded cap on top.
      b. Bolted aluminum flange on bottom.
      c. Slots cut 1- by 12-inch at 18 inches on center in front and back of pipe.
      d. Capable of covering threaded portion of greased stems that project above actuators when gates or valves are opened or closed.
   2. Ultraviolet light resistant, clear butyrate plastic or polycarbonate pipe:
      a. Capped on the upper end.
      b. Either threaded into the top of the gate operators or held in place by bolt-down aluminum brackets.
      c. Capable of covering threaded portion of greased stems that project above actuators when gates or valves are opened or closed.
   3. Staff gauges:
      a. Adhesive-backed mylar, suitable for outdoor service.
      b. Calibrated in hundredths of feet.
      c. Read the weir crest elevations directly.
      d. Gauge range: 1.5 feet minimum.
      e. Indicate the following elevations on each staff gauge:
         1) -0.75, -0.50, -0.25, 0.0, 0.25, 0.50, 0.75.
      f. Supplement with a stem-mounted pointer or indicator that permits direct observation of the weir gate crest elevation.
      g. Apply staff gauges to each stem cover after installation of the cover and after calibration and testing of the weir gates.
      h. Set gauges precisely by a survey crew using instruments acceptable to the Engineer.

C. Stem cover flanges, pipes, and caps:
   1. After fabrication, etch and anodize to produce the following chemical finishes in accordance with AA publication DAF-45:
      a. A 41 - Clear Anodic Coating.
      b. C 22 - Medium Matte Finish.

D. Gate stem covers: Concentric with stem.

E. Position indicators:
   1. For all aboveground worm gear or traveling nut manual actuators, provide position indication on the actuator enclosure.
   2. Tail rods on hydraulic cylinders, or dial indicators with clear full-open and closed position indicators, calibrated in number of turns or percentage of opening.

F. Manual or power actuator size:
   1. Sized to deliver maximum force required under most severe specified operating condition, including static and dynamic forces, seat and wedge friction, and seating and unseating forces with safety factor of 5, unless otherwise specified.

G. Actuator size: Capable of supporting weight of suspended shafting unless carried by bottom thrust bearings; shaft guides with wall mounting brackets.

H. Provisions for alternate operation: Where specified or indicated on the Drawings, position and equip crank or handwheel operated geared valve actuators or lifts for alternate operation with tripod mounted portable gate actuators.

I. Operation: Counterclockwise to open with suitable and adequate stops, capable of resisting at least twice normal operating force to prevent overrun of valve or gate in open or closed position.

J. Open direction indicator: Cast arrow and legend indicating direction to rotate actuator on handwheel, chain wheel rim, crank, or other prominent place.

K. Buried actuator housing: Oil and watertight, specifically designed for buried service, factory packed with suitable grease, completely enclosed space between actuator housing and valve body so that no moving parts are exposed to soil; provide actuators with 2-inch square AWWA operating nut.

L. Worm gear actuators: Provide gearing on worm gear actuators that is self-locking with gear ratio such that torque in excess of 160 foot-pounds will not need to be applied to operate valve at most adverse conditions for which valve is designed.

M. Traveling nut actuators: Capable of requiring maximum 100 foot-pounds of torque when operating valve under most adverse condition; limit stops on input shaft of manual actuators for fully open and closed positions; non-moving vertical axis of operating nut when opening or closing valve.

2.02 HANDWHEEL ACTUATORS

A. Manufacturers: One of the following or equal:
   1. Rodney Hunt Co.
   2. Waterman Industries, Inc.

B. Coating: Handwheel as specified in Section 09960 - High-Performance Coatings.

C. Mounting: Floor stand or bench stand. Unless otherwise indicated on the Drawings position actuator 36 inches (nominal) above top of walkway surface.

D. Bearings above and below finished threaded bronze operating nut: Ball or roller.

E. Wheel diameter: Minimum 24 inches.

F. Indicator: Counterclockwise opening with arrow, and word OPEN cast on top of handwheel indicating direction for opening.

G. Pull to operate: Maximum 40 pounds pull at most adverse design condition.

H. Stem travel limiting device: Setscrew locked stop nuts above and below lift nut.

I. Grease fittings: Suitable for lubrication of bearings.

2.03 HAND-CRANKED GEARED ACTUATORS

A. Type: Single removable crank; fully enclosed.

B. Mounting: Floor and bench stand. Unless otherwise indicated on the Drawings position actuator 36 inches (nominal) above top of walkway surface.

C. Operating nut: When scheduled for portable gate actuators.

D. Geared lifts: Single speed with minimum ratio of 2 to 1.

E. Teeth on gears, spur pinions, bevel gears, and bevel pinions: Cut.

F. Lift nuts: Cast manganese bronze.

G. Exterior surfaces on cast-iron lift parts: Smooth.

H. Bearings above and below flange on lift nuts: Ball or roller; capable of taking thrust developed by opening and closing of gates under maximum operating head; with bronze sleeve bearings and sufficient grease fittings for lubrication of moving parts, including bearings and gears.

I. Crank rotation indicator: Cast arrow with word OPEN in prominent location readily visible indicating correct rotation of crank to open gate.

J. Hand cranks: 15-inch radius; requiring maximum 25 pounds pull to operate gate at maximum operating head; with:
   1. Revolving brass sleeves.

2. Gears, spur pinions, bevel gears, and bevel pinions with cut teeth.
3. Cast manganese bronze lift nuts.
4. Cast-iron lift parts with smooth exterior surfaces.

K. Indicator: Dial position type mounted on gear actuator; enclosed in cast-iron or aluminum housing with clear plastic cover; marked with fully open, 3/4, 1/2, 1/4, and closed positions.

2.04 FLOOR BOXES

A. Manufacturers: The following or equal:
1. Waterman Industries, Inc.

B. Floor boxes: Cast-iron; with:
1. Counter type indicator.
2. Hinged, lockable lid with directional arrow.
3. 2-inch square AWWA operating nut.
4. Packing gland providing drip-tight seal around valve shaft.

2.05 FLOOR STAND

A. Manufacturers: One of the following or equal:
1. Rodney Hunt Co.
2. Waterman Industries, Inc.

B. Floor stand assemblies: Heavy-duty cast-iron, suitable for mounting specified actuator.

2.06 BENCH STANDS

A. Manufacturers: One of the following or equal:
1. Rodney Hunt Co.
2. Waterman Industries, Inc.

B. Bench stands: Handwheel actuators or hand crank, geared actuators conforming to hand-cranked geared actuator requirements, except capacity to be mounted on haunch, wall bracket, or self-contained gate yoke.

2.07 ACCESSORY EQUIPMENT

A. Wall brackets or haunches: As indicated on the Drawings.

B. Stems: Stainless steel; sized to match output of actuator; minimum gate or valve operating stem diameter; maximum 200 slenderness ratio.

C. Stem couplings: Stainless steel; internally threaded to match stem; lockable to stem by set screw.

D. Stem guides: Cast-iron with silicon bronze bushing; maximum 200 slenderness ratio; capable of being mounted with wall bracket; adjustable in 2 directions.

E. Wall brackets: Cast-iron, capable of withstanding output of actuator, adjustable in 2 directions.

F. Stem stuffing boxes: Cast-iron, with adjustable gland and packing.

G. Fasteners: Type 316 stainless steel.

H. Anchor bolts: As specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry except that the material shall be Type 316 stainless steel.

I. Geared valve actuators: Provided with cut gears, either spur or worm; sized to operate valves at most adverse design condition; with maximum 40-pound pull at handwheel or chain wheel rim.

J. Geared valve traveling nut actuators: Acceptable only where specified or indicated on the Drawings.

K. Accessory equipment for valves and gates requiring remote actuators: Operating stems, stem couplings, stem guides, wall brackets, and stem stuffing boxes.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install floor boxes in concrete floor with lid flush with floor.

B. After installation of gate and stem covers, mark stem covers at point where top of stems are at full-open position and at closed position.

C. Attach floor stand to structure with anchor bolts.

D. Install stem stuffing boxes where operating stems pass through intermediate concrete floor slabs.

3.02 SCHEDULES

A. Geared actuators: Provide geared actuators for following valves:
   1. Butterfly valves larger than 6 inches, nominal size, on liquid service.
   2. Butterfly valves larger than 10 inches, nominal size, on gas and air service.
   3. Plug valves 6 inches, nominal size, and larger.

B. Handwheel actuators: Provide handwheel actuators for valves mounted 6 feet or less above floors.

C. Chain wheel actuators: Provide chain wheel actuators for valves mounted more than 6 feet to centerline above floors.

END OF SECTION

SECTION 13447

ELECTRIC ACTUATORS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Electric motor-driven actuators for valves and gates.

1.02 REFERENCES

A. American Water Works Association (AWWA):
   1. C504 - Standard for Rubber-Seated Butterfly Valves.
   2. C542 - Standard for Electric Motor Actuators for Valves and Slide Gates.

B. National Electrical Manufacturers Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures and Section 15050 - Common Work Results for Mechanical Equipment.

B. Provide a complete list/schedule of all actuators being provided with their associated tag names as indicated on the design drawings and/or specifications, service process area and the size of the valve they are actuating.

C. Product data:
   1. Electrical ratings:
      a. Voltage and number of phases.
      b. Starting and running current.
      c. Voltage levels and source for control and status.
   2. Description of integral control interface.
   3. Remote control station components (If applicable).
   4. Environmental ratings, including NEMA enclosure rating and submergence capabilities.
   5. Gear ratios for both manual and motorized actuation.
   6. Opening and closing directions.
   7. Allowable starts per hour.
   8. List of all included options and accessories.
   9. Full travel times.
   10. Gearbox data including gear ratio, and gearbox efficiency.

D. Shop drawings:
   1. Wiring diagrams:
      a. Include all options and expansion cards furnished with each actuator.
   2. Dimensioned drawings of each valve and actuator combination.

3. Dimensioned drawings of each valve gearbox.
4. Electric motor data.

E. Calculations:
1. Operating torque.
2. Maximum torque calculations for seating and unseating.
3. Maximum operating torque at starting and normal operation.
4. Signed by Professional Engineer licensed in the State where project is located.

F. Provide draft vendor operation and maintenance manual as specified in Section 01782 - Operation and Maintenance Manuals:
1. Include a list of all configurable parameters, and the final values for each.
2. Include a troubleshooting chart covering the complete valve and controls/electrical power systems, showing description of trouble, probable cause, and suggested remedy.

G. Commissioning submittals:
1. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756 - Commissioning.
a. Affidavit in accordance with AWWA C542.
2. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

H. Project closeout documents:
1. Provide final vendor operation and maintenance manual as specified in Section 01782 - Operation and Maintenance Manuals.

1.04 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturer for actuators on valves FV-60100 and FV-60102:
1. The following, no equal:
a. Bray, Series 70.

B. Manufacturers for actuators on other valves:
1. The following or equal:
a. Rotork Controls Inc. IQ3 Range:
1) IQ for multi-turn applications.
2) IQT for quarter-turn applications.
b. Limitorque Corp.:
1) Accutronix MX for multi-turn applications.
2) Accutronix QX quarter-turn applications.

C. Linear actuators:
    1. The following or equal:
        a. Rotork Controls Inc.:
            1) CML Series.
    2. As required to actuate the waste gates for the advanced water treatment (AWT) clarifier/filter units. Refer to Specification Section 11802 - Packaged Water Treatment System Rehabilitation.

2.02 CHARACTERISTICS FOR ACTUATORS ON LINES 4 INCHES AND LARGER

A. Provide actuators complete and operable with all components and accessories required for operation.

B. Power supply:
    1. Voltage and phases as indicated in the Motorized Actuator Schedule.
    2. Valve or gate motion independent of power supply phase rotation.
    3. Provide an internal backup power source or mechanical indicator to maintain settings and track valve position when main power is off.
    4. The actuators shall incorporate all major components such as the motor, starter, local controls, terminals, etc. housed within a self-contained, sealed enclosure.

C. Size actuator to move gates or valves from full open to closed position within the time indicated in the Motorized Actuator Schedule:
    1. If an operating time is not indicated on the Motorized Actuator Schedule, size the actuator to move gates or valves at minimum 12 inches per minute under maximum load. Measure rate of closure for valves at maximum diameter of disc, plug, or ball.
    2. Size actuators so that gear boxes are not required where possible.

D. Control interface:
    1. Configuration:
        a. Provide a non-intrusive, non-contacting interface for configuring all input and output settings, control values, ranges, torque switch settings, valve positions switch settings, and options.
            1) Configurable from a handheld configuring tool or input devices on the actuator.
    2. Local interface, integral to actuator:
        a. Non-intrusive, non-contacting selector switches:
            1) LOCAL-STOP-REMOTE:
                a) Motor actuator operation is prevented with the switch in STOP.
            2) OPEN-CLOSE:
                a) Controls the valve when LOCAL-STOP-REMOTE is in LOCAL.
                b) Spring return to center.
                c) Configurable between maintained (actuator runs until end of travel, high torque, or a LOCAL-STOP-REMOTE is switched to STOP) and momentary (actuator stops when lever is released).
        b. Local display:
            1) Valve fully open and fully closed indicators.
            2) Numerical display showing actual valve or gate position in percent of travel.

3. Remote control station - (VCP):
    a. Provide remote control stations for all actuators located more than 5 feet above finished floor/grade or where indicated on the Drawings in the Schedule.
        1) NEMA rating to match those to the associated Actuator Schedule.
            a) Where the rating is not listed, use NEMA Type 4X enclosures for non-hazardous areas, and explosion-proof (XP) Class I Division 1 for hazardous areas.
            b) All pilot devices shall 30 millimeters, and pilot lights shall be illuminated by LEDs.
        2) LOCAL-STOP-REMOTE selector switch.
        3) LOCAL mode control devices:
            a) Operate valve when LOCAL-STOP-REMOTE integral to actuator is in REMOTE and LOCAL-STOP-REMOTE on remote control station is in LOCAL.
            b) OPEN-STOP-CLOSE maintained switch or OPEN, STOP, and CLOSE pushbuttons where Maintained operation is indicated in the Actuator Schedule.
            c) OPEN-CLOSE spring-return switch or OPEN and CLOSE pushbuttons where momentary operation is indicated in the Attachment A - Intelligent Actuator Schedule.
        4) Pilots' lights to indicate valve position:
            a) Fully open.
            b) Fully closed.
4. Coatings:
    a. Material requirements:
        1) Factory prime and coat with an ISO 12944 classification coating of C5M (Marine, offshore estuaries with high salinity) coating with 15-year durability.
        2) Touch-up damaged coatings with manufacturer provided coating repair kit.
    b. Application requirements:
        1) Painting shall commence within four hours of blast cleaning.
        2) Each paint coat within the system is to be applied in accordance with the paint manufacturer's instructions.
        3) Paint thickness shall be checked for each coat on each actuator.
    c. Qualification requirements:
        1) Operators shall be experienced and proficient in surface preparation and coating application techniques.
        2) Personnel shall have relevant knowledge of health and safety hazard, use of protective equipment, coating materials, mixing and thinning coatings, coating pot life, surface requirements etc.
        3) Personnel carrying out inspection or verification shall be certified as NACE coating inspector or equivalent such as ICorr.
5. Control inputs:
    a. Capable of using discrete 120 VAC.
    b. Controls the valve when LOCAL-STOP-REMOTE is in REMOTE.
    c. Isolated inputs capable of operating from external control voltage source or internal power supply:

d. Provide the following inputs:
    1) OPEN.
    2) CLOSE.
    3) STOP.
e. OPEN and CLOSE inputs configurable between maintained (actuator runs until end of travel, high torque, or a STOP input) and momentary (actuator stops when command is removed).

6. Status outputs:
    a. Monitor relay output: Dry contact, normally closed, opens when actuator is not in REMOTE or in the event of any internal fault or alarm condition.
    b. Dry contact outputs configured for the functions indicated on the Drawings. Provide the following outputs for all actuators:
        1) Fully closed.
        2) Fully open.
        3) LOCAL-STOP-REMOTE in REMOTE position.
    a. All output contacts rated for 5 amps, 120 VAC, and 24 VDC.
7. Analog input:
    a. Provide a 4-20 milliampere analog input for analog modulating valves when indicated on the Drawings.
    b. Modulate valve to maintain position based on analog input value.
    c. Maximum input impedance 250 ohms.
8. Analog output:
    a. Provide an isolated 4-20 milliampere analog output(s) when indicated on the Drawings.
        1) Loop power sourced from the actuator power supply.
        2) Capable of driving into a load up to 500 ohms.
        3) Output proportional to process value(s) indicated on the Drawings.
        4) Valve or gate position.
        5) Operating torque.
9. For actuators for non-vendor provided systems, provide native EtherNet/IP connectivity.

E. Features:
1. Time delay on reversal: Incorporate time delay between stopping actuator and starting in opposite direction to limit excessive current, torque, and heating from instantaneous reversal.
2. Data logging:
    a. Store diagnostic data and reference data.
    b. Time-stamped historical operating data, including number of operations and most recent operations.
3. Provide display of logged data on the actuator, or provisions to download to a personal computer.

F. Materials:
1. Construct motorized actuators of materials suitable for the environment in which actuator is to be installed.
    a. Enclosure ratings:
        1) As scheduled with the following requirements.
            a) All actuators will be double sealed for corrosion protection rated at ip68.

2) NEMA 4X for all actuators located outside of Class I areas.
3) All others shall be rated FM - Class I Groups B,C and D and Class II E, F, and G.

G. Components:
1. Motors:
a. Specifically designed for valve actuator service with high starting torque, totally enclosed non-ventilated construction.
b. Torque ratings equal to or greater than that required for valve seating and dynamic torques with a 25 percent factor of safety.
1) Design requirements for rubber-seated AWWA butterfly valves:
a) Design actuators for maximum gate or valve operating torque, in accordance with and using safety factors required in AWWA C504 and AWWA C542.
(1) Valve actuator torque requirement for open-close service: Not less than the required valve-seating and dynamic torques under design operating conditions in accordance with AWWA C504.
(2) Valve actuator torque requirement for modulating service: Not less than twice the required valve dynamic torque under design operating conditions in accordance with AWWA C504.
2) Design requirements for slide gates, gate valves, knife gate valves, globe valves, and diaphragm valves:
a) Design valves and actuators for maximum operating torque, in accordance with and using safety factors required in AWWA C542.
b) Design for the maximum torque and thrust running load over the full cycle.
c) Maximum torque or thrust rating: The actuator stall torque or maximum thrust output shall not exceed the torque or thrust capability of the valve or gate, as determined by the valve or gate manufacturer.
c. Capable of being removed and replaced without draining the actuator gear case.
d. Motor bearings shall be amply proportioned of the anti-friction type and permanently lubricated.
e. Rated for operating under the following conditions without exceeding temperature limits with ambient temperature of 40 degrees Celsius.
1) Continuous operation for 15 minutes or twice the open-to-close operating time (whichever is greater) at normal operating torque or 33 percent of maximum torque (whichever is greater).
2) 60 starts per hour for open/close service or 1,200 starts per hour for modulating service.
f. Provide the following motor protection features:
1) Jammed valve (no valve motion detected through a time delay).
2) High motor temperature (sensed by an embedded thermostats).
3) High torque.
4) Single phasing protection.

H. Enclosures:
   1. Actuator housing ratings as indicated in the Motorized Actuator Schedule.
   2. Stainless steel external fasteners.
   3. Provide O-ring seals for each of the following areas:
      a. Between the terminal compartment and the internal electrical elements.
      b. Between the mechanical and electrical portions to protect from the ingress of oil, and to protect the mechanical components of oil from dust and moisture when the electrical terminal is open.
   4. Provide actuators with the following minimum enclosure ratings as scheduled:
      a. NEMA Type 4X enclosure for general applications.
      b. NEMA Type 6P rated for actuators in underground vaults or where possible submergence is indicated in the Drawings.
         1) Suitable for a minimum of 48 hours submerged under 3 meters of water.
      c. NEMA Type 7 certified by FM for Class I, Division 1, Groups C, D, E, F, and G, for actuators installed in Class I, Division 1 and 2 areas.

I. Position sensing:
   1. Electronic and adjustable using a solid-state encoder wheel.
      a. Mechanical limit switches and potentiometers are not acceptable.
   2. Capable of retaining position and monitoring valve or gate motion when valve is manually actuated and when main power is not present.
   3. Valve range and position switch outputs field adjustable.

J. Torque sensing:
   1. Torque shutdown setting: 40 percent to 100 percent rated torque:
      a. Adjustable in 1 percent increments.
   2. Capable of interrupting control circuit during both opening and closing and when valve torque overload occurs.
   3. Electrical or electronic torque sensing.
   4. Independent of variations in frequency, voltage, or temperature.
   5. The actuator shall store actual operational torque curves for retrieval by plant maintenance staff.
   6. Provide a temporary inhibit of the torque sensing system during unseating or during starting in mid-travel against high inertia loads.
   7. Provide visible verification of torque switch status without any housing disassembly.

K. Manual actuators:
   1. Hand wheel for manual operation.
      a. Maximum 80-pound pull on rim when operating gate or valve under maximum load.
      b. Provide pull chain when motorized actuator is located more than 6 feet above floor surface.
         1) Chain shall be of sufficient length to reach approximately 4 feet above the operating level.

2) Where the chain obstructs an aisle or walkway, provide holdback or other means to ensure chain does not create a nuisance or hazard to operating personnel.
3) Provide Type 316 stainless steel.

2. Declutch lever: Padlockable, capable of mechanically disengaging motor and related gearing and freeing hand wheel for manual operation.

L. Gearing: Hardened alloy steel spur or helical gears and self-locking, alloy bronze worm gear set.
1. Accurately cut to ensure minimum backlash.

M. Bearings:
1. Anti-friction bearing with caged balls or rollers throughout.
2. Sealed-for-life type thrust bearings housed in a separate thrust base.

N. Drive bushing:
1. Easily detachable for machining to suit the valve stem or gearbox input shaft.
2. Positioned in a detachable base of the actuator.

O. Lubrication:
1. Provide totally enclosed actuator gearing with oil or grease filled gear case suitable for operation at any angle.
2. Actuators requiring special or exotic lubricants are not acceptable.

2.03 ACCESSORIES

A. Software:
1. Furnish PC-based diagnostic and configuration software to display diagnostic data.
2. Provide software communications to the valve actuator using Bluetooth wireless communications.
a. Provide all accessories and drivers required for operation and communications with a standard personal computer running Microsoft Windows.

B. Termination module cover:
1. For actuators on a valve network, provide a means to keep the valve network in service, in the event where the actuator must be removed.
2. Provide sunshades for all outdoor installations of remote control stations that use an LCD or similar screen. Regular pushbutton, sector switches, and pilot light control stations will not require a sunshade.

2.04 SPARE PARTS AND SPECIAL TOOLS

A. As specified in Section 01600 - Product Requirements.

B. Spare parts:
1. Provide the following (minimum 10 percent of total number of actuators of each model type furnished, but not less than 1 for each model of actuator furnished):
a. Stem nut.

b. Worm shaft subassembly.
c. Drive sleeve subassembly.
d. Complete actuator seal kit.
e. Actuator gearbox oil (sufficient quantity to fill 4 gearboxes).
f. Encoder.
g. Control module.

2. Provide 1 spare motor for each size motor furnished.

PART 3 EXECUTION

3.01 GENERAL

A. As specified in Section 15050 - Common Work Results for Mechanical Equipment.

B. Position visual indicators so that they are most easily visible.

3.02 COMMISSIONING

A. As specified in Section 01756 - Commissioning, Section 15958 - Mechanical Equipment Testing, and this Section.

B. Manufacturer services:
1. Provide certificates:
a. Manufacturer's Certificate of Source Testing:
1) Proof-of-Design and Performance Test Reports in accordance with AWWA C542.
b. Manufacturer's Certificate of Installation and Functionality Compliance.
2. Manufacturer's Representative on-site requirements:
a. Installation: 2 trips, 2-day minimum each.
b. Functional testing: 2 trips, 2-day minimum each.
3. Training:
a. Maintenance: 4 hours per session, 2 sessions.
b. Operation: 2 hours per session, 2 sessions.

C. Source testing:
1. Design and Performance Test Reports in accordance with AWWA C542.
2. Test each actuator with a simulated load.
a. Simulate a typical valve load.
3. Electrical Instrumentation and Controls:
a. Test witnessing: not witnessed.
b. Conduct testing as specified in Section 17950 - Commissioning for Instrumentation and Controls.

D. Functional testing:
1. Installed actuator:
a. Test witnessing: Witnessed.
b. Conduct Level 2 General Equipment Performance Tests.
c. Conduct Level 2 Vibration Tests.
d. Conduct Level 2 Noise Tests.

2. Electrical Instrumentation and Controls:
    a. Test witnessing: Witnessed.
    b. Conduct testing as specified in Section 17950 - Commissioning for Instrumentation and Controls.

3.03 INTELLIGENT ACTUATOR SCHEDULE

A. Provide actuators indicated on the Drawings:
    1. Major process actuators are listed in the Intelligent Actuator Schedule shown in Attachment A - Intelligent Actuator Schedule
        a. Attachment A - Intelligent Actuator Schedule does not include all number and types of actuators required for the Project.

END OF SECTION

ATTACHMENT A - INTELLIGENT ACTUATOR SCHEDULE

INTELLIGENT ACTUATOR SCHEDULE

Item	Reference DWG	Type	Size	Duty	NEMA Rating	Voltage/Phase/Hz	Notes	Service	Controls
FV-60100	60M01, 60N01	BFV	24”	ST	4X	480/3 60 Hz	-	O/C	E-IP
FV-60102	60M01, 60N01	BFV	24”	ST	4X	480/3 60 Hz	-	O/C	E-IP
FCV-85211	85M02, 85N01	BFV	12”	MD	4X	480/3 60 Hz	-	MOD	A
FV-85212	85M02, 85N01	BFV	6”	ST	4X	480/3 60 Hz	-	O/C	D O/C
FV-85214	85M02, 85N01	LA	-	ST	4X	480/3 60 Hz	-	O/C	D O/C
FV-85217	85M02, 85N01	BFV	14”	ST	4X	480/3 60 Hz	-	O/C	D O/C
FCV-85218	85M02, 85N01	BFV	12”	MD	4X	480/3 60 Hz	-	MOD	A
FV-85219	85M02, 85N01	BFV	8”	ST	4X	480/3 60 Hz	-	O/C	D O/C
FCV-85221	85M02, 85N02	BFV	12”	MD	4X	480/3 60 Hz	-	MOD	A
FV-85222	85M02, 85N02	BFV	6”	ST	4X	480/3 60 Hz	-	O/C	D O/C
FV-85224	85M02, 85N02	LA	-	ST	4X	480/3 60 Hz	-	O/C	D O/C
FV-85227	85M02, 85N02	BFV	14”	ST	4X	480/3 60 Hz	-	O/C	D O/C
FCV-85228	85M02, 85N02	BFV	12”	MD	4X	480/3 60 Hz	-	MOD	A

Item	Reference DWG	Type	Size	Duty	NEMA Rating	Voltage/Phase/Hz	Notes	Service	Controls
FV-85229	85M02, 85N02	BFV	8”	ST	4X	480/3 60 Hz	-	O/C	D O/C
FCV-85231	85M02, 85N03	BFV	12”	MD	4X	480/3 60 Hz	-	MOD	A
FV-85232	85M02, 85N03	BFV	6”	ST	4X	480/3 60 Hz	-	O/C	D O/C
FV-85234	85M02, 85N03	LA	-	ST	4X	480/3 60 Hz	-	O/C	D O/C
FV-85237	85M02, 85N03	BFV	14”	ST	4X	480/3 60 Hz	-	O/C	D O/C
FCV-85238	85M02, 85N03	BFV	12”	MD	4X	480/3 60 Hz	-	MOD	A
FV-85239	85M02, 85N03	BFV	8”	ST	4X	480/3 60 Hz	-	O/C	D O/C
FCV-85241	85M02, 85N04	BFV	12”	MD	4X	480/3 60 Hz	-	MOD	A
FV-85242	85M02, 85N04	BFV	6”	ST	4X	480/3 60 Hz	-	O/C	D O/C
FV-85244	85M02, 85N04	LA	-	ST	4X	480/3 60 Hz	-	O/C	D O/C
FV-85247	85M02, 85N04	BFV	14”	ST	4X	480/3 60 Hz	-	O/C	D O/C
FCV-85248	85M02, 85N04	BFV	12”	MD	4X	480/3 60 Hz	-	MOD	A

Item	Reference DWG	Type	Size	Duty	NEMA Rating	Voltage/Phase/Hz	Notes	Service	Controls
FV-85249	85M02, 85N04	BFV	8”	ST	4X	480/3 60 Hz	-	O/C	D O/C
FV-87130	87M01, 87N01	BFV	14”	ST	4X	480/3 60 HZ	-	O/C	D O/C

Notes:
None.

Abbreviations:

Types:
BFV = Butterfly Valve.
BV = Ball Valve.
PV = Plug Valve.
SG = Slide Gate.

Duty:
ST = Standard service (0-60 starts/hr) duty.
MD = Modulating duty (~1000 starts/hr).

Service:
O/C = Open/Close.
MOD = Modulating.

Controls:
PA = Profibus PA.
DP = Profibus DP.
DN = DeviceNet.
E-IP = Ethernet/IP.
E-TCP = Ethernet TCP or TCP/IP.
FF = Foundation Fieldbus H1.
MB = Modbus RTU (RS-485).
NET = Manufacturer’s proprietary network.
A = Analog (4-20 mA) control, modulating.
D O/C = Discrete open/close.
D JOD = Position control using discrete jumps.

CITY OF UKIAH
UKIAH, CA

RECYCLED WATER PIPELINE PROJECT – PHASE 4

CLIENT PROJECT NO. 8860F10

TECHNICAL SPECIFICATIONS

CONFORMED DOCUMENTS

VOLUME 2 OF 3

JULY 12, 2023

CONFORMED DOCUMENTS
These Conformed Documents unify addenda issued during the bid period. If discrepancies between the Conformed Documents and the Bid Documents are found, the Bid Documents with the original addenda shall govern.
Original sealed by
Brian W. Avon,
April 7, 2023,
California C-76832.

2795 MITCHELL DRIVE • WALNUT CREEK, CALIFORNIA 94598-1601 • P. 925.932.1710

CITY OF UKIAH

RECYCLED WATER PIPELINE PROJECT - PHASE 4

DISCIPLINES RESPONSIBLE FOR SPECIFICATION SECTIONS

Original sealed by
Brian W. Avon,
April 7, 2023,
California C-76832.

CIVIL

Original sealed by
Matthew C. Kallevant,
April 7, 2023,
California C-84405.

PROCESS/MECHANICAL

Original sealed by
Jitesh Kumar Renalagotla,
April 7, 2023,
California C-86094.

STRUCTURAL

Original sealed by
Erik M. Bahneman,
April 7, 2023,
California E-E19683.

ELECTRICAL

Original sealed by
Brett A. Lee,
April 7, 2023,
California E-22911.

INSTRUMENTATION & CONTROLS

CITY OF UKIAH

RECYCLED WATER PIPELINE PROJECT – PHASE 4

TABLE OF CONTENTS

KEY TO ADDENDA

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5	June 16, 2023

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3	**02448**	**JACKING STEEL PIPE CASINGS**
	02460	PILE LOAD TESTS
	02466A	BORED AND AUGERED PILES
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3	**02471**	**GEOTECHNICAL INSTRUMENTATION AND MONITORING**
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	02705	POLYVINYL CHLORIDE (PVC) PIPE: GRAVITY
	02706	POLYVINYL CHLORIDE (PVC) PIPE: PRESSURE - LINEAR INFRASTRUCTURE
	02710	POLYVINYL CHLORIDE (PVC) PIPE: SCHEDULE TYPE
	02742A	ASPHALTIC CONCRETE PAVING (CA)
	02747	BITUMINOUS PAVEMENT SURFACE SEAL
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	02772	CONCRETE CURBS, GUTTERS, AND SIDEWALKS
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	03300	CAST-IN-PLACE CONCRETE
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3	**09986**	**PAINTING PRESTRESSED CONCRETE WATER TANKS**

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3	**13207**	**STRAND-WOUND CIRCULAR PRESTRESSED CONCRETE TANK WITH A TYPE I CORE WALL AND FLAT ROOF**
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	15062	PREFORMED CHANNEL PIPE SUPPORT SYSTEM
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	15076	PIPE IDENTIFICATION
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	15110	COMMON WORK RESULTS FOR VALVES
	15111	BALL VALVES
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	15118	PRESSURE CONTROL VALVES
	15119	AIR AND VACUUM RELIEF VALVES
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	15127	DUCTILE IRON BALL-TYPE FLEXIBLE EXPANSION JOINTS
	15200	METERED SERVICES
	15209	HIGH-SILICON CAST IRON PIPE FOR DIGESTER GAS
	15211	DUCTILE IRON PIPE: AWWA C151
	15230	PLASTIC PIPING AND TUBING
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	15286	STAINLESS STEEL PIPE AND TUBING
	15400	PLUMBING SYSTEMS
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	15732	AIR CONDITIONING UNITS
	15936	INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
	15954	TESTING, ADJUSTING, AND BALANCING FOR HVAC
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ADDENDUM NO.	SECTION NO.	TITLE
	16050	COMMON WORK RESULTS FOR ELECTRICAL
	16060	GROUNDING AND BONDING
	16070	HANGERS AND SUPPORTS
	16075	IDENTIFICATION FOR ELECTRICAL SYSTEMS
	16123	600-VOLT OR LESS WIRES AND CABLES
	16125	FIBER OPTIC CABLE AND APPURTENANCES
	16130	CONDUITS
	16133	DUCT BANKS
	16134	BOXES
	16140	WIRING DEVICES
	16150	LOW VOLTAGE WIRE CONNECTIONS
	16210	UTILITY COORDINATION
	16222	LOW VOLTAGE MOTORS UP TO 500 HORSEPOWER
	16262	VARIABLE FREQUENCY DRIVES 0.50 - 50 HORSEPOWER
	16265	REDUCED HARMONIC VARIABLE FREQUENCY DRIVES
	16272	DRY-TYPE TRANSFORMERS
	16285	SURGE PROTECTIVE DEVICES
	16290	ELECTRICAL POWER MONITORING
	16305	ELECTRICAL SYSTEM STUDIES
	16411	DISCONNECT SWITCHES
	16412	LOW VOLTAGE MOLDED CASE CIRCUIT BREAKERS
	16422	MOTOR STARTERS
	16441	GROUP-MOUNTED CIRCUIT BREAKER SWITCHBOARDS
	16445	PANELBOARDS
	16494	LOW VOLTAGE FUSES
	16510	LIGHTING: LED LUMINAIRES
	16950	FIELD ELECTRICAL ACCEPTANCE TESTS
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ADDENDUM NO.	SECTION NO.	TITLE
	17050	COMMON WORK RESULTS FOR PROCESS CONTROL AND INSTRUMENTATION SYSTEMS
	17100	CONTROL STRATEGIES
	17101	SPECIFIC CONTROL STRATEGIES
	17201	LEVEL MEASUREMENT: SWITCHES
	17206	LEVEL MEASUREMENT: ULTRASONIC

	17208	LEVEL MEASUREMENT: RADAR PULSE TIME OF FLIGHT (PTOF)
	17301	FLOW MEASUREMENT: SWITCHES
	17302	FLOW MEASUREMENT: MAGNETIC FLOWMETERS
	17316	FLOW MEASUREMENT: ROTAMETERS (VARIABLE AREA FLOWMETERS)
	17317	FLOW MEASUREMENT: OPEN CHANNEL
	17402	PRESSURE/VACUUM MEASUREMENT: INSTRUMENT VALVES
	17404	PRESSURE/VACUUM MEASUREMENT: GAUGES
	17405	PRESSURE/VACUUM MEASUREMENT: DIRECT
	17407	PRESSURE MEASUREMENT: SUBMERSIBLE
	17505	ANALYZERS: RESIDUAL CHLORINE
	17710	CONTROL SYSTEMS: PANELS, ENCLOSURES, AND PANEL COMPONENTS
	17720	CONTROL SYSTEMS: PROGRAMMABLE LOGIC CONTROLLERS
	17721	CONTROL SYSTEMS: LOCAL OPERATOR INTERFACE (LOI)
	17733	CONTROL SYSTEMS: NETWORK MATERIALS AND EQUIPMENT
	17750	CONTROL SYSTEMS: WIRELESS COMMUNICATIONS - RADIO
	17901	SCHEDULES: FIELD INSTRUMENTS
	17903	SCHEDULES: I/O LIST
	17950	COMMISSIONING FOR INSTRUMENTATION AND CONTROLS

APPENDICES

ADDENDUM NO.	APPENDIX	TITLE
	APPENDIX A	MITIGATION MONITORING AND REPORTING PROGRAM
	APPENDIX B	WWTP GEOTECHNICAL REPORT (REVISION 2)
	APPENDIX C	RECYCLED WATER PIPELINE GEOTECHNICAL REPORT

SECTION 15050

COMMON WORK RESULTS FOR MECHANICAL EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Mechanical equipment requirements for:
      a. Basic design and performance criteria.
      b. Prescriptive requirements for common components.
      c. Installation requirements.

1.02 REFERENCES

A. American Bearing Manufactures Association (ABMA):
   1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. American Gear Manufacturer's Association (AGMA) Standards.

C. ASTM International (ASTM):
   1. A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
   2. A194 - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   3. A320 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
   4. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   5. F594 - Standard Specification for Stainless Steel Nuts.

D. Hydraulic Institute (HI):
   1. 9.6.8 - Guideline for Dynamics of Pumping Machinery.

E. International Concrete Repair Institute (ICRI):
   1. Guideline No. 310.2R, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.

F. International Organization for Standardization (ISO):
   1. 21940 - Mechanical Vibration - Rotor Balancing - Part 1: Introduction.

G. National Electrical Manufacturers Association (NEMA):
   1. MG-1 - Motors and Generators.

H. Society for Protective Coatings (SSPC):
   1. SP-1-Solvent Cleaning.

1.03 DEFINITIONS

A. Definitions used in this specification and equipment submittals for terms related to rotor-dynamic pumps shall be in accordance with HI 9.6.8, Appendix A, as clarified below.

B. These definitions shall be applied to equipment other than pumps, unless otherwise specified in technical sections.

C. Rotordynamic Analysis Level:
   1. The level of detail required for rotordynamic analysis is indicated in the technical sections schedules as None (no analysis required), Analysis Level 1, Analysis Level 2, or Analysis Level 3, which correlate to increasing levels of required detailed equipment design analysis. Analysis Levels 1, 2 and 3 are based on HI 9.6.8.
   2. Where these specifications differ from HI the more stringent shall apply.

D. Resonant Frequency:
   1. The frequency of a periodic excitation force that is close to the natural frequencies of an object. Also known as critical frequency, critical speed, or resonant speed.
   2. An undamped resonant frequency within the separation margin is always considered harmful under Level 1 analysis.
   3. A resonant frequency that occurs within a separation margin of 15 percent above or below the operating speed range and has a log decrement greater than +0.3 is considered harmful under Level 2 and Level 3 analysis.

E. Separation margin:
   1. The span of operating speeds within which interference between excitation orders and resonant frequencies indicate the possibility of harmful vibrations.
   2. The separation margin for a specific application extends 15 percent above and 15 percent below the span of operating speed required for the specified performance conditions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Roof coordination:
   1. Show roof penetrations for mechanical equipment on roof drawing submittal and include mechanical equipment information:
      a. Type.
      b. Size.
      c. Location.
      d. Configuration of penetration and the surround.
      e. Weight.
      f. Anchoring and support details.

1.05 SUBMITTALS

A. Items in this Section are components of equipment or systems specified in other sections.
   1. Include data for this Section’s components with the equipment or system submittal.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. General:
   1. Equipment manufacturer's responsibility extends to selection and mounting of gear drive units, motors or other prime movers, accessories, and auxiliaries to provide a complete, operable unit.
   2. Manufacturer shall analyze all rubber-bearing vertical-column pumps, and equipment identified as non-reversing in the technical sections for reverse rotation and provide non reversing motor ratchets.
   3. Equipment that prevents reverse rotation shall be capable of both:
      a. Handling 150 percent of the maximum torque at maximum operating speed.
      b. 150 percent of torque that will be generated in reverse direction due to equipment shutoff head as calculated by the manufacturer.
   4. The motor shall be designed to run safely in the reverse direction at up to 140 percent times the reverse runaway speed under shutoff head conditions.

B. Rotordynamic analysis and vibration testing:
   1. Submit information for the Rotordynamic Analysis Level specified for each piece of equipment as shown in the Technical Sections prior to manufacture of the equipment.
   2. Rotordynamic analysis shall be performed on "like-new" and "as-worn" conditions, representing conditions when first installed and conditions when parts wear to the manufacturer's maximum allowable operating tolerances. Conditions assumed for the "as-worn" condition shall be 2 times the "like-new" tolerances unless specified otherwise.
   3. Rotordynamic analysis criteria:
      a. Torsional excitation forcing function magnitudes shall be no less than 1 percent of the maximum transmitted torque at given speed.
      b. Motor mass elastic information in accordance with NEMA MG-1 shall be obtained from the original equipment manufacturer and included in the analysis. Motors shall be precision balanced to ISO 21940 grade G2.5.
      c. Bearings:
         1) At maximum bearing loads an L-10 life of 100,000 hours in accordance with ABMA 9-11 to be proven.
   4. Submit factory and field testing requirements as specified in the Technical Sections and specified in Section 15958 - Mechanical Equipment Testing after manufacture and installation respectively.

5. Repair, replace, and modify equipment exhibiting vibration performance that does not meet criteria specified in this Section at no additional cost to Owner. Acceptable remedies include adjustments to equipment component geometry, materials, energy absorbing couplings, etc. Locking out speed interval(s) within equipment specified operating range is unacceptable.
6. Vibration analysis expert:
    a. Provide vibration analysis expert when specified in the equipment Technical Sections:
        1) The vibration analysis expert must be a 3rd party, unaffiliated with the equipment vendor or Contractor.
    b. The vibration analysis expert, and analysis shall be provided by one of the following or equal:
        1) Mechanical Solutions, Inc. (MSI, New Jersey).
        2) Engineering Dynamics Inc. (EDI, Texas).
    c. The analysis shall be:
        1) Stamped by a registered professional mechanical engineer.
        2) Verified in-situ by the vibration analysis expert including certification that installation conforms to field conditions assumed in the reports.
        3) Verified in-situ by the vibration analysis expert including witness of at least one field vibration test, and certification that vibration measurements corroborate the rotordynamic analysis.
        4) Supplemented with additional field investigation and analysis should conditions during field vibration testing activity indicate non-compliance with these specifications; supplemental field investigation and analysis shall indicate remedies to comply with the specifications and shall be stamped by a registered professional mechanical engineer.
7. Rotordynamic Analysis Level 1:
    a. Before the equipment is released for manufacture it shall be determined that the equipment/motor structures do not have any harmful resonant frequencies in the lateral and torsional modes. Representative analysis results for identical equipment may be submitted.
    b. Calculate rotor lateral and torsional and equipment structural components' lateral frequencies with a spreadsheet calculation or finite element analysis software.
        1) Equipment structure lateral frequency shall include the motor.
        2) Speed changing drive systems (belt, gear) effects on rotational inertia and stiffness shall be incorporated.
    c. Determine the equipment system components (rotor and structure) resonant frequencies.
    d. An intersection of an equipment component resonant frequency with the 1x run speed excitation order that occurs within separation margin is unacceptable.
8. Rotordynamic Analysis Level 2:
    a. Before the equipment and motor are released for manufacture it shall be determined that the equipment/motor structures do not have any harmful critical speeds in the lateral and torsional modes.
    b. Calculate rotor lateral and torsional and structure lateral frequencies with finite element analysis software.
        1) Equipment structure lateral frequency shall include the motor.

2) Speed changing drive systems (belt, gear) effects on rotational inertia and stiffness shall be incorporated.
3) The rotational inertia of water within the impeller, in the wet well and inside the equipment structure, e.g., the column of a vertical pump, shall be included in the calculation at both the high level and low level conditions.

c. Potentially harmful critical speeds shall be investigated further with a forced, damped analysis to determine component stresses do not exceed material properties.

d. Forced damped analysis:
1) Forced lateral analysis shall include forcing function magnitudes at least 10 percent of rotor disc weight at each disc position and hydraulic imbalance at 5 operating conditions spaced equally over the equipment operating range. If synchronous motors are used ensure that the rotor analysis includes startup, shutdown, and motor control transients.
2) Forced torsional analysis shall include not less than 1 percent of the maximum permitted torque at any given speed. Damping shall be one percent of critical at all shaft elements.
3) The equipment rotor total stress (steady-state and alternating torque components plus lateral-bending stresses) shall not exceed:
a) Constant torque: Total stress limited to 30 percent of the material fatigue limit and to a maximum of 18 percent of ultimate tensile strength.
b) Variable torque (including variable speed equipment): Total stress limited to 50 percent of the material fatigue limit and to a maximum of 4 percent of the material ultimate tensile strength.
c) Submit documentation of material fatigue limit.

e. Report submittals:
1) Confirmation of compliance with this Section, or detailed exceptions taken.
2) Software used for analysis.
3) Results with interpretation.
4) Preparer's professional engineering stamp and seal.
5) Input data including component properties, materials, and connectivity to other components.
6) Schematic diagram of model mode shapes, nodes, and elements.
7) Bearing stiffness and damping properties, impeller/diffuser interaction coefficients, and seal dynamic properties.
8) Campbell diagrams showing the system natural frequencies, excitation orders, and operating speed range for both lateral and torsional analysis.
a) Campbell diagram shall include equipment operating range; excitation lines at 1x, 2x run speed, and vane pass (or equivalent); and critical speeds associated with equipment system components including the rotor, each major equipment structural component and the motor.
9) Forced, damped analysis indicating acceptable material stress limits are maintained at interference points shown on the Campbell diagram.

9. Rotordynamic Analysis Level 3:
    a. Before the equipment and motor are released for manufacture it shall be determined that the equipment/motor structures do not have any harmful critical speeds in the lateral and torsional modes.
    b. Calculate rotor lateral and torsional and structure lateral frequencies with finite element analysis software.
        1) Equipment structure lateral frequency shall include the motor.
        2) Speed changing drive systems (belt, gear) effects on rotational inertia and stiffness shall be incorporated.
        3) The rotational inertia of water within the impeller, in the wet well and inside the equipment structure, e.g., the column of a vertical pump, shall be included in the calculation at both the high level and low level conditions.
    c. Potentially harmful critical speeds shall be investigated further with a forced, damped analysis to determine component stresses do not exceed material properties.
    d. Forced damped analysis:
        1) Forced lateral analysis shall include forcing function magnitudes at least 10 percent of rotor disc weight at each disc position and hydraulic imbalance at 5 operating conditions spaced equally over the equipment operating range. If synchronous motors are used ensure that the rotor analysis includes startup, shutdown, and motor control transients.
        2) Forced torsional analysis shall include 1 percent of the maximum permitted torque at any given speed. Damping shall be 1 percent of critical at all shaft elements.
        3) The equipment rotor total stress (steady-state and alternating torque components plus lateral-bending stresses) shall not exceed:
            a) Constant torque: Total stress limited to 30 percent of the material fatigue limit and to a maximum of 18 percent of ultimate tensile strength.
            b) Variable Torque (including variable speed equipment): Total stress limited to 50 percent of the material fatigue limit and to a maximum of 4 percent of the material ultimate tensile strength.
            c) Submit documentation of material fatigue limit.
    e. Report submittals:
        1) Report 1: Executive Summary including:
            a) Confirmation of compliance with this specification section, or detailed exceptions taken.
            b) Software used for analysis.
            c) Results with interpretation.
            d) Preparer's professional engineering stamp and seal.

e) Campbell diagrams showing the system natural frequencies, excitation orders, and operating speed range for both lateral and torsional analysis.
(1) Campbell diagram shall include equipment operating range; excitation lines at 1x, 2x run speed, vane pass (or equivalent), line- and twice-line frequency, motor-pole frequency, torsional harmonics from reciprocating drivers (including up to 6 times operating speed), control pulse frequencies induced by VFDs (with certification from VFD manufacturer of frequencies up to 24 times motor running speed), any torque harmonic greater than 1 percent of steady torque at primary excitation, and synchronous motor requirements; and critical speeds associated with equipment system components including the rotor and each major equipment structural component.
f) Report 1 shall not include detailed analysis elements listed for submittal under Report 2 below, submittal of full analysis details in Report 1 is unacceptable.
g) Following submittal of Report 1, submit Report 2: Detailed Analysis including responses to comments made on Report 1: Rotor-dynamic Executive Summary.
2) Report 2: Rotor-dynamic Detailed Analysis including:
a) Input data including component properties, materials, and connectivity to other components.
b) Schematic diagram of model mode shapes, nodes, and elements.
c) Bearing stiffness and damping properties, impeller/diffuser interaction coefficients, and seal dynamic properties.
d) Forced, damped analysis indicating acceptable material stress limits are maintained at interference points shown on the Campbell diagram.
e) Synchronous motor information including time-integration study results showing transient peak stresses at startup, shutdown, and motor control transient events. Provide tomographic diagrams including root and keyway stress concentration locations and the corresponding speeds that result in reported peak stresses.

2.02 POWER TRANSMISSION SYSTEMS

A. V-belts, sheaves, shaft couplings, chains, sprockets, mechanical variable-speed drives, variable frequency drives, gear reducers, open and enclosed gearing, clutches, brakes, intermediate shafting, intermediate bearings, and U-joints:
1. Rated for 24 hour-a-day continuous service, or for intermittent service with frequent stops-and-starts, whichever is most severe.
2. Sized with a service factor of 1.5 or greater:
a. Apply service factor to nameplate horsepower and torque of prime source of power and not to actual equipment loading.
b. Apply service factors in accordance with AGMA or as specified in the Technical Sections.

2.03 BEARINGS

A. Oil or grease lubricated, ball or roller antifriction type, of standard manufacture.
   1. Design lubrication system based on the equipment location to operate in the temperatures as specified in Section 01850 - Design Criteria.
      a. Design lubrication system to safely start after being shut off for 24 hours and operate safely:
         1) Suitable for the outdoor winter temperature as specified in Section 01850 - Design Criteria.

B. Oil-lubricated bearings:
   1. Provide either pressure lubricating system or separate oil reservoir splash-type system as specified in the Technical Section.
   2. Design oil-lubrication system to safely absorb heat energy generated in bearings when equipment is operating in the following conditions:
      a. With the highest load and the temperature 15 degrees Fahrenheit above the outdoor summer temperature as specified in Section 01850 - Design Criteria.

C. Grease lubricated bearings, except those specified to be factory sealed:
   1. Fit with easily accessible grease supply, flush, drain, and relief fittings.
   2. Lubrication lines and fittings:
      a. Lines: Minimum 1/4-inch diameter stainless steel tubing.
      b. Multiple fitting assemblies: Mount fittings together in easily accessible location.
      c. Use standard hydraulic-type grease supply fittings:
         1) Manufacturers: One of the following or equal:
            a) Alemite.
            b) Zerk.

D. Ratings: Rated in accordance with ABMA 9 or ABMA 11 L10 life for bearings rating life of not less than 50,000 hours.

2.04 BELT DRIVES

A. Sheaves:
   1. Separately mounted on bushings by means of at least 3 pull-up bolts or cap tightening screws.
   2. When 2 sheave sizes are specified, provide separate belts sized for each set of sheaves.
   3. Statically balanced for all; dynamically balanced for sheaves that operate at a peripheral speed of more than 5,500 feet per minute.
   4. Key bushings to drive shaft.

B. Belts:
   1. Anti-static type when explosion-proof equipment or environment is specified.
   2. When spare belts are specified, furnish 1 spare belt for every different type and size of belt-driven unit:
      a. Where 2 or more belts are involved, furnish matched sets.

b. Identify as to equipment, design, horsepower, speed, length, sheave size, and use.
c. Package in boxes labeled with identification of contents.

C. Manufacturers: One of the following or equal:
1. Dodge, Dyna-V belts with matching Dyna-V sheaves and Taper-Lock bushings.
2. T. B. Woods, Ultra-V belts with matching Sure-Grip sheaves and Sure-Grip bushings.

2.05 FLANGED PIPING CONNECTIONS

A. Unless otherwise in the Technical Sections or indicated on the Drawings, provide flat face flanges.

2.06 ASSEMBLY FASTENERS

A. General service: Stainless steel, Type 316:
1. Bolts: In accordance with ASTM F593, Alloy Group 2.
2. Nuts: In accordance with ASTM F594, Alloy Group 2.
3. Washers: Alloy group matching bolts and nuts.

B. High-temperature service or high-pressure service: Stainless steel, Type 316:
1. Bolts: In accordance with ASTM A193, Grade B8M, Class 1, heavy hex.
2. Nuts: In accordance with ASTM A194, Grade 8, heavy hex.
3. Washers: Alloy group matching bolts and nuts.

C. Low-temperature service: Stainless steel, Type 316:
1. Bolts: In accordance with ASTM A320, Grade B8M, Class 1, heavy hex.
2. Nuts: In accordance with ASTM A194, Grade B8M, heavy hex.
3. Washers: Alloy group matching bolts and nuts.

2.07 GUARDS AT HIGH-TEMPERATURE SURFACES

A. Exposed surfaces having an external surface temperature of 120 degrees Fahrenheit or higher and located within 7 feet measured vertically from floor or working level or within 15 inches measured horizontally from stairways, ramps, or fixed ladders.

B. Cover with a thermal insulating material unless otherwise guarded against contact.
1. Insulation thickness such that the insulation exterior temperature is below 120 degrees Fahrenheit.
2. Insulation Type 3 and cover Type 5 as specified in Section 15082 - Piping Insulation.

2.08 GUARDS AT MOVING COMPONENTS

A. Provide guards on rotating components that are within 7.5 vertical feet of an operating floor or platform.

B. Allow visual inspection of moving parts without removal.

C. Allow access to lubrication fittings.

D. Easily removable for maintenance.

E. Prevent entrance of rain or dripping water for outdoor locations.

F. Size belt and sheave guards to allow for installation of sheaves 15 percent larger and addition of 1 belt.

G. Materials:
   1. Sheet metal: Carbon steel, 12-gauge minimum thickness, hot-dip galvanized after fabrication.
   2. Fasteners: Type 316 stainless steel.

2.09 SHOP FINISHES

A. Manufacturer's standard primer and finish coatings.
   1. Primer only if field coatings are to be applied.

2.10 GEAR MOTORS

A. Parallel shaft drives: Helical gearing.

B. Right-angle drives: Worm gearing.

C. Manufacturers: One of the following or equal:
   1. Baldor Electric Company.
   2. Bodine Electric Company.

2.11 GEAR REDUCTION UNITS

A. Design and performance criteria:
   1. Gear type:
      a. Helical or herringbone.
   2. AGMA Class II service:
      a. Use more severe service condition when such is recommended by unit's manufacturer.
   3. Cast-iron housing with gears running in oil.
   4. Anti-friction bearings.
   5. Thermal horsepower rating based on maximum horsepower rating of prime mover, not actual load.

2.12 MOUNTING AND LIFTING PROVISIONS FOR EQUIPMENT

A. Equipment bases and base plates:
   1. Provide equipment bases with machined support pads, dowels for alignment for mating of adjacent items, openings for electrical conduits, and openings to facilitate grouting.
   2. Provide jacking screws in bases and supports for equipment and for equipment weighing 500 pounds or more.

3. Materials:
    a. Match equipment material or steel.
    b. Coating: Match equipment.

B. Steel support frames:
    1. Carbon steel:
        a. At exterior locations, and at interior wet or moist locations, provide continuous welds on both sides to close seams and edges between steel members.
        b. Grind closure welds smooth.

C. Lifting lugs or eyes:
    1. Equipment units weighing 50 pounds or more:
        a. Provide with lifting lugs or eyes to allow removal with lifting device.

2.13 SPRING VIBRATION ISOLATORS

A. Design requirements:
    1. Telescopic top and bottom housing with vertical stabilizers to resist lateral and vertical forces.
    2. Use steel coil springs.
    3. Design vibration isolators in accordance with seismic design criteria as specified in Section 01850 - Design Criteria.

B. Performance requirements: Minimum spring deflection of 1-inch under static load and capable of limiting transmissibility to 10 percent maximum at design operating load.

C. Manufacturers: One of the following or equal:
    1. California Dynamics Corporation, Type RJSD.
    2. Mason Industries, equivalent product.

D. Materials:
    1. Fabricate isolators using welded-steel or shatterproof ductile iron in accordance with ASTM A536 Grade CS-45-12.
    2. Spring steel: ASTM A125.

2.14 NAMEPLATES

A. Fastened to equipment at factory in an accessible and visible location.

B. Metal engraved or stamped with text, holes drilled or punched for fasteners.

C. Material: Aluminum or stainless steel.

D. Fasteners: Number 4 or larger oval head stainless steel screws or drive pins.

E. Text:
    1. Manufacturer’s name, equipment model number, equipment serial number, and identification tag number.
    2. Additional items indicated in the Technical Sections.

3. Indicate the following additional information as applicable:
    a. Maximum and normal rotating speed.
    b. Service class per applicable standards.
4. Include for pumps:
    a. Rated total dynamic head in feet of fluid.
    b. Rated flow in gallons per minute.
    c. Impeller, gear, screw, diaphragm, or piston size.
5. Include for motors:
    a. Drive speed.
    b. Motor horsepower with rated capacity.
6. Include for gear reduction units:
    a. AGMA class of service.
    b. Service factor.
    c. Input and output speeds.

2.15 PUMP SHAFT COUPLINGS

A. General:
1. Type and ratings: Non-lubricated designed for not less than 50,000 hours of operating life.
2. Sizes: Provide as recommended by manufacturer for specific application, considering horsepower, speed of rotation, balance, and type of service.
3. Suitable for an ambient temperature range between -40 degrees to +200 degrees Fahrenheit.

B. Close-couplings for electric-motor-driven equipment:
1. Manufacturers: One of the following or equal:
    a. Lovejoy.
    b. T.B. Woods.
2. Provide flexible couplings designed to accommodate angular misalignment, parallel misalignment, and end float.
3. Manufacture flexible component of coupling from synthetic rubber or urethane.
4. Provide service factor of 2.5 for electric motor drives and 3.5 for engine drives.
5. Do not allow metal-to-metal contact between driver and driven equipment.

C. Flexible couplings for direct connected electric-motor-driven equipment:
1. Manufacturers: One of the following or equal:
    a. Rexnord.
    b. T.B. Woods.
2. Provide flexible couplings designed to accommodate shock loading, vibration, and shaft misalignment or offset.
3. Provide flexible connecting element of rubber and reinforcement fibers.
4. Provide service factor of 2.0.
5. Connect stub shafts through collars or round flanges, firmly keyed to their shafts with neoprene cylinders held to individual flanges by through pins.

D. Spacer couplings:
1. Where cartridge-type mechanical seals or non-split seals are specified, provide a spacer-type coupling of sufficient length to remove the seal without disturbing the driver or driven equipment.

2.16 PUMP SEAL CHAMBER AND SEALS

A. Seal chamber (stuffing box):
   1. Large enough to retrofit with double mechanical seal.

B. Seal Types: Based on the following and as specified in the Technical Section:
   1. Type 1: Packing:
      a. Provide when specified in the Technical Section for wastewater, non-potable water, and sludge applications:
         1) Asbestos free.
         2) PTFE (Teflon™) free.
         3) Braided graphite.
         4) Manufacturers: One of the following or equal:
            a) Chesterton, 1400.
            b) John Crane.
      b. Provide when specified for drinking water service:
         1) Asbestos free.
         2) Material: Braided PTFE (Teflon™).
         3) Manufacturers: One of the following or equal:
            a) Chesterton, 1725.
            b) John Crane.
      c. Design:
         1) Packing gland to allow adjustment and repacking without dismantling pump except to open up stuffing box.
         2) Seal chamber (stuffing box) large enough to retrofit with double mechanical seal.
         3) Manufacturers: One of the following or equal:
            a) Chesterton, 1725.
            b) John Crane.
   2. Type 2: Mechanical seal, flushing, cartridge, single O-ring.
      a. Manufacturers: One of the following or equal:
         1) Chesterton, S10.
         2) John Crane, 5610 Series.
   3. Type 3: Mechanical seal, flushing, cartridge, double O-ring:
      a. Manufacturers: One of the following or equal:
         1) Chesterton, S20.
         2) John Crane, 5620 Series.
   4. Type 4: Mechanical seal, flushing, cartridge, double split-ring:
      a. Manufacturers: One of the following or equal:
         1) Chesterton, S20.
         2) John Crane, 5620 Series.
   5. Type 5: Mechanical seal, flushing, cartridge, single split-ring:
      a. Manufacturers: One of the following or equal:
         1) Chesterton, 442.
         2) John Crane, 5860.
   6. Type 6: Mechanical seal, flushless, cartridge, single split-ring:
      a. Manufacturers: One of the following or equal:
         1) Chesterton, 156.
         2) John Crane, 3740 Series.

C. Mechanical seals, Types 2 to 6:
    1. Balanced hydraulically.
    2. Spring:
        a. Stationary, out of pumping fluid.
        b. Material as specified in the Technical Section. Hastelloy C; Type Elgiloy or 17-7 PH stainless steel for split seals.
    3. O-ring: Viton™ 747.
    4. Gland: Type 316L stainless steel.
    5. Set screws: Type 316L stainless steel.
    6. Faces: Reaction bonded, silicon carbide/carbon.
    7. Minimum differential pressures in either direction: 300 pounds per square inch gauge.
        a. Manufacturers: One of the following or equal:
            1) Chesterton, 1400.
            2) John Crane, equivalent product.
    8. Drinking water service:
        a. Asbestos free.
        b. Material: Braided PTFE (Teflon™).
        c. Manufacturers: One of the following or equal:
            1) Chesterton, 1725.
            2) John Crane, equivalent product.

D. Flushing system:
    1. Provide flushing connections:
        a. 3/4-inch size.
        b. Provide API Standard 682 seal water plan arrangement as specified in the Technical Section:
            1) Plan 11 - Product stream seal water from discharge thru seal.
            2) Plan 13 - Product stream seal water thru seal to suction.
            3) Plan 23 - Closed loop seal water with cooler and pumping ring.
            4) Plan 32 - Production seal water discharged to product stream.
            5) Plan 54 - Production Seal Water Excluded from Product Stream.

2.17 SAFETY SIGNS

A. Material, sign size, and text: As specified in Section 10400 - Signage.

2.18 SHIPPING

A. Prior to shipment of equipment:
    1. Bearings (and similar items):
        a. Pack separately or provide other protection during transport.
        b. Greased and lubricated.
    2. Gear boxes:
        a. Oil filled or sprayed with rust preventive protective coating.
    3. Fasteners:
        a. Inspect for proper torques and tightness.

PART 3 EXECUTION

3.01 PRE-INSTALLATION

A. Field measurements:
   1. Prior to shop drawings preparation, take measurements and verify dimensions indicated on the Drawings.
   2. Ensure equipment and ancillary appurtenances fit within available space.

B. Sequencing and scheduling:
   1. Coordinate details of equipment with other related parts of the Work, including verification that structures, piping, wiring, and equipment components are compatible.
   2. Equipment anchoring: Obtain anchoring material and setting drawings from equipment manufacturers in adequate time for templates to be constructed and anchors to be cast-in-place.

3.02 LUBRICATION LINES AND FITTINGS

A. Support and protect lines from source to point of use.

B. Fittings:
   1. Bring fittings to outside of equipment in manner such that they are readily accessible from outside without necessity of removing covers, plates, housings, or guards.
   2. Mount fittings together wherever possible using factory-mounted multiple fitting assemblies securely mounted, parallel with equipment lines, and protected from damage.
   3. Fittings for underwater bearings: Bring fittings above water surface and mount on edge of structure above.

3.03 ALIGNMENT OF DRIVERS AND EQUIPMENT

A. Where drive motors or other drivers are connected to driven equipment by flexible coupling, disconnect coupling halves and align driver and equipment after driven equipment has been leveled on its foundation.

B. Comply with procedures of appropriate HI, AGMA Standards, alignment tolerances of equipment manufacturers and the following requirements to bring components into angular and parallel alignment:
   1. Maximum total coupling offset (not the per-plane offset): Not to exceed 0.5 mils per inch of coupling length for spacer couplings based on coupling length (not dial separation).
   2. Utilize jacking screws, wedges, or shims as recommended by the equipment manufacturer and as specified in the equipment sections.

C. Use reverse-indicator arrangement dial-type or laser-type alignment indicators: Mount indicators on the driver/coupling flange and equipment/coupling flange. Alignment instrumentation accuracy shall be sufficient to read angular and radial misalignment at 10 percent or less of the manufacturer's recommended acceptable misalignment.

D. Alignment and calculations shall include measurement and allowance for thermal growth, spacer coupling length, indicator separation, and axial spacing tolerances of the coupling.

E. When alignment satisfies most stringent tolerance of system components, grout between base and foundation.
   1. Allow minimum 48 hours for grout to harden.
   2. After grout hardens, remove jacking screws, tighten anchor bolts and other connections, and recheck alignment.
   3. Correct alignment as required.

3.04 EQUIPMENT SUPPORT AND ANCHORING TO STRUCTURES

A. Anchor equipment to structures as indicated on the Drawings and as specified.

B. Obtain final anchor bolt layouts for equipment prior to:
   1. Detailing reinforcement for equipment pads.
   2. Preparation of shop drawings for metal structures supporting equipment.

C. Anchor bolt templates:
   1. Provide templates as specified in the Technical Sections.
   2. Use final anchor bolt layout to construct templates for setting anchor bolts.
   3. Make templates:
      a. Rigid, and non-deformable during use.
      b. With longitudinal axes of anchors parallel.
      c. With longitudinal axes of anchors perpendicular to surface supporting the equipment.
   4. Templates may be reused for multiple locations of the same equipment only if:
      a. Templates are in "like-new" condition prior to each reuse.
      b. The anchor layout has not been deformed or damaged by previous installation, removal, or handling of templates.
   5. Sequence:
      a. Set and support templates prior construction of structures surrounding anchors.
      b. Position anchors in templates to provide designated embedment in supporting structure, with required projection for installation of grout, base plates, and hardware for tightening.
      c. Construct concrete or masonry around anchors using methods that preserve required anchor positions and alignment, and clearances to edges of supports or structures.

D. Anchor adjustment sleeves:
   1. Use of adjustment sleeves around anchors:
      a. Is at the option of the Contractor.
      b. Does not relieve Contractor of obligation to construct and use templates for setting of anchors.
      c. May required increased anchor embedment length to develop the strength of the anchor in the embedded length below the adjustment sleeve.
   2. Submittal requirements for anchor adjustment sleeves:
      a. Provide within sufficient time for Engineer approval and not less than 10 working days before setting those items.

b. Proposed locations of sleeves.
c. Details and dimensions of sleeves.
d. Sleeve materials of construction, and coatings.
e. Information on sleeve filler material and means of filler removal.
f. Type, details, and dimensions of anchor bolts or anchor rods to be used with sleeves.
g. Calculations showing development of anchor load capacity below the bottom of the sleeve.
h. Plan for removal of sleeve fillers, if any.
i. Plan for placement and consolidation of flowable grout inside sleeves and to a level equal to top of concrete slab or equipment pad surrounding the sleeve.

3.05 GROUTING UNDER EQUIPMENT BASES, BASE PLATES, SOLE PLATES, AND SKIDS

A. General:
1. Comply with equipment manufacturer's installation instructions including:
a. Tolerances for level.
b. Tolerances for vertical and horizontal alignment.
c. Requirements or recommendations for grouting spaces and grout installation.
d. Recommendations for tightening of equipment anchors after grout has cured.
2. Install equipment over grout as indicated on the Drawings or specified only after:
a. Equipment is leveled and in proper alignment.
b. Piping connections are complete and in alignment with no strain transmitted to equipment.
3. Install flowable grout, as specified in Section 03600 - Grouting, placed with forms and head boxes.
a. Use flowable, non-shrink grout.
b. Use flowable, non-shrink epoxy grout, only where indicated on the Drawings, where specified in Technical Sections, or when approved in advance by the Engineer.
c. Grouting with dry-pack materials is not permitted.

B. Prepare equipment bases, base plates, soleplates, and skids for grouting:
1. Concrete equipment bases:
a. Roughen surface in accordance with ICRI, Guideline No. 310.2R, Surface Preparation Profiles CSP-3 and CSP-4.
b. Clean roughened concrete surfaces:
2. Base plates, soleplates, and skids:
a. Clean surfaces in accordance with SSPC-SP-1-Solvent Cleaning, to remove dirt, dust, oil, grease, paint, and other material.

C. Level equipment for grouting:
1. Use removable jack screws, or removable steel wedges and shims to support and level equipment bases, base plates, sole plates, and skids.
a. Do not use leveling nuts placed on equipment anchors to support or level equipment bases, base plates, sole plates, and skids.

2. Removable jack screws:
    a. Provide number, size, and locations of jack screws required to support and level equipment in accordance with manufacturer's recommendations.
    b. Drill and tap equipment base plates, sole plates, and skids for jack screws.
    c. Support jack screws on circular steel plates that have been epoxy bonded to the equipment foundation.
        1) Provide plates fabricated from Type 316 stainless steel where edges of support plates will have grout side cover of 3 inches or less in the finished work.
    d. Make provision for removal of jack screws after grouting:
        1) Prevent grout from bonding to jack screws by wrapping jack screw threads that will be in contact with grout with multiple layers of tape or other material acceptable to Engineer.
    e. Place and cure grout.
    f. After grout is placed and cured:
        1) Remove jack screws and material used to prevent grout from bonding to jack screws.
        2) Provide jack screws to Owner for future use.
        3) Fill jack screw holes with grout.
        4) Cure grout as specified.
3. Removable steel wedges and shims:
    a. Use for equipment bases, base plates, sole plates, and skids where it is not practical to use jack screws.
    b. Provide number, size, and locations of wedges and shims required to support and level equipment in accordance with manufacturer's recommendations.
    c. Make provision for removal of wedges and shims after grouting:
        1) Prevent grout from bonding to wedges and shims by wrapping wedges and shims that contact grout with multiple layers of tape or other material acceptable to Engineer.
        2) Locate and orient wedges and shims to allow for removal after grouting, and to facilitate placement of grout in the remaining voids.
    d. Place and cure grout.
    e. After grout is placed and cured:
        1) Remove wedges and shims, and material used to prevent grout from bonding to them.
        2) Fill jack screw holes with grout.
        3) Cure grout as specified.

D. Construct grout forms:
1. Provide forms:
    a. Rigid with adequate strength to withstand placement of grout.
    b. With surfaces that will produce a smooth, uniform finish for grout edges exposed in the finished work.
    c. That allow grout to flow horizontally beyond the perimeter of the equipment base plate a distance not less than the thickness of the grout, and not less than 1 inch.

2. Install forms:
    a. Seal form cracks and joints with elastomeric sealant to make form watertight.
    b. Line form surfaces in contact with grout with polyethylene film, or coat with 2 coats of heavy-duty paste wax.
3. Construct grout "head box" over entire length of one side of form.
    a. Make head box height sufficient to force grout to flow under full dimensions of equipment base and to the surrounding form faces.

E. Pre-grouting procedures:
1. Concrete surfaces receiving flowable, non-shrink grout:
    a. Saturate concrete surface in contact with grout and concrete surfaces extending not less than least 6 inches beyond limits of grout with clean water for a minimum of 24 hours prior to grouting.
    b. Just prior to grout placement, remove standing water using clean rags or oil-free compressed air. Provide "saturated surface dry" (SSD) concrete for grout placement.
2. Concrete surfaces receiving flowable, non-shrink epoxy grout:
    a. Do not saturate concrete prior to grout placement.

F. Grout placement and curing:
1. Place and cure grout as specified in Section 03600 - Grouting, and in this Section.
2. Grouting:
    a. Keep level of grout in head box above bottom of equipment bases, base plates, sole plates, and skids always to drive flow under base.
    b. Maintain continuous grout flow from head box to opposite sides of forms without trapping air or forming voids.
    c. Vibrate, rod, or chain grout to facilitate grout flow, to consolidate grout, and to remove entrapped air.
3. After grout sets, remove forms and trim grout edges at 45-degree angle from bottom edge of equipment bases, base plates, sole plates, and skids.
4. Cure grout as specified in Section 03600 - Grouting.

G. After grout is cured:
1. Remove jack screws or wedges and shims, and material used to prevent grout from bonding to leveling devices.
2. Fill pockets from removed leveling devices with grout.
3. Cure filled voids as specified in Section 03600 - Grouting.
4. Tighten equipment anchors in accordance with equipment manufacturer requirements.

3.06 FIELD FINISHES

A. When touchup or repair is required, apply primer and coating systems as recommended by the equipment manufacturer.

END OF SECTION

SECTION 15052

COMMON WORK RESULTS FOR GENERAL PIPING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Basic materials and methods for metallic and plastic piping systems.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 Through 24.
   2. B16.47 - Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard.

B. American Water Work Association (AWWA):
   1. C11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe.
   2. C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
   3. C151 - Ductile-Iron Pipe, Centrifugally Cast.
   4. C207 - Standard for Steel Pipe Flanges for Waterworks Services-Size 4 In. Through 144 In.

C. ASTM International (ASTM):
   1. A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
   2. A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
   3. A194 - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   4. A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
   5. A320 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
   6. A563 - Standard Specification for Carbon and Alloy Steel Nuts.
   7. B88 - Standard Specification for Seamless Copper Water Tube.
   8. D2000 - Standard Classification System for Rubber Products in Automotive Applications.
   9. D2513 - Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing and Fittings.
   10. F37 - Standard Test Methods for Sealability of Gasket Materials.
   11. F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements of Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

D. California Health and Safety Code.

E. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health. Effects.

1.03 DEFINITIONS

A. Buried pipes: Pipes that are buried in the soil with or without a concrete pipe encasement.

B. Exposed pipe: Pipes that are located above ground, or located inside a structure, supported by a structure, or cast into a concrete structure.

C. Underground pipes: Buried pipes - see A. above.

D. Underwater pipes: Pipes below the top of walls in basins or tanks containing water.

E. Wet wall: A wall with water on at least 1 side.

F. Pipes adjacent to a wet wall: Pipe centerline within 10 inches of the wet wall.

PART 2 PRODUCTS

2.01 GENERAL

A. Materials as specified in Section 01600 - Product Requirements including special requirements for materials in contact with drinking water.

2.02 LINK TYPE SEALS

A. Characteristics:
   1. Modular mechanical type, consisting of interlocking neoprene or synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening.
   2. Links to form a continuous rubber belt around the pipe.
   3. Provide a nylon polymer pressure plate with Type 316 stainless steel hardware. Isolate pressure plate from contact with wall sleeve.
   4. Hardware to be Type 316 stainless steel.
      a. Provide anti-galling lubricant for threads.

B. One of the following or equal:
   1. Link-Seal.
   2. Pipe Linx.

2.03 FLANGE BOLTS AND NUTS

A. General:
   1. Washer:
      a. Provide a washer for each nut.
      b. Washer shall be of the same material as the nut.

2. Nuts: Heavy hex-head.
3. Cut and finish flange bolts to project:
    a. Face of the bolt shall exceed face of nut by 1/8 inch minimum.
    b. A maximum of 1/4 inch beyond outside face of nut after assembly.
4. Tap holes for cap screws or stud bolts when used.
5. Lubricant for stainless steel bolts and nuts:
    a. Chloride-free.
    b. Manufacturers: One of the following or equal:
        1) Huskey FG-1800 Anti-Seize.
        2) Weicon Anti-Seize High-Tech.

B. Ductile iron pipe:
1. On exposed pipes with pressures equal to or less than 150 pounds per square inch gauge (psig):
    a. Bolts: In accordance with ASTM A307, Grade B.
    b. Nuts: In accordance with ASTM A563, Grade A.
    c. Bolts and Nuts: Hot-dip galvanized in accordance with ASTM F2329.
2. On exposed pipes with pressures greater than 150 psig:
    a. Bolts: In accordance with ASTM A193, Grade B7.
    b. Nuts: In accordance with ASTM A194, Grade 2H.
    c. Bolts and nuts: Hot-dip galvanized in accordance with ASTM F2329.
3. On underwater pipes and pipes adjacent to wet walls:
    a. Bolts: In accordance with ASTM A193, Grade B8M.
    b. Nuts: In accordance with ASTM A194, Grade 8M.

C. Plastic pipe:
1. On exposed pipes:
    a. Bolts: In accordance with ASTM A307, Grade B.
    b. Nuts: In accordance with ASTM A563, Grade A.
    c. Bolts and Nuts: Hot-dip galvanized in accordance with ASTM F2329.
2. On underwater pipes and pipes adjacent to wet walls:
    a. Bolts: In accordance with ASTM A193, Grade B8M.
    b. Nuts: In accordance with ASTM A194, Grade 8M.

D. Steel pipe:
1. On exposed pipes:
    a. For ASME B16.5 Class 150 flanges and AWWA C207 Class D flanges:
        1) Bolts: In accordance with ASTM A307, Grade B.
        2) Nuts: In accordance with ASTM A563, Grade A.
        3) Bolts and Nuts: Hot-dip galvanized in accordance with ASTM F2329.
    b. For ASME B16.5 and B16.47 Class 300 flanges and AWWA C207 Class E and F flanges:
        1) Bolts: In accordance with ASTM A193, Grade B7.
        2) Nuts: In accordance with ASTM A194, Grade 2H.
2. On underwater pipes and pipes adjacent to wet walls:
    a. Bolts: In accordance with ASTM A193, Grade B8M.
    b. Nuts: In accordance with ASTM A194, Grade 8M.
3. Low-temperature service: Stainless steel, Type 316:
    a. Bolts: In accordance with ASTM A320, Grade B8M, Class 1, heavy hex.
    b. Nuts: In accordance with ASTM A194, Grade B8M, heavy hex.
    c. Washers: Alloy group matching bolts and nuts.

4. High-temperature service or high-pressure service: Stainless steel, Type 316:
    a. Bolts: In accordance with ASTM A193, Grade B8M, Class 1, heavy hex.
    b. Nuts: In accordance with ASTM A194, Grade 8, heavy hex.
    c. Washers: Alloy group matching bolts and nuts.

2.04 MECHANICAL JOINTS BOLTS AND NUTS

A. Bolts including T-Bolts:
    1. High strength low alloy steel in accordance with AWWA C111.

B. Heavy Hex Nuts:
    1. High strength low alloy steel in accordance with AWWA C111.

2.05 GASKETS

A. General.
    1. Gaskets shall be suitable for the specific fluids, pressure, and temperature conditions.
    2. Capable of being applied on surface of piping with cavities to provide for an improved seal with the internal piping pressure.

B. Gaskets for flanged joints in ductile iron and steel piping for sewage service:
    1. Suitable for pressures equal and less than 150 pounds per square inch gauge, temperatures equal and less than 250 degrees Fahrenheit, and raw sewage service.
    2. Gasket material:
        a. SBR or neoprene elastomer with minimum Shore A hardness value of 70.
        b. Reinforcement: Cloth or synthetic fiber.
        c. Thickness: Minimum 3/32-inch thick for less than 10-inch pipe; minimum 1/8 inch thick for 10-inch and larger pipe.
    3. Manufacturers: One of the following or equal:
        a. Pipe less than 48 inches in diameter:
            1) Garlock, Style 7797.
            2) John Crane, similar product.
        b. Pipe 48 inches in diameter and larger:
            1) Garlock, Style 3760.
            2) John Crane, similar product.

C. Gaskets for flanged joints in polyvinyl chloride and polyethylene piping:
    1. Suitable for pressures equal to and less than 150 pounds per square inch gauge, with low flange bolt loadings, temperatures equal to and less than 120 degrees Fahrenheit, and polymer, chlorine, caustic solutions, and other chemicals, except chemicals which liberate free fluorine including fluorochemicals and gaseous fluorine.
    2. Material:
        a. Chemical systems: 0.125-inch thick Viton™ rubber.
        b. Sewer and water: 0.125-inch thick SBR.
    3. Manufacturers: One of the following or equal:
        a. Garlock.
        b. John Crane, similar product.

D. Gaskets for flanged joints in low pressure air piping:
   1. Suitable for pressures equal to and less than 150 pounds per square inch gauge, temperatures equal to and less than 300 degrees Fahrenheit, and compressed air service.
   2. Material: EPDM elastomer, 1/8-inch thick, 60 Shore hardness, smooth surface.
   3. Manufacturers: One of the following or equal:
      a. Garlock, Style 8314.
      b. John Crane, similar product.

E. Gaskets for flanged joints in ductile iron or steel water piping:
   1. Suitable for hot or cold water, pressures equal to and less than 150 pounds per square inch gauge, and temperatures equal to and less than 160 degrees Fahrenheit.
   2. Material:
      a. SBR or neoprene elastomer, compressed, with non-asbestos fiber reinforcement.
   3. Manufacturers: One of the following or equal:
      a. Garlock, Bluegard 3300.
      b. John Crane, similar product.

F. Gaskets for flanged joints in ductile iron or steel drinking water piping meeting NSF 61 requirements:
   1. Suitable for hot or cold water, pressures equal to or less than 150 pounds per square inch gauge, and temperatures equal to or less than 160 degrees Fahrenheit.
   2. Material:
      a. EPDM material with 80 Shore A durometer rating.
   3. Manufacturers: One of the following or equal:
      a. Garlock, 98206.
      b. John Crane, similar product.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
   1. Piping drawings:
      a. Except in details, piping is indicated diagrammatically. Not every offset and fitting, or structural difficulty that may be encountered has been indicated on the Drawings. Sizes and locations are indicated on the Drawings.
      b. Perform minor modifications to piping alignment where necessary to avoid structural, mechanical, or other type of obstructions that cannot be removed or changed.
         1) Modifications are intended to be of minor scope, not involving a change to the design concept or a change to the Contract Price or Contract Times.
   2. Piping alternatives:
      a. Provide piping as specified in this Section, unless indicated on the Drawings or specified otherwise.

b. Alternative pipe ratings:
    1) Piping with greater pressure rating than specified may be substituted in lieu of specified piping without changes to the Contract Price.
    2) Piping of different material may not be substituted in lieu of specified piping.
c. Valves in piping sections: Capable of withstanding specified test pressures for piping sections and fabricated with ends to fit piping.
d. Grooved joints: Use couplings, flange adapters, and fittings of the same manufacturer.
    1) Manufacturer's factory trained representative:
        a) Provide on-site training for Contractor's field personnel.
        b) Periodically visit the jobsite to verify Contractor is following best recommended practices.
    2) Distributor's representative is not considered qualified to conduct the training or jobsite visits.
e. Flanged joints: where 1 of the joining flanges is raised face type, provide a matching raised face type flange for the other joining flange.

3. Unless otherwise indicated on the Drawings, piping at pipe joints, fittings, couplings, and equipment shall be installed without rotation, angular deflection, vertical offset, or horizontal offset.

B. Wall and slab penetrations:
1. Provide sleeves for piping penetrations through aboveground masonry and concrete walls, floors, ceilings, roofs, unless specified or otherwise indicated on the Drawings.
2. For piping 1 inch in nominal diameter and larger, provide sleeves with minimum inside diameters of 1 inch plus outside diameter of piping. For piping smaller than 1 inch in nominal diameter, provide sleeve of minimum twice the outside diameter of piping.
    a. Arrange sleeves and adjacent joints so piping can be pulled out of sleeves and replaced without disturbing the structure.
    b. Cut ends of sleeves flush with surfaces of concrete, masonry, or plaster.
    c. Conceal ends of sleeves with escutcheons where piping runs through floors, walls, or ceilings of finished spaces within buildings.
    d. Seal spaces between pipes and sleeves with link-type seals when not otherwise specified or indicated on the Drawings.
3. Provide flexibility in piping connecting to structures to accommodate movement due to soil settlement and earthquakes. Provide flexibility using details indicated on the Drawings.
4. Core drilled openings:
    a. Do not damage or cut existing reinforcing bars, electrical conduits, or other items embedded in the existing concrete without acceptance by Engineer.
    b. Determine location of reinforcing bars or other obstructions with a non-destructive indicator device.
    c. Remove dust and debris from hole using compressed air.

C. Exposed piping:
    1. Install exposed piping in straight runs parallel to the axes of structures, unless otherwise indicated on the Drawings:
        a. Install piping runs plumb and level, unless otherwise indicated on the Drawings.
            1) Slope plumbing drain piping with a minimum of 1/4-inch per foot downward in the direction of flow.
    2. Install exposed piping after installing equipment and after piping and fitting locations have been determined.
    3. Support piping: As specified in Sections 15061 - Pipe Supports, 15062 - Preformed Channel Pipe Support System, and 15063 - Non-Metallic Pipe Support System:
        a. Do not transfer pipe loads and strain to equipment.
    4. In addition to the joints indicated on the Drawings, provide unions, flexible couplings, flanged joints, flanged coupling adapters, and other types of joints or means which are compatible with and suitable for the piping system, and necessary to allow ready assembly and disassembly of the piping.
    5. Assemble piping without distortion or stresses caused by misalignment:
        a. Match and properly orient flanges, unions, flexible couplings, and other connections.
        b. Do not subject piping to bending or other undue stresses when fitting piping.
        c. Do not correct defective orientation or alignment by distorting flanged joints or subjecting flange bolts to bending or other undue stresses.
        d. Flange bolts, union halves, flexible connectors, and other connection elements shall slip freely into place.
        e. Alter piping assembly to fit when proper fit is not obtained.
        f. Install eccentric reducers or increasers with the top horizontal for pump suction piping.

D. Buried piping:
    1. Bury piping with minimum 4-foot cover without air traps, unless otherwise indicated on the Drawings.
    2. Where 2 similar services run parallel to each other, piping for such services may be laid in the same trench.
        a. Lay piping with sufficient room for assembly and disassembly of joints, for thrust blocks, for other structures, and to meet separation requirements of public health authorities having jurisdiction.
    3. Laying piping:
        a. Lay piping in finished trenches free from water or debris. Begin at the lowest point with bell ends up slope.
        b. Place piping with top or bottom markings with markings in proper position.
        c. Lay piping on an unyielding foundation with uniform bearing under the full length of barrels.
        d. Where joints require external grouting, banding, or pointing, provide space under and immediately in front of the bell end of each section laid with sufficient shape and size for grouting, banding, or pointing of joints.
        e. At the end of each day's construction, plug open ends of piping temporarily to prevent entrance of debris or animals.

E. Venting piping under pressure:
   1. Lay piping under pressure flat or at a continuous slope without air traps, unless otherwise indicated on the Drawings.
   2. Install plug valves as air bleeder cocks at high points in piping.
      a. Provide 1-inch plug valves for water lines, and 2-inch plug valves for sewage and sludge lines, unless otherwise indicated on the Drawings.
   3. Provide additional pipe taps with plug cocks and riser pipes along piping as required for venting during initial filling, disinfecting, and sampling.
   4. Before piping is placed into service, close plug valves and install plugs. Protect plugs and plug valves from corrosion in as specified in Section 09960 - High-Performance Coatings.

F. Restraining buried piping:
   1. Restrain piping at valves and at fittings where piping changes direction, changes sizes, and at ends:
      a. When piping is underground, use concrete thrust blocks, mechanical restraints, or push-on restraints.
      b. Determine thrust forces by multiplying the nominal cross-sectional area of the piping by design test pressure of the piping.
   2. Provide restraints with ample size to withstand thrust forces resulting from test pressures:
      a. During testing, provide suitable temporary restraints where piping does not require permanent restraints.
   3. Place concrete thrust blocks against undisturbed soil.
   4. Place concrete so piping joints, fittings, and other appurtenances are accessible for assembly and disassembly.
   5. Provide underground mechanical restraints where specified in Attachment A - Piping Schedule.

G. Restraining above ground piping:
   1. Restrain piping at valves and at fittings where piping changes direction, changes sizes, and at ends:
      a. When piping is aboveground or underwater, use mechanical or structural restraints.
      b. Determine thrust forces by multiplying the nominal cross-sectional area of the piping by design test pressure of the piping.
   2. Provide restraints with ample size to withstand thrust forces resulting from test pressures:
      a. During testing, provide suitable temporary restraints where piping does not require permanent restraints.

H. Connections to existing piping:
   1. Expose existing piping to which connections are to be made with sufficient time to permit, where necessary, field adjustments in line, grade, or fittings:
      a. Protect domestic water/potable water supplies from contamination:
         1) Make connections between domestic water supply and other water systems in accordance with requirements of public health authorities.
         2) Provide devices approved by Owner of domestic water supply system to prevent flow from other sources into the domestic supply system.

2. Make connections to existing piping and valves after sections of new piping to be connected have been tested and found satisfactory.
3. Provide sleeves, flanges, nipples, couplings, adapters, and other fittings needed to install or attach new fittings to existing piping and to make connections to existing piping.
4. For flanged connections, provide stainless steel bolts with isolation bushings and washers, and full-face flange gaskets.

I. Connections between ferrous and nonferrous metals:
1. Connect ferrous and nonferrous metal piping, tubing, and fittings with dielectric couplings especially designed for the prevention of chemical reactions between dissimilar metals.
2. Nonferrous metals include aluminum, copper, and copper alloys.

J. Flanged connections between dissimilar metals such as ductile iron pipe and steel pipe:
1. Provide stainless steel bolts with isolation bushings and washers, and full-face flange gaskets.

3.02 CLEANING

A. Piping cleaning:
1. Upon completion of installation, clean piping interior of foreign matter and debris.
2. Perform special cleaning when required by the Contract Documents.

B. Conduct pressure and leak test, as specified.

3.03 PIPING SCHEDULE

A. As specified in Attachment A - Piping Schedule.

END OF SECTION

ATTACHMENT A - PIPING SCHEDULE

PIPING SCHEDULE											
Process Abbrev.	**Service**	**Nominal Diameter (inches)**	**Material**	**Pressure Class Special Thickness Class Schedule Wall Thickness**	**Pipe Spec. Section**	**Joints/ Fittings**	**Test Pressure/ Method**	**Lining**	**Coating**	**Service Conditions**	**Comments**
AA	Aeration Air										
	Exposed	4-14	Type 304L SST	SCH 10S	15286 - Stainless Steel Pipe	WLD or FL, FL where shown	25 psig/AM	None	None		Insulated per Section 15082
BW	Backwash										
	Exposed	8-14	DIP	150	15211 - Ductile Iron Pipe: AWWA C151	FL	120 psig/HH	CM	EPU-M-1		
FC	Ferric Chloride										
	Exposed	0.5-3	CPVC	SCH 80	15230 - Plastic Piping and Tubing	SW	120 psig/HH	None	None		
FE	Final Effluent										
	Buried	< 4	CPVC	SCH 80	15230 - Plastic Piping and Tubing	SW	120 psig/HH	None	None		
	Exposed	< 4	CPVC	SCH 80	15230 - Plastic Piping and Tubing	SW	120 psig/HH	None	None		
	Submerged	< 4	CPVC	SCH 80	15230 - Plastic Piping and Tubing	SW	120 psig/HH	None	None		

PIPING SCHEDULE											
Process Abbrev.	**Service**	**Nominal Diameter (inches)**	**Material**	**Pressure Class Special Thickness Class Schedule Wall Thickness**	**Pipe Spec. Section**	**Joints/ Fittings**	**Test Pressure/ Method**	**Lining**	**Coating**	**Service Conditions**	**Comments**
SE	Secondary Effluent										
	Buried	10-16	PVC C900	DR-25	15244 - Polyvinyl Chloride (PVC) Pipe: Pressure	Push on Mech Rest.	120 psig/HH	None	None		As Shown on Drawings
	Buried	10-16	DIP	150	15211 - Ductile Iron Pipe: AWWA C151	RPO	120 psig/HH	CM	EPX-M-6-BG and 1 layer V-Bio		As Shown on Drawings
	Exposed	12-16	DIP	150	15211 - Ductile Iron Pipe: AWWA C151	FL	120 psig/HH	CM	EPU-M-1		As Shown on Drawings

PIPING SCHEDULE

Process Abbrev.	Service	Nominal Diameter (inches)	Material	Pressure Class Special Thickness Class Schedule Wall Thickness	Pipe Spec. Section	Joints/ Fittings	Test Pressure/ Method	Lining	Coating	Service Conditions	Comments
SL	Sludge										
	Buried	6	DIP	150	15211 - Ductile Iron Pipe: AWWA C151	RPO	120 psig/HH	CE	EPX-M-6-BG and 1 layer V-Bio		

Abbreviations:

1. The following abbreviations used in the column of test method refer to the respective methods as specified in Section 15956 - Piping Systems Testing.
   - AM Air method
   - GR Gravity method
   - HH High head method
   - LH Low head method
   - SC Special case
2. Abbreviations to designate piping include the following:
   - B&SP Bell and spigot
   - BSP Black Steel Pipe
   - CE Ceramic epoxy lining
   - CI Cast iron
   - CISP Cast iron soil pipe
   - CL Class, followed by the designation
   - CM Cement mortar
   - CTP Coal tar pitch
   - DIP Ductile iron piping
   - EPP Epoxy polyurethane coating
   - FL Flange
   - GA Gauge, preceded by the designation GEGrooved end joint
   - GL Glass lined
   - GSP Galvanized steel pipe
   - MJ Mechanical joint
   - MWA Mechanical wedge action
   - NPS Nominal pipe size, followed by the number in inches
   - psi pounds per square inch
   - psig pounds per square inch gauge
   - PE Polyethylene
   - PEE Polyethylene encasement
   - PTW Polyethylene tape wrap
   - PVC Polyvinyl Chloride
   - RPO Restrained push-on
   - SCH Schedule, followed by the designation
   - SCRD Screwed-On
   - SST Stainless steel
   - STP Steel pipe
   - SW Solvent welded
   - VCP Vitrified clay piping
   - WLD Weld

SECTION 15061

PIPE SUPPORTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Supports for pipe, fittings, valves, and appurtenances.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   2. A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
   3. A967 - Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.

B. Manufacturer's Standardization Society (MSS):
   1. SP-58 - Pipe Hangers and Supports - Materials, Design, and Manufacture.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures

B. Product data:
   1. Design features.
   2. Load capacities.
   3. Material designations by UNS alloy number or ASTM Specification and Grade.
   4. Data needed to verify compliance with the Specifications.
   5. Catalog data.
   6. Clearly mark submittal information to show specific items, materials, and accessories or options being furnished.

1.04 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

A. As specified in Section 01600 - Product Requirements.

2.02 MATERIALS

A. General:
   1. Hot dip galvanized:
      a. Fabricate as specified in Section 05120 - Structural Steel Framing.
      b. Hot dip after fabrication of support in accordance with ASTM A123.
      c. Repair galvanized surface as specified in Section 05120 - Structural Steel Framing.
   2. Stainless steel:
      a. Fabricate as specified in Section 05120 - Structural Steel Framing.
      b. Finish requirements: Remove free iron, heat tint oxides, weld scale, and other impurities, and obtain a passive finished surface.
      c. At the shop, perform pickling and passivation on all surfaces inside and out in accordance with ASTM A380 or A967.
         1) Passivation treatments using citric acid are not allowed.
      d. Field welding is prohibited unless specifically allowed by the Owner. All field welds shall be passivated.

B. Outdoor areas: Areas exposed to the natural outdoor environment:
   1. Hot Dip Galvanized.

C. Indoor areas: Areas exposed to an indoor environment including galleries and tunnels:
   1. Hot Dip Galvanized.

D. Submerged, 3 feet or less above water level in a structure, or inside a water bearing structure:
   1. Type 316 Stainless Steel.

E. Stainless steel piping system:
   1. Type 316 Stainless Steel or Type 316L Stainless Steel.

F. Chemical containment areas and chemical piping:
   1. Type 316 Stainless Steel.

G. Fasteners:
   1. As specified in Section 05120 - Structural Steel Framing.

2.03 PIPE SUPPORTS

A. Hanger rods: Sized to match suspended pipe hanger, or as indicated on the Drawings:
   1. Manufacturers: One of following or equal:
      a. For stainless steel piping:
         1) Bergen-Power, Figure 133.
         2) Nibco-Tolco, Figure 103.

b. For all other piping, unless indicated on the Drawings:
1) Anvil International, Figure 140.
2) Bergen-Power, Figure 133.
3) Cooper B-Line Systems, Inc., Figure B3205.

B. Hanger rods, continuously threaded: Sized to match suspended pipe hanger, or as indicated on the Drawings:
1. Manufacturers: One of the following or equal:
a. For stainless steel piping:
1) Bergen-Power, Figure 94.
2) FM Stainless Fasteners.
b. For steel and ductile iron piping:
1) Anvil International, Figure 146.
2) Bergen-Power, Figure 94.

C. Eye bolts:
1. For stainless steel piping:
a. Type 316 stainless steel, welded and rated equal to full load capacity of rod.
2. For all other piping, unless indicated on the Drawings:
a. Welded and rated equal to full load capacity of rod.

D. Welded eyebolt rod:
1. Manufacturers: One of the following or equal:
a. For stainless steel piping:
1) Nibco-Tolco, Figure 101.
2) FM Stainless Fasteners.
b. For all other piping, unless indicated on the Drawings:
1) Anvil International, Figure 278.
2) Bergen-Power, Figure 93.
3) Cooper B-Line Systems, Inc., Figure B3210.

E. Adjustable ring hangers: MSS SP-58, Type 7 or Type 9 (system dependent):
1. Manufacturers: One of the following or equal:
a. For stainless steel piping:
1) Nibco-Tolco, Figure 1C.I.
2) Bergen-Power, Figure 100SS.
b. For all other piping, unless indicated on the Drawings:
1) Anvil International, Figure 69.
2) Cooper B-Line Systems, Inc., Figure B3172.

F. Adjustable clevis hangers: MSS SP-58, Type 1:
1. Manufacturers: One of the following or equal:
a. For stainless steel piping:
1) Cooper B-Line Systems, Inc., Figure B3100 or B3102.
2) FM Stainless Fasteners, Figure 60.
b. For all other piping, unless indicated on the Drawings:
1) Anvil International, Figure 260 or Figure 590.
2) Bergen-Power, Figure 100.
3) Cooper B-Line Systems, Inc., Figure B3100 or B3102.

G. Adjustable clevis hangers for insulated pipe: Oversize:
    1. Manufacturers: One of the following or equal:
        a. For stainless steel piping:
            1) Nibco-Tolco, Figure 1A.
        b. For all other piping, unless indicated on the Drawings:
            1) Anvil International, Figure 300.
            2) Bergen-Power, Figure 100EL.
            3) Cooper B-Line Systems, Inc. Figure B3108.

H. Single rod hangers for steam pipe: MSS SP-58, Type 43; malleable iron or steel yoke and roller hangers; swivel to allow rotation of yoke on rod:
    1. Manufacturers: One of the following or equal:
        a. For stainless steel piping:
            1) Nibco-Tolco, Figure 324.
            2) Cooper B-Line Systems, Inc., Figure B3110.
            3) FM Fasteners, Figure 81.
        b. For all other piping, unless indicated on the Drawings:
            1) Anvil International, Figure 181.
            2) Cooper B-Line Systems, Inc., Figure B3110.

I. Double rod hangers for steam pipe: MSS SP-58, Type 41:
    1. Manufacturers: One of the following or equal:
        a. For stainless steel piping:
            1) FM Stainless Fasteners, Figure 71.
        b. For all other piping, unless indicated on the Drawings:
            1) Anvil International, Figure 171.
            2) Cooper B-Line Systems, Inc., Figure B3114.

J. Brackets: MSS SP-58, Type 32 with back plate; rated for 1,500 pounds:
    1. Manufacturers: One of the following or equal:
        a. For stainless steel piping:
            1) Nibco-Tolco, Figure 30M.
            2) Cooper B-Line Systems, Inc., Figure B3066.
            3) FM Stainless Fasteners, Figure 98.
        b. For all other piping, unless indicated on the Drawings:
            1) Anvil International, Figure 195.
            2) Cooper B-Line Systems, Inc., Figure B3066.

K. Brackets, heavy duty: MSS SP-58, Type 33 with back plate; rated for 3,000 pounds:
    1. Manufacturers: One of following or equal:
        a. Anvil International, Figure 199.
        b. Cooper B-Line Systems, Inc., Figure B3067.

L. Standard U-bolt: MSS SP-58, Type 24:
    1. Manufacturers: One of the following or equal:
        a. For stainless steel piping:
            1) Nibco-Tolco, Figure 110.
            2) Cooper B-Line Systems, Inc., Figure B3188.
            3) FM Stainless Fasteners, Figure 37.

b. For all other piping, unless indicated on the Drawings:
1) Anvil International, Figure 137.
2) Bergen-Power, Figure 283.
3) Cooper B-Line Systems, Inc., Figure B3188.

M. Riser clamps: MSS SP-58, Type 8:
1. Manufacturers: One of the following or equal:
a. For stainless steel piping:
1) Cooper B-Line Systems, Inc., Figure B3373.
2) FM Stainless Fasteners, Figure 61.
b. For all other piping, unless indicated on the Drawings:
1) Anvil International, Figure 261.
2) Bergen-Power, Figure 126.
3) Cooper B-Line Systems, Inc., Figure B3373.

N. Pipe clamps: MSS SP-58, Type 4:
1. Manufacturers: One of the following or equal:
a. For stainless steel piping:
1) Nibco-Tolco, Figure 4.
2) Cooper B-Line Systems, Inc., Figure 3140.
b. For all other piping, unless indicated on the Drawings:
1) Anvil International, Figure 212.
2) Bergen-Power, Figure 175.
3) Cooper B-Line Systems, Inc., Figure B3140.

O. Adjustable offset pipe clamp:
1. Manufacturers: One of the following or equal:
a. For stainless steel piping:
1) Nibco-Tolco, Figure 4.
2) Cooper B-Line Systems, Inc., Figure B3149.
3) FM Stainless Fasteners, Figure 63.
b. For all other piping, unless indicated on the Drawings:
1) Anvil International, Figure 100.
2) Cooper B-Line Systems, Inc., Figure B3149.

P. Offset pipe clamp:
1. Manufacturers: One of the following or equal:
a. For stainless steel piping:
1) Nibco-Tolco, Figure 8.
2) Cooper B-Line Systems, Inc., Figure 3148.
b. For all other piping, unless indicated on the Drawings:
1) Anvil International, Figure 103.
2) Cooper B-Line Systems, Inc., Figure B3148.

Q. Floor stand or stanchion saddles: MSS SP-58, Type 37. Provided with U-bolt hold down yokes:
1. Manufacturers: One of the following or equal:
a. For stainless steel piping:
1) Nibco-Tolco, Figure 318.
2) FM Stainless Fasteners, Figure 59.

b. For all other piping, unless indicated on the Drawings:
1) Anvil International, Figure 259.
2) Bergen-Power, Figure 125.
3) Cooper B-Line Systems, Inc., Figure B3090.
c. Threaded pipe stand support stanchion. Match pipe support material:
1) Anvil International, Figure 63T.
2) Bergen-Power, Figure 138.
3) Cooper B-Line Systems Inc., Figure B3088ST.

R. Spring hangers:
1. Manufacturers: One of the following or equal:
a. For stainless steel piping:
1) Bergen-Power, Figure 920.
b. For all other piping, unless indicated on the Drawings:
1) Anvil International, Figure B-268, Type G.
2) Bergen-Power, Figure 920.

S. One hole pipe clamps:
1. Manufacturers: One of the following or equal:
a. For stainless steel piping: Engineer knows of no product.
b. For all other piping:
1) Anvil International, Figure 126.
2) Carpenter & Paterson, Figure 237S.

T. Welded beam attachment: MSS SP-58, Type 22:
1. Manufacturers: One of the following or equal:
a. For stainless steel piping:
1) Nibco-Tolco, Figure 304.
2) Cooper B-Line Systems, Inc., Figure 3083.
b. For all other piping, unless indicated on the Drawings:
1) Anvil International, Figure 66.
2) Bergen-Power, Figure 113A or 113B.
3) Cooper B-Line Systems, Inc., Figure B3083.

U. Heavy pipe clamp: MSS SP-58, Type 4:
1. Manufacturers: One of the following or equal:
a. For stainless steel piping:
1) Nibco-Tolco, Figure 4H.
b. For all other piping, unless called out otherwise on the drawings:
1) Anvil International, Figure 216.
2) Bergen-Power, Figure 298.

V. PTFE pipe slide assembly: MSS SP-58, Type 35 with lateral and vertical restraint:
1. Manufacturers: One of the following or equal:
a. For stainless steel piping:
1) Nibco-Tolco, Figure 426.

b. For all other piping, unless indicated on the Drawings:
   1) Anvil International, Figure 257, Type 3.
   2) Cooper B-Line Systems, Inc., Figure B3893.

W. Anchor bolts, concrete anchors, concrete inserts, powder-actuated fasteners, and sleeve anchors: As specified in Section 05120 - Structural Steel Framing.

2.04 THERMAL PIPE HANGER SHIELD

A. Thermal shields shall be provided at hanger, support and guide locations on pipe requiring insulation.

B. The shield shall consist of an insulation layer encircling the entire circumference of the pipe and a steel jacket encircling the insulation layer.

C. The thermal shield shall be the same thickness as the piping system insulation specified in Section 15082 - Piping Insulation.

D. The standard shield shall be used for hot systems and the vapor barrier shield shall be used for cold systems.

E. Stainless steel band clamps shall be used where specified to protect against slippage between the pipe wall and the thermal shield.

F. Standard shield:
   1. Insulation:
      a. Hydrous calcium silicate, high density, waterproof.
      b. Compressive strength: 100 pounds per square inch average.
      c. Flexural strength: 75 pounds per square inch average
      d. K factor: 0.38 at 100 degrees Fahrenheit mean.
      e. Temperature range: 20 degrees Fahrenheit to 500 degrees Fahrenheit.
   2. Steel jacket:
      a. The jacket shall be galvanized steel.
      b. Gage shall be the manufacturer's standard supplied for the given pipe size.
   3. Connection:
      a. Shield shall have butt connection to pipe insulation.
      b. Steel jacket and insulation ends shall be flush.

G. Vapor barrier shield:
   1. Insulation:
      a. Hydrous calcium silicate, high density, waterproof.
      b. Compressive strength: 100 pounds per square inch average.
      c. Flexural strength: 75 pounds per square inch average.
      d. K factor: 0.38 at 100 degrees Fahrenheit mean.
      e. Temperature range: 20 degrees Fahrenheit to 500 degrees Fahrenheit.

H. Steel jacket:
   1. The jacket shall be of galvanized steel.
   2. Gage shall be the manufacturer's standard supplied for the given pipe size.

I. Connection:
   1. Shield shall have butt connection to pipe insulation.

J. Insulation shall extend 1 inch each side of steel jacket for vapor tight connection to the pipe insulation vapor barrier.

PART 3 EXECUTION

3.01 INSTALLATION

A. Support, suspend, or anchor exposed pipe, fittings, valves, and appurtenances to prevent sagging, overstressing, or movement of piping; and to prevent thrusts or loads on or against connected pumps, blowers, and other equipment.

B. Field verify support location, orientation, and configuration to eliminate interferences prior to fabrication of supports.

C. Carefully determine locations of inserts. Anchor to formwork prior to placing concrete.

D. Use flush shells only where indicated on the Drawings.

E. Do not use anchors relying on deformation of lead alloy.

F. Do not use powder-actuated fasteners for securing metallic conduit or steel pipe larger than 1-inch to concrete, masonry, or wood.

G. Suspend pipe hangers from hanger rods and secure with double nuts.

H. Install continuously threaded hanger rods only where indicated on the Drawings.

I. Use adjustable ring hangers or adjustable clevis hangers for 4-inch and smaller diameter pipe.

J. Use adjustable clevis hangers for pipe larger than 4 inches in diameter.

K. Secure pipes with double nutted U-bolts or suspend pipes from hanger rods and hangers.
   1. For stainless steel piping, use stainless steel U-bolts.
   2. For all other piping, use galvanized U-bolts.

L. Support spacing:
   1. Support 2-inch and smaller piping on horizontal and vertical runs at maximum 5 feet on center, unless otherwise specified.
   2. Support larger than 2-inch piping on horizontal and vertical runs at maximum 10 feet on center, unless otherwise specified.
   3. Support exposed polyvinyl chloride and other plastic pipes at maximum 5 feet on center, regardless of size.

4. Support tubing, PVC pipe 1-inch and smaller, copper pipe and tubing, fiber-reinforced plastic pipe or duct, and rubber hose and tubing at intervals close enough to prevent sagging greater than 1/4-inch between supports.
5. Do not suspend or support valves, pipe and fittings from another pipe or conduit.

M. Install supports at:
1. Any change in direction.
2. Both sides of flexible pipe connections.
3. Base of risers.
4. Floor penetrations.
5. Connections to pumps, blowers, and other equipment.
6. Valves and appurtenances.

N. Securely anchor plastic pipe, valves, and headers to prevent movement during operation of valves.

O. Anchor plastic pipe between expansion loops and direction changes to prevent axial movement through anchors.

P. Provide elbows or tees supported from floors with base fittings where indicated on the Drawings.

Q. Support base fittings with metal supports or when indicated on the Drawings support on concrete piers.

R. Do not use chains, plumbers' straps, wire, or similar devices for permanently suspending, supporting, or restraining pipes.

S. Support plumbing drainage and vents in accordance with plumbing code as specified in Section 01410 - Regulatory Requirements.

T. Supports, clamps, brackets, and portions of support system bearing against copper pipe: Copper plated, copper throughout, or isolated with neoprene or polyvinyl chloride tape.

U. Where pipe is insulated, install over-sized supports and hangers.

V. Install thermal pipe shield in accordance with MSS SP-58, Type 40 on all pipe supports for insulated pipes.

W. Install riser clamps at floor penetrations and where indicated on the Drawings.

X. Coat support system components as specified in Section 09960 - High-Performance Coatings.

END OF SECTION

SECTION 15062

PREFORMED CHANNEL PIPE SUPPORT SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Preformed channel pipe support system consisting of preformed channels, fittings, straps, and fasteners engineered to support piping.

1.02 REFERENCES

A. American Institute of Steel Construction (AISC).

B. American Iron and Steel Institute (AISI).

C. Manufacturer's Standardization Society (MSS):
   1. SP-58 - Pipe Hangers and Supports - Materials, Design, and Manufacture.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data.

1.04 QUALITY ASSURANCE

A. Design preformed channel pipe support system for loads in accordance with applicable provisions of:
   1. AISC Manual of Steel Construction.
   2. AISI Cold-Formed Steel Design Manual.

B. Product standards:
   1. Pipe support materials: In accordance with MSS SP-58.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fabricate preformed channel pipe support system using, as a minimum, parts specified below and meeting the requirements specified under Design Criteria.
   1. Manufacturers: One of the following or equal:
      a. Unistrut, Series P1000 or P1001; P5500 or P5501.
      b. Allied Support Systems, Power Strut, Figure PS-200 or PS-200 2TS; PS-150 or PS-150 2TS.
      c. Cooper Ind., B-Line, Channel Type B22 or B22A; B12 or B12A.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Design responsibility:
   1. The manufacturer of the preformed channel pipe support system is responsible for the design of the support system.
   2. Prepare design calculations utilizing the design criteria included in these Specifications.
   3. Prepare detailed shop drawings illustrating the layout of the support system and identifying the components of the support system.

B. Design criteria:
   1. Include live, dead, and seismic loads associated with piping, valves, and appurtenances. Consider the content of the pipes in load calculations.
   2. Minimum gauge thickness: 12-gauge.
   3. Allowable stress of channels:
      a. Steel channels: The lesser of 25,000 pounds per square inch, or 0.66 times yield stress of steel.
      b. Stainless steel channels: 0.66 times the yield stress of the stainless steel alloy.
   4. Maximum deflection: 1/240 of span.
   5. Allowable column loads: As recommended by manufacturer in published instruction for column's unsupported height and "K" value for calculating effective column length of not less than 1.0.
   6. Future loads:
      a. Support systems indicated on the Drawings may include spaces intended to accommodate future pipes.
      b. Assume such spaces are occupied by 6-inch diameter ductile iron pipes. Only the number of pipes that would physically fit into the space need be considered.
      c. Include the weight of the pipe contents in determining future loads. Assume pipe contents are water.
   7. Seismic design criteria: As specified in Section 01850 - Design Criteria as specified for mechanical equipment.
   8. Spacing of supports: As required to comply with design requirements but not more than 5 feet.

C. Supports below the top of walls of water bearing structures: Use Type 316 stainless steel for support system components.
   1. Supports in other locations: Use hot-dipped galvanized components unless other materials are specifically indicated on the Drawings.

2.03 ACCESSORIES

A. Preformed channel concrete inserts: Minimum 12 inches long:
   1. Manufacturers: One of the following or equal:
      a. Unistrut, Series P-3200.
      b. Allied Support Systems, Figure 282.
      c. Cooper Ind., B-Line Series B32I.

B. 90-degree angle fittings:
   1. Manufacturers: One of the following or equal:
      a. Unistrut, P1026.
      b. Allied Support Systems, Power Strut, P603.

C. Pipe straps:
   1. For pipes 8 inches in diameter and smaller: Use 2-piece universal strap with slotted hex head screw and nut.
      a. Manufacturers: One of the following or equal:
         1) Unistrut, Series P1109 through P1126.
         2) Allied Support Systems, PS1100.
         3) Cooper Ind., B-Line Series B2000.
   2. For pipes greater than 8 inches in diameter: Unless different material is otherwise indicated on the Drawings use 1-piece 1-inch wide by 1/8-inch thick steel strap, hot-dip galvanized after fabrication.
   3. For stainless steel pipes: Use type of strap required for the pipe sizes specified above, but use Type 316 stainless steel materials.

D. Prefabricated double channel bracket:
   1. Manufacturers: One of the following or equal:
      a. Unistrut, P2542-P2546.
      b. Cooper Ind., B-Line Series B297.

E. Touch-up paint for galvanized surfaces:
   1. Manufacturers: The following or equal:
      a. Galvinox, Galvo-Weld.

F. Touch-up paint for painted surfaces: Same formulation as factory paint.

G. Cushion strip:
   1. For solvent welded plastic pipes in elevated temperatures, use a thermoplastic elastomer, cushion wrap designed for use from -50 degrees Fahrenheit to 275 degrees Fahrenheit. Contractor to add a cushion strip at each pipe support strap that meets this criteria.
      a. Manufacturers: One of the following or equal:
         1) Anvil, AS 3795.
         2) Unistrut, P2600 Unicushion.

2.04 FABRICATION

A. Hot-dip galvanize support system components after fabrication to required length and shape.

B. Do not galvanize or paint stainless steel components.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install preformed channel concrete inserts for vertical support, quantity based on manufacturer's structural design calculations.

B. Fasten preformed channel pipe supports to existing walls using Z-fittings and concrete anchors as indicated on the Drawings.

C. Fasten preformed channel pipe supports to preformed channel concrete inserts embedded in ceiling using U-shaped fittings.

D. Suspend threaded rods from concrete inserts embedded in ceiling. Support preformed channel pipe supports with threaded rods.

E. Touchup cut or damaged galvanized surfaces.

F. Prevent contact between pipes and support components of dissimilar metals. Utilize rubber coated, plastic coated, or vinyl coated components, stainless steel components, or wrap pipe with PVC or polyethylene tape.

G. Install support as near as possible to concentrated loads.

H. Install support within 2 feet of horizontal and vertical changes in pipe alignment.

I. Adjust supports or install shims to obtain specified slope or elevation.

END OF SECTION

SECTION 15063

NON-METALLIC PIPE SUPPORT SYSTEM

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Non-metallic pipe support system including the following:
   1. Channel framing and components.
   2. Pipe clamps.
   3. Fittings.
   4. Fasteners.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Shop drawings.

C. Calculations.

1.04 QUALITY ASSURANCE

A. Supply materials from a single manufacturer with sole responsibility for the pipe support system.

B. The supplied system, including pipe clamps, shall be interchangeable with industry standard 1-5/8-inch steel and fiberglass channel framing systems.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Transportation, handling, storage, and installation shall be in accordance with the manufacturers printed instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. StrutTech.
   2. Unistrut.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Design responsibility:
   1. The manufacturer of the non-metallic pipe support system shall be considered the designer of the support system.
   2. Prepare design calculations utilizing the design criteria included in these Specifications.
   3. Prepare detailed shop drawings illustrating the layout of the support system and identifying the components of the support system.

B. Design requirements:
   1. Include live, dead, and seismic loads associated with piping, valves, and appurtenances. Consider the content of the pipes in load calculations.
   2. Maximum allowable deflection: 1/240 of span.
   3. Allowable column loads: As recommended by manufacturer in published instruction for column's unsupported height and "K" value for calculating effective column length of not less than 1.0.
   4. Future loads:
      a. Support systems indicated on the Drawings may include spaces intended to accommodate future pipes.
      b. Assume such spaces are occupied by 6-inch diameter ductile iron pipes. Only the number of pipes that would physically fit into the space need be considered.
      c. Include the weight of the pipe contents in determining future loads. Assume pipe contents are water.
   5. Seismic design criteria: As specified in Section 01850 - Design Criteria as specified for mechanical equipment.
   6. Spacing of supports: As required to comply with design requirements but not more than 5 feet.

2.03 MATERIALS

A. Fiberglass resin: Corrosion-resistant premium grade vinylester.

B. Injection molded components: Polyurethane thermoplastics.

C. Flame spread of fiberglass:
   1. Vinylester fiberglass (Series VF): Class 1, ASTM E84.
   2. Polyurethane: V-O UL 94V.

D. Physical properties of fiberglass:

Physical Property	Longitudinal	Transverse
Tensile Strength	37,500 pounds per square inch (psi)	10,000 psi
Tensile Modules	3.0 X 10^6 psi	1.0 X 10^6 psi
Flexural Strength	37,500 psi	14,000 psi
Flexural Modules	2.0 X 10^6 psi	1.0 X 10^6 psi
Compressive Strength	37,500 psi	20,000 psi
Shear Strength	6,000 psi	5,500 psi
Izod Impact	30 foot-pounds per square inch	5 foot-pounds per square inch

E. Surface veil: Fiberglass channel shall have polyester surface veil over 100 percent of the surface to provide protection against degradation from ultraviolet light.

F. Touch-up resin:
1. Manufacturers: The following or equal:
   a. Krylon, 7006-Satin Polyurethane Clear Finish.

2.04 COMPONENTS

A. Channel framing:
1. All channel framing shall be supplied with integral notches 1 inch on center.
2. Locate notches on interior flange to prevent slippage of pipe clamps and fittings after installation.

B. Pipe clamps:
1. Adjustable type: Non-metallic and non-conductive.
2. Fixed type:
   a. Pipe clamps for pipe less than 6 inches in diameter shall be non-metallic and non-conductive.
   b. Pipe clamps for pipe equal to and greater than 6 inches in diameter shall be fiberglass.

C. Channel fittings:
1. Make fittings and post bases from glass-filled polyurethane or polyester.

D. Fasteners:
1. Make fasteners from one of the following materials:
   a. Glass-filled polyurethane.
   b. Vinylester fiberglass.

E. Cushion strip:
1. For solvent welded plastic pipes in elevated temperatures, use a thermoplastic elastomer, cushion wrap designed for use from -50 degrees Fahrenheit to

275 degrees Fahrenheit. Contractor to add a cushion strip at each pipe support strap that meets this criteria.

a. Manufacturers: One of the following or equal:
    1) Anvil, AS 3795.
    2) Unistrut, P2600 Unicushion.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
1. Install in accordance with manufacturer's instructions, shop drawings, and as indicated on the Drawings.
2. Seal machined edges and holes with touch-up resin.

END OF SECTION

SECTION 15076

PIPE IDENTIFICATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Pipe identification including the following:
   1. Pipe identification markers, flow direction arrows, tags, and bands.
   2. Underground warning tape.
   3. Tracer wire.
   4. Witness markers.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. A13.1 - Scheme for the Identification of Piping Systems.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Submit following:
   1. Product data.
   2. Samples.
   3. Manufacturer's installation instructions.
   4. Submit following as specified in Section 01770 - Closeout Procedures:
      a. Operation and Maintenance Data.
      b. Warranty.

PART 2 PRODUCTS

2.01 EXPOSED AND IN-CHASE PIPE IDENTIFICATION

A. For piping with outer diameter greater than or equal to 3/4-inch, provide lettered pipe markers and flow direction arrows:
   1. General requirements:
      a. Pipe markers shall include the following, minimum:
         1) Printed text identifying the pipe fluid.
            a) The text shall be all capital letters matching the text listed in the "Service" column of the Piping Schedule for the corresponding piping system.

2) An arrow identifying the direction of fluid flow:
   a) The arrow can either be integral to the text marker or provided separately. If provided separately, the arrow must be placed immediately adjacent to each text marker, with the arrow aligned with the text such that the text and arrow are both visible from the same viewpoint.
   b) The arrow color shall match the text color, and the arrow background color shall match the text background color.

b. Suitable for outdoor application from -40 degrees to 180 degrees Fahrenheit; in accordance with ASME A13.1 requirements.

c. Lettering:

Outside Pipe Diameter Including Covering	Lettering Height
Less than 0.75 inches	N/A
0.75 to 1.5 inches	1/2-inch
1.5 inches to 2 inches	3/4-inch
2.5 inches to 6 inches	1-1/4 inches
8 inches to 10 inches	2-1/2 inches
Over 10 inches	3-1/2 inches

d. Marker colors:

Marker Color System ID[(1)]	Fluid Service	Text/Arrow Color	Background Color
1	Flammable and oxidizing fluids	Black	Yellow
2	Potable, cooling, boiler feed, and other waters	White	Green
3	Compressed air	White	Blue
4	Fire quenching fluids	White	Red
5	Toxic and corrosive fluids	Black	Orange
6	Combustible fluids	White	Brown
7	Recycled Water	White	Purple
Notes: (1) See Piping Schedule.			

2. Self-adhesive type markers:
   a. Manufacturers: One of the following or equal:
      1) Seton, (of Brady Corporation), Opti Code Pipe Markers.
      2) Marking Services, Inc.
   b. Materials:
      1) Self-adhesive vinyl.
3. Snap-on markers:
   a. Manufacturers: One of following or equal:
      1) Brady Snap-On.
      2) Seton (of Brady Corporation) Setmark.

B. For piping with outer diameter less than 3/4-inch, provide identification tags and flow direction arrows:
   1. Manufacturer: One of the following or equal:
      a. Seton (of Brady Corporation).
   2. Tag and chain materials:
      a. Copper piping: Brass.
      b. Ferrous piping: Type 316 stainless steel.
      c. Plastic piping: PVC.
   3. Flow direction arrow colors shall adhere to the same requirements as for piping with outer diameter greater than or equal to 3/4-inch, as specified in this Section.

C. Pipe bands:
   1. When bands are required by the Piping Schedule for a specific piping system, provide solid-colored 4-inch-wide bands.
      a. Color as specified in the Piping Schedule.
   2. Self-adhesive type.
   3. Suitable for outdoor application from -40 degrees to 180 degrees Fahrenheit.

2.02 BURIED PIPELINE IDENTIFICATION

A. Underground warning tape:
   1. Manufacturer: One of the following or equal:
      a. Seton (of Brady Corporation).
      b. T. Christy Enterprises, Inc.
   2. Material:
      a. Polyethylene tape for prolonged underground use.
      b. Minimum tape thickness: 4 mils.
      c. Overall tape width: 4 inches.
      d. Message: “CAUTION” with the name of the service followed by “LINE BURIED BELOW.” in black lettering on colored background in accordance with approved APWA colors.

Service	Color
Potable water	Blue
Reclaimed water, irrigation, and slurry lines	Purple
Sewers and drain lines	Green
Gas, oil, steam, petroleum, chemicals, or other service	Yellow

B. Tracer wire:
   1. Manufacturers: One of the following or equal:
      a. Kris-Tech Wire.
      b. Aegion Corrpro.
   2. Materials: One of the following or equal:
      a. Solid copper conductor
      b. Thickness minimum: 10 gauge.

c. Insulation:
1) Match insulation color to the color of the pipe being installed.
2) UF type, direct bury.
3) 30 mil HMWPE.

3. Splicing kit:
a. Manufacturers: One of the following or equal:
1) 3M, Model 82 A1N.

4. Station box:
a. Lid and collar materials: Cast iron.
b. Lid type: Locking.
c. Able to withstand heavy traffic loading.
d. Manufacturers: One of the following or equal:
1) CP Test & Valve Products, Inc., Glenn Test Station.
2) Farwest Corrosion Control.

C. Witness markers:
1. Manufacturers: One of the following or equal:
a. Carsonite Composites, Utility Marker.
2. Materials:
a. Glass fiber and resin reinforced thermosetting composite material.
b. UV resistant.
3. Constructed as a single piece.
4. Pointed at the bottom end.
5. Information to be included on the marker:
a. “Caution” (type of service) “Pipeline”.
b. Phone number for Underground Service Alert.
c. Phone number for Owner in case of emergency.
d. Station number.
e. Offset:
1) Only provide offset if marker is not directly over the pipe.
f. Name of appurtenance or fitting (e.g., 45, BO, ARV, etc.)

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify satisfactory conditions of substrate for applying identification.

B. Verify that conditions are satisfactory for installation and application of products as specified in Section 01600 - Product Requirements.

3.02 PREPARATION

A. Prepare and coat piping with the coating systems defined in the Piping Schedule.

B. Prepare surface in accordance with identification product manufacturer's instructions.

3.03 EXPOSED AND IN-CHASE PIPING IDENTIFICATION

A. Identify exposed and in-chase piping with flow direction arrows and lettering (for piping with outer diameter greater than or equal to 3/4-inch) or tags (for piping with outer diameter less than 3/4-inch).

B. Provide lettering (or tags for pipes with outer diameter less than 3/4-inch) and flow direction arrows near equipment served, adjacent to valves, both sides of walls and floors where pipe passes through, at each branch or tee, and at intervals of not more than 50 feet in straight runs of pipe.
   1. Label all chemical tank fill pipelines at locations that are visible from chemical fill stations.
   2. Place markers on piping so they are visible from operator's position in walkway or working platform near piping. Locate markers along horizontal centerline of pipe, unless better visibility is achieved elsewhere.
   3. Do not apply markers, arrows, or tags to piping that is regularly submerged.

C. Where scheduled in the Piping Schedule, space solid-color bands along piping at 10-foot intervals.
   1. Do not apply bands to piping that is regularly submerged.

3.04 BURIED PIPING IDENTIFICATION

A. Underground warning tape:
   1. Non-detectable warning tape:
      a. Place continuous run of warning tape in pipe trench, 12 inches above the pipe.
   2. Detectable warning tape:
      a. Place continuous run of warning tape in pipe trench, 12 inches above the pipe or a greater height if necessary to limit the tape bury depth to 36 inches. Do not bury detectable warning tape deeper than 36 inches.

B. Tracer wire:
   1. Install on all non-metallic pipe.
   2. Install an electrically continuous run of tracer wire along the entire length of the pipe with wire terminations in valve boxes, vaults, or structures.
   3. Install tracer wire on top of the pipe and secure to pipe with tape a minimum of every 10 feet.
   4. Where approved by the Engineer, splice sections of wire together using approved direct bury wire nuts.
      a. Twisting the wires together is not acceptable.

C. Witness markers:
   1. Install over pipe in unpaved open-space areas at intervals not greater than 200 feet.
   2. Place markers at appurtenances located in unpaved areas.
   3. Embed markers at least 18 inches into the soil.

END OF SECTION

SECTION 15082

PIPING INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Insulation for piping and related systems that are not plumbing systems.

1.02 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. Standard Specifications for Highway Bridges.

B. ASTM International (ASTM):
   1. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded, and Seamless.
   2. C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
   3. C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
   4. C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
   5. C547 - Standard Specification for Mineral Fiber Pipe Insulation.
   6. C552 - Standard Specification for Cellular Glass Thermal Insulation.
   7. C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
   8. C929 - Standard Practice for Handling, Transporting, Shipping, Storage, Receiving, and Application of Thermal Insulation Materials for Use in Contact with Austenitic Stainless Steel.
   9. C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
   10. D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
   11. D2310 - Standard Classification of Machine-Made "Fiberglass" (Glass-Fiber-Reinforced-Thermosetting-Resin) Pipe.
   12. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
   13. E96 - Standard Test Methods for Water Vapor Transmission of Materials.

C. California Energy Commission:
   1. Title 24 - Building Energy Efficiency Standards.

1.03 DEFINITIONS

A. Buried: Piping that is installed below buildings, foundations, or finish grade, either in soil or encased in concrete in soil.

B. Concealed: Piping above suspended ceilings and within walls, partitions, shafts, or service spaces and spaces not normally exposed to view but not buried.

C. Exterior: Piping that is installed outside a building or within a pipe trench or tunnel.

D. Flame Spread and Smoke Density: Burning characteristics determined in accordance with ASTM E84.

E. Interior: Piping that is installed inside a building.

F. K Factor: Thermal conductivity determined in accordance with ASTM C177 or C518.

G. Mineral Fiber: Fibers manufactured of glass, rock, or slag processed from a molten state, with or without a binder.

H. Water Vapor Permeance: Water vapor transmission determined in accordance with ASTM E96 and expressed in units of perm-inch.

1.04 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: As specified in Section15050 - Common Work Results for Mechanical Equipment.
   1. Insulation properties: Include K factor, thickness, density, operating temperature limits, tensile strength, compressive strength, moisture absorption, flame spread, and smoke developed in accordance with ASTM E84 and corrosivity to stainless steel piping in accordance with ASTM C795.
   2. Jacket properties: Include covering material, cover thickness, tensile strength, tear strength, permeability in accordance with ASTM E96, flame spread, and smoke developed in accordance with ASTM E84, closure type or devices, and accessories.
   3. Insulating blankets: Include materials, performance characteristics, method of attaching to equipment, listing of locations where insulating blankets will be installed.
   4. Manufacturer's application instructions: Include assembly and application drawings and detailed instructions.

1.05 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

A. As specified in Section 01600 - Product Requirements with additional requirements in Section 15050 Common Work Results for Mechanical Equipment and Section 15500 - Common Work Results for HVAC.

B. In accordance with California Energy Commission Title 24.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. As specified in Section 15050 Common Work Results for Mechanical Equipment and Section 15500 - Common Work Results for HVAC.

B. Insulation thicknesses: Provide insulation thickness in inches in accordance with the following table. Insulation thickness shown is nominal. Manufacturing tolerance of 15 percent variation is permissible.

Table 1. Required Insulation Thicknesses

Required Insulation Thicknesses (inches)					
Service Temperature Range as Designated in Insulation Schedule at End of this Section	**Nominal Pipe Diameters**				
	1 inch and Less	**1.25 to 2 inches**	**2.5 to 4 inches**	**5 to 10 inches**	**Over 10 inches**
Above 200 degrees Fahrenheit	2.0	2.5	3.0	3.5	3.5
100 to 200 degrees Fahrenheit	1.5	1.5	1.5	2.0	2.5
40 to 100 degrees Fahrenheit	0.5	1.0	1.0	1.5	2.0
Below 40 degrees Fahrenheit	1.0	1.0	1.5	2.0	2.0
Airwash Air Pipes	0.5	0.5	1.0	1.0	1.0

2.03 PIPE INSULATION

A. Insulation types: Provide in accordance with the insulation types listed and scheduled.

B. Insulation, Type 2:
   1. Insulation material: Preformed mineral fiberglass insulation made from glass fibers bonded with a thermosetting resin.
      a. In accordance with ASTM C547, Class 1.
      b. Provide with factory installed vapor barrier.
         1) Material: White Kraft paper bound to aluminum foil in accordance with ASTM C1136, Type I.
         2) Longitudinal lap seals: Pressure-sensitive, self-sealing longitudinal lap strip with factory applied adhesive.
         3) Circumferential butt seals: 4-inch wide tape or similar properties or 4-inch wide overlap with adhesive seal.
         4) Vapor barrier permeability: 0.02 perms or lower.
         5) Vapor barrier flame spread rating: 25 or less.

2. Minimum temperature range: Minus 0 degrees Fahrenheit to plus 850 degrees Fahrenheit.
3. K factor at 75 degrees Fahrenheit: Not more than 0.23 BTU-inch/hour-square feet degrees Fahrenheit.
4. Maximum moisture absorption, volume percent: 5.
5. Manufacturers: One of the following or equal:
    a. Owens-Corning , Fiberglas™ FLEXWRAP® ASJ.
    b. Johns Manville, Micro-Lok® HP.
    c. Knauf Insulation, Earthwool® Redi-Klad® 1000° Pipe Insulation.

2.04 INSULATION JACKETS

A. Jacket, Type 2:
1. Material: Ultraviolet-resistant polyvinyl chloride jacketing, 20 mil minimum thickness.
2. Fire rating: 25 maximum flame spread, smoke developed 50 or less.
3. Color: White.
4. Overlap: 1-inch minimum at joints and fittings.
5. Joint seal: PVC solvent welded or adhesive as recommended by the manufacturer.
6. Fittings: Factory made with full thickness insulation.
7. Manufacturers: One of the following or equal:
    a. Johns Manville, Zeston® 2000 PVC.
    b. Proto Corp., LoSMOKE PVC.
    c. Speedline® Corp., Smoke-Safe™ PVC.

2.05 VAPOR BARRIERS

A. Vapor barrier, Type 1:
1. Material: White Kraft paper bound to aluminum foil in accordance with ASTM C1136, Type 1.
2. Permeability: 0.02 perms or lower.
3. Maximum flame spread rating: 25.
4. Edge seal: Pressure-sensitive tape lap seal.
5. Circumferential joints: 4-inch wide tape or 4-inch overlap with adhesive seal.

B. Vapor barrier, Type 2:
1. Material: Mastic.
2. Manufacturers: One of the following or equal:
    a. Benjamin Foster, No. 30-76.
    b. Insul-Coustic, No. I.C.-580.
    c. Foster Products, 36-10/46-10 Weatherite.
    d. Childers Products CP10/11 VI-CRYL.

2.06 RELATED MATERIALS

A. Cover adhesive: Premium adhesive as recommended by the insulation cover supplier for heavy-duty service in corrosive, wet environments. Standard-duty adhesives are not permitted.

2.07 REMOVABLE INSULATING BLANKETS

A. In piping systems specified to be insulated, use removable insulating blankets for valves, meters, strainers, filters, catalytic converters, engine exhaust silencers, pumps, and other in-line piping appurtenances and equipment requiring periodic servicing, regardless of pipe size.

B. Size limits: Use removable insulating blankets for equipment and piping appurtenances 3 inches in nominal size and larger. For equipment and piping appurtenances less than 3 inches that do not require periodic servicing, insulate with molded sections of insulation or by field cutting insulation to conform to the shape of the component and to fit tightly around the component.

C. Manufacturers: One of the following, or equal:
   1. Thermal Energy Products, Inc., Energy Wrap.
   2. Accessible Products, Thermazip 2000 Jacket.
   3. Owens Corning, Temp-Mat.

D. Low temperature insulating blankets rated up to 800 degrees Fahrenheit:
   1. Use: For service temperatures up to 800 degrees Fahrenheit.
   2. Insulation: Fiberglass fiber, K factor 0.27 at 75 degrees Fahrenheit.
   3. Cover: 17-ounce fabric with both sides covered with silicone-impregnated glass cloth suitable for temperatures up to 800 degrees Fahrenheit.
   4. Cover fasteners: Use one of the following systems:
      a. Grommets in the blanket and stainless steel wire.
      b. 1-inch wide straps with stainless steel rectangular ring buckles and Velcro on strap tail.

2.08 SHIPPING, SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS

A. As specified in Section 01600 - Product Requirements.

PART 3 EXECUTION

3.01 GENERAL

A. As specified in Section 01600 - Product Requirements.

B. Handle and store insulation for use on stainless steel in accordance with ASTM C929.

3.02 PREPARATION

A. Pressure test piping and complete application of coating system before applying insulation.

B. When piping is to be heat traced, install and functionally test heat tracing before installation of insulation.

C. Before beginning installation of piping insulation, verify that the Engineer has accepted piping tests, pipe coating applications, and heat tracing tests.

3.03 INSULATION SCHEDULE

A. Table 2. Insulation Schedule, does not include insulation required for plumbing systems. Plumbing systems insulation: As specified in Section 15400 - Plumbing Systems.

Table 2. Insulation Schedule

Service Designation[1]	Location[2]	Insulation Type[3]	Jacket Type[3]	Service Temp. °F[4]	Vapor Barrier
Airwash Air (AA)[5]	Interior/Exterior	2	2	Note 4	Required

Notes:

(1) Refer to Piping Schedule in Section 15052 - Common Work Results for General Piping for service designations.
(2) Insulation jackets are not required for interior installations that are concealed. See definitions for description of concealed locations.
(3) Contractor may select from options listed.
(4) Unless noted otherwise, use service temperature range provided in this table to establish insulation thickness as required by TABLE 1. Required Insulation Thicknesses.
(5) Install insulation on all new AA piping located from the discharge of blowers to the AWTs. Insulation is not required for existing AA piping or new AA that is installed higher than 10 feet above the slab.

3.04 INSTALLATION

A. Install insulation and jacket materials in accordance with manufacturer's written instructions.

B. Apply insulation in smooth, clean manner with tight and finished smooth joints. Fit insulation tightly against surfaces. Insulate each continuous run of pipe with full-length sections of insulation with a single piece cut to length to complete the run of pipe. Do not use cut pieces or scraps to complete the installation.

C. Butt longitudinal and circumferential insulation joints firmly together.

D. Maintain the integrity of vapor barrier jacketing. Do not use staples to hold vapor barrier overlaps in place.

E. Apply sealant or cement when previous applications of adhesives and cement have thoroughly dried.

F. Apply insulation to permit expansion or contraction of pipelines without damage to insulation or jacketing.

G. Fittings:
   1. Insulate fittings by covering with mitered sections of insulation or utilize factory-made prefabricated fitting shapes.

2. Terminate preformed pipe jackets or covering at sufficient distance from flanges to permit removal of bolts.
3. Overlap flange and flanged fitting insulation on adjacent pipe covering by at least 2 inches.

H. Valves:
1. Insulate valves 3 inches in nominal size and larger with removable insulating blankets.
2. Size blanket to extend up to packing gland only so that replacement of packing does not require removal of insulating blanket.

I. Provide continuous insulation through and over pipe supports and provide protection saddles at supports.

J. Extend insulation against insulation end protection shields or covers so that insulation voids do not exist and provide watertight end seals and covers where insulation terminates.

K. Provide continuous pipe insulation and covering through sleeves or openings in walls and floors. When buried pipe enters a building through a below grade wall or slab penetration, begin insulation system on interior side of penetration.

L. Apply pre-molded pipe insulation with extended legs when used on pipe traced with either tubing or electric cable type.

M. Thermally isolate all insulation closure locations (end caps, transitions, etc.) Type 1 or 2 jacket installation on piping with potential reach temperatures greater than 150 degrees Fahrenheit.

N. Apply piping identification on jackets as specified in Section 15076 - Pipe Identification.

END OF SECTION

SECTION 15110

COMMON WORK RESULTS FOR VALVES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Basic requirements for valves.

1.02 REFERENCES

A. American Water Works Association (AWWA):
   1. C111/A21.11 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe Fittings.

B. ASTM International (ASTM):
   1. A126 - Standard Specification for Gray Iron Casting for Valves, Flanges, and Pipe Fittings.
   2. A480 - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
   3. A536 - Standard Specification for Ductile Iron Castings.

C. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.

D. Society for Protective Coatings (SSPC):
   1. SP7 - Brush-Off Blast Cleaning.
   2. SP10 - Near-White Blast Cleaning.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Submit the following information for each valve:
      a. Valve type, size, pressure rating, Cv factor.
      b. Coatings.
      c. Power valve actuators:
         1) Information on valve actuator including size, manufacturer, model number, limit switches, mounting; and motor enclosure, seating and unseating torque coefficient, dynamic torque, and bearing friction for calculation of maximum operating torque.
         2) Complete wiring diagrams and control system schematics.
      d. Manual valve actuators:
         1) Information on valve actuator including size, manufacturer, model number.
      e. Certified drawings with description of component parts, dimensions, weights, and materials of construction.

f. Certifications of reference standard compliance:
    1) Submit certification that the valves and coatings are suitable in potable water applications in accordance with NSF 61.
g. Clearly mark submittal information to show specific items, materials, and accessories or options being furnished.
h. Factory test data.

C. Provide vendor operation and maintenance manual as specified in Section 01782 - Operation and Maintenance Manuals.
    1. Furnish bound sets of installation, operation, and maintenance instructions for each type of manual valve 4 inches in nominal size and larger, and all non-manual valves. Include information on valve operators.

D. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756 - Commissioning.

E. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.04 QUALITY ASSURANCE

A. Manufacturer qualifications:
    1. Valves manufactured by manufacturers whose valves have had successful operational experience in comparable service.

1.05 DELIVERY STORAGE AND HANDLING

A. Protect valves and protective coatings from damage during handling and installation; repair coating where damaged.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Pressure rating:
    1. Suitable for service under minimum working pressures of 150 pounds per square inch gauge.
    2. When a piping system is specified in the Piping Schedule to be tested at a pressure greater than 150 pounds per square inch gauge, provide valves for that piping system with design working pressure which is sufficient to withstand the test pressure.

B. Valve to piping connections:
    1. Metallic valves:
        a. Valves 3 inches nominal size and larger: Flanged ends.
        b. Valves less than 3 inches nominal size: Screwed ends.

2. Plastic valves in plastic piping systems:
    a. Up to 4 inches: Provide solvent or heat welded unions, except for plastic butterfly valves.
        1) Plastic butterfly valves shall be flanged per Section 15112 - Butterfly Valves.
    b. 6 inches and above: Provide solvent or heat-welded flanges.

2.02 MATERIALS

A. Stainless steel: In accordance with ASTM A480, Type 316, or Type 304, UNS Alloy S31600 or S30400.

B. Valve and operator bolts and nuts (not including flange bolts and nuts, which are specified in Section 15052 - Common Work Results for General Piping):
    1. Fabricated of stainless steel for the following installation conditions:
        a. Submerged in sewage or water.
        b. In an enclosed space above sewage or water.
        c. In structures containing sewage or water, below top of walls.
        d. At openings in concrete or metal decks.
    2. Where dissimilar metals are being bolted, use stainless steel bolts with isolation bushings and washers.
    3. Underground bolts: Low-alloy steel in accordance with AWWA C111/A21.11.

C. Bronze and brass alloys: Use bronze and brass alloys with not more than 6 percent zinc and not more than 2 percent aluminum in the manufacture of valve parts; UNS Alloy C83600 or C92200 unless specified otherwise.

D. Cast iron valve bodies: In accordance with ASTM A126, Class 30 minimum.

E. Ductile iron valve bodies: In accordance with ASTM A536, Grade 65-45-12 minimum unless specified otherwise.

2.03 INTERIOR PROTECTIVE LINING

A. When specified in the particular valve specification, provide valves with type of protective lining specified in the particular valve Specification.

B. Apply protective lining to interior, non-working surfaces, except stainless steel surfaces.

C. Lining types:
    1. Fusion bonded epoxy:
        a. Manufacturers: The following or equal:
            1) 3-M Company, ScotchKote 134; certified to NSF 61 for drinking water use.
        b. Clean surfaces in accordance with SSPC SP 7 or SP 10, as recommended by epoxy manufacturer.
        c. Apply in accordance with manufacturer's published instructions.
        d. Lining thickness: 0.010 to 0.012-inch, except that:
            1) Lining thickness in grooves for gaskets: 0.005-inch.
            2) Do not coat seat grooves in valves with bonded seat.

e. Quality control:
    1) Lining thickness: Measured with a non-destructive magnetic type thickness gauge.
    2) Verify lining integrity with a wet sponge-testing unit operating at approximately 60 volts, or as recommended by the lining manufacturer.
    3) Consider tests successful when lining thickness meets specified requirements and when no pinholes are found.
    4) Correct defective lining disclosed by unsuccessful tests, and repeat test.
    5) Repair pinholes with liquid epoxy recommended by manufacturer of the epoxy used for lining.

2. High solids epoxy:
    a. Product equivalent to high solids epoxy as specified in Section 09960 - High-Performance Coatings.
        1) Certified in accordance with NSF 61 for drinking water use.
        2) Interior: Coat valve interior with manufacturer's equivalent high performance high solids epoxy coating system with a certifiable performance history for the service conditions and as approved by the Engineer. Manufacturer shall provide for approval, coating information sufficient to allow Engineer to assess equivalence to the specified high solids epoxy as specified in Section 09960 - High-Performance Coatings.
    b. Clean surfaces to meet SP-7 or SP-10, or as recommended by coating manufacturer.
    c. Quality control: After coating is cured, check coated surface for porosity with a holiday detector set at 1,800 volts, or as recommended by coating manufacturer.
        1) Repair holidays and other irregularities and retest coating.
        2) Repeat procedure until holidays and other irregularities are corrected.

2.04 UNDERGROUND VALVES

A. Provide underground valves with flanged, mechanical, or other type of joint required for the type of pipe to which the valve is to be connected.

B. Coating and wrapping:
    1. After installation, encase valves in polyethylene wrap as specified for ductile iron piping in Section 15211 - Ductile Iron Pipe: AWWA C151.
        a. Ascertain that polyethylene wrapping does not affect operation of valve.

2.05 STEAM VALVES

A. Valves in steam or steam condensate piping: Ductile iron body in accordance with ASTM A536, Grade 65-45-12 minimum or cast steel or forged steel.

2.06 VALVE BOXES

A. Provide cast-iron valve boxes at each buried valve to access valve and valve operators.

B. Do not support boxes on valve, valve operator, or pipe.

C. Boxes:
   1. 2-piece, fabricated of cast iron; provide cover, with asphalt varnish or enamel protective coating.
   2. Adjustable to grade, install centered around the upper portions of the valve and valve operator.

D. Manufacturers: One of the following or equal:
   1. Tyler Pipe Industries, Inc.
   2. Neenah Foundry Co.

2.07 VALVE OPERATORS

A. Valve operator "Open" direction: Open counterclockwise.

B. Provide valves located below operating level or deck with extensions for key operation or floor stands and handwheels, as indicated on the Drawings.

C. Provide manually operated valves located not more than 6 feet above the operating level with tee handles, wrenches, or handwheels.
   1. Make the valve operator more conveniently accessible by rolling valves, located more than 5 feet but less than 6 feet above the operating level, toward the operating side.
   2. Secure tee handles and wrenches to the valve head or stem, except where a handle or wrench so secured constitutes a hazard to personnel; in which case, stow handle or wrench immediately adjacent to the valve on or in a suitable hanger, bracket, or receptacle.

D. Fit valves located more than 6 feet above operating level with chain operated handles or valve wheels.
   1. Chains: Sufficient length to reach approximately 4 feet above the operating level.
   2. Where chains constitute a nuisance or hazard to operating personnel, provide holdbacks or other means for keeping the chains out of the way.

E. Provide an operator shaft extension from valve or valve operator to finished grade or deck level when buried valves, and other valves located below the operating deck or level, are specified or indicated on the Drawings to be key operated; provide 2 inches square AWWA operating nut, and box and cover as specified, or a cover where a box is not required.

PART 3 EXECUTION

3.01 EXAMINATION

A. Preparation prior to installation:
   1. Install valves after the required submittal on installation has been accepted.
   2. Determine after flanged valves and flanged check valves are selected, the face-to-face dimensions of flanged valves and flanged check valves.

B. Fabricate piping to lengths taking into account the dimensions of flanged valves and flanged check valves.

3.02 INSTALLATION

A. Provide incidental work and materials necessary for installation of valves including flange gaskets, flange bolts and nuts, valve boxes and covers, concrete bases, blocking, and protective coating.

B. Where needed, furnish and install additional valves for proper operation and maintenance of equipment and plant facilities under the following circumstances:
   1. Where such additional valves are required for operation and maintenance of the particular equipment furnished by Contractor.
   2. Where such additional valves are required as a result of a substitution or change initiated by Contractor.

C. Valve and actuator orientation:
   1. Contractor shall coordinate with valve supplier final orientation of valve and actuator assembly based on Contractor's selection of equipment manufacturers and the valve and piping arrangement as indicated on the Drawings.
      a. Contractor shall rotate valve and/or actuator mounting orientation as specified in this Section unless otherwise indicated on the Drawings.
   2. Install valves with their stems in vertical position above the pipe, except as follows:
      a. Butterfly valves, gate valves aboveground, globe valves, ball valves, and angle valves may be installed with their stems in the horizontal position.
      b. Install buried plug valves with geared operators with their stems in a horizontal position.
   3. Install valves so that handles clear obstructions when the valves are operated from fully open to fully closed.

D. Place top of valve boxes flush with finished grade or as otherwise indicated on the Drawings.

E. Valves with threaded connections:
   1. Install valves by applying wrench on end of valve nearest the joint to prevent distortion of the valve body.
   2. Apply pipe joint compound or Teflon™ tape on external (male) threads to prevent forcing compound into valve seat area.

F. Valves with flanged connections:
   1. Align flanges and gasket carefully before tightening flange bolts.
   2. When flanges are aligned, install bolts and hand tighten.
   3. Tighten nuts opposite each other with equal tension before moving to next pair of nuts.

G. Valves with soldered connections:
   1. Do not overheat connection to prevent damage to resilient seats and metal seat rings.
   2. Position valves in full open position before starting soldering procedure.
   3. Apply heat to piping rather than to valve body.

3.03 FIELD APPLIED COATING OF VALVE EXTERIOR

A. Match color and be compatible with manufacturer's coating system and as specified in Section 09960 - High-Performance Coatings.
   1. When shop applied finish coating matches field applied coating on adjacent piping, touch up shop coating in damaged areas in accordance with instructions recommended by the paint manufacturer.
   2. When shop applied coating does not match field coating on adjacent piping, or when damage has occurred to the shop applied coating that requires more than touchup, blast clean valve surfaces or utilize other surface preparation recommended by the manufacturer of the coating material and apply the coating system used for coating adjacent piping.

3.04 COMMISSIONING

A. As specified in Section 01756 - Commissioning and this Section.

B. Manufacturer services from each manufacturer for all valves supplied:
   1. Provide Manufacturer's Certificate of Source Testing.
   2. Provide Manufacturer's Certificate of Installation and Functionality Compliance.

C. As specified elsewhere for specific valve types, sizes, or actuators.
   1. Source testing.
   2. Manufacturers on site services for Owner Training, Installation Testing, Functional Testing, and during the Process Operational Period.

END OF SECTION

SECTION 15111

BALL VALVES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Ball valves.

B. As specified in Section 15110 - Common Work Results for Valves.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
   2. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.

B. American Water Works Association (AWWA):
   1. C507 - Standard for Ball Valves 6 Inch Through 48 Inch.

C. ASTM International (ASTM):
   1. A48 - Standard Specification for Gray Iron Castings.
   2. A216 - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
   3. A351 - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: As specified in Section 15110 - Common Work Results for Valves:
   1. Metal body ball valves: 6 inches and larger only: Submit affidavit of compliance in accordance with AWWA C507.
   2. Operation and maintenance manual.

C. Commissioning submittals:
   1. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.04 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. General: Unless otherwise indicated on the Drawings use:
   1. Metal body ball valves on metallic pipelines.
   2. Plastic body ball valves on plastic pipelines.

B. Do not use metal body ball valves in sodium hypochlorite or sodium bisulfite systems.

2.02 METAL BODY BALL VALVES – FULL PORT (BAV00)

A. Metal Body Ball Valves, 6-Inch Size and Larger:
   1. Manufacturers: One of the following or equal:
      a. Crane ChemPharma Energy, Resilient seated valve.
      b. DeZURIK/APCO, Metal seated valve.
      c. Henry Pratt Company, Resilient seated valve.
   2. General:
      a. Type: Non-lubricated, resilient seated or metal seated and capable of sealing in either flow direction.
      b. In accordance with AWWA C507.
      c. Stem packing: Manually adjustable while valve is under pressure.
      d. ASME B16.1, Class 125 flanged ends.
   3. Materials:
      a. Body: ASTM A48 cast iron with 400 series Monel seats (metal seated valves only) and integrally cast bronze bushed trunnions.
      b. Ball: Type 304 or 316 stainless steel.
      c. Seats:
         1) Resilient seated valves:
            a) PTFE.
         2) Metal seated valves:
            a) 300 series stainless steel.
      d. Stem seals: PTFE or Viton™.
   4. Valve actuator:
      a. Manually operated valves: Self-locking worm gear type actuator with position indicator. Permanently lubricate gearing. Provide adjustable screws to stop travel at both open and closed positions.
      b. Electric motor operated valves: Provide electric motor operator as specified in Section 13447 - Electric Actuators.

B. Metal body ball valves, less than 6-inch size
   1. Manufacturers: One of the following, or equal:
      a. Conbraco Industries, Inc., Apollo Valves.
      b. Flow-Tek, Inc.
      c. Metso Automation/Jamesbury.
      d. NIBCO, Inc.
   2. General:
      a. Type: Non-lubricated, full port and capable of sealing in either direction.
      b. End connections:
         1) Threaded or solder ends for sizes 3-inch and smaller.

2) Class 150 flanged for sizes larger than 3 inches.
a) Flanges: In accordance with ASME B16.1 standards.
c. Stem packing: Manually adjustable while valve is under pressure.
d. Shafts:
1) Rigidly connected to the ball by a positive means.
a) Design connection to transmit torque equivalent to at least 75 percent of the torsional strength of the shaft.
e. Handles: Stainless steel latch lock handle with vinyl grip and stainless steel nut designed to open and close the valve under operating conditions.
f. Temperature limits: Suitable for operation between minus 20 and 350 degrees Fahrenheit.
3. Materials:
a. Valves in copper lines: Bronze body.
b. Valves in steel and ductile iron piping: Ductile iron or cast steel body.
c. Valves in stainless steel piping: Stainless steel body, material type to match piping material as specified in Section 15052 - Common Work Results for General Piping.
d. Ball: Type 304 or 316 stainless steel, Type 316 in digester gas applications.
e. Seats: PTFE.
f. Stem seals: PTFE or Viton™.
g. Bearings: Self-lubricated, corrosion resistant material that will not contaminate potable water.
h. Valves for combustible fluid applications (digester gas, natural gas, fuel oil, etc.) must be of fire safe design.
4. Venting requirements:
a. Metal ball valves for hydrogen peroxide service:
1) Provide valve with factory drilled 0.125-inch hole in the upstream side of the ball.
2) Provide an engraved Type 316 stainless steel tag permanently attached to the valve stem stating, "One side of ball drilled for hydrogen peroxide service".

2.03 PLASTIC BODY BALL VALVES – FULL PORT (BAV40)

A. Manufacturers: One of the following or equal:
1. Asahi America.
2. Chemtrol Division, NIBCO, Inc.
3. Georg Fischer Piping Systems.
4. Hayward Flow Control.
a. For sodium hypochlorite service, provide model TB-Z. Model TBH-Z shall not be used.
5. IPEX USA, LLC
6. Plast-O-Matic Valves, Inc.

B. General:
   1. Type: Non-lubricated and capable of sealing in either flow direction.
   2. End connections:
      a. 4 inches and smaller size: Socket end true unions for solvent welded connection to adjacent piping.
      b. 6-inch size: Socket end true unions with attached flanges for flanged connection to adjacent piping.
   3. All valves shall have integral ISO 5211 mounting pad for actuator installation.
   4. All valves shall have integral plate for lock-out/tag-out.
   5. Stem: Double O-ring seal with shear point above seal.
   6. Pressure rating: Suitable for the test pressure and maximum temperature of the corresponding piping system listed in the Piping Schedule.

C. Materials:
   1. Body and ball:
      a. PVC piping systems: PVC.
      b. CPVC piping systems: CPVC.
   2. Seats: PTFE (Teflon™).
   3. O-rings: Match gasket material of corresponding piping system listed in the Piping Schedule.

D. Limit switches, when indicated on the Drawings:
   1. Mechanical cam type with watertight enclosure and suited for remote indication of valve open-close status.
   2. Mount on valve actuator.
   3. Contacts: 120-volt alternating current, 20 amperes at 75 to 100 percent power factor and 24-volt direct current, 5 amperes minimum.

E. Valve actuator:
   1. Valves shall be quarter turn operated with valve seat adjustability.
   2. Manually operated valves: Lever.
      Electric motor operated valves, when indicated on the Drawings: Provide electric motor operator as specified in Section 13447 - Electric Actuators.

F. Venting requirements:
   1. PVC and CPVC ball valves for hypochlorite service:
      a. Provide valve with factory drilled 0.125-inch hole in the upstream side of the ball.
      b. Provide an engraved plastic tag permanently attached to the valve stem stating, "One side of ball drilled for hypochlorite service".
      c. Provide an arrow inscribed on the valve body to indicate direction of flow.

2.04 PLASTIC BODY BALL VALVES – V-PORT (BAV50):

A. Provide proportional flow control ("V-port") ball valve when indicated on the Drawings.

B. Manufacturer and model shall be the following or equal:
   1. Hayward Flow Control CVH Series.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Install each type of valve in accordance with manufacturers' printed instructions.

3.02 COMMISSIONING

A. As specified in Section 01756 - Commissioning and this Section.

B. Manufacturer services:
   1. Provide certificates:
      a. Manufacturer's Certificate of Installation and Functionality Compliance.

C. Functional testing:
   1. Valves:
      a. Test witnessing: Witnessed.
      b. Conduct pressure and leak test, as specified in Section 15956 - Piping Systems Testing.

END OF SECTION

SECTION 15112

BUTTERFLY VALVES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Butterfly valves:
   1. As specified in Section 15110 - Common Work Results for Valves.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Classes 25, 125 and 250.
   2. B16.5 - Pipe Flanges and Flanged Fittings, NPS 1/2 through NPS 24.

B. American Water Works Association (AWWA):
   1. C110 - Standard for Ductile-Iron and Gray-Iron Fittings.
   2. C504 - Rubber-Seated Butterfly Valves.
   3. C540 - Standard for Power-Actuating Devices for Valves and Sluice Gates.
   4. C550 - Protective Interior Coatings for Valves & Hydrants.
   5. C606 - Standard for Grooved and Shouldered Joints.

C. ASTM International (ASTM):
   1. A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   2. A216 - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for Higher-Temperature Service.
   3. A276 - Standard Specification for Stainless Steel Bars and Shapes.
   4. A351 - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
   5. A395 - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
   6. A479 - Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.
   7. A515 - Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate - and Higher-Temperature Service.
   8. A516 - Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower-Temperature Service.
   9. A536 - Standard Specification for Ductile Iron Castings.
   10. A564 - Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes.
   11. A582 - Standard Specification for Free-Machining Stainless Steel Bars.

12. A743 - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.
13. A890 - Standard Specification for Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-Resistant, Duplex (Austenitic/Ferritic) for General Application.
14. B462 - Standard Specification for Forged or Rolled UNS N06030, UNS N06022, UNS N06035, UNS N06200, UNS N06059, UNS N10362, UNS N06686, UNS N08020, UNS N08024, UNS N08026, UNS N08367, UNS N10276, UNS N10665, UNS N10675, UNS N10629, UNS N08031, UNS N06045, UNS N06025, UNS R20033 Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service.
15. B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
16. B691 - Standard Specification for Iron-Nickel-Chromium-Molybdenum Alloys (UNS N08366 and UNS N08367) Rod, Bar, and Wire.
17. D429 - Standard Test Methods for Rubber Property-Adhesion to Rigid Substrate.

D. Compressed Gas Association (CGA):
   1. Standard G-4.1 - Cleaning Equipment for Oxygen Service.

E. United States Code of Federal Regulations (CFR):
   1. 21 - Food and Drugs.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: 15110 - Common Work Results for Valves:
   1. For general purpose AWWA butterfly valves, include description of the method of attachment of the disc edge to the valve disc.
   2. Interior epoxy coatings: Affidavit of compliance attesting that epoxy coatings applied to interior surfaces of butterfly valves comply with all provisions in accordance with AWWA C550.

C. Commissioning submittals:
   1. Provide Manufacturer’s Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.04 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Design requirements:
   1. Valve pressure rating shall be greater than or equal to the piping system test pressure specified in the Piping Schedule at the maximum service temperature.
   2. General purpose AWWA butterfly valves:
      a. Design standard: Provide valves designed and manufactured in accordance with AWWA C504.
      b. Class:
         1) Provide butterfly valves in accordance with AWWA Class 150B, unless otherwise specified.
         2) Provide butterfly valves in accordance with AWWA Class 250B in piping systems with test pressure greater than 150 pounds per square inch gauge and less than 250 pounds per square inch gauge.
   3. High pressure butterfly valves:
   4. Piping systems designed for test pressures greater than 250 pounds per square inch gauge and less than 500 pounds per square inch gauge: Provide ASME B16.5, Class 300 flanged high pressure valves.
   5. Industrial class butterfly valves:
      a. Industrial class butterfly valves capable of 150 pounds per square inch gauge leak tight shut off.
   6. Stainless steel butterfly valves:
      a. Stainless steel butterfly valves capable of a minimum of 100 pounds per square inch gauge leak tight shut off and with special cleaning, packaging, and handling.

B. Usage:
   1. Provide and install butterfly valve types as outlined in the Butterfly Valve Application Schedule at the end of this Section.

C. Design requirements for all butterfly valves with power actuating devices:
   1. Design valves and actuators for maximum operating torque, in accordance with and using safety factors required in AWWA C540, using the following values:
      a. Maximum water velocity: 16 feet per second with valve fully open.
      b. Maximum pressure differential across the closed valve equal to the pressure class designation.
      c. Coefficient for seating and unseating torque, dynamic torque, and bearing friction in accordance with valve manufacturer's published recommendations.
   2. Valve disc: Seat in an angular position of 90 degrees to the pipe axis and rotate an angle of 90 degrees between fully open and fully closed positions:
      a. Do not supply valves with stops or lugs cast with or mechanically secured to the body of the valve for limiting the disc travel.
   3. Unacceptable thrust bearings: Do not provide valves with thrust bearings exposed to the fluid in the line and consisting of a metal bearing surface in rubbing contact with an opposing metal bearing surface.

D. Performance requirements:
   1. Tight shutoff at the pressure rating of the valve with pressure applied in either direction.
   2. Suitable for the following service conditions:
      a. Throttling.
      b. Frequent operation.
      c. Operation after long periods of inactivity.
      d. Installation in any position and flow in either direction.

2.02 GENERAL PURPOSE AWWA BUTTERFLY VALVES (BFV00)

A. Manufacturers: One of the following or equal:
   1. DeZURIK/Sartell Model BAW.
   2. Mueller/Pratt Co.

B. Valve body:
   1. Material: Cast iron, ASTM A126, Grade B, or ductile iron, ASTM A536, Grade 65-45-12.
   2. Body design:
      a. Flanged body valves:
         1) Usage: Comply with limitations specified in the Butterfly Valve Application Schedule.
         2) Flanges: In accordance with ASME B16.1 Class 125 flanges for Class 150B valves, in accordance with ASME B16.1 Class 250 flanges for Class 250B valves.
      b. Mechanical joint body valves:
         1) Usage: Comply with limitations specified in the Butterfly Valve Application Schedule.
         2) Mechanical joint design: In accordance with AWWA C110.
         3) When mechanical joint body valves are used, incorporate valve into thrust restraint analysis as specified in Section 15211 - Ductile Iron Pipe: AWWA C151. Utilize test pressure on one side of valve and zero pressure on the opposite side of the valve. Restrain pipe joints on both sides of valve as determined by thrust analysis calculations.
      c. Grooved end body valves:
         1) Usage: Butterfly valves with grooved ends may be used in piping systems specified in the Piping Schedule to have grooved end joints. Comply with additional limitations specified in the Butterfly Valve Application Schedule.
         2) Grooved end joint design: In accordance with AWWA C606.

C. Disc:
   1. Material: Cast iron or ductile iron with Type 316 stainless steel edge that matches seat in valve body.
   2. Secure valve disc to shaft by means of smooth-sided, taper or dowel pins, Type 316 stainless steel, or Monel.
   3. Extend pins through shaft and mechanically secure in place.

D. Shaft and bearings:
   1. Shaft design:
      a. Valves 20-inches and less: 1-piece, through disc design.
      b. Valves greater than 20-inch size: 2-piece, stub shaft design.
   2. Shaft seal: Vee type, chevron design.
   3. Shaft material for Class 150B valves: Type 316 stainless steel, ASTM A276.
   4. Shaft material for Class 250B valves: Type 17-4 pH stainless steel, ASTM A564.
   5. Shaft bearings: Self-lubricating sleeve type:
      a. Valves 20 inches and less: Nylatron.
      b. Valves greater than 20-inch size: Teflon™ with stainless steel or fiberglass backing.

E. Seats:
   1. Seat materials:
      a. In low-pressure air applications: EPDM.
      b. In digester gas applications: Teflon™.
      c. In all other applications: NBR, natural rubber, or EPDM.
   2. For valves 20 inches in nominal size and smaller, bond or vulcanize seat into the valve body.
   3. For valves 24 inches in nominal size and larger, retain seats mechanically or by adhesive:
      a. Mechanical retainage: Retain seat by a clamping ring with segmented clamping ring locks with adjusting locking screws.
         1) Clamping ring, ring locks, and adjusting locking screws: Type 316 stainless steel.
         2) Provide means to prevent ring locks and screws used to retain seats from loosening due to vibration or cavitation.
      b. Adhesive retainage: Inset the seat within a groove in the valve body and retain in place with epoxy injected behind the seat so that the seat expands into the body.
      c. Do not provide valves with seats retained by snap rings or spring-loaded retainer rings.
   4. Resilient seat: Withstand 75 pound per inch pull when tested in accordance with ASTM D429, Method B.

F. Valve packing:
   1. Valves 4 inches to 48 inches nominal size: Self-adjusting V-type packing or chevron-type packing. NBR or EPDM to match seat material.
   2. Valves 54 inches nominal size and larger: Adjustable V-type packing with bronze packing gland or self-adjusting V-type packing. NBR or EPDM to match seat material.

2.03 INDUSTRIAL CLASS BUTTERFLY VALVES (BFV05)

A. Manufacturers: One of the following or equal:
   1. DeZURIK Style BOS.
   2. Emerson-Keystone, Series GR.

B. Valve body:
   1. Pressure rating: 150 pounds per square inch gauge, minimum.
   2. Material: Cast iron, ASTM A126, Class B or Ductile Iron, ASTM A395, Grade 60/40/18.
   3. Body design: Lugged style body with drilled and tapped boltholes in accordance with ASME B16.1, Class 125 and Class 150 flange drilling dimensions.

C. Disc:
   1. Materials:
      a. Air and water service: Cast iron, ASTM A126, Class B or Ductile Iron, ASTM A536, Grade 65/45/12 or Type 316 stainless steel, ASTM A351, Grade CF8M.
      b. Natural gas and digester gas service: Type 316 stainless steel, ASTM A351, Grade CF8M.
   2. Disc edge: Nickel-plated when cast iron or ductile iron disc is used.

D. Shaft and bearings:
   1. Shaft: Type 316 stainless steel, ASTM A276 or Type 416 stainless steel, ASTM A582.
   2. Shaft bearings: Self-lubricating sleeve type, Teflon™ with stainless steel or fiberglass backing.

E. Disc pins: Secure valve disc to shaft by means of solid, smooth-sided, taper or dowel pins, Type 316 stainless steel:
   1. Extend pins through shaft and mechanically secure in place.

F. Seats:
   1. Material:
      a. In digester gas applications: Teflon™.
      b. In natural gas applications: Neoprene or Buna N.
      c. All other applications: EPDM.
   2. Seat retention ring, if used on larger sizes: Type 316 stainless steel or bronze, ASTM B584, with stainless steel fasteners. For all such valves, bond the seat to the retention ring.

G. Valve shaft packing:
   1. Natural gas and digester applications: Neoprene or Buna N.
   2. All other applications: EPDM or Teflon™.

2.04 HIGH PRESSURE BUTTERFLY VALVES (BFV20)

A. Manufacturers: One of the following or equal:
   1. Neles-Jamesbury, Series 800 Model D.

B. Valve body:
   1. Material: Carbon steel ASTM A515 or A516, Grade 70, or ASTM A216, WCB.
   2. Body design: Flanged, in accordance with ASME B16.5, Class 300 dimensions. Wafer and lugged style valves may not be used for high-pressure service.

C. Disc:
   1. Offset disc.
   2. Material: Type 316 stainless steel, ASTM A351, Grade CF-8M.

D. Shaft and bearings:
   1. Shaft: Type 316 stainless steel, ASTM A479 or Type 17-4 PH stainless steel, ASTM A564.
   2. Shaft bearings: Self-lubricating sleeve type; Teflon™ with stainless steel or fiberglass backing.

E. Disc pins: Secure valve disc to shaft by means of solid, smooth-sided, taper or dowel pins, Type 316 stainless steel or Monel:
   1. Extend pins through shaft and mechanically secure in place.

F. Seats:
   1. Material: Teflon™, or Teflon™ with titanium back-up ring.
   2. Seat retainer ring:
      a. If used on sizes above 20 inches: Type 316 stainless steel with stainless steel fasteners.
      b. Type 316 stainless steel for digester gas applications.
      c. For all such valves, bond the seat to the retention ring.

G. Valve shaft packing: Teflon™, chevron type design. Field adjustable and field replaceable.

2.05 COATING REQUIREMENTS FOR METAL VALVES

A. Shop coat interior and exterior metal surfaces of valves, except as follows:
   1. Interior machined surfaces.
   2. Surfaces of gaskets and elastomeric seats and stem seals.
   3. Bearing surfaces.
   4. Stainless steel surfaces and components.

B. Coating material for components in contact with potable water applications:
   1. Formulate interior coating material from materials in accordance with CFR 21, AWWA C550, and NSF 61.
   2. Submit affidavit of compliance attesting that epoxy coatings applied to interior surfaces of butterfly valves in accordance with CFR 21, AWWA C550, and NSF 61.

C. Interior surfaces:
   1. Interior surfaces, except for valves used in low-pressure air service: High solids epoxy as specified in Section 09960 - High-Performance Coatings, Attachment A - Coating Schedule.
   2. Interior surfaces of valves used in low-pressure air service: High temperature coating for range of 150 to 350 degrees Fahrenheit as specified in Section 09960 - High-Performance Coatings, Attachment A - Coating Schedule.

D. Exterior surfaces:
   1. Exterior surfaces of valves, actuators, and accessories coating as specified in Section 09960 - High-Performance Coatings, Attachment A - Coating Schedule for the following conditions:
      a. Submerged valves: High solids epoxy.
      b. Buried valves: Coal tar epoxy.
      c. Other valves: High solids epoxy with polyurethane topcoat.
   2. Polished and machined surfaces: Apply rust-preventive compound,
      a. Manufacturers: One of the following or equal:
         1) Houghton, Rust Veto 344.
         2) Rust-Oleum, R-9.

E. Field applied coatings of valve exterior:
   1. Match color and be compatible with manufacturer's coating system and as specified in Section 09960 - High-Performance Coatings.
      a. When shop applied finish coating matches field applied coating on adjacent piping, touch up shop coating in damaged areas in accordance with instructions recommended by the paint manufacturer.
      b. When shop applied coating does not match field coating on adjacent piping, or when damage has occurred to the shop applied coating that requires more than touchup, blast clean valve surfaces or utilize other surface preparation recommended by the manufacturer of the coating material and apply the coating system used for coating adjacent piping.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install valves with valve shafts horizontal, unless a vertical shaft is required to suit a particular installation, and unless a vertical shaft is indicated on the Drawings.

B. Install pipe spools or valve spacers in locations where butterfly valve disc travel may be impaired by adjacent pipe lining, pipe fittings, valves, or other equipment.

3.02 COMMISSIONING

A. As specified in Section 01756 - Commissioning and this Section.

B. Manufacturer services:
   1. Provide certificates:
      a. Manufacturer's Certificate of Installation and Functionality Compliance.

C. Functional testing:
   1. Valves:
      a. Test witnessing: Witnessed.
      b. Conduct pressure and leak test, as specified in Section 15110 - Common Work Results for Valves.

3.03 BUTTERFLY VALVE APPLICATION SCHEDULE

A. Acceptable butterfly valve types and body styles are listed in the Butterfly Valve Application Schedule provided at the end of this Section. Furnish and install butterfly valves in accordance with this Schedule.

BUTTERFLY VALVE APPLICATION SCHEDULE	
Valve Type and Style	**Acceptable Applications**
General Purpose AWWA Butterfly Valves - Flanged Body Design.	Aboveground or submerged in the following service applications only: - Acceptable in all service applications except oxygen and ozone service and high-pressure service. - May be used in buried applications when required by the specified piping system.
General Purpose AWWA Butterfly Valves - Mechanical Joint Body Design.	Buried in the following service applications only: - Acceptable in all service applications except oxygen and ozone service and high-pressure service.
General Purpose AWWA Butterfly Valves - Lugged Body Design.	Aboveground in the following service applications only: - Aeration Air Systems.
General Purpose AWWA Butterfly Valves - Wafer (not lugged) Body Design.	Not allowed.
General Purpose AWWA Butterfly Valves - Grooved End Body Design.	Aboveground, in sizes 20 inches and less, with piping system test pressure less than 100 psi, and in the following service applications only: - Acceptable in all service applications, except oxygen and ozone service, where piping for that service is specified in the Piping Schedule to have grooved end joints.

BUTTERFLY VALVE APPLICATION SCHEDULE	
Valve Type and Style	**Acceptable Applications**
High Pressure Butterfly Valves - Flanged Body Design.	Service applications with piping system test pressure greater than 250 psi. Acceptable in aboveground and buried installations.
High Pressure Butterfly Valves - Wafer or Lugged Wafer Body Design.	Not allowed.
Industrial Class Butterfly Valves - Lugged Body Design.	Aboveground in the following service applications only: - Aeration Air Systems. - Natural Gas Systems. - Digester Gas Systems. - Chilled and Hot Water Systems.
Industrial Class Butterfly Valves - Wafer (not lugged) Body Design.	Not allowed.
Stainless Steel Butterfly Valves - Lugged Body Design.	Aboveground in the following service applications only: - Oxygen Systems. -Ozone Systems.
Stainless Steel Butterfly Valves - Wafer (not lugged) Body Design.	Not allowed.

BUTTERFLY VALVE SCHEDULE			
Tag Number or Mark Number	**Drawing Number**	**Location**	**Size of Valve**
FCV-60100	60M01, 60N01	Dechlorination Structure	24 in.
FCV-60102	60M01, 60N01	Dechlorination Structure	24 in.
FCV-85211	85M02, 85M03, 85N01	AWT Clarifier No. 1	12 in.
FV-85212	85M02, 85M03, 85N01	AWT Clarifier No. 1	6 in.
FCV-85221	85M02, 85M03, 85N02	AWT Clarifier No. 2	12 in.
FV-85222	85M02, 85M03, 85N02	AWT Clarifier No. 2	6 in.
FCV-85231	85M02, 85M03, 85N03	AWT Clarifier No. 3	12 in.
FV-85232	85M02, 85M03, 85N03	AWT Clarifier No. 3	6 in.
FCV-85241	85M02, 85M03, 85N04	AWT Clarifier No. 4	12 in.
FV-85242	85M02, 85M03, 85N04	AWT Clarifier No. 4	6 in.
FV-85217	85M02, 85M03, 85N01	AWT Filter No. 1	14 in.
FCV-85218	85M02, 85M03, 85N01	AWT Filter No. 1	12 in.
FV-85227	85M02, 85M03, 85N02	AWT Filter No. 2	14 in.
FCV-85228	85M02, 85M03, 85N02	AWT Filter No. 2	12 in.
FV-85237	85M02, 85M03, 85N03	AWT Filter No. 3	14 in.
FCV-85238	85M02, 85M03, 85N03	AWT Filter No. 3	12 in.
FV-85247	85M02, 85M03, 85N04	AWT Filter No. 4	14 in.
FCV-85248	85M02, 85M03, 85N04	AWT Filter No. 4	12 in.
FV-87130	87M01, 85N01	Backwash Pump Station	14 in.
FV-87230	87M01, 85N01	Backwash Pump Station	14 in.
FV-87330	87M01, 85N01	Backwash Pump Station	8 in.
BFV-89111	89M01, 89N01	Carousel Pump Station	16 in.
BFV-91111	91M01, 91N01	PAU Pump Station	10 in.

Notes:
(1) Operator: CO = Hand crank operator with 2-inch AWWA nut for portable operator; HW = Handwheel; HC = Hand crank; MO = Motor Operator; MOD = Modulating Motor Operator; BS = Bench Stand; FS = Floor Stand; IFS = Interconnect Floor Stand; PS = Pedestal Support.

END OF SECTION

SECTION 15114

CHECK VALVES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes requirements for:
   1. Center Guide (Silent) Check Valves
   2. Swing Check Valves:
      a. General Swing Check Valves.
      b. Cushioned Swing Check Valves.
   3. Dual Flapper Check Valves:
      a. Metal hinge.
      b. Elastomer hinge.
   4. High-Pressure Gas Check Valves.
   5. Titling (Slanting) Disc Check Valves.
   6. Ball Check Valves:
      a. Metal Body Ball Check Valves.
      b. Plastic Ball Check Valves.
   7. Angled Disc Rubber Flapper Check Valves.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

B. American Water Works Association (AWWA):
   1. C508 - Standard for Swing-Check Valves for Waterworks Service 2 Inch Through 24 Inch NPS.

C. ASTM International (ASTM):
   1. A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   2. A276: Standard Specification for Stainless Steel Bars and Shapes.
   3. A313 - Standard Specification for Stainless Steel Spring Wire.
   4. A536 - Standard Specification for Ductile Iron Castings.
   5. A582 - Standard Specification for Free-Machining Stainless Steel Bars.
   6. B16 - Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
   7. B61 - Standard Specification for Steam or Valve Bronze Casting.
   8. B62 - Standard Specification for Composition Bronze or Q=Ounce Metal Castings.
   9. B582 - Standard Specification for Nickel-Chromium-Iron-Molybdenum-Copper Alloy Plate, Sheet, and Strip.
   10. B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

D. National Electrical Manufacturers Association (NEMA).

E. NSF International (NSF):
   1. Standard 61 - Drinking Water Components Health Effects.
   2. 372 - Drinking Water System Components - Lead Content.

F. Underwriters Laboratories, Inc. (UL).

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: As specified in Section 01600 - Product Requirements

C. Commissioning submittals:
   1. Provide Manufacturer's Certificate of Installation Compliance as specified in Section 01756 - Commissioning.

1.04 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

A. As specified in 01600 - Product Requirements and 15110 - Common Work Results for Valves.

B. Provide check valves as shown on the Check Valve Schedule and suitable for service:
   1. In either horizontal or vertical position.
   2. For working pressures up to 150 pounds per square inch.

C. Check valve materials as follows unless otherwise specified:
   1. Cast iron conforming to ASTM A126 Grade B.
   2. Ductile iron conforming to ASTM A536 Grade 65-45-12.
   3. T-303 stainless steel conforming to ASTM A582 (UNS S30300).
   4. Type 316 stainless steel conforming to ASTM A313.

D. Flanges: Drilled per ASME B16 Class 125/150 unless otherwise specified or indicated on the Drawings.

2.02 GENERAL SWING CHECK VALVES (CKV00)

A. Valves 1/4-inch through 3 inches:
   1. Manufacturers: One of the following or equal:
      a. Crane Valve Co., Number 36.
      b. Lunkenheimer Co., Figure 554Y.

2. Valve design:
    a. Y-pattern body with integral seat.
    b. Female threaded ends.
    c. Renewable hinged disc.
    d. Threaded cap for access to valve seat without disassembly of piping.
    e. Integral seats suitable for regrinding.
3. Materials:
    a. Body: Bronze in accordance with ASTM B62-83600.
    b. Disc Bronze ASTM B62 C92200:
        1) On valves less than 1-inch: Brass in accordance with ASTM B16.
    c. Hinge: Bronze in accordance with ASTM B584 C 87600.
    d. Lock nut and hinge pin plug: Brass in accordance with ASTM B16 HO2.
    e. Hinge pin: Stainless steel in accordance with ASTM A276.
    f. Cap: Bronze in accordance with ASTM B61 C92200.
    g. If used for steam service:
        1) Body and disc:S1 steam bronze in accordance with ASTM B61.

B. Valves 4 inches through 24 inches:
1. Manufacturers: One of the following or equal:
    a. Kennedy, Figure 106LW or M&H, Model 159.
    b. Mueller Co., Model A-2600.
    c. APCO Model 250.
    d. Crispin SWL Series.
2. Valve design:
    a. In accordance with AWWA C508.
    b. Constructed to permit top entry and removal of internal components without removing the valve.
    c. Equipped with outside lever and weight.
3. Materials:
    a. Body: Cast iron, ASTM A126 Class B or ASTM A536 Grade 65-45-12 Ductile Iron.
    b. Disc:
        1) Valve disc shall be ASTM A126 cast iron, ASTM A536 ductile iron, or ASTM B584 bronze.
        2) 4-inch valves: Bronze or stainless steel rings and seats.
        3) 6 inches and larger valves: Bronze-faced or stainless steel rings and seats.
        4) Rubber seat Buna-N or EPDM.
    c. Hinge pins: Stainless steel.

2.03 CUSHIONED SWING CHECK VALVES (CKV20)

A. Manufacturers: One of the following or equal:
1. Crispin:
    a. Series SWC-OC for valve sizes 4-inch to 10-inch.
    b. Series SWC-BD for valve sizes 12-inch to 36-inch.
2. APCO:
    a. Series 6100 for valve sizes from 4-inch to 10-inch.
    b. Series 6000BMB for valve sizes from 12-inch to 36-inch.

B. Valve design:
   1. Counterweight:
      a. Single counterweight on sizes 4 inches to 12 inches.
         1) Mounted on the valve side indicated in the Check Valve Schedule.
      b. Dual counterweights on sizes 14 inches and larger.
   2. Disc:
      a. Single top-shaft mount with machined pin.
      b. Dual device hinge pinning on linkage arm to disc pinning.
      c. Disc seat: Bolted in replaceable seat.
      d. Shaft packing seals on both ends of body casting or O-rings.
      e. Shaft pin-shaft design for full rating of the valve fully extended through valve cast on each end of body casting.
      f. Shaft minimum sizing is:

Valve Size (inch)	8	10	12	14	16	18	20	24	30	36
Shaft Size (inch)	1.75	2.125	2.5	3 10	3.5	3.75	4	3	3.75	4

   3. Bottom-mounted hydraulic oil cushion system:
      a. Totally enclosed oil-dampening chambers with external adjustment for closing speed to permit free opening and positive non-slam controlled closure of the disc:
         1) Hydraulic cushion shall make contact with the disc during the last 10 percent of closure to control the disc until shutoff.
      b. Externally adjustable to suit operating conditions.
      c. Removable without need to remove the entire valve:
         1) Oil system shall be totally independent from the main line to prevent corrosion or contamination to the process water, side-mounted oil reservoir to be oriented in the vertical position after valve installation.

C. Materials: Valve body, cover, and disc: Ductile iron:
   1. Disc seat: As indicated in the Check Valve Schedule.
   2. Shaft: T303 high-strength stainless steel.
   3. Seat pins and lock screws: Type 316 stainless steel.

2.04 CENTER GUIDE (SILENT) CHECK VALVES (CKV60)

A. Manufacturers: One of the following or equal:
   1. APCO, CSC 600A.
   2. Crispin, GC Series.

B. Valve design:
   1. Center-guided, spring-loaded plug.
   2. Replaceable seat and plug.
   3. Shaft guide bushing.
   4. Non-slam, silent shutoff.
   5. Flanged body.

C. Materials:
   1. Body: Cast iron, ASTM A126 Grade B, or Type 316 stainless steel, ASTM A313.
   2. Plug and seat: Bronze, ASTM B584 C83600.

3. Spring: Stainless steel, ASTM A313 Type 316.
4. Shaft and bushing: Bronze, ASTM B584 C83600.
5. Seat: Buna-N or EPDM.

D. Certified hydrostatic shell and seat test report.
1. Only for valves larger than 16 inch.

2.05 DUCKBILL CHECK VALVES

A. Manufacturers: One of the following or equal:
1. Tide Flex, Series TF-1.
2. Tide Flex, Series TF-2.
3. J&S Valve Hedflex.
4. Proco Products, Inc. 700 Series.

B. Design:
1. Maximum downstream head: 0 feet.
2. With internal pressure 1 to 2 inches w.c. above backpressure, bill of valve opens, allowing flow.
3. With backpressure 1 inches w.c. above internal pressure, bill of valve closes, preventing backflow.

C. End connection:
1. Flanged.

D. Materials of construction:
1. Single piece elastomer construction with internal polyester fabric reinforcing all vulcanized into a composite material.
a. Internal reinforcing sufficient to maintain structural integrity under the specified operating conditions.
b. Exterior applications require coating for UV protection and to resist pest gnawing.
2. Elastomeric material: EPDM.

2.06 INTERIOR PROTECTIVE LININGS

A. As shown in the valve schedules and in accordance with Section 15110 - Common Work Results for Valves.

PART 3 EXECUTION

3.01 INSTALLATION

A. Flapper-type check valves:
1. Install with proper orientation of flow direction arrow on valve body or as indicated in the Manufacturer’s Recommendation (Instruction).
2. When installed in horizontal pipelines, mount with shaft on vertical locations.

3. When mounted in a vertical pipeline, directly downstream of an elbow, mount with the shaft perpendicular to the outermost portion of the elbow.
4. Mount on downstream side of discharge silencer when used on positive displacement and centrifugal blowers.

3.02 COMMISSIONING

A. As specified in Section 01756 - Commissioning and this Section.

B. Manufacturer services:
   1. Provide certificates:
      a. Manufacturer's Certificate of Installation and Functionality Compliance.

C. Functional testing:
   1. Test witnessing: Witnessed.
   2. Conduct pressure and leak test, as specified in Section 15956 - Piping Systems Testing.

END OF SECTION

SECTION 15115

GATE, GLOBE, AND ANGLE VALVES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Gate, globe (non-pilot controlled), and needle valves.

B. As specified in Section 15110 - Common Work Results for Valves.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 inch Standard.
   2. B16.47 - Large Diameter Steel Flanges: NPS 26 through NPS 60 inch Standard.

B. American Water Works Association (AWWA):
   1. C515 - Standard for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Services.
   2. C 550 - Protective Interior Coatings for Valves and Hydrants.

C. ASTM International (ASTM):
   1. B98 - Standard Specification for Copper-Silicon Alloy Rod, Bar, and Shapes.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: As specified in Section 15110 - Common Work Results for Valves.

C. Commissioning submittals: For valves larger than 16 inches:
   1. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.04 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

B. Interior epoxy coatings: Affidavit of compliance attesting that epoxy coatings applied to interior surfaces of valves comply in accordance with all provisions of AWWA C550.

PART 2 PRODUCTS

2.01 GATE VALVES - GENERAL SERVICE (GV00)

A. Gate valves aboveground:
   1. Valves less than 3 inches in size for clean water and air service:
      a. Manufacturers: One of the following or equal:
         1) Crane, Figure 431.
         2) Jenkins, Figure 47.
         3) Lunkenheimer Co., Figure 2151.
      b. Design:
         1) Size and configuration: Indicated on the Drawings.
         2) Manufacturer's standard bronze, solid wedge disc, rising stem, screwed end, Class 150 pounds.
   2. Valves 3 inches in size and larger, single disk:
      a. Manufacturers: One of the following or equal:
         1) M&H/Kennedy Valve Co.
         2) Mueller.
         3) American Flow Control, Series 2500.
      b. Design:
         1) Size, material, configuration: Indicated on the Drawings.
         2) Resilient wedge type in accordance with AWWA C515.
         3) Flange, iron body, and bonnet rated for 200-pound working pressure:
            a) Provide O-ring seal between valve body and bonnet.
         4) Ductile or cast iron wedge encapsulated in nitrile rubber and capable of sealing in either flow direction.
         5) Bronze stem with double or triple O-ring or braided packing stem seals.
         6) Rising stem configuration with handwheel diameter sized to allow opening of valve with no more than a 40-pound pull.
         7) Coat interior and exterior surfaces of valve body and bonnet with fusion-bonded epoxy in accordance with AWWA C550.
   3. Valves 3 inches in size and larger, double disc:
      a. Flanged.
      b. Materials:
         1) 200-pound iron body.
         2) Bronze mounted.
      c. Configuration:
         1) Outside screw and yoke (OS&Y).
         2) with stems of silicon bronze in accordance with ASTM B98, Alloy No. C66100.
      d. Inside configuration:
         1) Double disc; parallel seat.
         2) Handwheel.
      e. Manufacturers: One of the following or equal:
         1) M&H Valve Co., Figure 68-02.
      f. Design:
         1) Size, material, configuration: Indicated on the Drawings.

B. Gate valves underground:
   1. Manufacturers: One of the following or equal:
      a. M&H/Kennedy Valve Co.
      b. Mueller Co.
      c. American Flow Control.
   2. Design:
      a. Size, material, configuration: Indicated on the Drawings.
      b. Resilient wedge type in accordance with AWWA C515.
      c. Stem:
         1) Iron body, resilient seat, non-rising stem, double O-ring stem seal.
         2) Rising stem configuration with handwheel diameter sized to allow opening of valve with no more than a 40-pound pull.
      d. Ductile or cast iron wedge encapsulated in nitrile rubber and capable of sealing in either flow direction.
      e. Bronze stem with double or triple O-ring or braided packing stem seals.
      f. Coat interior and exterior surfaces of valve body and bonnet with fusion-bonded epoxy in accordance with AWWA C550.
      g. Valve operator: Provide standard AWWA 2-inch operating nut, matching valve key, and valve box for operating stem.

2.02 GATE VALVES - STEAM AND CONDENSATE SERVICE(GV20)

A. Valves 3 inches and smaller in size:
   1. Manufacturers: One of the following or equal:
      a. Crane, No. 428.
      b. Jenkins, Figure 47U.
      c. Lunkenheimer Co., Figure 2127.
   2. Design:
      a. Size and configuration: Indicated on the Drawings.
      b. Bronze, screwed, rising stem, solid wedge, screwed bonnet, suitable for service under pressures equal to and less than 125 pounds per square inch gauge, steam working pressure (SWP).

B. Valves larger than 3 inches in size:
   1. Manufacturers: One of the following or equal:
      a. Crane No. 465-1/2.
      b. Jenkins, Figure 651C.
      c. Lunkenheimer Co., Figure 1430.
   2. Design:
      a. Size and configuration: Indicated on the Drawings.
      b. Suitable for service under pressures equal to and less than 125 pounds per square inch gauge, steam working pressure (SWP), flanged, iron body, bronze mounted, solid wedge, outside screw and yoke (OS&Y).

2.03 KNIFE GATE VALVES (GV60)

A. Manufacturers: One of the following or equal:
   1. Non-AIS compliant valves:
      a. Dezurick KGC series.
      b. ITT Fabri-Valve, Standard C37.
      c. Pentair, Figure PCS17.

2. AIS compliant valves:
    a. ITT Fabri-Valve, C37.
    b. Dezurick Hilton, H-200 Series.

B. Design:
1. Size and configuration: Indicated on the Drawings.
2. Suitable for service under pressures equal to and less than 150 pounds per square inch gauge
3. Full round port, metal or resilient seated, raised face design.
4. Flanged wafer design drilled and tapped to ASME Class 125/150 standard. Face-to-face dimension shall meet MSS SP-81 for knife gate valves ASME B16.5 class 150, 2 to 24 inches or ASME 16.47 Series A class 150, 26 to 48 inches
5. Rounded gate with beveled edge, finish-ground to 32 RMS, maximum, on both sides. The bottom edge shall have a beveled knife edge.
6. Body to incorporate guides and jams to assist in seating.
7. Packing shall consist of multiple layers of packing.
8. Materials:
    a. Body: Cast or ductile iron or cast steel, with Type 316 stainless steel lining or cast Type 316 stainless steel or 2205 Duplex.
    b. Wetted components (including gate): Type 316 stainless steel or 2205 Duplex.
    c. Seat: Metal or NBR, EPDM, CR, Viton™.
    d. Yoke sleeve: Acid resisting bronze or aluminum bronze.
    e. Packing: PTFE.
    f. Packing gland: Match valve body material.
    g. Yoke: Type 304 stainless steel.
    h. Fasteners: Shall be stainless steel.
9. Outside screw and yoke (OS&Y) with handwheel operator.

2.04 GLOBE VALVES, NON-PILOT-CONTROLLED (GLV00 AND GLV 20)

A. Globe valves, non-pilot controlled, general (GLV00):
1. Valves 3 inches and smaller:
    a. Manufacturers: One of the following or equal:
        1) Except in welded steel piping:
            a) Crane, No. 1 Globe or No. 2 Angle.
            b) Lunkenheimer Co. Figure No. 2140 Globe or No. 2141 Angle.
        2) In Welded steel piping:
            a) Crane, No. 351.
            b) Lunkenheimer Co., Figure No. 1123; or equal with flanged ends.
    b. Design:
        1) Size and configuration: Indicated on the Drawings.
        2) Valve: Class 125 threaded ends, rated for 250 degrees Fahrenheit at pressure of 170 pounds per square inch.
2. Valves larger than 3 inches:
    a. Manufacturers: One of the following or equal:
        1) Crane, No. 351.
        2) Lunkenheimer Co., Figure No. 1123.
    b. Design:
        1) Size and configuration: Indicated on the Drawings.

B. Globe valves, non-pilot controlled, plug disc type for throttling or severe service (GLV20):
    1. Manufacturers: One of the following or equal:
        a. Crane, No. 212P or No. 384P.
        b. Lunkenheimer Co., 72-PS or 73-PS1.
    2. Design:
        a. Size and configuration: Indicated on the Drawings.
            1) Material: Iron body stainless steel trimmed plug type seat and disc.

C. Hose valves:
    1. Manufacturers:
        a. Globe threaded valve: One of the following or equal:
            1) Crane, No. 7TF.
            2) Stockham, Figure No. B22T.
        b. Angle threaded valve: One of the following or equal:
            1) Crane, No. 17TF.
            2) Stockham, Figure No. B222T.
    2. Design:
        a. Size and configuration: Indicated on the Drawings.
        b. Valve: Globe or angle valve with threaded ends.
        c. Disc: Renewable, made of Teflon™ or Buna-N.
        d. Threaded ends rated for a pressure of 200 pounds per square inch.

D. Yard hydrants:
    1. Freezeless yard hydrant:
        a. Manufacturers: One of the following or equal:
            1) Kupferle Foundry Co.
                a) No. 1 Total Eclipse Yard Hydrant - 3/4-inch and 1 inch.
            2) Murdock Company:
                a) No. M-75 - 3/4-inch or No. M100 - 1 inch.
            3) Zurn Company:
                a) No. 1385 - 3/4-inch or 1 inch.
        b. Design:
            1) Self-draining, non-freezing, compression type.
                a) Inlet connection size: Indicated on the Drawings.
                b) Outlet connection size: Indicated on the Drawings.
                c) Materials:
                    (1) Exterior casing pipe material: Indicated on the Drawings.
                    (2) Interior operating rod material: Indicated on the Drawings.
                    (3) Casing guard material: Indicated on the Drawings.
                    (4) Principal interior operating parts material: brass and/or bronze and removable from yard hydrant for servicing without excavation.
                d) Provide 4 Spoke, Ball Wheel Handle operated.
    2. Freezeless post hydrants (HYD01):
        a. Manufacturers: The following or equal:
            1) Kupferle Foundry Co.:
                a) No. 2 Eclipse Post Hydrant.
            2) Mueller Co.:
                a) No. A-411 Post Hydrant.

3) Murdock Co.:
    a) No. M-200 Post Hydrant.

b. Design:
    1) Self-draining, non-freezing, compression type with a 2-3/16-inch valve opening.
    2) Inlet connection size: Indicated on the Drawings.
    3) Outlet connection size: Indicated on the Drawings.
    4) Materials:
        a) Exterior casing pipe material: Indicated on the Drawings.
        b) Interior operating rod material: Indicated on the Drawings.
        c) Top stock material: Indicated on the Drawings.
        d) Principal interior operating parts material: Brass and/or bronze and removable from hydrant for servicing without excavation.
    5) Provide 1-1/2-inch pentagon operating nut operated by a hydrant wrench or 10-inch hand wheel:
        a) Manufacturers: The following or equal:
            (1) Kupferle Foundry Co.

2.05 NEEDLE VALVES (NV00)

A. Manufacturers: One of the following or equal:
    1. Powell, Figure No. 180.
    2. Lunkenheimer Co., Figure No. 906-BS or No. 907-BS.
    3. Crane No. 88 or No. 89.

B. Design:
    1. Size and configuration: Indicated on the Drawings.

PART 3 EXECUTION

3.01 INSTALLATION

A. Mount yard hydrants on minimum 1-inch supply pipe or size indicated on the Drawings.

B. Mount Post hydrants on minimum 2-inch supply pipe or size indicated on the Drawings.

C. Set yard and post hydrants in 4 cubic feet of 3/4-inch minimum crushed stone surrounding valve body to allow for proper drainage.
    1. Install in accordance with AWWA recommendations for hydrants.

3.02 COMMISSIONING

A. As specified in Section 01756 - Commissioning and this Section.

B. Manufacturer services: For valves larger than 16-inches.
    1. Provide certificates:
        a. Manufacturer’s Certificate of Installation and Functionality Compliance.

C. Functional testing:
    1. Valves:
        a. Test witnessing: Witnessed.
        b. Conduct pressure and leak test as specified in Section 15110 - Common Work Results for Valves.

END OF SECTION

SECTION 15116

PLUG VALVES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Non-lubricated plug valves.
   2. Lubricated plug valves.
   3. Multi-port plug valves.

1.02 REFERENCES

A. American Water Works Association (AWWA):
   1. C517 - Resilient-Seated Cast Iron Eccentric Plug Valves.
   2. C606 - Grooved and Shouldered Joints.

B. ASTM International (ASTM):
   1. A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   2. A536 - Standard Specification for Ductile Iron Castings.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures and 15110 - Common Work Results for Valves.

B. Product data as defined in 01600 - Product Requirements.

C. Shop drawings showing installation arrangement of major component assemblies.

D. Calculations.

E. Vendor operation and maintenance manual as specified in Section 01782 - Operation and Maintenance Data.

F. Commissioning submittals:
   1. Provide Manufacturer's Certificate of Source Testing as specified in Section 01756 - Commissioning:
      a. Interior coating.
   2. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.04 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

A. As specified in Section 01600 - Product Requirements and Section 15110 - Common Work Results for Valves.

2.02 NON-LUBRICATED PLUG VALVES (PV00)

A. Manufacturers: One of the following or equal:
   1. DeZurik, "PEC".
   2. Clow Valve.
   3. Milliken Valve, Model 600/601.

B. Design:
   1. Type: Non-lubricated eccentric type, in accordance with AWWA C517.
   2. Plug face: Resilient material that operates satisfactorily at a temperature of 180 degrees Fahrenheit continuous and 215 degrees Fahrenheit intermittent, except for valves in compressed air or digester gas service.
      a. Valves in compressed air service: Resilient material suitable for continuous duty at 250 degrees Fahrenheit.
      b. Valves in digester gas service: Resilient material suitable for petroleum or digester gas at continuous duty at 180 degrees Fahrenheit.
   3. Compression washer: Provide flat compression washer made of Teflon™, or of a material having equal physical characteristics on valve stem between plug and bonnet.
   4. Stem seals: Provide stem seals serviceable without unbolting the valve bonnet assembly.
   5. Grit excluders: Provide PTFE grit excluders at upper plug journals to prevent entry of foreign solids in bearing area.
   6. Clearly mark valves to indicate their open and closed positions.
   7. Provide valves with ends as required by piping details indicated on the Drawings.
      a. Grooved end body valves:
         1) Usage: Plug valves with grooved ends may be used in piping systems specified in the Piping Schedule to have grooved end joints and as indicated on the Drawings.

C. Materials:
   1. Body and plug: ASTM A126, Class B, cast-iron, with plug face of Viton™ material suitable for the intended service as specified under paragraph "Design" above.
   2. Body seats in valves 3 inch size and larger: Provide with overlay of not less than 90-percent nickel and minimum thickness of 1/8-inch on surfaces contacting the plug face.
   3. Stem bearing and bottom bearing: Type 316 stainless steel.
   4. Internal parts, except the body and plug: Type 316 stainless steel.
   5. Exposed nuts, bolts, and washers: Zinc plated. Exception: Exposed nuts, bolts, and washers for buried service: Stainless steel.

2.03 NON-LUBRICATED PLUG VALVES, FULL PORT (PV05)

A. Manufacturers: One of the following or equal:
   1. DeZurik, PEF.
   2. Clow Valve.
   3. Milliken, 601F/600F.

B. Design:
   1. Type: Non-lubricated eccentric type, in accordance with AWWA C517.
   2. Plug face: Resilient material that operates satisfactorily at a temperature of 180 degrees Fahrenheit continuous and 215 degrees Fahrenheit intermittent, except for valves in compressed air or digester gas service.
      a. Valves in compressed air service: Resilient material suitable for continuous duty at 250 degrees Fahrenheit.
      b. Valves in digester gas service: Resilient material suitable for petroleum or digester gas at continuous duty at 180 degrees Fahrenheit.
   3. Compression washer: Provide flat compression washer made of Teflon™, or of a material having equal physical characteristics on valve stem between plug and bonnet.
   4. Stem seals: Provide stem seals serviceable without unbolting the valve bonnet assembly.
   5. Grit excluders: Provide PTFE grit excluders at upper plug journals to prevent entry of foreign solids in bearing area.
   6. Clearly mark valves to indicate their open and closed positions.
   7. Provide valves with ends as required by piping details indicated on the Drawings.
      a. Grooved end body valves:
         1) Usage: Plug valves with grooved ends may be used in piping systems specified in the Piping Schedule to have grooved end joints and as indicated on the Drawings.
         2) Grooved end joint design: In accordance with AWWA C606.

C. Materials:
   1. Body and plug: ASTM A126, Class B, cast-iron, with plug face of Viton™ material suitable for the intended service as specified under paragraph "Design" above.
   2. Body seats in valves 3 inch size and larger: Provide with overlay of not less than 90-percent nickel and minimum thickness of 1/8-inch on surfaces contacting the plug face.
   3. Stem bearing and bottom bearing: Type 316 stainless steel.
   4. Internal parts, except the body and plug: Type 316 stainless steel.
   5. Exposed nuts, bolts, and washers: Zinc plated. Exception: Exposed nuts, bolts, and washers for buried service: Stainless steel.

2.04 LUBRICATED PLUG VALVES (PV60)

A. Manufacturers: One of the following or equal:
   1. Nordstrom, Super Nordstrom.
   2. Walworth.

B. Type: Semi-steel tapered plug valves.

C. Design:
   1. Plug removable through top of valve.
   2. Combined lubricant screw and grease gun fitting, of the type where the pressure of the grease can be used to raise the plug slightly off its seat.

D. Where indicated on the Drawings or specified, provide plug valves with high head extension and floor stand with indicator. Provide worm gear-operated valves with worm shaft extension and floor stand, and with indicator supplied by manufacturer of plug valve:
   1. Equip floor stands serving plug valves with individual operating wrenches.

2.05 MULTI-PORT PLUG VALVES FOR SLUDGE SERVICE (PV80)

A. Manufacturers: One of the following or equal:
   1. DeZurik, PTW, for 3-way valve, and PFW for 4-way valve.
   2. Milliken, equivalent product.

B. Design: Non-lubricated tapered plug type including plugs faced with neoprene, body of cast iron, and stainless steel bearings in the upper and lower journal areas.

C. Furnish valves with single, double, or transfer style plug as indicated on the Drawings or as required.

2.06 VALVE OPERATORS

A. Furnish valves with an operating wrench or worm gear operator:
   1. Equip valves 4-inch nominal size and smaller with a lever operator.
   2. Equip valves 6-inch nominal size and larger with a worm gear operator.

2.07 COATING

A. Coat and test interior metal surfaces as specified in Section 15110 - Common Work Results for Valves.

B. Field applied coating of valve exterior:
   1. Match color and be compatible with manufacturer’s coating system and as specified in Section 09960 - High-Performance Coatings.
      a. When shop applied finish coating matches field applied coating on adjacent piping, touch up shop coating in damaged areas in accordance with instructions recommended by the paint manufacturer.
      b. When shop applied coating does not match field coating on adjacent piping, or when damage has occurred to the shop applied coating that requires more than touchup, blast clean valve surfaces or utilize other surface preparation recommended by the manufacturer of the coating material and apply the coating system used for coating adjacent piping.

2.08 SHIPMENT, SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS

A. As specified in Section 01600 - Product Requirements.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install valves as specified in Section 15110 - Common Work Results for Valves and the manufacturer's instructions.
   1. Unless differently indicated on the Drawings install valves so that in the closed position the pressure in the pipeline applies a seating head on the valves.
   2. Install valves so that in the open position the plug is located in the top half of the valve body.

B. For valves requiring lubrication: Lubricate and fill extended lubricant pipes with lubricant suitable for service intended.

3.02 COMMISSIONING

A. As specified in Section 01756 - Commissioning and this Section.

B. Manufacturer services:
   1. Provide certificates:
      a. Manufacturer's Certificate of Installation and Functionality Compliance.

C. Functional testing:
   1. Valves:
      a. Test witnessing: Witnessed.
      b. Conduct pressure and leak test as specified in Section 15110 - Common Work Results for Valves.

END OF SECTION

SECTION 15117

SPECIALTY VALVES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Specialty valves.

B. As specified in Section 15110 - Common Work Results for Valves.

1.02 REFERENCES

A. American Society of Civil Engineers (ASCE):
   1. 25 - Earthquake-Actuated Automatic Gas Shutoff Devices.

B. American Society of Mechanical Engineers (ASME):
   1. B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

C. American Water Works Association (AWWA):
   1. C511 - Standard for Reduced Pressure-Principle Backflow-Prevention Assembly.
   2. C800 - Underground Service Line Valves & Fittings (Also Included: Collected Standards For Service Line Materials).

D. ASTM International (ASTM):
   1. A48 - Standard Specification for Gray Iron Castings.
   2. A126 - Standard Specification for Gray Iron Casting for Valves, Flanges, and Pipe Fittings.
   3. A276 - Standard Specification for Stainless Steel Bars and Shapes.
   4. A536 - Standard Specification for Ductile Iron Castings.
   5. B584 - Standard Specification for Copper Alloy Sand Castings for General Application.

E. National Electrical Manufacturers Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: As specified in Section 15110 - Common Work Results for Valves.

C. Commissioning submittals:
   1. Backflow preventer certification.
   2. Provide Manufacturer’s Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.04 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 RESERVOIR (ALTITUDE) CONTROL VALVES

A. Manufacturers: One of the following or equal:
   1. ~~Cla~~Cal-Val Co., 131-0~~6~~6.[AD5]

B. Operation:
   1. Altitude control: Close at high water level and allow filling at levels less than high water level.
      a. Range of height control: 1 to 25.
      b. Factory setting of the valve shall be 24.5 feet.
   2. Flow direction: 1 way.
   3. Pressure reducing control: Reduce pressure on downstream side of valve.
      a. Valve factory setting: 30 feet.
      b. Pressure reducing setting shall be manually adjustable.
   4. Suitable at rated working pressure of 250 pounds per square inch.

C. Design:
   1. Maximum pressure: 250 pound per square inch.
      a. Valve Manufacturer to provide anti-cavitation trim if pressure drop causes cavitation.
   2. Maximum continuous flow: 1,400 gallons per minute.
   3. Minimum continuous flow: 600 gallons per minute.
   4. Pattern: Globe.
   5. Control:
      a. Hydraulic pilot control, valve shall have solenoid pilot override; coordinate with electrical drawings for details of override control.
      b. Valve shall close when high level has been reached, and shall open when a lower set point has been reached:
         1) Initial setpoint: 1 to 26 feet.
      c. Valve shall have the ability to modulate to maintain desired flow through valve.
         1) Flow rate shall be adjustable in SCADA.
   6. Pilot valve strainer.
   7. Adjustable pilot valve with stainless steel trim.
   8. Flanged ends.
   9. Reservoir sensing line: Shall be minimum 3/4-inch copper tubing.
   10. Electric Valve position indicator.
   11. Pilot insulation. Provide insulation to protect control valve pilots from freezing.

D. Materials:
   1. Valve body: Cast or ductile iron.
   2. Body trim: Bronze.
   3. Stem, nut, and spring: Type 303 stainless steel.
   4. Disc guide, seat and cover bearing: Type 304 or Type 316 stainless steel.
   5. Diaphragm: Buna-N rubber.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install as specified in Section 15110 - Common Work Results for Valves in accordance with manufacturer's published instructions.

B. Install with a minimum clearance of 12 inches and with maximum clearance of 30 inches between the relief port and the floor or finished grade or top of containment wall.

C. Plastic body diaphragm valves for sodium hypochlorite service:
   1. When valves are installed horizontally, install valves with valve stem position rotated as necessary such that no internal valve obstruction prevents the passage of vapors traveling along the top of adjacent piping from traveling through the valve.

D. Backflow preventers:
   1. Install with a minimum clearance of 12 inches and with maximum clearance of 30 inches between the relief port and the floor or finished grade or top of containment wall.
   2. Install with sufficient side clearance for access for testing and maintenance.

3.02 COMMISSIONING

A. As specified in Section 01756 - Commissioning and this Section.

B. Manufacturer services:
   1. Provide certificates:
      a. Manufacturer’s Certificate of Installation and Functionality Compliance.
   2. Manufacturer’s Representative onsite requirements:
      a. For the following valves:
         1) Altitude valves and flow control valves.
      b. Installation: 1 trip, 1 day minimum.
      c. Functional Testing: 1 trip, 1 day minimum each.
      d. Training:
         1) Maintenance: 2 hours per session, 2 sessions.
         2) Operations: 2 hours per session, 2 sessions.

C. Functional testing:
    1. Altitude valves:
        a. Test witnessing: Witnessed.
        b. Conduct pressure and leak test as specified in Section 15110 - Common Work Results for Valves.
    2. Flow control valves:
        a. Test witnessing: Witnessed.
        b. Conduct pressure and leak test as specified in Section 15110 - Common Work Results for Valves.

END OF SECTION

[AD5] Addendum No. 5

SECTION 15118

PRESSURE CONTROL VALVES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Pressure reducing and pressure relief valves for water, air, sludge, and chemical service.

B. As specified in Section 15110 - Common Work Results for Valves.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

B. ASTM International (ASTM):
   1. A536 - Standard Specification for Ductile Iron Castings.

C. Underwriters Laboratories, Inc. (UL).

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: As specified in Section 15110 - Common Work Results for Valves.

C. Commissioning submittals:
   1. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.04 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 METAL BODY PRESSURE REDUCING VALVES - WATER SERVICE (PRV00)

A. Metallic pressure reducing valves for water service, 2 1/2 inches and smaller:
   1. Manufacturers: One of the following or equal:
      a. Watts, Series LF223.
      b. Zurn Wilkins, 500 Series.
   2. Direct operated, single seat type pressure reducing valve.
   3. Downstream pressure adjustment range: 30 to 300 pounds per square inch gauge (psig).

4. Materials:
    a. Body and spring cover: Bronze or brass alloy meeting the zinc and aluminum requirements of Section 15110 - Common Work Results for Valves.
    b. Valve seat: Series 300 stainless steel.
    c. Diaphragm: Match the gasket/elastomer material of the corresponding piping system, as specified in the Piping Schedule.
    d. Disk: Match the gasket/elastomer material of the corresponding piping system, as specified in the Piping Schedule.

B. Metallic pressure reducing valves for water service, 3 inches and larger:
1. Manufacturers: One of the following, or equal:
    a. Watts, Ames Fire & Waterworks ACV Series LF910GD.
    b. Cla-Val Model 90-01.
2. Design:
    a. Pilot controlled, hydraulically operated, diaphragm actuated, globe patterned valve.
    b. Rated for the test pressure of the corresponding piping system, as specified in the Piping Schedule.
    c. Downstream pressure adjustment range: 30 to 300 psig.
    d. Pilot line: Equipped with a strainer.
    e. Flanges: Class 150, in accordance with ASME B16.42.
3. Materials:
    a. Body and cover: Ductile Iron ASTM A536.
    b. Valve trim: Bronze.
    c. Pilot control: Cast bronze with Type 303 stainless steel trim.
    d. Diaphragm: Match the gasket/elastomer material of the corresponding piping system, as specified in the Piping Schedule.

2.02 METAL BODY PRESSURE RELIEF AND BACKPRESSURE SUSTAINING VALVES - WATER SERVICE (PRV20)

A. Metallic pressure relief valves for water service, 1 inches and smaller:
1. Manufacturers: One of the following, or equal:
    a. Cla-Val Model CRL-60.
2. Design:
    a. Direct-acting, spring loaded, diaphragm type relief valve.
    b. Pressure relief adjustment range: 20 to 200 psig.
3. Materials:
    a. Body and spring cover: Bronze or brass alloy meeting the zinc and aluminum requirements of Section 15110 - Common Work Results for Valves.
    b. Valve seat: Type 303 stainless steel.
    c. Diaphragm: Match the gasket/elastomer material of the corresponding piping system, as specified in the Piping Schedule.
    d. Disk: Match the gasket/elastomer material of the corresponding piping system, as specified in the Piping Schedule.

B. Metallic pressure relief valves for water service, 1 1/2 inches and larger:
   1. Manufacturers: One of the following, or equal:
      a. Watts, Ames Fire & Waterworks ACV Series LF920GD.
      b. Cla-Val Model 50-01 KO.
   2. Design:
      a. Pilot controlled, hydraulically operated, diaphragm actuated, globe patterned valve.
      b. Rated for 125 pounds per square inch gauge, minimum, or higher pressure rating if necessary to meet the test pressure of the corresponding piping system, as specified in the Piping Schedule.
      c. Pressure relief adjustment range: 20 to 200 psig.
      d. Pilot line: Equipped with a strainer.
      e. End connections:
         1) 2 1/2 inch and smaller: Screwed.
         2) 3 inch and larger: Class 150 flanges in accordance with ASME B16.42.
      f. Anti-cavitation trim.
   3. Materials:
      a. Body and cover: Ductile Iron ASTM A536.
      b. Valve trim: Bronze.
      c. Pilot control: Cast bronze with Type 303 stainless steel trim.
      d. Diaphragm: Match the gasket/elastomer material of the corresponding piping system, as specified in the Piping Schedule.

2.03 PLASTIC BODY PRESSURE REDUCING VALVES - CHEMICAL OR WATER SERVICE (PRV40)

A. Manufacturers: One of the following or equal:
   1. Plast-O-Matic: Series PRHM.

B. Materials:
   1. Valve body:
      a. PVC piping systems: PVC.
      b. CPVC piping systems: CPVC.
      c. HDPE and PE piping systems: PVC.
   2. U-cups:
      a. Match gasket/elastomer material of corresponding piping system, as indicated on the Piping Schedule.
   3. Non-wetted metallic components: Stainless steel.

C. Design:
   1. Diaphragm type.
   2. Pressure rating: Not less than 150 pounds per square inch.
   3. In-line or angle pattern design, size as indicated on the Drawings.
   4. End connections: Threaded.
   5. Downstream pressure set point:
      a. Externally adjustable without removing valve from piping system.
      b. Adjustable from 5 to 125 psig.

2.04 PLASTIC BODY PRESSURE RELIEF VALVES FOR CHEMICAL OR WATER SERVICE (PRV24)

A. Manufacturers: One of the following or equal:
   1. Plast-O-Matic, Series RVT, RVDT or TRVDT.
   2. Asahi/America.
   3. Georg Fischer Piping Systems.

B. Materials:
   1. Valve body:
      a. PVC piping systems: PVC.
      b. CPVC piping systems: CPVC.
      c. HDPE and PE piping systems: PVC.
   2. U-cup seals:
      a. Match gasket/elastomer material of corresponding piping system, as specified in the Piping Schedule.
   3. Adjusting bolt, locknut, control spring and fasteners: stainless steel.

C. Design:
   1. Pressure rating: Not less than 150 pounds per square inch.
   2. In-line or angle pattern design, size as indicated on the Drawings.
   3. End connections:
      a. 1 inch and smaller: Threaded.
      b. Larger than 1 inch: Flanged.
   4. Relief set point:
      a. Externally adjustable without removing valve from piping system.
      b. Adjustment range:
         1) Valve sizes 2 inches and smaller: 5 to 125 psig.
         2) Valve sizes 3 inches and larger: 5 to 100 psig.
      c. For chemical pump discharge applications, set valve to open at 10 pounds per square inch more than pump discharge pressure at maximum operating point, or as indicated on the Drawings.

2.05 METAL BODY AIR PRESSURE REGULATING VALVES (PRV30 AND PRV35)

A. Air pressure regulating valves for instrument air systems (PRV35):
   1. Manufacturers: One of the following, or equal:
      a. Emerson, Fisher Series 67CFR.
      b. Rotork, Fairchild Industrial Products Company Model 65A.
   2. Design:
      a. Inlet pressure rating: Not less than 250 pounds per square inch gauge.
      b. Inlet and outlet ports: Tapped, 1/4-inch diameter.
      c. Internal pressure relief capability for minor seat leakage.
      d. Integral 40 micron filter.
      e. Drain valve at low point of body.
      f. Provide pressure gauge integrally mounted on the valve:
         1) Gauge units: Pounds per square inch gauge.
         2) Gauge range: Upper end of range approximately 150 percent of output pressure.

3. Materials:
    a. Body: Aluminum.
    b. Diaphragm and o-rings: Nitrile.
    c. Filter element: Stainless steel.
4. Output pressure:
    a. As required for the application as determined by the manufacturer of the instrument receiving the regulated air.
    b. Pressure range: As follows for the required output pressure:
        1) Output pressure 20 pounds per square inch gauge, range 1 to 30.
        2) Output pressure 30 pounds per square inch gauge, range 1 to 60.
        3) Output pressure 40 pounds per square inch gauge, range 1 to 60.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install as specified in Section 15110 - Common Work Results for Valves.

3.02 COMMISSIONING

A. As specified in Section 01756 - Commissioning and this Section.

B. Manufacturer services:
    1. Provide certificates:
        a. Manufacturer's Certificate of Installation and Functionality Compliance.

C. Functional testing:
    1. Valves:
        a. Test witnessing: Witnessed.
        b. Conduct pressure and leak test as specified in Section 15110 - Common Work Results for Valves.

END OF SECTION

SECTION 15119

AIR AND VACUUM RELIEF VALVES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Air release valves, air and vacuum valves, and air vents.

B. As specified in Section 15110 - Common Work Results for Valves.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
   2. B16.5 Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.

B. American Water Works Association (AWWA).

C. ASTM International (ASTM):
   1. A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   2. A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   3. A270 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Sanitary Tubing.
   4. B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: As specified in Section 15110 - Common Work Results for Valves.

C. Commissioning submittals:
   1. Provide Manufacturer’s Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

1.04 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bond.

PART 2 PRODUCTS

2.01 METAL BODY AIR RELEASE VALVES - WATER SERVICE (ARV00)

A. Manufacturers: One of the following or equal:
   1. Valve and Primer Corp., DeZURIK/APCO Series 200.
   2. Multiplex Manufacturing Co., Crispin PL Series.

B. Design:
   1. Pressure rating: Suitable for service under operating pressures equal to and a minimum ANSI Class 150 unless differently indicated on the Drawing.
   2. Inlet: Screwed, 2-inch.
   3. Orifice size: 1/4-inch diameter.

C. Materials:
   1. Valve body: Cast iron.
   2. Float and internal trim: Type 316 stainless steel.
   3. Seat or valve plunger: Buna-N.

2.02 METAL BODY AIR AND VACUUM VALVES - WATER SERVICE (AVV00)

A. Manufacturers: One of the following or equal:
   1. Valve and Primer Corp., DeZURIK/APCO Series 140.
   2. Multiplex Manufacturing Co., Crispin A Series.

B. Design:
   1. Minimum performance requirements:
      a. Air in-flow through valve: Not less than 2 standard cubic feet per second.
      b. Air exhaust through valve: Not less than 5 standard cubic feet per second.
   2. Pressure rating: Suitable for service under operating pressures equal to and a minimum ANSI Class 150.
   3. Inlet: Screwed, size as indicated on Drawings.

C. Materials:
   1. Body: Ductile iron.
   2. Float: Type 304 stainless steel.
   3. Plug and Seat: Brass bushing.

2.03 METAL BODY COMBINATION AIR VALVES - WATER SERVICE (CAV00)

A. Manufacturers: One of the following or equal:
   1. Valve and Primer Corp., DeZURIK/APCO, Series 140C.
   2. Multiplex Manufacturing Co., Crispin UL Series.

B. Design:
   1. Operation: Automatic exhaust of large quantities of air from pipelines during filling and draining and release of accumulated air while pipeline is under pressure.
   2. Utilize compound lever system in conjunction with large and small orifices.
   3. Internal parts removable through top cover without removing valve from pipeline.

4. Pressure rating: ANSI Class 150
5. Inlet: Screwed, size as indicated on Drawings.

C. Materials:
1. Body: Ductile iron.
2. Float: Type 316 stainless steel.
3. Needle: Buna-N.
4. Lever frame: Cast iron or Delrin.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install as specified in Section 15110 - Common Work Results for Valves and manufacturer’s instructions.

B. Install air release valves and air and vacuum valves with suitable discharge lines to nearest drainage system.

3.02 COMMISSIONING

A. As specified in Section 01756 - Commissioning and this Section.

B. Manufacturer services:
1. Provide certificates:
a. Manufacturer's Certificate of Installation and Functionality Compliance.

C. Functional testing:
1. Valves:
a. Test witnessing: Witnessed.
b. Conduct pressure and leak test as specified in Section 15110 - Common Work Results for Valves.

END OF SECTION

SECTION 15120

PIPING SPECIALTIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Piping specialties including:
   1. Flexible rubber connections.
   2. Bellows type expansion joints.
   3. Rubber expansion joints.
   4. Transition fittings.
   5. Pipe couplings for stainless steel piping.
   6. Pipe saddles.
   7. Chemical Injector/Diffuser.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24.

B. American Water Works Association (AWWA):
   1. C110 - Standard for Ductile-Iron and Gray-Iron Fittings.
   2. C151 - Standard for Ductile-Iron Pipe, Centrifugally Cast.

C. ASTM International (ASTM):
   1. A148 - Standard Specification for Steel Castings, High-Strength, for Structural Purposes.
   2. A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
   3. A194 - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   4. A536 - Standard Specification for Ductile Iron Castings.

D. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects, Includes Errata.
   2. 372 - Drinking Water System Components - Lead Content.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. For each piping product in this Section as applicable:
      a. Design features.
      b. Load capacities.

c. Material designations by UNS alloy number or ASTM Specification and Grade.
d. Data needed to verify compliance with the Specifications.
e. Catalog data.
f. Clearly mark submittal information to show specific items, materials, and accessories or options being furnished.

C. Calculations:
1. Provide calculations in accordance with NSF 372 for materials in contact with drinking water.

D. Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning:
1. Provide as specified in this Section.

1.04 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

A. As specified in Section 01600 - Product Requirements.

B. Materials in contact with drinking waters: In accordance with NSF 61 and NSF 372.

2.02 FLEXIBLE RUBBER CONNECTIONS

A. Manufacturers: One of the following or equal:
1. Mercer Rubber Co., Type 150 Vibraflex.
2. Red Valve Co., Inc., Part Number P-5.

B. Provide flexible rubber connections with 3/8 inch thick Viton™ rubber tube with full-faced flanged ends suitable to withstand a pressure of 150 pounds per square inch gauge.

C. Provide complete flexible rubber connections, including galvanized retaining rings and control rods.

2.03 BELLOWS TYPE EXPANSION JOINTS

A. Expansion joints for general service:
1. Expansion joints: Flexible bellows type, or as otherwise specified or indicated on the Drawings.
2. Manufacturers:
a. Expansion joints: One of the following or equal:
1) Senior Flexonics Pathway, Inc., Controlled Flexing Expansion Joint.
2) Flex-Weld, Inc., Keflex, Series 308.
3) Victaulic, Depend-o-Lok, Omniflex stainless bellows expansion joint.

b. Pipe alignment guides: One of the following or equal:
   1) Senior Flexonics Pathway, Inc.
   2) Flex-Weld, Inc.
c. Intermediate supports: Provide with protective saddles. One of the following or equal:
   1) Unistrut Corporation, Roller-type.
   2) Bergen-Paterson Pipe Support Corp.

3. Design:
   a. Expansion joint rating: 150 pounds per square inch gauge, at 300 degrees Fahrenheit.
   b. Bellows: Multi-ply (3 ply minimum) stainless steel, equipped with a self-draining liner guide.
   c. Axial travel of expansion joints: Not less than 1.50 inches.
   d. Ends: 150 pound ASME flanges, Victaulic, Depend-o-Lok Airmaster/Fluidmaster coupled ends, or plain suitable for welding connections, as required for piping in which installed.

B. Expansion joints for steam and hot water:
1. Manufacturers: One of the following or equal:
   a. Flex-Weld, Inc., Keflex, Series 308-1215.
   b. Senior Flexonics Pathway, Inc., Controlled Flexing Expansion Joint.
   c. Victaulic, Depend-o-Lok Omniflex Expansion Joint.
2. Design:
   a. Single reinforced bellows type or Victaulic mechanical couplings.
   b. Pressure and temperature ratings: 150 pounds per square inch gauge, and 500 degrees Fahrenheit service.
   c. Bellows: Multi-ply (3 ply minimum) Type 321 stainless steel, equipped with a Type 321 stainless steel liner.
   d. Axial travel of expansion joints: 3 inches minimum.
   e. Ends: 150 pound ASME flanges.

C. Copper piping expansion joints:
1. Expansion joints for copper pipe: As specified before, except externally guided, and provide for 3-1/4 inch expansion per 100 feet of piping.

D. Roof drain expansion joints:
1. Neoprene bellows between roof drain fitting and drain piping.
2. Up to 12-inch static head.
3. Complete with Type 316 stainless steel clamps.
4. Manufacturers: One of the following or equal:
   a. Watts, Model RD-900.
   b. Flexicraft Industries, DWV.

2.04 RUBBER EXPANSION JOINTS

A. Manufacturers: One of the following or equal:
1. Mercer Rubber Co., Style 500 or 700.
2. Red Valve Co., Inc., Type J-1.
3. Proco Products, Inc., Series 230 or 240.

B. Provide rubber expansion joints complete with control units and split retaining rings.

C. Design:
   1. Material: Neoprene rubber, reinforced with embedded steel rings, and a strong synthetic fabric.
   2. Expansion rings, suitable for pressures of at least 125 pounds per square inch gauge, except as follows:
      a. Expansion joints in pump suction piping and where indicated on the Drawings suitable for minimum 90 pounds per square inch gauge pressure, and minimum 30 inches mercury vacuum.
      b. Ends of expansion joints, 150 pound ASME flanges with drilling to match that of the piping.
   3. Bolts, nuts, control rods/plates, and retaining rings shall be galvanized steel unless otherwise specified.
   4. Bolts, nuts, control rods/plates, and retaining rings for low pressure air systems provide materials matching the piping system.
   5. Bolts, nuts, control rods/plates, and retaining rings submerged in water or wastewater, buried, in wet vaults or structures, adjacent to wet walls, or above open water-containing structures shall be Type 316 stainless steel in accordance with ASTM A193, Grade B8M for bolts and in accordance with ASTM A194, Grade 8M for nuts.

D. Rubber expansion joints for blowers: Butyl type rubber formulated for service application and for maximum temperature of 250 degrees Fahrenheit, suitable for minimum 40 pounds per square inch gauge pressure, and minimum 15 inches mercury vacuum.

2.05 TRANSITION FITTINGS

A. Manufacturers: One of the following or equal:
   1. Spears.

B. Materials:
   1. Slip socket: Schedule 80 PVC.
   2. Collar: Type 316 stainless steel.
   3. Threaded insert: Brass.

2.06 FLANGES: CARBON STEEL PIPE SADDLES

A. For ductile iron pipe:
   1. Double strap brass type.
   2. Manufacturers: One of the following or equal:
      a. A.Y. McDonald, Style 3825.
      b. The Ford Meter Box Company, Style 202B.
      c. Mueller Company, Style BR2B.
   3. Materials:
      a. Pipe saddle body, straps, and nuts: Brass or silicon bronze.
      b. Gaskets: Rubber.

B. For PVC C900 or C905 pipe:
   1. Manufacturers: One of the following or equal:
      a. Smith-Blair, Inc., Style 317.
      b. Romac Industries, Inc., Style 202S.
   2. Materials:
      a. Pipe saddles: Ductile iron with fusion bonded epoxy finish.
      b. Straps, bolts, and nuts: Type 304 stainless steel with Teflon™ coating on nuts.
      c. Gaskets: Rubber TAPPING SLEEVES.

C. Manufacturers: One of the following or equal:
   1. Smith-Blair, Inc., Style 622.
   2. Romac Industries, Inc., Style FTS 420.

D. Materials:
   1. Tapping sleeves: Steel construction.
   2. Bolts and nuts: Type 304 stainless steel.
   3. Nuts: Teflon™ coated.
   4. Gaskets: Rubber.
   5. Size of tapped boss: As indicated on the Drawings.

2.07 CHEMICAL INJECTOR/DIFFUSER

A. Design:
   1. Chemical Injector/Diffuser:
      a. Injector configuration: Single feed point into center of water main.
   2. Heavy duty brass corporation stop or stainless steel ball valve:
      a. Thread connection shall be NPT or AWWA inlet.
      b. Corporation stop must include a safety device to prevent accidental withdrawal of Injection/Diffuser solution tube.
   3. Injector/Diffuser solution tube sized to match pump discharge line or injection flow rate:
      a. Tube shall extend 1/3 to 1/2 diameter of water main into center of main.
      b. Able to safely withdraw or insert injector/diffuser tube into center of water main while under pressure and without having to shut down the main.
      c. Ball check valve located on injector/diffuser solution tube.
      d. Stainless steel safety chain located on injector/diffuser solution tube.

B. Materials:
   1. Injector/Diffuser: Compatible with chemical solution.

C. Manufacturers: The following or equal:
   1. Saf-T-Flo.

2.08 SHIPPING

A. As specified in Section 01600 - Product Requirements.

PART 3 EXECUTION

3.01 GENERAL

A. As specified in Section 01600 - Product Requirements.

B. Drawings supersede conflicts with this Section.

C. Bellows type expansion joints and vibration control joints:
   1. Protect joints against damage during pressure test.

3.02 INSTALLATION

A. Transition couplings:
   1. Application:
      a. Use transition couplings with function and design similar to flexible couplings and flanged coupling adapters for connecting piping having different outside diameters.
   2. Install transition-coupling products specifically designed and manufactured for that application.

B. Pipe saddles:
   1. Coat threads on bolts with anti-gall coating prior to installation.

C. Tapping sleeves:
   1. Verify existing pipe material and outer diameter prior to ordering materials.
   2. Large diameter pipe:
      a. Verify the existence of lining material.
      b. Verify lining material type.
      c. Repair lining after hot tap operations are complete with similar lining or equal.
      d. Demonstrate ability to accomplish hot tap by staging a dry run simulation of the procedure prior to the initiation of the hot tap procedure:
         1) Walk through each step of the hot tap installation, and show the Engineer every component needed to install the hot tap, including but not limited to, tools and materials, to ensure that all the required components are on-site and in place prior to beginning the procedure.
   3. Coat threads on bolts with anti-gall coating prior to installation.

D. Spray nozzles:
   1. Install spray nozzles so that elevation of the nozzles is 18 inches above the water surface.

3.03 COMMISSIONING

A. As specified in Section 01756 - Commissioning and this Section.

B. Manufacturer services:
   1. Required only for:
      a. Transition couplings.
      b. Tapping sleeves for large diameter pipe.
   2. Provide Manufacturer's Certificate of Installation and Functionality Compliance.
   3. Provide Manufacturer's Representative Onsite:
      a. Installation: 2 trip/1 day each:
         1) Installation consultation and advice.
         2) Installation inspection.

C. Field testing:
   1. As specified in Section 15052 - Common Work Results for General Piping.
   2. Protect bellows type expansion joints and vibration control joints.

END OF SECTION

SECTION 15121

PIPE COUPLINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Pipe couplings for ductile iron piping.
   2. Pipe couplings for carbon steel piping.
   3. Pipe couplings for stainless steel piping.

1.02 REFERENCES

A. American National Standards Institute (ANSI).

B. American Society of Mechanical Engineers (ASME):
   1. B31.1 - Power Piping.
   2. B31.9 - Building Services Piping.

C. American Water Works Association (AWWA):
   1. C111 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   2. C207 - Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 In. Through 144 In.
   3. C213 - Standard for Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings.
   4. C606 - Standard for Grooved and Shouldered Joints.

D. ASTM International (ASTM):
   1. A36 - Standard Specification for Carbon Structural Steel.
   2. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
   3. A193 - Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
   4. A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   5. A351 - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
   6. A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/9 ksi Minimum Tensile Strength, General Use.
   7. A536 - Standard Specification for Ductile Iron Castings.
   8. A563 - Standard Specification for Carbon and Alloy Steel Nuts.
   9. A576 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.

10. C425 - Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
11. C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
12. C564 - Standard Specification for Rubber Gasket for Cast Iron Pipe and Fittings.
13. C1173 - Standard Specification for Flexible Transition Couplings for Underground Piping Systems.
14. D1869 - Standard Specification for Rubber Rings for Asbestos-Cement Pipe.
15. D2000 - Standard Classification System for Rubber Products in Automotive Applications.
16. D5926 - Standard Specification for Poly (Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems.
17. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
18. F594 - Standard Specification for Stainless Steel Nuts.

E. NSF International (NSF):
1. 61 - Drinking Water System Components - Health Effects.
2. 372 - Drinking Water System Components - Lead Content.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data:
1. For each product in this Section as applicable:
a. Design features.
b. Load capacities.
c. Material designations by UNS alloy number or ASTM Specification and Grade.
d. Data needed to verify compliance with the Specifications.
e. Catalog data.
f. Clearly mark submittal information to show specific items, materials, and accessories or options being furnished.

C. Calculations:
1. Provide calculations in accordance with NSF 372 for materials in contact with drinking water.

1.04 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

A. As specified in Section 01600 - Product Requirements:
   1. Materials in contact with drinking waters: In accordance with NSF 61 and NSF 372.

B. Known acceptable manufacturers are listed by specific products.

C. Provide references as specified in this Section by specific product.

D. Manufacturer's representatives' requirements as specified in Section 01756 - Commissioning and this Section by specific product.

E. Gaskets for flexible couplings and flanged coupling adapters:
   1. Provide gasket materials for piping applications as follows:
      a. Low-pressure and high-pressure air, steam, hot water: EPDM.
      b. All other piping applications: Neoprene rubber or Buna-N.

F. Exterior coatings for underground and submerged applications:
   1. Manufacturers: One of the following or equal:
      a. Tapecoat Co., Inc., T.C. Mastic.
      b. Kop-Coat Co., Inc., Bitumastic Number 50.
   2. Thickness: Minimum 0.040 inch.

2.02 PIPE COUPLINGS FOR DUCTILE IRON PIPING

A. Dismantling joints:
   1. Manufacturers: One of the following or equal:
      a. Romac Ind., Inc., Style DJ400.
      b. Smith-Blair, Inc., Series 975.
   2. Materials:
      a. Flanged spool: AWWA C207 steel pipe:
         1) ASTM A53 for sizes 3 inches to 12 inches.
         2) ASTM A36 for sizes 14 inches to 72 inches.
      b. End ring and body:
         1) For sizes 3 inches to 12 inches, ductile iron in accordance with ASTM A536.
         2) For sizes 14 inches to 72 inches, steel in accordance with ASTM A36 or A53.
      c. Follower ring: Ductile iron in accordance with ASTM A536.
      d. Bolts and hex nuts:
         1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
         2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F593.
      e. Tie rods: High tensile steel in accordance with ASTM A193 Grade B7.

3. Flange design: Class D steel ring flange in accordance with AWWA C207, compatible with ANSI Class 125 and 150 bolt circles.
4. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.

B. Flanged coupling adapters: 12-inch size and smaller:
1. Manufacturers: One of the following or equal:
   a. Dresser, Inc., Style 227.
   b. Romac Ind., Inc., Style FCA501.
   c. Smith-Blair, Inc., Series 912.
2. Materials:
   a. Flanged body: Ductile iron in accordance with ASTM A536.
   b. Follower ring: Ductile iron in accordance with ASTM A536.
   c. Bolts and hex nuts:
      1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
      2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F593.
3. Flange design: Class D steel ring flange in accordance with AWWA C207 compatible with ANSI Class 125 and 150 bolt circles.
4. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.

C. Flanged coupling adapters: Greater than 12-inch size:
1. Manufacturers: One of the following or equal:
   a. Dresser, Inc., Style 128-W.
   b. Romac Ind., Inc., Style FC400.
   c. Smith-Blair, Inc., Series 913.
2. Materials:
   a. Flange and flanged body: Ductile iron or low carbon steel having a minimum yield strength of 30,000 pounds per square inch.
   b. Follower ring: Low carbon steel having a minimum yield strength of 30,000 pounds per square inch.
   c. Bolts and hex nuts:
      1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
      2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F593.
3. Flange design: Class D steel ring flange in accordance with AWWA C207 compatible with ANSI Class 125 and 150 bolt circles.
4. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.

D. Flexible couplings:
1. Manufacturers: One of the following or equal:
   a. Dresser, Inc., Style 253.
   b. Romac Ind., Inc., Style 501.
   c. Smith-Blair, Inc., Series 441.
2. Materials:
   a. Center rings: Ductile iron in accordance with ASTM A536.
   b. Follower rings: Ductile iron in accordance with ASTM A536.

c. Bolts and hex nuts:
    1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
    2) Buried and underwater: Type 316 stainless steel in accordance with ASTM F593.
3. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.
4. Center sleeve dimensions: Provide center sleeves with lengths in accordance with following table:

Nominal Pipe Size	Sleeve Length
3 inch and smaller	Manufacturer's standard
4 inch through 8 inch	7 inches
10 inch through 14 inch	12 inches
Greater than 16 inch	Use steel flexible coupling per Pipe Couplings for Steel Piping

E. Restrained flange coupling adapter:
1. Manufacturers: One of the following or equal:
    a. Romac Ind., Inc., Style RFCA.
    b. Star Pipe Products, 3200 StarFlange™.
2. Materials:
    a. Flange and flanged body: Ductile iron in accordance with ASTM A536.
    b. Follower ring: Lug type restraint system.
        1) Follower ring: Ductile iron in accordance with ASTM A536.
        2) Restraining lugs: Ductile iron in accordance with ASTM A536.
            a) Designed to contact the pipe and apply forces evenly.
        3) Restraining bolts:
            a) Ductile iron in accordance with ASTM A536.
            b) Bolt heads shall be designed to twist off when the proper torque has been applied.
    c. Bolts and hex nuts:
        1) Aboveground: High strength, low alloy steel in accordance with AWWA C111.
        2) Buried and underwater: Type 316 stainless steel bolts in accordance with ASTM F593.
3. Flange design: Class D steel ring flange in accordance with AWWA C207 compatible with ANSI Class 125 and 150 bolt circles.
4. Coating and lining: Manufacturer's standard fusion bonded epoxy, NSF 61 certified.
5. Angular deflection: Restrained flange coupling adapter must allow angular deflection after assembly.

F. Grooved joint couplings:
1. Manufacturers: The following or equal:
    a. Victaulic Co., Series 31 or equal.

2. Materials:
    a. Housings: Ductile iron in accordance with ASTM A536.
    b. Gasket:
        1) FlushSeal® type, or equal. Elastomer in accordance with ASTM D2000.
        2) Neoprene or BUNA-N.
    c. Bolts and nuts: Electroplated steel in accordance with ASTM A449.
    d. Coating: As specified in Section 09960 - High-Performance Coatings.
3. For use with rigid or flexible radius grooved components in accordance with AWWA C606.
4. For connection to IPS steel pipe sizes, Victaulic Style 307.

2.03 PIPE COUPLINGS FOR STAINLESS STEEL PIPING

A. Flexible couplings:
    1. Manufacturers: The following or equal:
        a. Dresser, Inc., Style 38.

PART 3 EXECUTION

3.01 INSTALLATION

A. In underground and underwater installations, coat the exterior of coupling with a protective coating in accordance with manufacturer's instructions.

B. Joints and flexible connections shall be installed centered with no angular deflection unless otherwise indicated on the Drawings.

C. Flexible couplings and flange coupling adapters: Install with gap between pipe ends in accordance with the following table unless a greater gap is indicated on the Drawings. Maximum gap tolerance shall be within 1/8 inch.
    1. Install flexible coupling with pipe gap located in middle of center sleeve.
    2. Install flanged coupling adapter with end of plain end pipe in middle of flanged coupling body.

Center Ring Length	Gap Dimension and Tolerance
4 inch through 6 inch	3/8 inch
7 inch	5/8 inch
10 inch and greater	7/8 inch

D. Provide harnesses (tie-downs) for flexible couplings unless otherwise indicated on the Drawings with a written note.
    1. Design harnesses (tie-downs) for the test pressures as specified in the Piping Schedule in Section 15052 - Common Work Results for General Piping.

E. Grooved joint couplings:
   1. Grooved ends: Clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
   2. Gaskets: Elastomer grade suitable for the intended service, and molded and produced by the coupling manufacturer.

F. Bolted, split-sleeve couplings:
   1. Inspect each coupling to ensure that there are no damaged portions of the coupling.
      a. Pay particular attention to the sealing pad/sealing plate area.
      b. Before installation, thoroughly clean each coupling of any foreign substance which may have collected thereon and shall be kept clean at all times.
   2. Wrenches:
      a. Conform to manufacturer instructions.
      b. Bolts and studs shall be tightened so as to secure a uniform gasket compression between the coupling and the body of the pipe with all bolts or studs tightened approximately the same amount.
      c. Final tightening shall be done by hand (no air impact wrenches) and is complete when the coupling is in uniform contact with the outside surface of the pipe all around the circumference of the pipe.
   3. No joint shall be misfit in any plane.
   4. On the fixed ends of bolted, split-sleeve couplings, the shoulders shall bear on the restraint rings all around with no visible gap.
   5. Ends of piping where coupler are installed shall be smooth and free of defects.
      a. Remove weld splatter and grind smooth.
      b. Grind pipe seam welds flush with pipe wall and smooth.

END OF SECTION

SECTION 15127

DUCTILE IRON BALL-TYPE FLEXIBLE EXPANSION JOINTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Ductile iron ball-type flexible expansion joints.

1.02 REFERENCES

A. American Water Works Association (AWWA):
   1. C110 - Ductile-Iron and Gray-Iron Fittings.
   2. C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   3. C153 - Ductile-Iron Compact Fittings for Water Service.
   4. C210 - Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
   5. C213 - Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.

B. ASTM International (ASTM):
   1. A536 - Standard Specification for Ductile Iron Castings.

C. NSF International:
   1. 14 - Plastics Plumbing System Components and Related Materials.
   2. 61 - Drinking Water System Components - Health Effects.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: As specified in Section 15052 - Common Work Results for General Piping.

C. Source quality test reports:
   1. Holiday test of lining.
   2. Pressure test.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The following or equal:
   1. EBAA Iron, Inc., Flex-Tend.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Design requirement:
   1. Performance requirements:
      a. Joints capable of angular deflecting and expanding or contracting simultaneously without leakage.
      b. Angular deflection: Capable of providing a minimum angular deflection from centerline at each ball joint as follows:
         1) 14 to 36-inch pipe: 15 degrees.
      c. Axial movement capacity: Unless otherwise indicated on the Drawings, factory pre-set axial movement to reserve 50 percent of the total axial movement capacity for expansion and 50 percent of the total axial movement capacity for compression. Provide one or more expansion sleeves to provide a total axial movement:
         1) 3 inch through 12 inch: 8 inches minimum expansion or compression.
      d. Working pressure rating:
         1) Sizes 3 inch through 24 inch: 350 pounds per square inch.

2.03 MATERIALS

A. Ductile iron: Material properties in accordance with ASTM A536 with wall thickness meeting requirements of AWWA C153.

B. Gaskets:
   1. At ball joints and sleeves: EPDM.
   2. At flanged end connections: As specified in Section 15052 - Common Work Results for General Piping.
   3. At mechanical joint end connections: As specified in Section 15211 - Ductile Iron Pipe: AWWA C151.

C. Bolts and nuts:
   1. At flanged end connections: As specified in Section 15052 - Common Work Results for General Piping.

2.04 MANUFACTURED UNITS

A. Consist of 2 ball and socket type joints with one or more expansion sleeves located between the 2 ball joints. The ball and socket ends shall be integrally cast with the expansion sleeve.

B. End connections: Provide end connections indicated on the Drawings:
   1. Mechanical joint end connections in accordance with the dimensional requirements of either AWWA C111 or AWWA C153.
   2. Flange end connections in accordance with the dimensional requirements of AWWA C110 with the addition of an o-ring groove.

2.05 FINISHES

A. Coat external surfaces as follows:
   1. Aboveground installations: Field apply coating system as specified in Section 15052 - Common Work Results for General Piping for the piping system.

B. Line all internal wetted surfaces and seal contact surfaces with a minimum of 15 mils of fusion-bonded epoxy in accordance with AWWA C213.
   1. Holiday test epoxy lining with a 1,500-volt spark test in accordance with AWWA C213.

2.06 SOURCE QUALITY CONTROL

A. Pressure test to rated working water pressure before shipment.

2.07 PACKING AND SHIPPING

A. Protect sliding and rotating surfaces against damage during packing and shipping.

PART 3 EXECUTION

3.01 INSTALLATION

A. Protect sliding and rotating surfaces against damage during installation.

B. Install ball-type flexible expansion joints in accordance with manufacturer's published instructions to meet minimum expansion and contraction values as specified or as indicated on the Drawings.

C. Isolate ball-type flexible expansion joints from piping system test pressure, or provide temporary restraint on joint during the pressure test.

END OF SECTION

SECTION 15200

METERED SERVICES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Metered service lines.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 24, 125, and 250.
   2. B16.24 - Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500 and 2500.

B. American Water Works Association (AWWA):
   1. C600 - Installation of Ductile Iron Water Mains and Their Appurtenances.
   2. C700 - Standard for Cold-Water Meters -- Displacement Type, Metal Alloy Main Case.
   3. C702 - Cold Water Meters - Compound Type.
   4. C800 - Underground Service Line Valves and Fittings.

C. ASTM International (ASTM):
   1. B88 - Standard Specification for Seamless Copper Water Tube.

D. Federal Communications Commission (FCC).

E. National Sanitation Foundation (NSF).

1.03 SUBMITTALS

A. Shop Drawings and manufacturer's literature for all materials.

B. Contact Owner representative to arrange for pick-up of Owner furnished materials.

PART 2 PRODUCTS

2.01 GENERAL

A. Furnish metered service lines in accordance with the Metered Service Installation Details as indicated on the Drawings.

2.02 WATER METERS

A. 5/8 thru 2-inch meters.
   1. Type:
      a. Only Magnetic Drive, Sealed Register, Positive Displacement, Oscillating Piston type meters are acceptable.
   2. Size:
      a. In accordance with AWWA C700.
   3. Length:
      a. In accordance with AWWA C700.
   4. Cases:
      a. Outer case made of a non-corrosive Water Works Bronze (minimum 75 percent copper content) with a separate measuring chamber that can easily be removed from the case.
         1) Provide raised characters cast on the outer case indicating the size and direction of water flow through the meter.
         2) Provide plastic polymer or cast iron frost bottoms on 5/8 inch, 3/4 inch, and 1 inch size meters.
         3) The manufacturer's serial number must be permanently affixed to the maincase to aid in identification and must be visible so that it can be read from directly above the water meter.
      b. Guarantee cases to be free from defects for 25 years from date of shipment.
      c. Meter of 1-1/2 inch and 2 inch size: Provide 2-bolt oval flanges, faced and drilled. No threaded body meters are required.
   5. External bolts and washers:
      a. Corrosion resistant material.
      b. Easily removed from the maincase.
      c. Cover all threaded maincase bolt holes to aid in removal of the bolts for repair.
   6. Measuring chamber:
      a. Suitable synthetic polymer.
      b. Not be cast as part of the maincase.
      c. All piston assemblies interchangeable in all measuring chamber assemblies of the same size.
   7. Magnetic coupling:
      a. The motion of the piston will be transmitted to the sealed register through the use of a magnetic coupling.
   8. Strainers:
      a. All meters, 2 inch or greater, must be provided with a corrosion resistant strainer, with an effective straining area at least twice the bore diameter which can be easily removed from the meter without the meter itself being disconnected from the pipeline.
   9. Change gears:
      a. Change gears will not be allowed to calibrate the meter.
   10. Provide identical and completely interchangeable registers of a particular registration and meter size. Accuracy and head loss tests:
      a. Meters meet or exceed current AWWA C700, current revision, test flows, head loss and accuracy standards.

11. Pressure capability:
    a. Meters operate up to a working pressure of 150 pounds per square inch, without leakage or damage to any parts.
    b. Meter accuracy not affected when operating at 150 pounds per square inch due to possible distortion.
12. Meter accuracy not affected by variations in pressure up to 150 pounds per square inch. Register and remotes:
    a. Permanently and hermetically sealed register and firmly attached to meter case.
        1) Provide a security seal to prevent easy removal and tampering.
        2) The register must be an encoder type and must be readily adaptable to an outside wall or pit mount inductive reading pad, a walk-by or drive-by short range radio or an automatic fixed network radio meter reading system.

B. 2 inch thru 6 inch compound meters:
1. Scope:
    a. The meters in accordance with AWWA C702, as most recently revised, except as modified in this Section.
2. Type:
    a. Single or dual register type meters.
        1) Single register type:
            a) Totalize the output from 2 interacting measuring chambers.
                (1) One turbine type for measuring high flows.
                (2) One displacement chamber of the oscillating piston type for measuring low flows.
            b) Direct flows through the chambers using an automatic valve mechanism so as to have them function within their normal designed limits.
                (1) Flows first pass through the turbine chamber prior to passing through the oscillating piston measuring chamber so as to ensure continuous registration during low flow to high flow measurement.
3. Size:
    a. Determine size of meter by the nominal size of the opening of the inlet and outlet flanges of the meter.
4. Length:
    a. Maximum overall length of the unit is the face-to-face dimension as listed below:

Size of Meter	Length
2 inch	17 inches
3 inch	17 inches
4 inch	20 inches
6 inch	24 inches

5. Cases:
    a. Construct maincases of Water Works Bronze.
    b. Repaired casings are not acceptable.
        1) Construct the turbine and oscillating piston measuring chambers as separate units.
        2) Operation of an external valve cannot inhibit the oscillating piston measuring chamber operation.
        3) Access both measuring chambers without disturbing the maincase as set in the pipeline.
        4) All sizes of meters include flanged ends.
    c. Provide drain plugs for ease of removing water or other debris from the bottom of the maincase.
    d. Provide a test port of adequate size must be accessible from the top so as to allow testing in pit settings and confined areas.
    e. Provide a threaded port outlet with a bronze plug.
    f. Provide raised characters cast on the outer case indicating the size and direction of water flow through the meter.
6. Strainers:
    a. External body strainers may be specified as part of the meter assembly package.
        1) When specified, construct external body strainers of Water Works Bronze similar to that of the compound meter body.
        2) Provide strainer with a removable cover plate for inspection and debris removal.
        3) Provide strainer screen that is externally accessible and easily removable without disturbing the pipeline setting of the meter assembly package.
7. External fasteners:
    a. Provide external fasteners on the meter made of stainless steel or nonferrous material.
8. Connections:
    a. Flanges on 2 inch size meters:
    b. Oval faced and drilled on the horizontal axis with a bolt circle diameter of 4-1/2 inches.
        1) Thickness conforming to Class 150 bronze round flange requirements.
    c. Flanges for 3 inch, 4 inch, and 6 inch size meters: Class 150 bronze round type, flat faced, in accordance with ASME B16.24 for specified diameter.
    d. Companion flanges, if required with the meters:
    e. Consist of 1 standard cast iron flange, tapped with American Standard internal taper pipe threads, of the same nominal size as the meter, and 1 flanged coupling adaptor.
        1) Provide type and outside diameter of connecting pipe for appropriate gasket sizing.
9. Provide stainless steel or non-corrosive bolts, nuts, and gaskets for connection to the meter assembly.
10. Register box:
    a. Construct register box of the same material as the maincase.
    b. Mount and orient the register box, which encloses the register, to allow reading in any position.

11. Register box sealing:
    a. Seal register box to the meter in such a manner that unauthorized removal is apparent.
    b. Recess seal screws and prohibit their removal by properly affixing seal wire through appropriate holes provided in the register box casting body.
12. Encoder register and remotes:
    a. All Compound meters must be supplied with registers as specified in Class II Turbine Type Meters in this Section.
13. Displacement measuring chamber:
    a. Provide self-contained unit measuring chamber including a strainer, which can be firmly seated and removed as a unit.
        1) Do not cast any part of this chamber as part of the maincase.
    b. Oscillating piston type composed of Water Works Bronze or a suitable synthetic polymer.
        1) Piston, piston roller, and division plate: rubber composition or an approved synthetic polymer as well.
        2) All other components of the measuring chamber: corrosion-resistant materials such as stainless steel.
14. Turbine measuring chamber:
    a. Chamber: Water Works Bronze or suitable synthetic polymer construction.
    b. Secured by 2 stainless steel bolts. Positioned so that water must essentially travel in a straight line path from the meter inlet to the meter outlet during high flow operation.
    c. Polypropylene, mounted on a replaceable Type 316 stainless steel shaft and rotate on roller bearings.
        1) Offset the entire propeller assembly weight, while in operation, by magnetic suspension so that the rotating turbine components are essentially weightless in water.
15. Adjustable tungsten carbide bearing provided to take up the turbine shaft end-play tolerance.
    a. Automatic valve:
        1) Weighted, link-mounted, swing type:
        2) All moving shafts and linkage made of hard rubber bearings and sleeves.
        3) Valve and linkage made of Water Works Bronze.
        4) All shafts made of Type 316 stainless steel.
        5) Position valve in the meter so that water passing through it will follow a straight line path in passing from inlet to outlet. The valve will open at a pressure differential of 2-1/2 pounds per square inch or less.
        6) Access to the valve requires only the upper portion of the meter's maincase be removed.
        7) Displacement and turbine chambers need not be disturbed.
        8) Oscillating piston nor the turbine chamber need to be disturbed.
16. Valve seat:
    a. Consists of a trapezoidal shaped rubber gasket, retained by a bronze or synthetic polymer seat.
    b. Secure valve seat assembly by Type 316 stainless steel screws that are accessible from the maincase opening so as to facilitate easy access for inspection and ease of maintenance.

17. Registration:
    a. Record registration through the normal test flow limits at not less than 98.5 percent nor more than 101.5 percent of actual throughput. At crossover, that point when measurement transfers from 1 measuring chamber to the other, accuracy must exceed 95 percent.
    b. Accuracy at minimum test flow: minimum 95 percent at rate of flow specified in table below:

Size	Normal Flows	Limits Minimum Flows
2 inch	1/2 - 160	1/4
3 inch	1/2 - 350	1/4
4 inch	3/4 - 1,000	3/8
6 inch	3/4 - 2,500	3/8

18. Pressure test:
    a. Guarantee meters will operate successfully at a working pressure of 150 pounds per square inch, without leakage or damage to any component.
19. Guarantee and maintenance program:
    a. Guarantee meters against defects in material and workmanship for a period of 1 year from the date of shipment.
    b. Provide a price schedule of manufacturer factory maintenance program offering as a printed brochure available nationally. Include offerings for both the complete meter and individual meter component assemblies on an exchange basis.
20. Intent:
    a. Specifications are designed to create guidelines for selecting an extremely critical metering device.
    b. Ease of installation, operational features, readability, and maintenance are of prime concern.
    c. A design that best reflects longevity of operation of all elements and a high degree of sustained accuracy through the entire range of the meter is to be considered mandatory.

C. Turbine type meters, 1-1/2 inch thru 10 inch sizes:
1. Type:
    a. Provide horizontal axis, multi-vane design meters suited for moderately low to sustained high flow demands.
2. Size:
    a. Meter assembly size will be determined by the nominal size of the opening of the inlet and outlet flanges of the meter.
3. Length:
    a. Provide meters at maximum overall length unless otherwise noted.
    b. Maximum overall length of the unit is the face-to-face dimension, including external strainer and test port apparatus as listed below. Supplemental

spools or spacers may be provided to achieve the noted dimension; these components will be considered a part of the meter.

Size of Meter	Minimum Length	Maximum Length
1-1/2 inch	10 inch	17 inch
2 inch	10 inch	17 inch
3 inch	12 inch	24 inch
4 inch	14 inch	29 inch
6 inch	18 inch	36-1/2 inch
8 inch	20 inch	42 inch
10 inch	26 inch	45 inch

4. Maincases:
    a. Cast Water Works Bronze, epoxy coated steel or some other non-corrosive material that can withstand minimum water pressures of not less than 150 pounds per square inch.
    b. Repaired casings are not acceptable.
    c. Provide flanged ends.
    d. Provide tapped test port:
        1) 1-1/2 inch through 3 inch size turbines: not less than 1 1/2 inches.
        2) 4 inch and larger size turbines: not less than 2 inch.
        3) Plugged female iron pipe thread (F-IPT).
    e. Provide raised characters cast on the outer case indicating the size and direction of water flow through the meter.
5. Strainers:
    a. External body strainers may be specified as part of the meter assembly package. When specified, construct external body strainers of Water Works Bronze, epoxy coated steel or some other non-corrosive material that can withstand water pressures of not less than 150 pounds per square inch.
6. Provide strainer with a removable cover plate for inspection and debris removal. External fasteners:
    a. Provide external fasteners on the meter made of stainless steel or nonferrous material.
7. Connections:
    a. Flanges for 1-1/2 inch and 2 inch turbine meters: 2-bolt oval type.
    b. Flanges for meters 3 inch through 10 inch size meters: Class 150 bronze round type or Class 125 Steel Epoxy Coated, flat faced in accordance with ASME B16.1 for specified diameter.
    c. No companion flanges are required.
8. Register and remotes:
    a. Permanently and hermetically sealed register and firmly attached to meter case.
    b. If applicable, a security seal must be provided to prevent easy removal and tampering.
    c. Register may be direct read, absolute encoder, digital encoder, or high resolution pulse output and must be readily adaptable to an outside wall

or pit mount inductive reading pad; a walk-by, drive-by short range radio; or a fixed network radio meter reading system.

9. Turbine measuring chamber: Multiple connectivity is not required:
   a. Chamber: Water Works Bronze or suitable synthetic polymer construction.
   b. Secured by 2 stainless steel bolts or other nonferrous fasteners.
   c. Position chamber so that water must essentially travel in a straight line path from the meter inlet to the meter outlet during high flow operation.
10. Registration:
   a. Record registration through the normal test flow limits at not less than 97 percent nor more than 103 percent of actual throughput at all normal test flows.
   b. Meter capable of continuous operation up to the rated maximum flows as listed below without affecting long-term meter accuracy caused by undue wear.

Meter Size	Low Flow (95 percent minimum)	Normal Range (GPM) (100.0 + 1.5 percent)
1-1/2 inch	3	4 to 120
2 inch	3	4 to 160
3 inch	4	5 to 350
4 inch	10	15 to 1,000
6 inch	20	30 to 2,000
8 inch	30	35 to 3,500
10 inch	55	55 to 5,500

   c. Pipeline size applications of 12 inch, can be accomplished by using 10 inch size meters with the appropriate tapered, concentric reducers.
11. Maximum operating pressure:
   a. Operate without leakage, damage or malfunction up to a maximum operating pressure of 150 pounds per square inch.
12. Guarantee:
   a. Guarantee meters against defects in material and workmanship for a period of 1 year from date of shipment.

2.03 SERVICE SADDLES

A. Saddles for 1-inch, 1-1/2-inch and 2-inch taps: Made of bronze.

B. Made to specially fit the contour of the pipe they are to be installed on.
   1. Saddles for ductile-iron, cast-iron, and asbestos-cement pipe:
      a. Made of brass body with double bronze straps, female iron pipe threads in accordance with AWWA C800.
      b. Manufacturers: One of the following or equal:
         1) Ford Model S91.
         2) Mueller Series H-13000.DSfa.
   2. Saddles for PVC C900 pipe:
      a. Made of brass body, single wide bolted brass band, female iron pipe thread outlet.

b. Manufacturers: One of the following or equal:
   1) A.Y. McDonald Model 3826.
   2) Mueller BR 2B.
   3) Ford 202B.

C. Reducer bushings: Made of bronze.

2.04 STOPS

A. Corporation stops:
   1. Install corporation stops with approved saddles as specified in this Section.
   2. Copper service:
      a. Compression coupling outlets and male iron pipe (I.P.) thread inlets in accordance with AWWA C800.
   3. Manufacturers: One of the following or equal:
      a. Mueller Model H-15028 up to 1-inch size.
      b. Mueller Model Ori-Corp H-15013 for 1-1/2-inch to 2-inch size.

B. Angle stops:
   1. Service valves up to 2-inch:
      a. Install angle stops. Copper services up to 1-inch diameter:
      b. Install 1-inch compression coupling inlet angle stops with 1 inch meter nut outlets.
   2. 1-1/2-inch through 2-inch curb stops:
      a. Install compression fitting inlets and meter flange outlets.
   3. All stops: include "Lock Off" holes.
   4. Manufacturers: One of the following or equal:
      a. Mueller B-24258 for up to 1-inch size.
      b. Mueller B-24276 for 1-1/2-inch to 2-inch size.

2.05 WATER SERVICE LINE

A. Size service lines to meet the requirements of the California Uniform Plumbing Code, Public Utilities Commission General Order No. 103, and Tariff Rule No. 16.

B. Standard domestic service lines: 1-inch minimum, Type K, copper tubing in accordance with the requirements of ASTM B88.

2.06 WATER METER COUPLING

A. Made of "no-lead" (less than .1 percent).
   1. All parts listed by NSF for use in potable water service.

B. Provide long straight meter coupling, swivel nut and neoprene meter gasket.

C. Manufacturers: The following or equal:
   1. Cambridge Brass.

2.07 WATER METER BOX BODY

A. Cal American Water shall furnish the Water Meter Box for installation by the Contractor.

2.08 WATER METERS

A. Manufactures and models:
   1. Turbo Meters:
   2. Badger Meter, Turbo Series.
   3. Master Meter, MMT Turbine.
   4. Sensus, OMNI Compound or Turbo.
   5. Approved Equal.

PART 3 EXECUTION

3.01 INSTALLATION

A. Confirm the location of all service lines with the Owner's representative in the field prior to tapping the main.
   1. The Contractor will field mark the proposed location for the corporation stop (pavement) and meters for inspection, confirmation, or adjustment.

B. Experienced craftsmen familiar with installation of water service lines will perform tapping of all water mains.

C. A suitable tapping machine (Mueller, Ford, Hays or Dresser type) using the proper combined drill and tap is required for all taps.
   1. Hand held drilling equipment is not acceptable.

D. Inspect corporation stops for damaged threads and proper operation prior to installation.

E. Tap the main as indicated on the service tap detail.

F. Make taps to polyethylene encased water main in accordance with AWWA C600.

G. Pressure test metered service lines when installed with new mains from the corporation stop to the angle stop.

H. Flush each metered service prior to installation of the meter and connection to the customer service line.

END OF SECTION

SECTION 15209

HIGH-SILICON CAST IRON PIPE FOR DIGESTER GAS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: High-silicon cast iron pipe.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. A518 - Standard Specification for Corrosion-Resistant High-Silicon Iron Castings iron castings.
   2. A861 - Standard Specification for High-Silicon Iron Pipe and Fittings.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: As specified in Section 15052 - Common Work Results for General Process Piping.

PART 2 PRODUCTS

2.01 MATERIALS

A. High-silicon cast iron pipe:
   1. Manufacturers: The following or equal:
      a. The Duriron Co., Inc.
      b. Taiyuan Water Industrial.
   2. Pipe and fitting material:
      a. In accordance with ASTM A518 and A861.
   3. Joints:
      a. Acid-resistant.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

A. Test as specified in Section 15052 - Common Work Results for General Process Piping and Section 15956 - Piping Systems Testing.

END OF SECTION

SECTION 15211

DUCTILE IRON PIPE: AWWA C151

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Ductile iron pipe, joints, connections, fittings, and pipe linings and coatings.

B. As specified in Section 15052 - Common Work Results for General Piping.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

B. American Water Works Association (AWWA):
   1. C104 - Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
   2. C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
   3. C110 - Standard for Ductile-Iron and Gray-Iron Fittings.
   4. C111 - Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   5. C150 - Standard for Thickness Design of Ductile-Iron Pipe.
   6. C151 - Standard for Ductile-Iron Pipe, Centrifugally Cast.
   7. C153 - Standard for Ductile-Iron Compact Fittings for Water Service.
   8. C210 - Liquid-Epoxy Coatings and Linings for Steel Water Pipe and Fittings.
   9. C222 - Polyurethane Coatings and Linings for Steel Water Pipe and Fittings.
   10. C600 - Installation of Ductile Iron Water Mains and Their Appurtenances.

C. American Welding Society (AWS):
   1. D11.2 - Guide for Welding Iron Castings.

D. ASTM International (ASTM):
   1. A536 - Standard Specifications for Ductile Iron Castings.
   2. B1000 - Standard Practices for Casting Preparation and Test Procedure of Porcelain Enamel-Lined Pipe, Fittings, and Valves for Use in the Municipal Wastewater, Sewage, and Water Treatment Industry.
   3. C33 - Standard Specification for Concrete Aggregates.
   4. C150 - Standard Specification for Portland Cement.
   5. C283 - Standard Test Methods for Resistance of Porcelain Enameled Utensils to Boiling Acid.
   6. D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
   7. D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

E. Ductile Iron Pipe Research Association (DIPRA):
   1. Thrust Restraint Design Manual.

F. International Organization for Standardization (ISO):
   1. 8179 - Ductile iron pipe, fittings, accessories, and their joints - External zinc-based coating – Part 1: Metallic zinc with finishing layer.

G. National Association of Pipe Fabricators, Inc. (NAPF):
   1. 500-03 - Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings.

H. Society for Protective Coatings (SSPC):
   1. SP 5 - White Metal Blast Cleaning.
   2. PA-2 - Measurement of Dry Coating Thickness With Magnetic Gages.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data.

C. Manufacturer's qualifications:
   1. Manufacturer qualifications and list of projects using the specified material: 5 years minimum.

D. Manufacturer's Quality Assurance Manual:
   1. Submit manufacturer's coating and lining application quality assurance manual to Engineer prior to beginning coating application.
      a. Strict conformance to the requirements of the manual will be required.
      b. Deviation from the requirements of the manual will be grounds for the Engineer to reject the applied coating.

E. Shop drawings:
   1. Detailed layout drawings showing alignment of pipes, location of valves, fittings, and appurtenances, types of joints, and connections to pipelines or structures.
   2. Thrust restraint systems.
   3. Photographs, drawings, and descriptions of fittings, gaskets, couplings, grooving of pipe and fittings.

F. Calculations:
   1. Calculations for thrust restraint system design.

G. Manufacturer's Certificate of Source Testing for ceramic epoxy, glass lined, plural component polyurethane, and zinc materials:
   1. Certify successful performance of holiday detection tests on 100 percent of lining in accordance with ASTM B1000.
   2. Identify each test piece by mark designation and show the actual test results during the final inspection by manufacturer prior to shipment.

3. Zinc coating: Regular measurements in accordance with ISO 8179 Part 4.4.
4. Include Coating Manufacturer's Technical Representative's reports.

1.04 QUALITY ASSURANCE

A. Ductile iron pipe shall be supplied by a single manufacturer.

B. Hydrostatically test each joint of ductile iron pipe in accordance with AWWA C151.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Block piping and associated fittings for shipment to prevent damage to coatings and linings.

B. Carefully handle piping and associated fittings during loading, unloading, and installation:
   1. Do not drop piping material from cars or trucks.
   2. Lower piping by mechanical means.
   3. Do not drop or pound pipe to fit grade.

C. Handle pipe from the outside if lined with ceramic epoxy, glass or plural component polyurethane.
   1. No forks, chains, straps, hooks, or other lifting device shall be placed inside the pipe or fittings for lifting, positioning, or laying.

D. Protect gaskets and polyethylene encasement from long-term exposure to sunlight.

E. Store piping, fittings, and other accessories such that they do not accumulate and hold rainwater, dirt, and debris.

PART 2 PRODUCTS

2.01 MANUFACTURED UNITS

A. Ductile iron piping:
   1. Manufacturers: One of the following or equal:
      a. American Cast Iron Pipe Co.
      b. McWane Ductile.
      c. SIP Industries.
      d. U.S. Pipe.

2.02 THRUST RESTRAINT SYSTEM DESIGN

A. The length of pipe that must be restrained on each side of the focus of a thrust load as specified in the Pipe Schedule.

B. Design pressure: Test pressure.

C. Laying condition: Type 5 in accordance with AWWA C150.

D. Soil type: Silt 1.

E. Unit friction resistance for polyethylene encasement of pipe: DIPRA factor multiplied by a safety factor of 1.5.

2.03 CONCRETE THRUST BLOCK RESTRAINT

A. Joint thrust restraint system designed by Contractor.
   1. Concrete thrust blocks will not be permitted for DIP restraint.

2.04 DUCTILE IRON JOINTS AND CONNECTIONS

A. General:
   1. Pressure class or special thickness class as indicated in the Piping Schedule provided in Section 15052 - Common Work Results for General Piping.
   2. In accordance with AWWA C150 and AWWA C151.
   3. Joints:
      a. Flanged.
      b. Mechanical.
      c. Push-on Rubber Gasket.
      d. Integrally Restrained Mechanical.
      e. Mechanical Wedge Action.
      f. Integrally Restrained Push-On.
      g. Push-On Joint Restraint Harness.
   4. Connections:
      a. Tapping saddle.
      b. Tapping sleeve.
      c. Welded outlet.
   5. Fittings.

B. Joints:
   1. Flanged joints:
      a. Screw-on flanges:
         1) Comply with the diameter, thickness, drilling, and other characteristics in accordance with ASME B16.1.
         2) Ductile iron.
         3) Long hub, threaded, and specially designed for ductile iron pipe.
         4) After attaching to pipe, machine flange face to make pipe end and flange even and perpendicular to the axis of the pipe.
      b. Bolt holes on flanges: 2-holed and aligned at both ends of pipe.
      c. Cap screw or stud bolt holes: Tapped.
      d. Bolts and nuts:
         1) As specified in Section 15052 - Common Work Results for General Piping.
      e. Gaskets:
         1) Standard styrene butadiene copolymer (SBR) unless specified otherwise in Section 15052 - Common Work Results for General Piping.
      f. Couplings:
         1) Rigid type, cast from ductile iron in accordance with ASTM A536, Grade 65-45-12.

g. Bolts and nuts:
    1) As specified in Section 15052 - Common Work Results for General Piping.
h. Gaskets:
    1) As specified in Section 15052 - Common Work Results for General Piping.
i. Fittings:
    1) In accordance with AWWA C606, rigid radius-cut groove:
    2) Center-to-center dimensions: In accordance with AWWA C110.
    3) Wall thickness and other characteristics: In accordance with AWWA C606.
j. Flanged unit connections:
    1) Flanged to grooved joint adapters or a long enough spool with one end flanged and the other end grooved to prevent interference with the operation of adjacent valves, pumps, or other items.

2. Mechanical joints:
    a. In accordance with AWWA C111.
    b. Gaskets:
        1) As specified in Section 15052 - Common Work Results for General Piping.
    c. Bolts and nuts, including T-bolts:
        1) As specified in Section 15052 - Common Work Results for General Piping.
3. Push-on rubber gasket joints:
    a. In accordance with AWWA C111.
    b. Gaskets:
        1) As specified in Section 15052 - Common Work Results for General Piping.
4. Mechanical wedge action joint restraints:
    a. Manufacturers: One of the following or equal:
        1) EBAA Iron, Inc., Megalug® Series 1100.
        2) Star Pipe Products, Split Stargrip Series 3000.
        3) Sigma Corp., One-Lok Model SLDE.
    b. Materials:
        1) Gland body:
            a) Ductile iron in accordance with ASTM A536.
        2) Wedges and wedge actuating components:
            a) Ductile iron in accordance with ASTM A536.
            b) Wedges shall be heat treated to a minimum of 370 BHN.
        3) Actuating bolts and nuts:
            a) Ductile iron in accordance with ASTM A536.
            b) Provide torque-limiting twist off components to ensure proper installation.
        4) Gaskets:
            a) As specified in Section 15052 - Common Work Results for General Piping.

c. Coatings:
    1) Provide manufacturer applied coating system.
    2) Manufacturers: One of the following or equal:
        a) EBAA Iron Inc., Mega-Bond.
        b) Star Pipe Products, Star-Bond.
        c) Sigma Corp., Corrsafe™ Electro-deposition coating.
d. Working pressure:
    1) Shall include a minimum safety factor of 2:1.
    2) For sizes 3- through 16-inch: 350 pounds per square inch.
    3) For sizes 18- through 48-inch: 250 pounds per square inch.
e. Restraint shall consist of multiple gripping wedges incorporated into a follower gland meeting the requirements of AWWA C111.
f. Restraint shall allow post assembly angular deflection that is a minimum of 50 percent of the angular deflection allowed by the mechanical joint.
g. Restraint must be in accordance with applicable requirements of AWWA C110 and AWWA C111 for mechanical joints.

5. Push-on joint restraint harnesses:
    a. Manufacturers: One of the following or equal:
        1) EBAA Iron, Inc., Megalug® Series 1700.
        2) Star Pipe Products, Split Stargrip Series 3100S.
        3) Sigma Corp., One-Lok Model SLDEH.
    b. Materials:
        1) Restraint and backup ring: Ductile iron in accordance with ASTM A536.
        2) Wedges and wedge actuating components: Ductile iron in accordance with ASTM A536.
            a) Wedges shall be heat treated to a minimum of 370 BHN.
        3) Actuating bolts and nuts:
            a) Ductile iron in accordance with ASTM A536.
            b) Provide torque-limiting twist off components to ensure proper installation.
        4) Tie rods:
            a) Low alloy steel in accordance with AWWA C111.
        5) Bolts and nuts, including T-bolts:
            a) As specified in 15052 - Common Work Results for General Piping.
    c. Coatings:
        1) Provide manufacturer applied coating system.
        2) Manufacturers: One of the following or equal:
            a) EBAA Iron Inc., Mega-Bond.
            b) Star Pipe Products, Star-Bond.
            c) Sigma Corp., Corrsafe™ Electro-deposition coating.
    d. Working pressure:
        1) Shall include a minimum safety factor of 2:1.
        2) For sizes 3- through 16-inch: 350 pounds per square inch.
        3) For sizes 18- through 48-inch: 250 pounds per square inch.
    e. Restraint shall consist of a backup ring behind the ductile iron bell and a restraint ring consisting of multiple gripping wedges connected with number and type of tie rods as recommended by the manufacturer.
    f. Restraint shall allow post assembly deflection of a minimum of 50 percent of the deflection capability of the push-on joint.

C. Connections:
    1. Tapping saddle as specified in Owner standard specification.
        a. If Owner does not have a standard specification, provide tapping saddles as specified in Section 15120 - Piping Specialties.
    2. Tapping sleeve as specified in Owner standard specification.
        a. If Owner does not have a standard specification, provide tapping sleeves as specified in Section 15120 - Piping Specialties.
    3. Welded outlet:
        a. Fabrication:
            1) Welded outlets shall be fabricated by the pipe manufacturer at the same facility where the pipe is produced.
            2) The pipe manufacturer shall have a minimum of 5 years of experience in the fabrication and testing of outlets of similar size and configuration as those used on the Project.
            3) Application is limited to branch outlets having a nominal diameter not greater than 70 percent of the nominal diameter of the main line pipe or 36 inches.
            4) Parent pipe and branch outlet candidate pipe shall be centrifugally cast ductile iron pipe designed in accordance with AWWA C150 and manufactured in accordance with AWWA C151. Minimum classes for parent and outlet pipe:
                a) Sizes 4- through 54-inch: Special Thickness Class 53.
                b) Sizes 60- through 64-inch: Pressure Class 350.
            5) Electrodes for reinforcing welds:
                a) Manufacturers: One of the following or equal:
                    (1) NCO Alloys, Ni-Rod 55-0 flux cored wire.
                    (2) INCO Alloys, Ni-Rod 55 welding electrode.
                    (3) Stoody Castweld, Ni 55-0 flux cored wire.
                    (4) INCO Alloys, Ni-Rod 44 Filler Metal.
                b) Carbon steel electrodes are not acceptable.
        b. Pressure rating:
            1) Welded outlets 6- through 30-inch:
                a) Rated for a working pressure of 250 pounds per square inch.
            2) Welded outlets 36-inch and larger:
                a) Rated for a working pressure of 200 pounds per square inch.
            3) Welded outlets of all diameters and configurations:
                a) Have a minimum safety factor of 2.0 based on proof of design hydrostatic test results.
                b) Contractor shall, at the request of Engineer, provide the manufacturer’s representative proof test data confirming the design, hydrostatic test results, and safety factors.
        c. Source quality control:
            1) Branch outlets shall be subjected to an air pressure test of at least 15 pounds per square inch.
                a) Air leakage is not acceptable.
                b) Any leakage shall be detected by applying an appropriate foaming solution to the entire exterior surface of the weldment and adjoining pipe edges or by immersing the entire area in a vessel of water and visually inspecting the weld surface for the presence of air bubbles.

c) Hydrostatic testing to 500 pounds per square inch on each branch outlet can be used in lieu of air testing.
d) Any weldment that shows any signs of leakage shall be repaired and retested in accordance with the manufacturer's written procedures.

2) Pipe manufacturer shall have a fully documented welding quality assurance system and maintain resident quality assurance records in accordance with AWS D11.2.

3) Pipe manufacturer shall maintain appropriate welding procedure specification, procedure qualification, and welder performance qualification test records as well as appropriate air-test logs documenting air-leakage tests on all welded-on outlet pipes furnished to the Project.

D. Fittings:
1. Ductile iron in accordance with AWWA C110.
2. Joint type:
a. Same as that of the associated piping as specified in Section 15052 - Common Work Results for General Piping.
3. Plain end-to-flanged joint connectors using setscrews are not acceptable.

2.05 CEMENT MORTAR

A. Line pipe with cement mortar in accordance with AWWA C104 and as specified in this Section.

B. Cement:
1. Cement: In accordance with ASTM C150, Type II.

C. Water:
1. In accordance with AWWA C104 and as specified in this Section.

D. Sand and aggregate:
1. In accordance with AWWA C104.
2. Provide silica sand or other aggregate that is not subject to leaching in accordance with ASTM C33.

E. Lining:
1. Minimum lining thickness: Standard in accordance with AWWA C104.
2. Apply cement mortar on clean bare metal surfaces.
3. Extend to faces of flanges, ends of spigots, and shoulders of hubs.
4. Line special pieces or fittings by mechanical, pneumatic, or hand placement.
a. Extend to faces of flanges and ends of spigots.
b. Less than 12 inches in width: Coat with epoxy bonding agent prior to applying cement mortar.
c. Larger than 12 inches in width: Reinforced with 2-inch by 4-inch No. 13 gauge welded steel wire mesh prior to applying cement mortar.
5. Provide plastic end caps of sufficient thickness and strength to resist shipping, handling, and storage stresses.

6. Repair damage to the cement mortar lining, including disbondment, or cracking caused by improper curing, shipping, handling, or installation in accordance with AWWA C104 and approved by the Engineer.
    a. Reinforce coating with 2 layers spirally-wound steel wire positioned approximately in center of mortar coating positioned approximately at the third points of mortar coating:
        1) No. 12 gage spaced at maximum 1-inch centers.
        2) No. 14 gage steel wire at maximum 1/2-inch centers.

2.06 CERAMIC EPOXY

A. Line pipe with ceramic epoxy.

B. Manufacturers: One of the following or equal:
1. PROTECTO 401.
2. SP-2000W.

C. Material:
1. Amine cured Novolac epoxy containing at least 20 percent by volume of ceramic quartz pigment.

D. Application:
1. The lining shall only be applied by a manufacturer-authorized representative with no less than 5 years of experience in applying the specified material.
2. The application of the lining shall be performed in accordance with manufacturer's published specifications.
3. Pipe and fittings shall be delivered to application facility with no interior lining.
4. Interior of pipe shall be abrasive blasted in accordance with manufacturer instructions.
5. Apply lining in accordance with manufacturer instructions.
6. Minimum dry film thickness (DFT): 40 mills.

E. Coverage:
1. Gasket and spigot ends on joints:
    a. Minimum coverage using joint compound: 6 mils.
    b. Maximum coverage using joint compound: 10 mils.
2. Mechanical joints:
    a. Extend lining from spigot end to edge of gauging ring.
3. Number of coats:
    a. In accordance with manufacturer instructions.

F. Source quality control:
1. Test pipe and fitting lining with a magnetic film thickness gauge in accordance with SSPC PA-2 Film Thickness Rating.
2. Test lining integrity of pipes in accordance with coating manufacturer instructions using a holiday detection testing instrument set at the specified voltage.
3. Discard pipe or reline pipe when pinholes or discontinuities are found.
4. Repair holidays with joint compound in accordance with coating manufacturer instructions and re-test.

2.07 COATINGS

A. As specified in Section 15052 - Common Work Results for General Piping and Section 09960 - High-Performance Coatings.

2.08 POLYETHYLENE ENCASEMENT

A. General:
   1. Polyethylene encasement shall be supplied by the pipe manufacturer.

B. Materials: Supply one of the following polyethylene encasements:
   1. Single layer of V-Bio® enhanced polyethylene encasement (3 layers of coextruded LLDPE film with anti-microbial additive and volatile corrosion inhibitor infused on the inside surface), meeting all requirements of AWWA C105.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
   1. Install ductile iron piping in accordance with AWWA C600, or as modified in Section 15052 - Common Work Results for General Piping.
   2. For underground piping, the trenching, backfill, and compaction:
      a. Inspect coating prior to backfill.
      b. As specified in Section 02318 - Trenching.

B. Joints:
   1. Install types of joints as specified in the piping schedule provided in Section 15052 - Common Work Results for General Piping.
   2. Mechanical joints are not acceptable in above ground applications.
   3. Field closure for restrained push-on pipe:
      a. Locate field closures in areas where thrust calculations demonstrate restraint is not required.

C. Connection:
1. Tapping ductile iron pipe:
a. Direct tapping of ductile iron pipe may be performed but is limited to the following conditions:
1) Maximum allowable tap diameter by pipe diameter and pressure class:

Pipe Size (inches)	Pressure Class				
	150	200	250	300	350
	Maximum Allowable Direct Tap Size (inches)				
3	-	-	-	-	3/4
4	-	-	-	-	3/4
6	-	-	-	-	1
8	-	-	-	-	1
10	-	-	-	-	1
12	-	-	-	-	1-1/4
14	-	-	1-1/4	1-1/2	1-1/2
16	-	-	1-1/2	2	2
18	-	-	2	2	2
20	-	-	2	2	2
24	-	2	2	2	2

b. The maximum allowable tap diameter for pipelines greater than 24 inches is 2 inches.
c. 2 layers of 3-mil thread sealant are required to minimize the torque required to effect a watertight connection.
2. Direct tapping of glass lined ductile iron pipe may be performed only when approved in writing by the Engineer. Direct tapping of glass lined pipe shall be performed in accordance with the above conditions for tapping ductile iron pipe in addition to the following conditions:
a. Drilling and tapping shall be performed using a hole saw:
1) Use of a large drill bit is not acceptable.
b. As the hole saw approaches the glass lining, lessen the inward pressure to avoid excess chipping or cracking of the lining.
c. Minor chipping or spalling of the glass lining shall be repaired using an epoxy resin “glass repair kit” provided by the fabricator.
1) Manufacturers: One of the following or equal:
a) Devoe - Devran 224 HS.
b) Sherwin-Williams Co. - Sher-Tile High Solids Epoxy.
2) Repair kit use is only allowed for areas of damage less than 1/2 inch in diameter.
a) Larger areas of damage will require replacement.
3) Surface shall be prepared and repair kit shall be applied in accordance with manufacturer and/or fabricator’s instructions.

3.02 DEFECTS IN COATINGS EXCEPT TAPE WRAP AND CEMENT MORTAR COATING

A. Engineer will identify defective coating to be field repaired in accordance with the applicable AWWA standard.
   1. Pipe joints exceeding the following defect maximum will be rejected.
      a. Minor defects:
         1) No more than 1.5 per 100 square feet of surface area.
         2) 2 or more minor repairs within an 8-inches diameter circle will be considered a single repair.
         3) Repairs for adhesion testing will not be included in the total number of repairs.
         4) Repair in accordance with manufacturer's requirements.
      b. Major defects:
         1) No more than 3 major repairs on each pipe joint.
         2) No more than 30 percent repairs on the pipe surface area with defects.
   2. Minor repairs:
      a. Repairs less than 8-inches in the greatest dimension.
      b. Repair in accordance with manufacturer's requirements.
   3. Major repairs:
      a. Repairs that exceed 8-inches in the greatest dimension.
      b. Repair in accordance with manufacturer's requirements.

3.03 PLURAL COMPONENT EPOXY

A. Joints:
   1. Field applied coating shall be of the same density, smoothness, and thickness as shop applied coating.
   2. Comply with same application requirements as shop applied coating or lining.
      a. Provide heating and/or dehumidification equipment as required to meet the environmental conditions necessary for proper coating application.

3.04 PLURAL COMPONENT POLYURETHANE

A. Joints:
   1. Field applied coating or lining shall be of the same density, smoothness, and thickness as shop applied coating or lining.
   2. Comply with same application requirements as shop applied coating or lining.
      a. Provide heating and/or dehumidification equipment as required to meet the environmental conditions necessary for proper coating application.

3.05 POLYETHYLENE ENCASEMENT

A. Wrap buried ductile iron pipe and fittings in 2 layers of loose low-density polyethylene wrap or a single layer of high-density polyethylene wrap in accordance with AWWA C105 and as specified in this Section.

B. Wrap polyethylene encasement to be continuous and terminated neatly at connections to below grade equipment or structures.

C. At wall penetrations, extend encasement to the wall and neatly terminate.

D. At slab penetrations, extend encasement to 2 inches below the top of slab and neatly terminate.

E. When rising vertically in unimproved areas, extend encasement on pipe 6 inches above existing grade and neatly terminate.

F. Repair tears and make joints with 2 layers of plastic tape.

G. Work shall be inspected prior to backfilling of pipe and associated items.

3.06 FIELD QUALITY CONTROL

A. Testing ductile iron piping:
   1. Test as specified in Section 15052 - Common Work Results for General Piping and Section 15956 - Piping Systems Testing.

B. Repair damaged cement mortar lining to match quality, thickness, and bonding of original lining in accordance with AWWA C104.
   1. When lining cannot be repaired or repairs are defective, replace defective piping with undamaged piping.

C. Verify that interior surfaces of ceramic epoxy and glass lined pipe and fittings have continuous coverage:
   1. Test random samples, as directed by Engineer, in accordance with ASTM B1000.
   2. Discard lined piping and fittings found to have pinholes, crazing, or fish scales, which expose the metal substrate.

END OF SECTION

SECTION 15230

PLASTIC PIPING AND TUBING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Plastic pipe, tubing, and fittings for systems that are not plumbing systems.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.12 - Cast Iron Threaded Drainage Fittings.

B. ASTM International (ASTM):
   1. D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
   2. D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
   3. D1869 - Standard Specification for Rubber Rings for Asbestos-Cement Pipe.
   4. D2241 - Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated (SDR Series).
   5. D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
   6. D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
   7. D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
   8. D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
   9. D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
   10. D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
   11. D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
   12. F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
   13. F439 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
   14. F441 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
   15. F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
   16. F493 - Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.

17. F645 - Standard Guide for Selection, Design and Installation of Thermoplastic Water-Pressure Piping Systems.
18. F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

1.03 ABBREVIATIONS

A. ABS: Acrylonitrile-butadiene-styrene.

B. CPVC: Chlorinated polyvinyl chloride.

C. ID: Inside diameter of piping or tubing.

D. NPS: Nominal pipe size followed by the size designation.

E. NS: Nominal size of piping or tubing.

F. PVC: Polyvinyl chloride.

1.04 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: As specified in Section 15052 - Common Work Results for General Piping.

C. Shop Drawings:
1. Describe materials, pipe, fittings, gaskets, and solvent cement.
2. Installation instructions.

1.05 QUALITY ASSURANCE

A. Mark plastic pipe with nominal size, type, class, schedule, or pressure rating, manufacturer and all markings required in accordance with ASTM and AWWA standards.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect piping materials from sunlight, scoring, and distortion.

B. Do not allow surface temperatures on pipe and fittings to exceed 120 degrees Fahrenheit.

PART 2 PRODUCTS

2.01 MATERIALS

A. Extruding and molding material: Virgin material containing no scrap, regrind, or rework material except where permitted in the referenced standards.

B. Fittings: Same material as the pipe and of equal or greater pressure rating.

C. Unions 2-1/2 inches and smaller: Socket end screwed unions. Make unions 3 inches and larger of socket flanges with 1/8-inch full-face soft Viton™ gasket.

2.02 PVC PIPING, SCHEDULE TYPE

A. The requirements for PVC piping used in plumbing systems are found in Section 15400 - Plumbing Systems.

B. Materials:
   1. PVC Pipe: Designation PVC 1120 in accordance with ASTM D1785 and appendices:
      a. Pipe and fittings: Extruded from Type I, Grade 1, Class 12454 material in accordance with ASTM D1784.
      b. PVC Pipe: Schedule 80 unless otherwise indicated on the Drawings.
   2. Fittings:
      a. Supplied by pipe manufacturer.
      b. Pressure fittings: In accordance with ASTM D2466 or ASTM D2467.
      c. DWV fittings: In accordance with ASTM D2665.
   3. Solvent cement: In accordance with ASTM D2564:
      a. Chemical service: For CPVC or PVC pipe in chemical service, provide the following primer and cement, or equal:
         1) Primer: IPS Corp., Type P70.
         2) Cement: IPS Corp., Type 724 cement or another cement certified by the manufacturer for chemical service.

2.03 CPVC PIPING

A. Materials:
   1. CPVC pipe: Schedule 40 or Schedule 80, as specified, in accordance with ASTM F441 and Appendix, CPVC 4120:
      a. Pipe: Extruded from Type IV, Grade 1, Class 23447 material in accordance with ASTM D1784.
      b. Manufacturers: One of the following or equal:
         1) Charlotte Pipe and Foundry Co.
         2) Eslon Thermoplastics, Inc.
         3) GF Harvel.
   2. Fittings: In accordance with ASTM F438 or ASTM F439 for pressure fittings, as appropriate to the service and pressure requirement:
      a. Fittings: Supplied by the pipe manufacturer.
      b. Manufacturers: One of the following or equal:
         1) Colonial Engineering.
         2) Eslon Thermoplastics, Inc.
         3) Chemtrol.
         4) Spears Manufacturing Co.
   3. Solvent cement: In accordance with ASTM F493:
      a. For CPVC pipe in chemical service, utilize IPS Corp., Type 724 cement or another cement certified by the manufacturer for high strength hypochlorite service.

2.04 SOURCE QUALITY CONTROL

A. The requirements for PVC piping used in plumbing systems are found in Section 15400 - Plumbing Systems.

B. PVC piping, Schedule Type:
   1. Mark pipe and fittings in accordance with ASTM D1785.

C. CPVC piping:
   1. Mark pipe and fittings in accordance with ASTM F441.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
   1. Where not otherwise specified, install piping in accordance with ASTM F645, or manufacturer's published instructions for installation of piping, as applicable to the particular type of piping.
   2. Provide molded transition fittings for transitions from plastic to metal or IPS pipe. Do not thread plastic pipe.
   3. Locate unions where indicated on the Drawings, and elsewhere where required for adequate access and assembly of the piping system.
   4. Provide serrated nipples for transition from plastic pipe to rubber hose.

B. Installation of PVC piping, Schedule Type:
   1. The requirements for PVC piping used in plumbing systems are found in Section 15400 - Plumbing Systems.
   2. Solvent weld joints in accordance with ASTM D2855:
      a. For PVC pipe in chemical service use IPS Corp., Type 724 cement in accordance with manufacturer's instructions.
   3. Install piping in accordance with manufacturer's published instructions.

C. Installation of CPVC piping:
   1. Clean dirt and moisture from pipe and fittings.
   2. Bevel pipe ends in accordance with manufacturer's instructions with chamfering tool or file. Remove burrs.
   3. Use solvent cement and primer formulated for CPVC:
      a. For CPVC pipe in chemical service use IPS Corp., Type 724 cement in accordance with manufacturer's instructions.
   4. Use primer on pressure and non-pressure joints.
   5. Do not solvent weld joints when ambient temperatures are below 40 degrees Fahrenheit or above 90 degrees Fahrenheit unless solvent cements specially formulated for these conditions are utilized.

END OF SECTION

SECTION 15244

POLYVINYL CHLORIDE (PVC) PIPE: PRESSURE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. AWWA C900 PVC pipe and fittings.

1.02 REFERENCES

A. American Water Works Association (AWWA):
   1. C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   2. C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.
   3. C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In.
   4. C905 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. through 48 In., for Water Transmission and Distribution.
   5. M23 - PVC Pipe - Design and Installation Manual.

B. ASTM International (ASTM):
   1. A536 - Standard Specification for Ductile Iron Castings.
   2. D1784 - Standard Specification for Rigid PolyVinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
   3. D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
   4. F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
   5. F645 - Standard Guide for Selection, Design, and Installation of Thermoplastic Water-Pressure Piping Systems.

C. NSF International (NSF):
   1. 61 - Drinking Water System Components - Health Effects.

1.03 ABBREVIATIONS

A. DR: Dimension Ratio = OD/t (OD is pipe outer diameter, t is pipe wall thickness).

B. NPS: Nominal pipe size followed by the size designation.

1.04 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. As specified in Section 15052 - Common Work Results for General Piping.

C. Shop drawings.

1.05 QUALITY ASSURANCE

A. Pipe in potable water applications: Provide pipe bearing NSF 61 seal.

B. Mark plastic pipe with date of extrusion, nominal size, class, manufacturer, and markings required in accordance with ASTM and AWWA standards.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect from sunlight, scoring, and distortion.

B. Do not allow surface temperatures to exceed 120 degrees Fahrenheit.

C. Deliver, offload, handle, and store pipe in accordance with manufacturer's or pipe supplier's recommendations and best practices provided by AWWA M23 and AWWA C605, including compliance with minimum recommended bending radius and maximum safe pulling forces for each specific pipe.

PART 2 PRODUCTS

2.01 PIPE

A. General:
   1. As specified in Section 15052 - Common Work Results for General Piping.
   2. Extruding and molding material: Virgin material containing no scrap, regrind, or rework material except where permitted in the referenced standards.
   3. In accordance with AWWA C900.
   4. Made from a PVC compound conforming to cell classification 12454 in accordance with ASTM D1784.

B. Pipe:
   1. Bell and spigot:
      a. Pipe with integral bell.
      b. Pressure Class as scheduled in Section 15052 - Common Work Results for General Piping with a maximum DR of 18.
      c. Manufacturers: One of the following or equal.
         1) Diamond Plastics Corp.
         2) CertainTeed.
         3) North American Pipe Corp.

2.02 FITTINGS

A. Material:
   1. Cast or ductile iron fittings as specified in Section 15211 - Ductile Iron Pipe: AWWA C151 sized for the dimensions of the pipe being used.

B. Equal to or greater pressure rating than the pipe.

2.03 JOINTS

A. Bell and spigot joints:
   1. Push-on or mechanical joint type as identified in the Piping Schedule in Section 15052 - Common Work Results for General Piping.
   2. Gasketed joint assembly: Meet or exceed the requirements in accordance with ASTM D3139.
   3. Factory installed gaskets: Neoprene in accordance with ASTM F477.
   4. Joint restraint at fittings:
      a. Concrete thrust blocks:
         1) Install thrust blocks at changes in pipe diameter and at fittings.
         2) Design thrust blocks using a safety factor of at least 1.5:1 for both the test and peak operating pressures.
      b. Mechanical wedge action joint restraints:
         1) Manufacturers: One of the following or approved equal:
            a) EBAA Iron, Inc.:
               (1) For pipes 3 to 36-inch: Series 2000PV.
               (2) For pipes 42 and 48-inch: Series 2200.
            b) Star Pipe Products, Series 4000.
            c) Sigma Corp.*:*
               (1) For pipes 3 to 36-inch: One-Lok Model SLCE.
               (2) For pipes 42 and 48-inch: PV-Lok Model PWM.
         2) Materials:
            a) Mechanical joints bolts and nuts as Specified in Section 15052 - Common Work Results for General Piping.
            b) Gland body: Ductile iron in accordance with ASTM A536.
            c) Wedge and wedge actuating components: Ductile iron in accordance with ASTM A536.
               (1) Wedges: Heat-treated to a minimum of 370 BHN.
            d) Actuating bolts and nuts: Ductile iron in accordance with ASTM A536.
               (1) Provide torque-limiting twist off components to ensure proper installation.
         3) Coatings:
            a) Provide a manufacturer applied coating system.
            b) Manufacturers: One of the following or equal:
               (1) EBAA Iron Inc., Mega-Bond.
               (2) Star Pipe Products, Star-Bond.
               (3) Sigma Corp., Corrsafe™ Electro-Deposition Coating.
         4) Consist of multiple gripping wedges incorporated into a follower gland meeting the requirements in accordance with AWWA C111.
         5) Allow post assembly angular deflection that is a minimum of 50 percent of the angular deflection allowed by the mechanical joint.
         6) Pressure rating equal to or greater than that of the pipe on which it is being used and a minimum safety factor of 2:1 for all sizes.
      c. Push-on joint restraint harnesses:
         1) Manufacturers: One of the following or approved equal:
            a) EBAA Iron, Inc.:
               (1) For pipes 4 to 12-inch: Series 1500.
               (2) For pipes 14 to 48-inch: Series 2800.

b) Star Pipe Products, Series 4100P.
c) Sigma Corp., PV-Lok Model PWP.

2) Materials:
   a) Restraint and backup rings: Ductile iron in accordance with ASTM A536.
   b) Wedge and wedge actuating components: Ductile iron in accordance with ASTM A536.
   c) Tie rods: Low alloy steel in accordance with AWWA C111.
3) Coatings:
   a) Provide manufacturer applied coating system.
   b) Manufacturers: One of the following or equal:
      (1) EBAA Iron Inc., Mega-Bond.
      (2) Star Pipe Products, Star-Bond.
      (3) Sigma Corp., Corrsafe ™ Electro-deposition coating.
4) Consist of a backup ring behind the PVC bell and a restraint ring consisting of multiple gripping wedges connected with number and type of tie rods as recommended by the manufacturer.
5) Allow post assembly angular deflection that is a minimum of 50 percent of the angular deflection allowed by the push-on joint.
6) Pressure rating equal to or greater than that of the pipe on which it is being used and a minimum safety factor of 2:1 for all sizes.

2.04 SOURCE QUALITY CONTROL

A. Bell and spigot piping:
   1. Hydrostatic proof testing in accordance with AWWA C900: Test pipe and integral bell to withstand, without failure, 2 times the pressure class of the pipe for a minimum of 5 seconds.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
   1. Install PVC piping in accordance with ASTM F645, AWWA C605, and manufacturer's or pipe supplier’s published installation instructions.
   2. Trenching and backfill as specified in Section 02318 - Trenching.
   3. Install pipe with tracer wire as specified in Section 15076 - Pipe Identification.

B. Tapping FPVC:
   1. Direct tapping of FPVC is not allowed.
   2. Saddle tapping:
      a. Saddle taps are allowable on all sizes and classes of AWWA C900 FPCVP.
      b. As specified in Section 15120 - Piping Specialties for allowable service saddles.

3. Tapping sleeves:
    a. Tapping sleeves are allowable on all sizes and classes of AWWA C900 FPVC.
    b. As specified in Section 15120 - Piping Specialties for allowable tapping sleeves.
4. Use only allowable tap sizing and recommended tapping procedures provided by the pipe supplier for all tapping operations on FPVC.

3.02 FIELD QUALITY CONTROL

A. Leakage test for piping:
    1. Subject to visible leak test and pressure test with maximum leakage allowance, as specified in Section 15956 - Piping Systems Testing.
    2. Pressure test with maximum leakage allowance:
        a. Perform test after placing sufficient backfill.
        b. In areas requiring immediate backfill, test prior to placement of permanent surfacing.
        c. Test pressure: As specified in the Piping Schedule in Section 15052 - Common Work Results for General Piping.
        d. Maximum leakage allowance for bell and spigot pipe is as listed in the table below:

Test Pressure (psi)	**Bell and Spigot Pipe Allowable Leakage (Gallons per 50 joints per hour)**									
	Nominal Pipe Size (inches)									
	4	**6**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**24**
50	0.19	0.29	0.38	0.48	0.57	0.67	0.76	0.86	0.96	1.15
75	0.23	0.35	0.47	0.59	0.70	0.82	0.94	1.05	1.17	1.40
100	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62
125	0.3	0.45	0.6	0.76	0.91	1.06	1.21	1.36	1.51	1.81
150	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99
175	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15
200	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29
225	0.41	0.61	0.81	1.01	1.22	1.42	1.62	1.82	2.03	2.43
250	0.43	0.64	0.85	1.07	1.28	1.50	1.71	1.92	2.14	2.56
275	0.45	0.67	0.90	1.12	1.34	1.57	1.79	2.02	2.24	2.69
300	0.47	0.70	0.94	1.17	1.40	1.64	1.87	2.11	2.34	2.81

END OF SECTION

SECTION 15249

POLYVINYL CHLORIDE (PVC) PIPE: SCHEDULE TYPE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Schedule type PVC pipe and fittings.

1.02 REFERENCES

A. ASTM International (ASTM):
   1. D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
   2. D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
   3. D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
   4. D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
   5. D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
   6. D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets.
   7. F645 - Standard Guide for Selection, Design and Installation of Thermoplastic Water-Pressure Piping Systems.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: As specified in Section 15052 - Common Work Results for General Piping.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect from sunlight, scoring, and distortion.

B. Do not allow surface temperatures to exceed 120 degrees Fahrenheit.

C. Store and handle as recommended by manufacturer in published instructions.

PART 2 PRODUCTS

2.01 MATERIALS

A. Extruding and molding material: Virgin material containing no scrap, regrind, or rework material except where permitted in the referenced standards.
   1. Pipe: Designation PVC 1120 in accordance with ASTM D1785 and appendices:
      a. Extruded from Type I, Grade 1, Class 12454 material in accordance with ASTM D1784.
      b. Schedule 80 unless otherwise indicated on the Drawings or specified in the Piping Schedule in Section 15052 - Common Work Results for General Piping.
   2. Fittings: In accordance with ASTM D2467.
      a. Same material as the pipe and of equal or greater pressure rating.
      b. Supplied by pipe manufacturer.
      c. Unions 4 inches and smaller:
         1) Use socket end screwed unions.
      d. Unions 6 inches and larger:
         1) Use socket flanges with 1/8-inch full-face soft gasket.
            a) Gasket material: As indicated on the Piping Schedule.
   3. Solvent cement:
      a. In accordance with ASTM D2564.
      b. Manufacturers: The following or equal:
         1) IPS Corp.
            a) Primer: Type P70.
            b) Cement: Type 724.
      c. Certified by the manufacturer for the service of the pipe.
      d. In potable water applications: Provide solvent cement listed by NSF for potable water applications.

2.02 SOURCE QUALITY CONTROL

A. Meets or exceeds all quality assurance test requirements stated in ASTM D1785.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install piping in accordance with ASTM F645, or manufacturer's published instructions for installation of piping, as applicable.

B. Provide molded transition fittings for transitions from plastic to metal pipe.
   1. Do not thread pipe.
   2. Do not use flanged transition fittings unless specifically indicated on the Drawings.

C. Locate unions where indicated on the Drawings, and elsewhere where required for adequate access and assembly of the piping system.

D. Provide serrated nipples for transition from pipe to rubber hose.

E. Solvent weld joints in accordance with ASTM D2855.

3.02 FIELD QUALITY CONTROL

A. Test pipe as specified in Section 15052 - Common Work Results for General Piping and Section 15956 - Piping Systems Testing.

END OF SECTION

SECTION 15286

STAINLESS STEEL PIPE AND TUBING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Stainless steel piping and tubing.

1.02 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
   2. B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24.
   3. B16.11 - Forged Fittings, Socket-Welded and Threaded.
   4. B31.3 - Process Piping.
   5. B36.19 - Stainless Steel Pipe.

B. American Welding Society (AWS):
   1. D1.6 - Structural Welding Code - Stainless Steel.

C. ASTM International (ASTM):
   1. A182 - Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
   2. A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
   3. A194 - Standard Specification for Carbon and Alloy Steel Nuts and Bolts for High Pressure or High Temperature Service, or Both.
   4. A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   5. A269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
   6. A276 - Standard Specification for Stainless Steel Bars and Shapes.
   7. A312 - Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
   8. A351 - Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
   9. A380 - Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
   10. A403 - Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.
   11. A743 - Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application.

12. A744 - Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.
13. A774 - Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Services at Low and Moderate Temperatures.
14. A778 - Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
15. A789 - Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Tubing for General Service.
16. A790 - Standard Specification for Seamless and Welded Ferritic/Austenitic Stainless Steel Pipe.
17. A928 - Standard Specification for Ferritic/Austenitic (Duplex) Stainless Steel Pipe Electric Fusion Welded with Addition of Filler Metal.
18. A967 - Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.
19. B622 - Standard Specification for Seamless Nickel and Nickel-Cobalt Alloy Pipe and Tube.
20. B912 - Standard Specification for Passivation of Stainless Steels Using Electropolishing.
21. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: As specified in Section 15052 - Common Work Results for General Piping.

C. Shop drawings:
   1. Detailed layout drawings:
      a. Dimensions and alignment of pipes.
      b. Location of valves, fittings, and appurtenances.
      c. Location of field joints.
      d. Location of pipe hangars and supports.
      e. Connections to equipment and structures.
      f. Location and details of shop welds.
   2. Thickness and dimensions of fittings and gaskets.
   3. Photographs, drawings, and descriptions of pipe, fittings, welding procedures, and pickling and passivating procedures.
   4. Material specifications for pipe, gaskets, fittings, and couplings.
   5. Data on joint types and components used in the system including stub ends, backing flanges, flanged joints, grooved joint couplings and screwed joints.
   6. Location of material fabrication.
   7. Chemical analysis certificates.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. Add joints and flexible couplings in a manner that achieves intent of maximizing size of individual piping sections.

B. Shop fabrication: Fabricate piping sections in the shop and pickle and passivate at point of manufacture.

C. Field assembly:
   1. Field welding is prohibited.
   2. Assemble shop-fabricated piping in the field using the joints designed into the piping layout or by using flexible couplings.

2.02 STAINLESS STEEL PIPE

A. General:
   1. Pipe sizes specified in the Specifications and indicated on the Drawings are nominal.

B. Wall thickness:
   1. As specified in Section 15052 - Common Work Results for General Piping.

C. Piping material and manufacturing:
   1. Comply with the requirements outlined in the following table:

Service	Stainless Steel Grade	Pipe Manufacturing Process
For low chloride water service with chloride concentrates below 200 parts per million and/or free chlorine less than 2 parts per million at ambient temperatures.		
Piping 3 inches in nominal diameter and larger	Type 304L stainless steel in accordance with ASTM A240	In accordance with ASTM A778
Piping less than 3 inches in nominal diameter	Type 304L stainless steel in accordance with ASTM A240	In accordance with ASTM A312
PREN: Pitting Resistance Equivalency Number PREN = Cr% + (3.3 x Mo%) + (16 x N%)		

UNS #	ALLOY	Cr%	Mo%	N%	Other	PREN
N10276	C-276	14.5-16	15-17	-	W 3-4.5	64
S32750	Alloy 2507	24-26	6-8	0.24-0.32	-	48
S32654	654SMO	24-25	7-8	-	-	47
N06625	Alloy 625	20-23	8-10	-	Cb 3.25-4.15	46
N08366	AL6XN	20-22	6-7	-	-	40

UNS #	ALLOY	Cr%	Mo%	N%	Other	PREN
N06985	Alloy G	21-23.5	5.5-7.5	-	-	39
S32760	Zeron 100	24-26	3-4	0.2-0.3	W 0.5-1.0	37
S32205	Alloy 2205	22-23	3-3.5	0.14-0.20	-	34
N08904	904L	19-23	4-5	-	-	32
S31726	317LNM	17-20	4-5	0.1-0.2	-	32
N08825	Alloy 825	19-23.5	2.5-3.5	-	-	27
S32101	LDX-2101	21.5	0.3	0.22	-	26
S31603	316L	16-18	2-3	-	-	23
S30403	304L	18-20	-	-	-	18

D. Fittings for piping 3 inches in nominal diameter and greater:
   1. Material: In accordance with ASTM A240 stainless steel, grade to match the pipe.
   2. Manufacturing standard: In accordance with ASTM A774.
   3. Wall thickness of fitting: In accordance with ASME B36.19 for the schedule of pipe specified.
   4. End configuration: As needed to comply with specified type of joint.
   5. Dimensional standards:
      a. Fittings with weld ends: In accordance with ASME B16.11.
      b. Fittings with flanged ends: In accordance with ASME B16.5, Class 150.

E. Fittings for piping less than 3 inches in diameter:
   1. Material: In accordance with ASTM A240 stainless steel, grade to match the pipe.
   2. Manufacturing standard: In accordance with ASTM A403, Class WP.
   3. Wall thickness and dimensions of fitting: In accordance with ASME B16.11 and as required for the schedule of pipe specified.
   4. End configuration: As needed to comply with specified type of joint.
   5. Forgings in accordance with ASTM A182, or barstock in accordance with ASTM A276. Match forging or barstock material to the piping materials.

F. Piping joints:
   1. Joint types, piping greater than 2 inches in diameter, general:
      a. Where type of joint is specifically indicated on the Drawings or specified, design and shop-fabricate piping sections utilizing type of joint illustrated or scheduled.
      b. Where type of joint is not specifically indicated on the Drawings or as specified in Section 15052 - Common Work Results for General Piping, Piping Schedule, design and shop-fabricate piping sections utilizing any of the following joint types:
         1) Welded joints.
         2) Flanged joints.
      c. Joints at valves and pipe appurtenances:
         1) Provide flanged valves and flanged pipe appurtenances in stainless steel piping systems with flanged ends.

2) Design and fabricate piping sections to make connections with flanged valves and pipe appurtenances using flanged coupling adapters or flanged joints.
a) Flexible couplings and flanged coupling adapters: Provide stainless steel construction with materials matching the piping system, and conforming to requirements as specified in Section 15121 - Pipe Couplings.

2. Welded joints:
   a. Pipe 12 inches and larger in diameter: Automatically weld joints using gas tungsten-arc procedures.
   b. Piping 4 inches through 12 inches in diameter: Double butt welded joints.
   c. Piping less than 4 inches in diameter: Single butt-welded joints.
   d. Mark each weld with a symbol that identifies the welder.
3. Flanged joints: Conforming to the requirements in accordance with ASME B16.5, Class 150 , 300, or 600, as scheduled.
4. Flanges for Schedule 40S and Schedule 80S pipe:
   a. Provide forged stainless steel (type matching piping system) welding neck flanges or slip-on flanges in accordance with ASME B16.5 Class 150.
   b. Material: In accordance with ASTM A182.

G. Gaskets:
1. Aeration air service: As specified in Section 15052 - Common Work Results for General Piping.
2. All other service applications: EPDM, nitrile, or other materials compatible with the process fluid.

H. Bolts for flanges :
1. Bolts and nuts: Type 316 stainless steel in accordance with ASTM A193 heavy hex head.
   a. Bolt length such that after installation, end of bolt projects 1/8-inch to 3/8-inch beyond outer face of nut.
   b. Nuts: In accordance with ASTM A194 heavy hex pattern.

I. Fabrication of pipe sections:
1. Welding: Weld in accordance with ASME B31.3.
2. Weld seams:
   a. Full penetration welds, free of oxidation, crevices, pits and cracks, and without undercuts.
   b. Provide weld crowns of 1/16 inch with tolerance of plus 1/16 inch and minus 1/32 inch.
   c. Where internal weld seams are not accessible, use gas tungsten-arc procedures with internal gas purge.
   d. Where internal weld seams are accessible, weld seams inside and outside using manual shielded metal-arc procedures.

J. Cleaning (pickling) and passivation:
1. Following shop fabrication of pipe sections, straight spools, fittings, and other piping components, clean (pickle) and passivate fabricated pieces.

2. Clean (pickle) and passivate in accordance with ASTM A380 or A967.
    a. If degreasing is required before cleaning to remove scale or iron oxide, cleaning (pickling) treatments with citric acid are permissible.
        1) However, these treatments must be followed by inorganic cleaners such as nitric acid/hydrofluoric acid.
    b. Passivation treatments with citric acid are not allowed.
3. Finish requirements: Remove free iron, heat tint oxides, weld scale, and other impurities, and obtain a passive finished surface.

K. Electropolishing:
1. Required for the following stainless steel piping:
    a. Pipe interior: All piping.
    b. Pipe exterior: All piping except concrete encased piping.
2. For piping greater than 2-inches in diameter:
    a. Electropolish stainless steel pipe inside and out in accordance with ASTM B912.
        1) Electropolish process: Remove no more than 5 micrometers from the surface.
    b. Following shop fabrication of pipe sections, straight spools, fittings, and other components, prepare surface using preparatory and cleaning procedures in accordance with ASTM A380.
        1) Wipe all items with appropriate solvent to remove any marks, sugar, markers, or crayon.
    c. A post dip in room temperature 10 to 30 percent nitric acid solution is required to remove residuals from the electropolishing process and to provide a shine to the metal surface.
        1) Follow the post dip procedure by final rinsing with water to remove residual acid or any other materials that may affect the appearance or performance of the passivated part.
    d. Finished surfaces: Free of imperfections such as pitting, etches, burn marks or stains.

2.03 STAINLESS STEEL TUBING

A. Stainless steel tubing:
1. Seamless tubing made of Type 316L stainless steel and in accordance with ASTM A269, wall thickness not less than 0.035 inch.

B. Fittings: Swage ferrule design:
1. Components made of:
    a. Type 316 stainless steel.
2. Double acting ferrule design, providing both a primary seal and a secondary bearing force.
3. Flare type fittings are not acceptable.
4. Manufacturers: One of the following or equal:
    a. Crawford Fitting Co., Swagelok.
    b. Hoke, Gyrolok.
    c. Parker, CPI.

C. Valves for use with stainless steel tubing:
   1. Ball type valves with swage ends to match tubing diameter.
   2. Constructed from:
      a. Type 316 stainless steel with TFE seats.
   3. Manufacturers: The following or equal:
      a. Crawford Fitting Co., Swagelok.

2.04 SOURCE QUALITY CONTROL

A. Visually inspect pipe for welding defects such as crevices, pits, cracks, protrusions, and oxidation deposits.

B. Provide written certification that the pipe as supplied are in accordance with ASTM A778. Supplemental testing is not required.

C. Provide written certification that the fittings as supplied are in accordance with ASTM A774.
   1. Supplementary testing is not required.

D. Thoroughly clean any equipment before use in cleaning or fabrication of stainless steel.

E. Storage: Segregate location of stainless steel piping from fabrication of any other piping materials.

F. Shipment to site:
   1. Protect all flanges and pipe ends by encapsulating in dense foam.
   2. Securely strap all elements to pallets with nylon straps. Use of metallic straps is prohibited.
   3. Cap ends of tube, piping, pipe spools, fittings, and valves with non-metallic plugs.
   4. Load pallets so no tube, piping, pipe spools, fittings, or valves bear the weight of pallets above.
   5. Notify Engineer when deliveries arrive so Engineer may inspect the shipping conditions.
   6. Engineer may reject material due to improper shipping methods or damage during shipment.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install piping in such a manner as not to impart strain to connected equipment.

B. Slope horizontal lines so that they can be drained completely.

C. Provide valve drains at low points in piping systems.

D. Install eccentric reducers where necessary to facilitate draining of piping system.

E. Provide access for inspection and flushing of piping systems to remove sediment, deposits, and debris.

3.02 FIELD ASSEMBLY OF SHOP-FABRICATED PIPING SECTIONS

A. Join shop-fabricated piping sections together using backing flanges, flexible couplings, flanged coupling adapters, grooved couplings, or flanges.

3.03 FIELD QUALITY CONTROL

A. Test piping to pressure and by method as specified in Section 15052 - Common Work Results for General Piping.
   1. If pressure testing is accomplished with water:
      a. Use only potable quality water.
      b. Piping: Thoroughly drained and dried or place immediately into service.

B. Visually inspect pipe for welding defects such as crevices, pits, cracks, protrusions, and oxidation deposits.

3.04 PROTECTION

A. Preserve appearance and finish of stainless steel piping by providing suitable protection during handling and installation and until final acceptance of the Work.
   1. Use handling methods and equipment to prevent damage to the coating, include the use of wide canvas slings and wide padded skids.
   2. Do not use bare cables, chains, hooks, metal bars, or narrow skids.
   3. Store stainless steel piping and fittings away from any other piping or metals. Storage in contact with ground or outside without projection from bad weather is prohibited.
   4. Protect stainless steel piping and fittings from carbon steel projections (when grinding carbon steel assemblies in proximity) and carbon steel contamination (do not contact stainless steel with carbon steel wire brush or other carbon steel tool).
   5. Electropolished stainless steel:
      a. Do not handle with bare hands or gloves contaminated with oils, metals, or other materials. Use disposable latex gloves or equivalent with handling.
      b. Clean, repair, or replace damaged, stained, scarred or dirty electropolished stainless steel to restore shop-finish quality.

END OF SECTION

SECTION 15400

PLUMBING SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for materials and installation of plumbing systems.

1.02 REFERENCES

A. Abbreviations:
   1. gpf - gallons per flush.
   2. gph - gallons per hour.
   3. gpm - gallons per minute.
   4. psig - pounds per square inch, gauge.

B. Definitions:
   1. Buried: Piping that is installed below buildings, foundations, or finish grade, either in soil or encased in concrete in soil.
   2. Exterior: Piping that is installed outside a building or within a pipe trench or tunnel.
   3. Flame Spread and Smoke Density: Burning characteristics determined in accordance with ASTM E84.
   4. Interior: Piping that is installed inside a building.
   5. K Factor: Thermal conductivity determined in accordance with ASTM C177 or C518.
   6. Mineral Fiber: Fibers manufactured of glass, rock, or slag processed from a molten state, with or without a binder.
   7. Water Vapor Permeance: Water vapor transmission determined in accordance with ASTM E96 and expressed in units of perm-inch.

C. Standards:
   1. American Concrete Institute (ACI).
   2. American Gas Association (AGA).
   3. American Society of Mechanical Engineers (ASME).
      a. B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300.
      b. B16.12 - Cast Iron Threaded Drainage Fittings.
   4. American Society of Sanitary Engineering (ASSE):
      a. 1070 - Performance Requirements for Water Temperature Limiting Devices.
   5. American Water Works Association (AWWA):
      a. C511 - Reduced-Pressure Principle Backflow Prevention.
      b. C700 - Standard for Cold-Water Meters -- Displacement Type, Bronze Main Case.
      c. C702 - Standard for Cold-Water Meters -- Compound Type.
   6. Americans with Disabilities Act (ADA).

7. ASTM International (ASTM):
    a. A48 - Standard Specification for Gray Iron Castings.
    b. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
    c. A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
    d. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
    e. A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
    f. A888 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
    g. B32 - Standard Specification for Solder Metal.
    h. B88 - Standard Specification for Seamless Copper Water Tube.
    i. B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.
    j. B828 - Standard Specification for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
    k. C117 - Standard Test Method for Materials Finer than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing.
    l. C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
    m. C547 - Standard Specification for Mineral Fiber Pipe Insulation.
    n. C552 - Standard Specification for Cellular Glass Thermal Insulation.
    o. C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
    p. C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
    q. D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
    r. D297 - Standard Test Methods for Rubber Products-Chemical Analysis.
    s. D395 - Standard Test Methods for Rubber Property-Compression Set.
    t. D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
    u. D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position.
    v. D638 - Standard Test Method for Tensile Properties of Plastics
    w. D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
    x. D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
    y. D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride (CPVC) Compounds.
    z. D1785 - Standard Specification for Poly(Vinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
    aa. D2240 - Standard Test Method for Rubber Property-Durometer Hardness.
    bb. D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
    cc. D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
    dd. D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.

ee. D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
ff. D2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.
gg. D2863 - Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index).
hh. D4101 - Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials.
ii. E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
jj. E96 - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.
kk. F438 - Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
ll. F439 - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
mm. F441 - Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
nn. F493 - Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
oo. F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
pp. F594 - Standard Specification for Stainless Steel Nuts.
qq. F645 - Standard Guide for Selection, Design, and Installation of Thermoplastic Water- Pressure Piping Systems.

8. California Code of Regulations (CCR):
   a. Title 24 - Building Standard Code.
9. International Association of Plumbing and Mechanical Officials (IAPMO):
   a. IS 03 - Copper plumbing Tube Pipe and Fittings.
10. National Electrical Manufacturers Association (NEMA):
   a. 250 - Enclosures for Electrical Equipment (1000 V Maximum).
11. Plumbing and Drainage Institute (PDI):
   a. WH 201 - Water Hammer Arresters Standard.
12. Underwriters Laboratories, Inc. (UL):
   a. 94 - Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.
13. United States Environment Protection Agency (EPA): Water Sense.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Roof coordination:
   1. Provide plumbing equipment roof penetrations information required in the preparation of roofing drawings including, but not limited to:
      a. Location.
      b. Diameter.
      c. Configuration of penetration and the surround.

2. Provide roof mounted plumbing equipment information required in the preparation of roofing drawings including, but not limited to:
    a. Location.
    b. Size.
    c. Weight.
    d. Anchoring and support details.

1.04 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Manufacturer's instructions.

C. Shop drawings: and as applicable:
1. System layout, mechanical, electrical power, and control diagrams.
2. Nameplate information.
3. Materials.
4. Coatings and linings.
5. Rough-in drawings.
6. Supports, vibration isolators, and details.
7. Primary and ancillary equipment.
8. Proposed cutting and patching.
9. Maximum recommended equipment vibration levels and field-testing method.
10. Copy of factory test results.

D. Certificates: As specified in Section 01600 - Product Requirements:
1. American Backflow Prevention Association for backflow prevention assembly.
2. National Science Foundation for products when specified.

E. Field testing documentation.

F. Warranties.

1.05 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

A. All devices and fixtures shall be in accordance with CCR Title 24.

2.02 PIPE INSULATION

A. General:
1. Insulation thicknesses: Provide insulation thickness in inches in accordance with Table 1 per 2021 International Energy Conservation Code (IECC). Insulation thickness shown is nominal. Manufacturing tolerance of 15 percent variation is permissible.

2. Insulation conductivity and nominal pipe size as specified in Table 1.

Table 1 - Insulation Thickness Requirements							
	CONDUCTIVITY Btu x in./(h x ft^2 x $^\circ$F)[b]	**MEAN RATING TEMPERATURE Degree Fahrenheit**	**<1**	**1 to <1 1/2**	**1 1/2 to < 4**	**4 to < 8**	**>8**
105-140	0.21-0.28	100	1.0	1.5	1.5	1.5	1.5
40-60	0.21-0.27	75	0.5	1.0	1.0	1.0	1.0

3. Service designation and location requirements as specified in Table 2 including the following requirements.
   a. Insulation type.
   b. Jacket type.
   c. Vapor barrier requirements.

Table 2 - Insulation Schedule					
Service Designation[(1)]	**Location[(2)]**	**Insulation Type[(3)]**	**Jacket Type[(3)]**	**Service Temp. °F[(4)]**	**Vapor Barrier**
Hot Water	Interior or Exterior	1 or 2	Type 1 on Exterior installations, none required on Interior installations	100-200	Install on Type 2 insulation
Hot Water Supply and Return	Interior or Exterior	2 or 3	1 or 2	100-200	Required
Tepid Water	Interior or Exterior	1 or 2	Type 1 on Exterior installations, none required on Interior installations	60-100	Install on Type 2 insulation
Tepid Water Supply and Return	Interior or Exterior	2 or 3	1 or 2	60-100	Required
Steam Condensate	Interior or Exterior	3	2	Above 200	Required

Table 2 - Insulation Schedule					
Service Designation[1]	**Location[2]**	**Insulation Type[3]**	**Jacket Type[3]**	**Service Temp. °F[4]**	**Vapor Barrier**
Chilled Water	Interior or Exterior	1	1	Below 40	Required
Heat Traced Pipes[5]	Exterior	1 or 2	2	N/A	Install on Type 2 insulation

Notes:
1. Refer to Plumbing Piping Schedule as indicated on the Drawings for service designations.
2. Insulation jackets are not required for concealed interior installations in accordance with appliable plumbing code.
3. Contractor may select from options listed.
4. Unless noted otherwise, use service temperature range provided in this table to establish insulation thickness as required by Table 1.
5. Insulate all piping systems that are heat traced as indicated on the Drawings.

B. Type 1: Pipe insulation, closed cell elastomeric insulation:
   1. Manufacturers: One of the following or equal:
      a. Aeroflex USA Inc., Aerocel® AC.
      b. Armacell®, AP Armaflex.
   2. Insulation material: Closed cell elastomeric insulation.
   3. Minimum temperature range: Minus 40 degrees Fahrenheit to plus 220 degrees Fahrenheit.
   4. K factor at 75 degrees Fahrenheit: Not more than 0.27 BTU-inch/hour-square feet-degrees Fahrenheit.
   5. Fire ratings:
      a. Flame spread: 25 or less.
      b. Smoke density: 50 or less for insulation thicknesses up to 1.5 inches.
   6. Joints: Seal with manufacturer's recommended contact adhesive to form continuous water barrier.

C. Type 2: Pipe insulation, preformed mineral fiberglass:
   1. Manufacturers: One of the following or equal:
      a. Johns Manville, Micro-Lok® HP.
      b. Knauf Insulation.
      c. Owens-Corning.
   2. Insulation material: Preformed mineral fiberglass insulation made from glass fibers bonded with a thermosetting resin.
      a. In accordance with ASTM C547, Class 1.
      b. Provide with factory installed vapor barrier.
         1) Material: White Kraft paper bound to aluminum foil in accordance with ASTM C1136, Type I.
         2) Longitudinal lap seals: Pressure-sensitive, self-sealing longitudinal lap strip with factory applied adhesive.
         3) Circumferential butt seals: 4-inch wide tape or similar properties or 4 inch wide overlap with adhesive seal.

4) Vapor barrier permeability: 0.02 perms or lower.
5) Vapor barrier flame spread rating: 25 or less.

3. Minimum temperature range: Minus 0 degrees Fahrenheit to plus 850 degrees Fahrenheit.
4. K factor at 75 degrees Fahrenheit: Not more than 0.23 BTU-inch/hour-square feet-degrees Fahrenheit.
5. Maximum moisture absorption, volume percent: 5.

D. Type 3: Pipe insulation, rigid cellular glass:
1. Manufacturers: One of the following or equal:
a. Owens- Corning, Foamglas® One™.
2. Insulation material: Rigid cellular glass in accordance with ASTM C552, Type II.
3. Temperature range: Minus 450 degrees Fahrenheit to plus 900 degrees Fahrenheit.
4. K factor at 75 degrees Fahrenheit: Not more than 0.32 BTU-inch/hour-square feet-degrees Fahrenheit.
5. Minimum average density: 7.5 pounds per cubic foot.
6. Maximum moisture absorption, volume percent: 5.
7. Minimum compressive strength: 87 pounds per square inch.
8. Moisture permeability: 0.00 perm-inch.

E. Insulation jackets:
1. Type 1: Pipe insulation jacket, ultraviolet-resistant polyvinyl chloride:
a. Manufacturers: One of the following or equal:
1) Johns Manville, Zeston® 2000 PVC.
2) Proto Corp., LoSMOKE PVC.
3) Speedline® Corp., Smoke-Safe™ PVC.
b. Material: Ultraviolet-resistant polyvinyl chloride jacketing, 20 mil minimum thickness.
c. Fire rating: 25 maximum flame spread, smoke developed 50 or less.
d. Color: White.
e. Overlap: 1-inch minimum at joints and fittings.
f. Joint seal: PVC solvent welded or adhesive as recommended by the manufacturer.
g. Fittings: Factory made with full thickness insulation.
2. Type 2: Pipe insulation jacket, aluminum:
a. Manufacturers: One of the following or equal:
1) Childers Products.
2) Premetco International.
b. Material: Aluminum, Alloy 5005; 0.016-inch (26-gauge) minimum thickness.
c. Overlap: Overlap circumferential joints 4 inches minimum; overlap longitudinal joints 1-inch minimum; longitudinal joints oriented to minimize water entry.
d. Bands: 0.5-inch wide, 0.0508-inch (16-gauge) thick aluminum, same alloy as jacket or 0.0179-inch thick Type 304 stainless steel; install on 18-inch centers, uniformly spaced and at all fitting joints.
e. Joint seal: Apply waterproof adhesive at joints and overlaps.
f. Fittings: Custom fit of same materials.

F. Vapor barriers:
    1. Type 1: Pipe insulation vapor barrier, white Kraft paper bound to aluminum foil:
        a. Material: White Kraft paper bound to aluminum foil in accordance with ASTM C1136, Type 1.
        b. Permeability: 0.02 perms or lower.
        c. Maximum flame spread rating: 25.
        d. Edge seal: Pressure-sensitive tape lap seal.
        e. Circumferential joints: 4-inch wide tape or 4-inch overlap with adhesive seal.
    2. Type 2: Pipe insulation vapor barrier, mastic:
        a. Manufacturers: One of the following or equal:
            1) Benjamin Foster, No. 30-76.
            2) Childers Products.
            3) Foster Products.
            4) Insul-Coustic.
        b. Material: Mastic.

PART 3 EXECUTION

3.01 GENERAL

A. Furnish and install vents required in drainage piping as part of the plumbing system, in accordance with Laws and Regulations.

B. Use anti-seize lubricant for stainless steel treads on fittings and fasteners.

3.02 INSTALLATION

A. Fixtures:
    1. Rough-in fixtures and accessories in accordance with the dimensions supplied by the manufacturers of the fixtures.
    2. Mount fixtures and accessories without cutting of finish surface.

B. Plumbing and drainage products:
    1. Traps:
        a. Install traps as near the fixtures as possible.
    2. Sizes of equipment drains and of floor drains shall be as indicated on the Drawings.

C. Plumbing piping systems:
    1. Cast iron soil pipe, PVC, polypropylene piping systems:
        a. Where not specified otherwise, install horizontal piping with a grade of 1/4 inch per foot.
        b. Provide vents, roof drains, and pipes flashed and made watertight at the roof with lead sheet flashings.
            1) Minimum 4-pound lead sheet.
        c. Extend flashing not less than 6 inches up the pipes, and counter flash with standard cast iron or malleable iron recessed roof couplings.

d. Extend flashing for vents up to the top of the vent and turn down into the pipe.
e. Extend flashing shields not less than 8 inches from vent and pipe in all directions.

2. Copper tube piping system:
   a. Install in accordance with ASTM B828 and IAPMO IS 03.
   b. Install in straight runs, supported at intervals close enough to avoid sagging.
   c. Make cuts square with a tubing cutter or with a 32-tooth hacksaw.
      1) Provide a sizing tool to correct distortions.
   d. Insulate piping as specified.
3. Black steel piping system:
   a. Install per applicable codes and regulations.
4. CPVC piping system:
   a. Install piping in accordance with ASTM F645, or manufacturer's published instructions for installation of piping, as applicable to the particular type of piping.
   b. Provide molded transition fittings for transitions from plastic to metal or IPS pipe.
      1) Do not thread pipe.
      2) Do not use flanged transition fittings unless specifically indicated on the Drawings.
   c. Locate unions where indicated on the Drawings, and elsewhere where required for adequate access and assembly of the piping system.
   d. Provide serrated nipples for transition from plastic pipe to rubber hose.
   e. Clean dirt and moisture from pipe and fittings.
   f. Bevel pipe ends in accordance with manufacturer's instructions with chamfering tool or file.
      1) Remove burrs.
   g. Use solvent cement and primer formulated for CPVC.
   h. Use primer on pressure and non-pressure joints.
   i. Do not solvent weld joints when ambient temperatures are below 40 degrees Fahrenheit or above 90 degrees Fahrenheit unless solvent cements specially formulated for these conditions are utilized.

D. Wall and floor seals:
   1. Provide seals at rated walls.
   2. Provide seals between floors.
   3. Use specified barrier seals for concrete/masonry wall and floor penetrations.

E. Anti-seize lubricant:
   1. Use with assembly of stainless steel nuts and bolts.

F. Pipe insulation:
   1. Install insulation and jacket materials in accordance with manufacturer's written instructions.
   2. Fittings:
      a. Insulate fittings by covering with mitered sections of insulation or utilize factory-made prefabricated fitting shapes.

b. Terminate preformed pipe jackets or covering at sufficient distance from flanges to permit removal of bolts.
c. Overlap flange and flanged fitting insulation on adjacent pipe covering by at least 2 inches.

3. Valves:
a. Insulate valves 3 inches in nominal size and larger with removable insulating blankets.
b. Size blanket to extend up to packing gland only so that replacement of packing does not require removal of insulating blanket.

4. Provide continuous insulation through and over pipe supports and provide protection saddles at supports.

5. Provide continuous pipe insulation and covering through sleeves or openings in walls and floors.
a. When buried pipe enters a building through a below grade wall or slab penetration, begin insulation system on interior side of penetration.

6. Apply pre-molded pipe insulation with extended legs when used on pipe traced with either tubing or electric cable type.

7. Thermally isolate insulation closure locations (end caps, transitions, etc.).
a. Type 1 or 2 jacket installation on piping with potential reach temperatures greater than 150 degrees Fahrenheit.

8. Apply piping identification on jackets as specified in Section 15076 - Pipe Identification.

G. Backflow preventers:
1. Include shutoff valves at each end of backflow preventer with properly located test cocks.

3.03 FIELD QUALITY CONTROL

A. Test water piping in accordance with the plumbing code as specified in Section 01410 - Regulatory Requirements.

B. Test drain, waste, and vent lines as specified and in accordance with the plumbing code as specified in Section 01410 - Regulatory Requirements.

C. Backflow preventer:
1. Test witnessing: Witnessed.
2. Conduct pressure and leak test as specified in Section 15110 - Common Work Results for Valves.
3. Certificate of backflow prevention from a tester listed by the American Backflow Prevention Association.

3.04 CLEANING

A. Upon completion of installation, clean piping interior of foreign matter and debris.

3.05 SCHEDULES

A. As indicated on the Drawings.

END OF SECTION

SECTION 15500

COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. General prescriptive, design, and performance requirements for products and mechanical equipment used to heat, ventilate, cool, or otherwise condition or distribute indoor air.
   2. Specific requirements for ductwork accessories:
      a. Dampers and damper operators.
      b. Diffusers, grills, and registers.
   3. Specific requirements for refrigerant piping.

1.02 REFERENCES

A. Air-Conditioning, Heating, and Refrigeration Institute (AHRI):
   1. 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
   2. 270 - Sound Rating of Outdoor Unitary Equipment.
   3. 340/360 - Performance Rating of Commercial and Industrial Unitary Air Conditioning and Heat Pump Equipment.
   4. 430 - Performance Rating of Central Station Air-handling Unit Supply Fans.

B. Air Movement and Control Association International, Inc. (AMCA):
   1. 11 - Certified Ratings Program Operating Manual.
   2. 210 - Laboratory Methods for Testing Fans for Certified Aerodynamic Performance Rating.
   3. 211 - Certified Rating Program- Product Rating Manual for Fan Air Performance.
   4. 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
   5. 311 - Certified Ratings Program — Product Rating Manual for Fan Sound Performance.
   6. 500 - Laboratory Methods of Testing Dampers for Rating.
   7. 511 - Certified Ratings Program Product Rating Manual for Air Control Devices.

C. American Bearing Manufacturer's Association (ABMA):
   1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

D. American National Standards Institute (ANSI):
   1. Z21.47 - Gas Fired Central Furnaces (except Direct Vent Central Furnaces).

E. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE):
   1. Standard 15 - Safety Standard for Refrigeration System.
   2. Standard 52.2 - Methods of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

F. American Society of Mechanical Engineers (ASME):
   1. RTP-1 – Reinforced Thermoset Plastic Corrosion-Resistant Equipment.

G. ASTM International (ASTM):
   1. B32 - Standard Specification for Solder Metal.
   2. B75 - Standard Specification for Seamless Copper Tube.
   3. B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
   4. B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.
   5. B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fitting.
   6. C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
   7. D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
   8. D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
   9. D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
   10. D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
   11. D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.

H. California Energy Commission (CEC):
   1. Title 24 - Building Energy Efficiency Standards.

I. National Bureau of Standards: NBS PS15-69 - Custom Contact-Molded Reinforced-Polyester Chemical-Resistant Process Equipment.

J. National Electrical Manufacturers Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

K. National Fire Protection Association (NFPA):
   1. 70 - National Electrical Code (NEC).
   2. 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

L. National Roofing Contractors Association (NRCA).

M. International Association of Plumbing and Mechanical Officials (IAPMO):
   1. IS 3 - Installation Standard for Copper Plumbing Tube, Pipe, and Fittings.

N. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

O. Underwriters Laboratories, Inc. (UL):
   1. 555 - Standard for Fire Dampers.
   2. 555S - Standard for Smoke Dampers.
   3. 900 - Standard for Air Filter Units.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination.
   1. Provide roof mounted HVAC equipment information required in the preparation of roofing drawings including, but not limited to:
      a. Location.
      b. Size.
      c. Weight.
      d. Anchoring and support details.

1.04 SUBMITTALS

A. Where items in this Section are components of equipment or systems specified in other sections, include data for this Section's components with the equipment or system submittal.

B. When products are specified in this Section but are not referenced in other Technical Sections, submit:
   1. As specified in Section 01330 - Submittal Procedures.
   2. Product data:
      a. Sufficient to substantiate specified requirements.
   3. Description of coating system and instructions for field touch up and re-coating.

C. Projects subject to CEC Title 24:
   1. Damper operators:
      a. Electric: Wiring diagrams.
   2. Manufacturer's recommendation for testing and/or maintenance of product.

PART 2 PRODUCTS

2.01 GENERAL

A. Technical Sections product requirements supersede conflicting requirements in this Section.

B. As specified in Section 01600 - Product Requirements.

C. Electrical:
   1. Components and assemblies.
   2. Carry UL Listing Marking.
   3. In accordance with NEC requirements.

D. Fans:
   1. Rated and labeled in accordance with AMCA 210 and AMCA 211.
   2. Belt drive systems:
      a. Adjustable for minimum within 5 percent speed change.
      b. Rated for 150 percent of maximum motor horsepower.

E. Unitary air conditioners and heat pumps:
   1. Rated in accordance with AHRI Standards 210/240 or 340/360, AHRI 270, and AHRI 430.
   2. In accordance with ASHRAE Standard 15.
   3. Heating: Certified in accordance with ANSI Z21-47.
   4. Refrigerant: HFC R-410A.

F. Filters:
   1. Media: UL 900 listed.

G. Insulation and adhesives: In accordance with NFPA 90A requirements for flame spread and smoke generation.

H. Roof curbs: Supplied by manufacturer of product requiring the curb.

I. Factory coating: For equipment with factory coatings, manufacturer to supply 2 containers (each about a pint) of the paint for Contractor/Owner touch up.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. General:
   1. Environmental conditions as specified in Section 01850 - Design Criteria.
   2. Provide instrumentation and controls to meet the equipment operating requirements as specified in Section 15936 - Instrumentation and Control Devices for HVAC.

B. Fans
   1. Sharply rising pressure characteristics throughout the operating range and beyond the efficiency peak.
   2. Peak operating points to be as close as possible to the maximum efficiency and whose operating range is within the normal fan selection range.
   3. Bearings rated per ABMA 9 or 11 for a L10 life rating of not less than 50,000 hours.
   4. Total sound power levels in the 8 octave band range in accordance with, AMCA 301, not to exceed the lesser of the following or the sones level indicated on the Drawings.

Sound Power Level, decibels levels referenced to 10-12 watts								
Frequency, Hz	63	125	250	500	1,000	2,000	4,000	8,000
General	100	98	94	88	84	84	78	75

   5. Shall comply with AMCA Publication 11 and bear the AMCA Certified Ratings Program seal for air performance and sound performance according to AMCA Publication 211 and AMCA Publication 311.

C. Unitary air conditioners and heat pumps:
   1. Outdoor noise levels: Outdoor noise levels in the 8 octave band ranges, as measured in accordance with AHRI 270 shall not exceed the following:

OCTAVE BANDS								
Unit Nominal Capacity (Tons)	**63**	**125**	**250**	**500**	**1,000**	**2,000**	**4,000**	**8,000**
0 to 5	64	70	71	74	74	71	67	67
6	79	85	78	74	71	73	66	59
7-1/2 to 10	64	70	73	79	82	78	74	67
12 and larger	84	88	84	83	84	78	72	68

   2. Capable of starting and cooling from 45 to 125 degrees Fahrenheit ambient outdoor air temperature and exceeding the maximum load criteria of AHRI Standard 210/240 or 340/360.
   3. Heat pumps capable of starting and heating at or above 0 degrees Fahrenheit outdoor ambient air temperature.
   4. Minimum cooling, Energy Efficiency Ratio (EER) and Integrated Energy Efficiency Ratio (IEER), as rated in accordance with AHRI 210/240 or 340/360 for split systems and packaged units is as follows:

Equipment Type	**Net Cooling Cap (British Thermal Units per hour)**	**EER[(1)]**	**IEER[(2)]**
Space Constrained, Air Cooled	<30,000	11.7	N/A
Small Duct, High Velocity, Air Cooled	<65,000	12.1	N/A
Air Cooled	<65,000	13.4	N/A
Air Cooled	>65,000 and <135,000	11.2	14.8
Air Cooled	>135,000 and <240,000	11.0	14.2
Air Cooled	>240,000 and <760,000	10.0	13.2
Air Cooled	>760,000	9.7	12.5
Water Cooled	<65,000	12.1	12.3
Water Cooled	>65,000 and <135,000	12.1	13.9
Water Cooled	>135,000 and <240,000	12.5	13.9
Water Cooled	>240,000 and <760,000	12.4	13.6
Water Cooled	>760,000	12.2	13.5

Equipment Type	Net Cooling Cap (British Thermal Units per hour)	EER(1)	IEER(2)
Evaporatively Cooled	<65,000	12.1	12.3
Evaporatively Cooled	>65,000 and <135,000	12.1	12.3
Evaporatively Cooled	>135,000 and <240,000	12.0	12.2
Evaporatively Cooled	>240,000 and <760,000	11.9	12.0
Evaporatively Cooled	>760,000	11.7	11.9

(1) Deduct 0.2° from the required EER for units with a heating section other than electric resistance heat.

(2) IEER is only applicable to equipment with capacity control in accordance with AHRI 340/360

5. Units with heating capabilities: Meet or exceed the following:
   a. Annual fuel utilization efficiency: 80 percent.
   b. Steady state efficiency: 80 percent.
   c. Comply with CEC Title 24: Seasonal Energy Efficiency Ratio (SEER) minimum: 76.9 percent.
6. Energy efficiency requirements:
   a. Comply with CEC Title 24
7. Unit air flows for cooling:
   a. Minimum of 300 cubic feet per minute (cfm) per ton.
   b. Maximum 500 cfm per ton.

D. Filters:
   1. Efficiency: 45 to 50 percent dust spot efficiency when rated in accordance with ASHRAE Test Standard 52.2.

E. Smoke detector requirements:
   1. Provide all supply, exhaust, and odor control fans greater than or equal to 2,000 cubic feet per minute with smoke detectors:
      a. Duct or fan mounted smoke detector as specified in Section 15936 - Instrumentation and Control Devices for HVAC.

2.03 REFRIGERANT PIPING

A. Seamless copper tube:
   1. Type:
      a. Straight lengths: ASTM B75, USN Alloy C12200, H55 Temper.
      b. Coiled lengths: ASTM B280, USN Alloy C12200, O60.
      c. Outside diameter sized, minimum wall thickness in accordance with ASTM B280 and B75.
   2. VRF-System Refrigerant Piping:
      a. Entire refrigerant piping system shall be brazed connections and fittings and meet test pressures required by VRF manufacturer.
   3. Non-VRF System Refrigerant Piping:
      a. Solder: ASTM B32, Alloy Grade Sb5.
      b. Flux: ASTM B813.

2.04 CONDENSATE DRAIN PIPING

A. PVC:
   1. PVC Pipe: Designation PVC 1120 in accordance with ASTM D1785 and appendices:
      a. Pipe and fittings: Extruded from Type I, Grade 1, Class 12454 B material in accordance with ASTM D1784.
      b. PVC Pipe: Schedule 80 unless otherwise indicated on the Drawings.
   2. Fittings:
      a. Supplied by pipe manufacturer.
      b. Pressure fittings: In accordance with ASTM D2466 or ASTM D2467.
      c. DWV fittings: In accordance with ASTM D2665.
   3. Solvent cement: In accordance with ASTM D2564:
      a. Manufacturers: The following or equal:
         1) Primer: IPS Corp Type P-70™.
         2) Cement: IPS Corp Type 724™ cement or cement certified by the manufacturer for chemical service.

2.05 PIPE INSULATION

A. General:
   1. As specified in Section 01600 - Product Requirements.
   2. Insulation thicknesses: Provide insulation thickness in inches in accordance with the following table. Insulation thickness shown is nominal. Manufacturing tolerance of 15 percent variation is permissible.

Table 1 - Required Insulation Thicknesses (inches)		
Service Temperature Range as Designated in Insulation Schedule at End of this Section	**Nominal Pipe Diameters**	
	1 inch and Less	**1.25 to 2 inches**
100 to 200 degrees Fahrenheit	1.5	1.5
40 to 100 degrees Fahrenheit	0.5	1.0

B. Insulation, Type 1:
   1. Manufacturers: One of the following or equal:
      a. Aeroflex USA Inc., Aerocel® AC.
      b. Armacell®, AP Armaflex.
   2. Insulation material: Closed cell elastomeric insulation.
   3. Minimum temperature range: Minus 40 degrees Fahrenheit to plus 220 degrees Fahrenheit.
   4. K factor at 75 degrees Fahrenheit: Not more than 0.27 BTU-inch/hour-square feet-degrees Fahrenheit.
   5. Fire ratings:
      a. Flame spread: 25 or less.
      b. Smoke density: 50 or less for insulation thicknesses up to 1.5 inches.
   6. Joints: Seal with manufacturer’s recommended contact adhesive to form continuous water barrier.

C. Insulation jackets:
   1. Type 1:
      a. Manufacturers: One of the following or equal:
         1) Johns Manville, Zeston® 2000 PVC.
         2) Proto Corp., LoSMOKE PVC.
         3) Speedline® Corp., Smoke-Safe™ PVC.
      b. Material: Ultraviolet-resistant polyvinyl chloride jacketing, 20 mil minimum thickness.
      c. Fire rating: 25 maximum flame spread, smoke developed 50 or less.
      d. Color: White.
      e. Overlap: 1-inch minimum at joints and fittings.
      f. Joint seal: PVC solvent welded or adhesive as recommended by the manufacturer.
      g. Fittings: Factory made with full thickness insulation.

D. Vapor barriers:
   1. Vapor barrier, Type 1:
      a. Material: White Kraft paper bound to aluminum foil in accordance with ASTM C1136, Type 1.
      b. Permeability: 0.02 perms or lower.
      c. Maximum flame spread rating: 25.
      d. Edge seal: Pressure-sensitive tape lap seal.
      e. Circumferential joints: 4-inch wide tape or 4-inch overlap with adhesive seal.
   2. Vapor barrier, Type 2:
      a. Manufacturers: One of the following or equal:
         1) Benjamin Foster, No. 30-76.
         2) Childers Products CP10/11 Vi-Acryl.
         3) Foster Products, 36-10/46-10 Weatherite.
         4) Insul-Coustic, No. I.C.-580.
      b. Material: Mastic.

E. Insulation schedule:

Table 2 - Insulation Schedule

Service Designation[1]	Location[2]	Insulation Type	Jacket Type	Service Temp. °F[3]	Vapor Barrier
HVAC Refrigerant	Interior or Exterior	1	1	40 - 200	Required
HVAC Condensate	Interior or Exterior	1	1	Below 60	Required

Notes:
1. Refer to Piping Schedule in Section 15052 - Common Work Results for General Piping for service designations.
2. Insulation jackets are not required for interior installations that are concealed. See definitions for description of concealed locations.
3. Unless noted otherwise, use service temperature range provided in this table to establish insulation thickness as required by Table 1.

2.06 EQUIPMENT NAMEPLATES

A. Provide a nameplate with the following markings that is plainly visible after installation:
   1. Manufacturer's name, trademark, or other descriptive marking to identify specific equipment.
   2. Where equipment is electrically powered:
      a. Supply voltage, phase, frequency, and full-load current.
      b. Power source or circuit ID.
      c. Short-circuit current rating based on one of the following:
         1) Short-circuit current rating of a listed and labeled assembly.
         2) Short-circuit current rating established utilizing an approved method.

2.07 SHIPPING, SPARE PARTS, MAINTENANCE PRODUCTS, AND SPECIAL TOOLS

A. As specified in Section 01600 - Product Requirements.

B. Inspect fasteners for proper tightness.

C. Ship units in 1 piece (or modular, if required), factory assembled, piped, internally wired, and factory tested.

D. Provide:
   1. Filters: 2 extra (3 total) sets per each unit with filters.
   2. Sheaves and belts: 1 set for change-out for final balance per unit installed.
   3. Belts: 1 extra set for each unit installed as determined by final balance.

E. Provide a 2-year supply of maintenance products as indicated in manufacturer's maintenance literature.

PART 3 EXECUTION

3.01 GENERAL

A. Technical Sections execution requirements supersede conflicting requirements in this Section.

B. As specified in Section 01600 - Product Requirements.

C. Inspect fasteners for proper tightness.

D. Provide temporary closures for openings designed for airflow.

3.02 INSTALLATION

A. Examine and verify details and sections as indicated on the Drawings, ascertain adequacy, and determine conflicts in dimensions and clearances.
   1. Take measurements and verify dimensions to ascertain fit of installation.
   2. Ascertain structural sufficiency to support installation.

3. Ascertain that supports and openings are correctly located; otherwise cut new openings where required.
4. Confirm specified thermostat or other controls are compatible with specified equipment.

B. Install in accordance with manufacturer instructions.
   1. Electrical products installation in accordance with NFPA 70 NEC.
   2. If there are conflicts, NEC supersedes manufacturer's instruction.
      a. Notify Engineer of conflicts.

C. Equipment and ducts:
   1. Remove dust and debris before installation.
   2. Protect from dust and debris by covering openings with tape or plastic during installation and until equipment is operated.
   3. Install and wire unitary air conditioners, controls, and thermostats in accordance with manufacturer's recommendations.
   4. Lubrication lines and fittings:
      a. Support and protect lines from source to point of use.
      b. Fittings:
         1) Bring to outside of equipment in manner such that fittings are readily accessible from outside without necessity of removing covers, plates, housings, or guards.
         2) Mount together wherever possible using factory-mounted multiple fitting assemblies securely mounted, parallel with equipment lines, and protected from damage.
   5. Remove dust and debris from ductwork and equipment at completion of installation.
   6. Set equipment to achieve flows and flow patterns indicated on the Drawings.

D. Refrigerant piping:
   1. Support copper tubing as specified in Sections 15061 - Pipe Supports and 15062 - Preformed Channel Pipe Support System.
   2. Clean copper lines with high-pressure air after first disconnecting piping at instruments, filters, pressure reducers, valve operators, and other special devices.
   3. Installation of copper tubing:
      a. Install copper tubing in accordance with ASTM B828 and IAPMO IS 3.
      b. Install copper tubing in straight runs, supported at intervals close enough to avoid sagging.
      c. Make cuts square with a tubing cutter or with a 32-tooth hacksaw.
         1) Provide a sizing tool to correct distortions.
   4. Ream the inside of the tubing and remove burrs from the outside, holding the end of the tubing downward and preventing chips and fillings from entering the tubing.
   5. Perform flaring with a flare block and yoke type screw feed flaring tool:
      a. After removing the tubing from the flare block, inspect both surfaces of the flare for splits, cracks, or other imperfections.
      b. Where there are imperfections, cut off the imperfect flare and prepare a new flare.
   6. Insulate piping as specified in Sections 15400 - Plumbing systems.

E. Gas, water piping, drains, and venting in accordance with the authority having jurisdiction and applicable codes.

F. Completed equipment installations must have confirmation that:
   1. The equipment is properly assembled.
   2. The equipment moves or rotates in the proper direction.
   3. Shafting, drive elements, and bearings are installed and lubricated in accordance with proper tolerances.
   4. No unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.
   5. The installation meets the requirements for intended use as well as the specified vibration and noise tolerances.

END OF SECTION

SECTION 15732

AIR CONDITIONING UNITS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Packaged units.
   2. Split system units.
   3. Wall mounted units.
   4. Accessories.

1.02 REFERENCES

A. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE):
   1. Standard 62.1 - Ventilation for Acceptable Indoor Air Quality.

B. California Code of Regulations (CCR):
   1. Title 24 - Building Standards Code.

C. Federal Specification (FS):
   1. Standard 141 - Paint, Varnish, Lacquer and Related Materials: Methods of Inspection, Sampling and Testing.

D. National Electrical Manufacturers Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1,000 V Maximum).

E. National Roofing Contractors Association (NRCA).

1.03 ABBREVIATIONS

A. MERV - Minimum Efficiency Reporting Values.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Roof coordination:
   1. As specified in Section 15500 - Common Work Results for HVAC.

1.05 DELEGATED DESIGN

A. As specified in Section 01357 - Delegated Design Procedures.

B. Anchoring and bracing.

1.06 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Catalog cuts, bulletins, and brochures.
   1. Design features.
   2. Load capacities.
   3. Efficiency ratings.
   4. Dimensions.
   5. Weight: Shipping and operating.

C. Drawings:
   1. Component layout and identification.
   2. Views:
      a. Front, side, rear elevations, and top and bottom views, with dimensions.
      b. Connection locations including electrical, mechanical, and other.
   3. Cut away drawings.
      a. Parts list.
      b. Material specification lists.
   4. Wiring, control schematics, control logic diagrams and ladder logic or similar for computer-based controls.
   5. Details for supports, isolators, and bracing.

D. Delegated Design Submittals:
   1. Anchoring and bracing: Provide project-specific calculations based on support conditions and requirements to resist loads specified in Section 01850 - Design Criteria.
      a. To structures for equipment installed in structures designated as seismic design category C, D, E, or F.
      b. For equipment installed outdoors.

E. Engineering data:
   1. Manufacturer's published data for compressor, evaporator coil, condenser, evaporator fan, refrigerant, filter, etc.
   2. Maximum equipment vibration levels and field-testing method.
   3. Sound power level in each of 8 octave bands and overall Sones.
   4. Fan performance curves showing specified operating condition.
   5. Bearing life.

F. Manufacturer's recommendations for handling, storage, and installation.

G. Nameplate data.

H. Vendor operation and maintenance manuals: Manufacturer's standard instruction manual for operation and maintenance.

1.07 WARRANTY

A. Provide warranty as specified in Section 01783 - Warranties and Bonds.

B. Special warranty:
   1. Refrigerant compressors and closed or sealed refrigerant systems warranty duration: Provide 5-year warranty.
   2. Evaporator and condensing coils warranty duration: Provide 10-year warranty.

PART 2 PRODUCTS

2.01 GENERAL

A. As specified in Section 15500 - Common Work Results for HVAC.

B. Supplied components of the unit shall be furnished and fully integrated by the unit system supplier:
   1. Provide piping, valves, dampers, sensors and wiring within the unit package.
   2. Provide a unit mounted control panel prewired on the unit to dampers and sensors within the unit.

C. Motors:
   1. Totally enclosed.
   2. Voltage and phases as scheduled.
   3. Compressor motors:
      a. Cooled by refrigerant gas passing through windings.
      b. Provided with line break thermal and current overload protection.
   4. Fan and blower motors:
      a. Permanently lubricated ball bearings.
      b. Integral automatic reset thermal overload protection.
   5. Other requirements as specified.

D. Electrical:
   1. Provide a single conduit connection in the unit for both power and control wiring.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. As specified in Section 15500 - Common Work Results for HVAC.

B. Provide instrumentation and controls to meet the equipment operating requirements as specified in Section 15936 - Instrumentation and Control Devices for HVAC.

2.03 MINI-SPLIT SYSTEMS

A. Manufacturers: One of the following or equal:
   1. Condenser:
      a. Mitsubishi, Series PUY.
      b. Daikin, Similar series.
      c. Trane, similar series.
      d. Lennox, similar series.

2. Indoor air handling unit:
    a. Mitsubishi, Series PLA (ceiling recessed cassette).
3. Daikin, similar series.
4. Trane, similar series.
5. Lennox, similar series.

B. Compressors:
1. Fully hermetically sealed, high efficiency, reciprocating or rotary or scroll type, with rubber grommet vibration isolation.

C. Fans:
1. Indoor air fan:
    a. Direct driven with capacitor start motor; turbo fan propeller, steel with corrosion resistant finish, statically and dynamically balanced.
    b. Bearings: Permanently sealed ball bearing type and permanently lubricated.
2. Outdoor condenser fan:
    a. Propeller type, direct drive, aluminum blades, dynamically balanced.
    b. Bearings: Permanently sealed ball bearing type and permanently lubricated.

D. Coils:
1. Evaporator and condenser coils: Seamless copper tubes with mechanically bonded aluminum plate fins.
2. Provide corrosion resistant finish, suitable for marine environment.

E. Refrigerant components: Refrigerant circuit including:
1. Accumulator and filter/drier.
2. Expansion device.
3. Flow control valves.
4. Service and gauge connections on compressor suction and discharge, and liquid lines to charge, evacuate, and contain refrigerant.

F. Controls and equipment safety features:
1. Provide system controls for a complete functioning system:
    a. High and low evaporator fan speed control for cooling and heating modes.
    b. Fan only operation.
    c. Space temperature condition setting.
    d. Vapor bellows thermostat to cycle unit to maintain space condition.
2. Equipment safety features:
    a. Thermostatic base pan drain to prevent freeze up of the fan in collected condensate.
3. Provide with a low ambient cooling option.

G. Unit casing:
1. Space-saving ceiling-recessed cassette formed of galvanized steel and outdoor casing shall be constructed from galvanized steel plate, finished with an electrostatically applied, polyester powder coating for corrosion protection.
2. Weatherproof design, reinforced and braced for maximum rigidity.

3. Provided with:
    a. Filter rack for filters accessible through the bottom of the unit.
    b. Non-corrosive drain pan in accordance with ASHRAE Standard 62.1.
    c. Horizontal drain connection.
    d. Provide mini condensate pump suitable to be powered from indoor/outdoor unit.
    e. Knockouts for power connections.
    f. Provide wall sleeve of galvanized steel coated similar to unit casing.

2.04 ACCESSORIES

A. Required accessories:
    1. Sensors: As specified in Section 15936 - Instrumentation and Control Devices for HVAC.
    2. Hail guard.
    3. Dirty filter switch with contacts.
    4. Coil guard.

PART 3 EXECUTION

3.01 GENERAL

A. As specified in Section 15500 - Common Work Results for HVAC.

3.02 PREPARATION

A. Anchoring and bracing to structures:
    1. Prepare equipment anchor setting template(s) and use to position anchors during construction of supporting structure(s).
    2. Install anchors of type and material indicated on approved anchoring designs.
    3. Install anchors with embedment indicated on approved anchoring designs.

3.03 INSTALLATION

A. Install the equipment in accordance with the accepted installation instructions and anchorage details.

B. Insulate refrigerant and condensate piping as specified in Section 15500 - Common Work Results for HVAC.

3.04 TESTING

A. Test equipment performance and balance equipment as specified in Section 15954 - Testing, Adjusting, and Balancing for HVAC.

3.05 SCHEDULES

A. As indicated on the Drawings.

END OF SECTION

SECTION 15936

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Controls for Heating, Ventilating, and Air Conditioning (HVAC) Systems.

1.02 REFERENCES

A. CSA International (CSA).

B. National Electrical Code (NEC).

C. Restriction of Certain Hazardous Substances (RoHS).

D. National Electrical Manufacturers Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1,000 Volts Maximum).

E. National Fire Protection Association (NFPA):
   1. 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems.

F. Underwriters' Laboratories, Inc. (UL):
   1. 13 - Standard for Safety Power-Limited Circuit Cables.
   2. 268A - Standard for Smoke Detectors for Duct Application.
   3. 508 - Standard for Industrial Control Equipment.
   4. 1479 - Fire Tests of Through-Penetration Firestops.
   5. 1685 - Standard for Safety Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables

G. California Code of Regulations (CCR):
   1. Title 24 - Building Standard Code.

1.03 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Product data: As specified in Section 15050 - Common Work Results for Mechanical Equipment.

C. Shop drawings:
   1. Manufacturer's information including:
      a. Catalog information clearly marked to show specific products, models, and sizes being furnished.
      b. Component cut sheets.
   2. Provide certification that components and systems meet CCR Title 24 and are approved by the California Energy Commission.

D. Provide vendor operation and maintenance manual as specified in Section 01782 - Operation and Maintenance Manuals:
   1. VVVT control systems only.

E. Provide Manufacturer’s Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning:
   1. VVVT control systems only.

1.04 QUALITY ASSURANCE

A. The control system shall be designed in accordance with UL and CSA standards.

B. Regulatory requirements: In accordance with CCR Title 24.

1.05 DELIVERY, STORAGE, AND HANDLING

A. The system control products shall be stored and handled per manufacturer's recommendations.

1.06 SITE CONDITIONS

A. Elevation and ambient conditions as specified in Section 01850 - Design Criteria.

1.07 WARRANTY

A. Special warranties: Warranty period begins at date of Project Acceptance or first date of Beneficial Use by the Owner:
   1. 1 year: Parts and on-site labor for components, systems, and programming.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. General requirements:
   1. All electrical components shall be UL-listed and meet the design and installation requirements of the NEC.
   2. Complete, functional system: Provide all necessary electrical power and control systems, components, and wiring to make a complete functioning system.
   3. Comply with electrical Sections for electrical power and control systems.
   4. System control functions to perform as described in Products.
   5. Materials: New, free from defects, and of the quality specified.
   6. Common manufacturer: Provide components, component accessories, and devices, as much as possible, by the same manufacturer throughout the work.
   7. Mounting: Mount control components and devices in accessible locations for maintenance and as recommended by the manufacturer; provide necessary

manufacturer-approved mounting and configuration hardware for mounting and operation of control components and devices.

8. Components and systems must in accordance with CCR Title 24 energy conservation regulations and be listed with the California Energy Commission as approved for sale in California.

B. Fire detection system design requirements:
   1. Provide all supply and exhaust fans greater than 2,000 cubic feet per minute with a smoke control system including the following minimum components.
      a. Fan and air handling unit interlocks interlock to shut down upon smoke detection signal from fire alarm control panel.
      b. Field wiring terminal blocks for connection of shut down signals from local fire alarm control panel.

2.02 HVAC CONTROL DESCRIPTIONS

A. General: Provide control systems that will maintain room or area comfort under changing ambient conditions and varying use; descriptions in this Section are general in nature and do not cover every mode of operation.

B. Hypo Feed Building Control Sequences:
   1. Fan coil unit/Condenser unit mini-split systems, FCU/CU-99421 and FCU/CU-99422 will each be controlled by manufacturer provided wired thermostats with adjustable set points. The cooling set-point will be 90 degrees Fahrenheit. When the temperature rises 3 degrees above the set point, the unit will energize. When the temperature falls 3 degrees below the set point, the unit will de-energize.

PART 3 EXECUTION

3.01 PREPARATION

A. Before installation remove dust and debris from equipment and accessories.

B. During installation and until equipment is operated, protect equipment and accessories from dust and debris.

3.02 INSTALLATION

A. Install as indicated on the Drawings, in accordance with NFPA 90A, and per the manufacturer’s written instructions.

B. Coordinate installation of HVAC control systems with other trades.
   1. Prior to installation, coordinate wiring and conduit requirements with electrical subcontractor.

3.03 COMMISSIONING

A. As specified in Section 01756 - Commissioning and this Section.

B. Functional testing:
   1. HVAC Instrumentation and Controls:
      a. Test witnessing: Witnessed.
      b. Test each control component and system as part of HVAC system testing, adjusting, and balancing as specified in Section 15954 - Testing, Adjusting, and Balancing for HVAC.

END OF SECTION

SECTION 15954

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Requirements for testing air systems installed as part of this contract and existing air systems affected by the installation of new equipment.

1.02 REFERENCES

A. Associated Air Balance Council (AABC):
   1. National Standards Total System Balance.

B. National Environmental Balancing Bureau (NEBB):
   1. Procedural Standards for Testing, Adjusting, and Balancing Environmental Systems.

C. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
   1. HVAC Systems - Testing, Adjusting, & Balancing.

D. Testing, Adjusting, and Balancing Bureau (TABB):
   1. TAB Procedural Guide.

1.03 SUBMITTALS

A. Resumes of proposed supervisor and personnel showing training and qualifications.
   1. Include courses, exams, or tests relating to HVAC testing - taken and passed.

B. Testing plan:
   1. At least 30 days prior to starting field work:
   2. Set of report forms completed with design flow values and installed equipment pressure drops, and required cubic feet per minute for air terminals.
   3. Heating, ventilating, and air conditioning system schematic similar to Figure 6-1 in SMACNA HVAC Testing, Adjusting, & Balancing.
   4. Complete list of instruments proposed to be used, organized in appropriate categories, with data sheets for each showing:
      a. Manufacturer and model number.
      b. Description and use when needed to further identify instrument.
      c. Size or capacity range.
      d. Latest calibration date.
   5. Proposed schedule for testing and balancing.

C. Report:
   1. Not more than 45 days prior to Contractor's request for final inspection, submit draft report on applicable reporting forms.
   2. At least 15 days prior to Contractor's request for final inspection, submit 3 copies of final reports incorporating Engineer's comments on draft report.
   3. List of instruments used and last date of calibration of each.
   4. Procedures followed for testing, adjusting, and balancing.
   5. Identification and succinct description of systems included in report.
   6. Initial balance test results made with all dampers and air control devices in full open positions.
   7. Description of final locations and sizes, including opening area and dimensioned configuration of orifices and other restrictions used to achieve final balanced flows.
   8. Description of final location and opening positions of dampers, registers, louvers, and valves.
   9. Schematics of systems included in report; use schematics as part of testing, adjusting, and balancing report to summarize design and final balanced flows.
   10. Testing, adjusting, and balancing report forms.
   11. Final field results established for system balancing including airflow, fan speeds, and fan static pressures at the fan inlet and outlet.
   12. Appendices:
      a. Raw field data taken during testing.
      b. Sample calculation sheet for each type of calculation made to convert raw field data to final results.
      c. Initial air balance results with dampers and registers in full open position; include airflow at all inlets and outlet, initial fan speed and fan suction and discharge pressures.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Work of testing, adjusting, and balancing of heating, ventilation, and air conditioning systems to be by an independent testing agency and a certified member in good standing with AABC, NEBB, or TABB.

B. Field testing to be performed or directly supervised by personal who have passed a Test and Balance course or exam and is a AABC, NEBB, or TABB certified supervisor

C. Prior to start of testing, adjusting, and balancing, verify that:
   1. System installation is complete in accordance with the requirements for completed equipment installations in Section 15500 - Common Work Results for HVAC and capable of full operation
   2. Outside conditions are within reasonable range relative to design conditions.
   3. Lighting fixtures are energized.

4. Special equipment such as computers, laboratory equipment, and electronic equipment are in full operation.
5. Requirements for preparation for testing and balancing have been met for elements of each system which require testing.

3.02 TESTING, ADJUSTING, AND BALANCING

A. Test, adjust, and balance each separate complete heating, ventilating, and air conditioning systems.
   1. Include existing heating, ventilating, and air conditioning components when effected by the Work.

B. Perform testing, adjusting, and balancing cycles until airflows meet acceptance criteria.
   1. Ascertain airflow balance between overall requirements and flow in individual supply and exhaust grilles.

C. Initial testing, adjusting, and balancing:
   1. Test each system with dampers, grilles, orifices, and other variable airflow devices in their full open position; measure and report initial airflows, fan speed, and fan static pressures at fan inlet and outlet.
   2. Adjust total system flow downward or upward by adjusting fan speed until one inlet or outlet is at indicated flow and all other flows exceed indicated flows.
   3. Adjust fan speed by changing fan drives or sheaves as necessary.

D. Subsequent testing, adjusting, and balancing:
   1. Perform adjustments by adjusting dampers, louvers, or size of orifices or plates.
   2. Measure and record air volume discharged at each inlet and outlet and adjust air inlets and outlets to design air volumes within 0 to 5 percent over design rates.
   3. Adjust fan speeds and motor drives within drive limitations, for required air volume.
   4. Measure air flow and static pressures and adjust air supply and exhaust fan units to deliver at least 100 to 105 percent of the design air volume.
   5. Measure and record static air pressure conditions on fans, including filter and coil pressure drops, and total pressure across the fan.
   6. Evaluate building and room pressure conditions to determine adequate supply and return air conditions.
   7. Evaluate space and zone temperature of conditions to determine adequate performance of the systems to maintain temperatures without draft.
   8. Permanently mark final balance positions of balancing dampers.

E. Develop heating, ventilating, and air conditioning system schematics similar to Figure 6-1 in SMACNA Testing, Adjusting, and Balancing.

F. Accurately record the required data on AABC, NEBB, or TABB test and balance report forms.

G. Measure amperage draw of fan and pump motors at final balance.

H. Following completion of balancing procedures for air systems, test, adjust, and balance hydronic systems.
   1. Measure flow and adjust circuit setter valves so pumps deliver at least 100 percent of the design water flow.
   2. Measure and adjust water flow at coils for design conditions, within 5 percent. Check conditions at cooling and heating coils for required performance at design conditions.
   3. Lock balance valves in the adjusted position and permanently mark the design set point.
      a. Record valve settings in the design report.

I. Test primary source equipment in accordance with AABC, NEBB, or TABB procedures.
   1. Primary source equipment includes items listed in this Section not previously tested as part of this testing, adjusting, and balancing work.
   2. Complete appropriate AABC, NEBB, or TABB equipment test forms for each piece of equipment.
   3. Calculate cooling and heating capacities to show conformance with specified capacities.
   4. Adjust equipment as needed to deliver specified cooling and heating loads.
   5. Record final equipment performing characteristics and adjustment settings in the final design report.

J. Testing, adjusting, and balancing acceptance criteria:
   1. Procedures successful and complete when heating, ventilating, and air conditioning systems and components are functioning properly and system air flows are within specified tolerances of design flows.

END OF SECTION

SECTION 15956

PIPING SYSTEMS TESTING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Test requirements for piping systems.

1.02 REFERENCES

A. National Fuel Gas Code (NFGC).

B. American Society of Mechanical Engineers (ASME):
   1. B31.1 - Power Piping.
   2. B31.3 - Process Piping.
   3. B31.8 - Gas Transmission and Distribution Piping Systems.

C. Underwriters Laboratories Inc. (UL).

1.03 TESTING REQUIREMENTS

A. General requirements:
   1. Testing requirements are stipulated in Laws and Regulations; are included in the Piping Schedule in Section 15052 - Common Work Results for General Piping; are specified in the specifications covering the various types of piping; and are specified in this Section.
   2. Requirements in Laws and Regulations supersede other requirements of Contract Documents, except where requirements of Contract Documents are more stringent, including higher test pressures, longer test times, and lower leakage allowances.
   3. Test plumbing piping in accordance with Laws and Regulations, the plumbing code, as specified in Section 01410 - Regulatory Requirements, and UL requirements.
   4. Test natural gas or digester gas piping:
      a. For less than 125 pounds per square inch gauge working pressure, test in accordance with mechanical code, as specified in Section 01410 - Regulatory Requirements, or the National Fuel Gas Code, whichever is more stringent.
      b. For 125 pounds per square inch gauge or greater working pressure, test per ASME B31.3 or ASME B31.8, whichever is more stringent.
   5. When testing with water, the specified test pressure is considered to be the pressure at the lowest point of the piping section under test.
      a. Lower test pressure as necessary (based on elevation) if testing is performed at higher point of the pipe section.

B. Furnish necessary personnel, materials, and equipment, including bulkheads, restraints, anchors, temporary connections, pumps, water, pressure gauges, and other means and facilities required to perform tests.

C. Water for testing, cleaning, and disinfecting:
   1. Water for testing, cleaning, and disinfecting will be provided as specified in Section 01500 - Temporary Facilities and Controls.

D. Pipes to be tested: Test only those portions of pipes that have been installed as part of this Contract. Test new pipe sections prior to making final connections to existing piping. Furnish and install test plugs, bulkheads, and restraints required to isolate new pipe sections. Do not use existing valves as test plug or bulkhead.

E. Unsuccessful tests:
   1. Where tests are not successful, correct defects or remove defective piping and appurtenances and install piping and appurtenances that comply with the specified requirements.
   2. Repeat testing until tests are successful.

F. Test completion: Drain and leave piping clean after successful testing.

G. Test water disposal: Dispose of testing water at the designated location in accordance with requirements of federal, state, county, and city regulations governing disposal of wastes in the location of the Project and disposal site. All requirements and costs associated with notifications and obtaining any discharge permit or approvals shall be responsibility of Contractor.

1.04 SUBMITTALS

A. Submit as specified in Section 01330 - Submittal Procedures.

B. Schedule and notification of tests:
   1. Submit a list of scheduled piping tests by noon of the working day preceding the date of the scheduled tests.
   2. Notification of readiness to test: Immediately before testing, notify Engineer in writing of readiness, not just intention, to test piping.
   3. Have personnel, materials, and equipment specified in place before submitting notification of readiness.

1.05 SEQUENCE

A. Clean piping before pressure or leak tests.

B. Test gravity piping underground, including sanitary sewers, for visible leaks before backfilling and compacting.

C. Underground pressure piping may be tested before or after backfilling when not indicated or specified otherwise.

D. Backfill and compact trench, or provide blocking that prevents pipe movement before testing underground piping with a maximum leakage allowance.

E. Test underground piping before encasing piping in concrete or covering piping with slab, structure, or permanent improvement.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 AIR TESTING METHOD FOR PRESSURE PIPING

A. Air test piping, indicated with "AM" in the Piping Schedule, with air or another nonflammable or inert gas.

B. Test gas, air, liquefied petroleum gas, liquid chlorine, and chlorine gas piping by the air test method:
   1. Test chlorine piping with dry air or nitrogen having a dew point of minus 40 degrees Fahrenheit or less. Supply temporary air dryers as necessary.

C. Test at pressure as specified in Piping Schedule in Section 15052 - Common Work Results for General Piping:
   1. Provide temporary pressure relief valve for piping under test:
      a. Set at the lesser of 110 percent of the test pressure or 50 pounds per square inch gauge over the test pressure.
   2. Air method test pressures shall not exceed 110 percent of the piping maximum allowable working pressure calculated in accordance with the most stringent of ASME B31.1, ASME B31.3, ASME B31.8, or the pipe manufacturer's stated maximum working pressure.
   3. Gradually increase test pressure to an initial test pressure equal to the lesser of 1/2 the test pressure or 25 pounds per square inch gauge.
   4. Perform initial check of joints and fittings for leakage.
   5. Gradually increase test pressure in steps no larger than the initial pressure. Check for leakage; at each step increase until test pressure reached.
   6. At each step in the pressure, examine and test piping being air tested for leaks with soap solution.
   7. Consider examination complete when piping section under test holds the test pressure for 15 minutes without losses.

3.02 TESTING HIGH-HEAD PRESSURE PIPING

A. Test piping for which the specified test pressure in the Piping Schedule is 20 pounds per square inch gauge or greater, by the high head pressure test method, indicated "HH" in the Piping Schedule.

B. General:
   1. Test connections, hydrants, valves, blowoffs, and closure pieces with the piping.
   2. Do not use installed valves for shutoff when the specified test pressure exceeds the valve's maximum allowable seat differential pressure. Provide blinds or other means to isolate test sections.
   3. Do not include valves, equipment, or piping specialties in test sections if test pressure exceeds the valve, equipment, or piping specialty safe test pressure allowed by the item's manufacturer.
   4. During the performance of the tests, test pressure shall not vary more than plus or minus 5 pounds per square inch gauge with respect to the specified test pressure.
   5. Select the limits of testing to sections of piping. Select sections that have the same piping material and test pressure.
   6. When test results indicate failure of selected sections, limit tests to piping:
      a. Between valves.
      b. Between a valve and the end of the piping.
      c. Less than 500 feet long.
   7. Test piping for minimum 2 hours for visible leaks test and minimum 2 hours for the pressure test with maximum leakage allowance.

C. Testing procedures:
   1. Fill piping section under test slowly with water while venting air:
      a. Use potable water for all potable waterlines and where noted on the Piping Schedule.
   2. Before pressurizing for the tests, retain water in piping under slight pressure for a water absorption period of minimum 24 hours.
   3. Raise pressure to the specified test pressure and inspect piping visually for leaks:
      a. Consider visible leakage testing complete when no visible leaks are observed.

D. Pressure test with maximum leakage allowance:
   1. Leakage allowance is zero for piping systems using flanged, National Pipe Thread threaded and welded joints.
   2. Pressure test piping after completion of visible leaks test.
   3. For piping systems using joint designs other than flanged, threaded, or welded joints, accurately measure the makeup water necessary to maintain the pressure in the piping section under test during the pressure test period:
      a. Consider the pressure test to be complete when makeup water added is less than the allowable leakage and no damage to piping and appurtenances has occurred.
      b. Successful completion of the pressure test with maximum leakage allowance shall be achieved when the observed leakage during the test

period is equal or less than the allowable leakage and no damage to piping and appurtenances has occurred.

c. When leakage is allowed, calculate the allowable leakage by the following formula:

$L = S \times D \times P^{1/2} \times 148{,}000^{-1}$

wherein the terms shall mean:

L = Allowable leakage in gallons per hour.

S = Length of the test section in feet.

D = Nominal diameter of the piping in inches.

P = Average observed test pressure in pounds per square inches gauge, at the lowest point of the test section, corrected for elevation of the pressure gauge.

x = The multiplication symbol.

3.03 TESTING LOW-HEAD PRESSURE PIPING

A. Test piping for which the specified test pressure is less than 20 pounds per square inch gauge, by the low head pressure test method, indicated "LH" in the Piping Schedule.

B. General:
   1. Test pressures shall be as scheduled in Section 15052 - Common Work Results for General Piping.
   2. During the performance of the tests, test pressure shall not vary more than plus or minus 2 pounds per square inch gauge with respect to the specified test pressure.
   3. Test connections, blowoffs, vents, closure pieces, and joints into structures, including existing bell rings and other appurtenances, with the piping.
   4. Test piping for minimum 2 hours for visible leaks test and minimum 2 hours for the pressure test with maximum leakage allowance.

C. Visible leaks test:
   1. Subject piping under test to specified pressure measured at the lowest end.
   2. Fill piping section under test slowly with water while venting air:
      a. Use potable water for all potable waterlines and where noted on the Piping Schedule.
   3. Before pressurizing for the tests, retain water in piping under slight pressure for the water absorption period of minimum 24 hours.
   4. Raise pressure to the specified test pressure and inspect piping visually for leaks. Consider testing complete when no visible leaks are observed.

D. Pressure test with maximum leakage allowance:
   1. Pressure test piping after completion of visible leaks test.
   2. Accurately measure the makeup water necessary to maintain the pressure in the piping section under test during the pressure test period:
      a. Consider the pressure test to be complete when makeup water added is less than the allowable leakage of 80 gallons per inch of nominal diameter, per mile of piping section under test after 24 hours, and no damage to piping and appurtenances has occurred.
      b. Successful completion of the leakage test shall have been achieved when the observed leakage is equal or less than the allowable leakage and no damage to piping and appurtenances has occurred.

E. Optional joint test:
   1. When joint testing is allowed by note in the Piping Schedule, the procedure shall be as follows:
      a. Joint testing will be allowed only for low head pressure piping.
      b. Joint testing does not replace and is not in lieu of any testing of the piping system or trust restraints.
   2. Joint testing may be performed with water or air.
   3. Joint test piping after completion of backfill and compaction to the top of the trench.
   4. Joint testing with water:
      a. Measure test pressure at the invert of the pipe. Apply pressure of 4 feet plus the inside diameter of the pipe in water column within 0.20 feet in water column.
      b. Maintain test pressure for 1 minute.
      c. Base the allowable leakage per joint on 80 gallons per inch nominal diameter, per mile of piping, per 24 hours equally distributed to the actual number of joints per mile for the type of piping.
      d. Consider the pressure test to be complete when makeup water added is less than the allowable leakage.
      e. Successful completion of the joint test with water shall have been achieved when the observed leakage is equal or less than the allowable leakage.
   5. Joint testing with air:
      a. Apply test pressure of 3 pounds per square inch gauge with a maximum variation of plus 0.20 and minus 0.00 pounds per square inch.
      b. Maintain test pressure for 2 minutes.
      c. Consider the pressure test to be complete when the test pressure does not drop below 2.7 pounds per square inch for the duration of the test.

END OF SECTION

SECTION 15958

MECHANICAL EQUIPMENT TESTING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Testing of mechanical equipment and systems.

1.02 REFERENCES

A. American National Standards Institute (ANSI):
   1. S1.4 Specification for Sound Level Meters.

B. Hydraulic Institute (HI).

C. National Institute of Standards and Technology (NIST).

1.03 SUBMITTALS

A. Provide Source Test Plans as specified in Section 01756 - Commissioning.

B. Provide Installation and Functional Testing Plans as specified in Section 01756 - Commissioning.

C. Provide vendor operation and maintenance manual as specified in Section 01782 - Operation and Maintenance Manuals.
   1. Include motor rotor bar pass frequencies for motors larger than 500 horsepower.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Commissioning of equipment as specified in:
   1. This Section.
   2. Section 01756 - Commissioning.
   3. Equipment sections:
      a. If testing requirements are not specified, provide Level 1 Tests.

B. Test and prepare piping as specified in Section 15956 - Piping Systems Testing.

C. Operation of related existing equipment:
   1. Owner will operate related existing equipment or facilities necessary to accomplish the testing.
   2. Schedule and coordinate testing as required by Section 01756 - Commissioning.

D. Provide necessary test instrumentation that has been calibrated within 1 year from date of test to recognized test standards traceable to the NIST or approved source.
   1. Properly calibrated field instrumentation permanently installed as a part of the Work may be utilized for tests.
   2. Prior to testing, provide signed and dated certificates of calibration for test instrumentation and equipment.

E. Test measurement and result accuracy:
   1. Use test instruments with accuracies as recommended in the appropriate referenced standards. When no accuracy is recommended in the referenced standard, use 1 percent or better accuracy test instruments.
      a. Improved (lower error tolerance) accuracies specified elsewhere prevail over this general requirement.
   2. Do not adjust results of tests for instrumentation accuracy.
      a. Measured values and values directly calculated from measured values shall be the basis for comparing actual equipment performance to specified requirements.

3.02 VARIABLE SPEED EQUIPMENT TESTS

A. Establish performance over the entire speed range and at the average operating condition.

B. Establish performance curves for the following speeds:
   1. The speed corresponding to the rated maximum capacity.
   2. The speed corresponding to the minimum capacity.
   3. The speed corresponding to the average operating conditions.

3.03 PUMP TESTS, ALL LEVELS OF TESTING

A. Test in accordance with the following:
   1. Applicable HI Standards.
   2. This Section.
   3. Equipment sections.

B. Test tolerances: In accordance with appropriate HI Standards, except the following modified tolerances apply:
   1. From 0 to plus 5 percent of head at the rated design point flow.
   2. From 0 to plus 5 percent of flow at the rated design point head.
   3. No tolerance for head and flow when ranges are specified.
   4. No negative tolerance for the efficiency at the rated design point, and other specified conditions.

5. Use of specified test tolerances shall not result in motor overload while operating at any point on the supplied pump operating head-flow curve, including runout.
6. No positive tolerance for vibration limits. Vibration limits and test methods in HI Standards do not apply, use limits and methods specified in this or other Sections of the Specifications.

3.04 DRIVERS TESTS

A. Test motors as specified in Section 16222 - Low Voltage Motors up to 500 Horsepower.

B. Test other drivers as specified in the equipment section.

3.05 NOISE REQUIREMENTS AND CONTROL

A. Perform noise tests in conjunction with vibration test analysis.

B. Make measurements in relation to reference pressure of 0.0002 microbar.

C. Make measurements of emitted noise levels on sound level meter meeting or exceeding ANSI S1.4, Type II.

D. Set sound level meter to slow response.

E. Unless otherwise specified, maximum free field noise level not to exceed 85 dBA measured as sound pressure level at 3 feet from the equipment.

3.06 PRESSURE TESTING

A. Hydrostatically pressure test pressure containing parts at the appropriate standard or code required level above the equipment component specified design pressure or operating pressure, whichever is higher.

3.07 INSPECTION AND BALANCING

A. Statically and dynamically balance each of the individual rotating parts as required to achieve the required field vibration limits.

B. Statically and dynamically balance the completed equipment rotating assembly and drive shaft components.

C. Furnish copies of material and component inspection reports including balancing reports for equipment system components and for the completed rotating assembly.

D. Critical speed of rotating equipment:
   1. Satisfy the following:
      a. The first lateral and torsional critical speed of all constant, variable, and 2-speed driven equipment that is considered rigid such as horizontal pumps, all non-clog pumps, blowers, air compressors, and engines shall be at least 25 percent above the equipment's maximum operating speed.

b. The first lateral and torsional critical speed of all constant, variable, and 2-speed driven equipment that is considered flexible or flexibly mounted such as vertical pumps (vertical in-line and vertical non-clog pumps excluded) and fans shall at least 25 percent below the equipment's lowest operating speed.
c. The second lateral and torsional critical speed of all constant, variable, and 2-speed equipment that is considered flexible or flexibly mounted shall be at least 25 percent above the maximum operating speed.

E. Vibration tests:
1. Definitions:
a. Root mean square: for pumps operating at speeds greater than 600 rpm, the vibration measurement shall be measured as the overall velocity in inches per second root mean square (RMS).
b. Peak-to-peak displacement: The root means squared average of the peak-to-peak displacement multiplied by the square root of 2.
c. Peak velocity: The root mean squared average of the peak velocity multiplied by the square root of 2.
d. Peak acceleration: The root mean squared average of the peak acceleration multiplied by the square root of 2.
e. High frequency enveloping: A process to extract very low amplitude time domain signals associated with impact or impulse events such as bearing or gear tooth defects and display them in a frequency spectrum of acceleration versus frequency.
1) Manufacturers: One of the following or equal:
a) Rockwell Automation, Entek Group, "Spike Energy" analysis.
b) CSI, "PeakVue."
f. Rotor bar pass frequency (RBF), for detecting loose rotor bars.
g. Low speed equipment: Equipment or components of equipment rotating at less than 600 revolutions per minute.
h. High speed equipment: Equipment and equipment components operating at or above 600 revolutions per minute.
i. Preferred operating range: Manufacturer's defined preferred operating range (POR) for the equipment.
j. Allowable operating range: Manufacturer's defined allowable operating range (AOR) for the equipment.
2. Vibration instrumentation requirements:
a. Analyzers: Use digital type analyzers or data collectors with anti-aliasing filter, 12-bit A/D converter, fast fourier transform circuitry, phase measurement capability, time wave form data storage, high-frequency enveloping capabilities, 35 frequency ranges from 21 to 1,500,000 cycles per minute, adjustable fast fourier transform resolution from 400 to 6,400 lines, storage for up to one hundred 3,200 line frequency spectra, data output port, circuitry for integration of acceleration data to velocity or double integration to displacement.
1) Manufacturers: One of the following or equal:
a) Computational Systems Inc., (CSI) Division of Emerson Process Management, Model 2120A, Data Collector/analyzer with applicable analysis software.
b) Pruftechnik, VIBXPERT II.

b. Analyzer settings:
    1) Units: English, inches/second, mils, and gravitational forces.
    2) Fast fourier transform lines: Most equipment 1,600 minimum; for motors, enough lines as required to distinguish motor current frequencies from rotational frequencies, use 3,200 lines for motors with a nominal speed of 3,600 revolutions per minute; 3,200 lines minimum for High Frequency Enveloping; 1,600 lines minimum for low speed equipment.
    3) Sample averages: 4 minimum.
    4) Maximum frequency (Fmax): 40 times rotational frequency for rolling element bearings, 10 times rotational frequency for sleeve bearings.
    5) Amplitude range: Auto select but full scale not more than twice the acceptance criteria or the highest peak, whichever is lower.
    6) Fast fourier transform windowing: Hanning Window.
    7) High pass filter: Minus 3 dB at 120 cycles per minute for high speed equipment. Minus 3 dB at 21 cycles per minute for low speed equipment.
c. Accelerometers:
    1) For low speed equipment: Low frequency, shear mode accelerometer, 500 millivolts per gravitational force sensitivity, 10 gravitational force range, plus/minus 5 percent frequency response from 0.5 hertz to 850 hertz, magnetic mount.
        a) Manufacturers: One of the following or equal:
            (1) Wilcoxon Research, Model 797L.
            (2) PCB, Model 393C.
    2) For high speed equipment: General purpose accelerometer, 100 millivolts per gravitational force sensitivity, 50 gravitational force range, plus/minus 3dB frequency response range from 2 hertz to 12,000 hertz when stud mounted, with magnetic mount holder.
        a) Manufacturers: One of the following or equal:
            (1) Wilcoxon Research, Model 793.
            (2) Entek-IRD Model 943.

3. Accelerometer mounting:
    a. Use magnetic mounting or stud mounting.
    b. Mount on bearing housing in location with best available direct path to bearing and shaft vibration.
    c. Remove paint and mount transducer on flat metal surface or epoxy mount for High Frequency Enveloping measurements.
4. Vibration acceptance criteria:
    a. Testing of rotating mechanical equipment: Tests are to be performed by an experienced, factory trained, and independent authorized vibration analysis expert.

b. Vibration displacement limits: Unless otherwise specified, equipment operating at speeds 600 revolutions per minute or less is not to exhibit unfiltered readings in excess of following:

Operating Conditions and Application Data	Overall Peak-to-Peak Displacement	
	Field, mils	Factory, mils
Operation within the POR	3.0	4.0
Operation within the AOR	4.0	5.0
Additive value when measurement location is greater than 5 feet above foundation.	2.0	2.0
Additive value for solids-handling pumps	2.0	N/A
Additive value for slurry pumps	2.0	N/A

c. Vibration velocity limits: Unless otherwise specified, equipment operating at speeds greater than 600 revolutions per minute is not to exceed the following peak velocity limits:

HI Pump Type	Horsepower	Field Test	Factory Test
		Overall RMS	Overall RMS
Horizontal Solids Handling Centrifugal Pumps	Below 33 hp	0.25	0.28
Horizontal and Vertical In-Line Centrifugal Pumps (other than Non-Clog type)	Between 33 and 100 hp	0.28	0.31
	100 hp and above	0.31	0.34
Vertical Solids Handling Centrifugal Pumps	Below 33 hp	0.30	0.33
Vertical Turbine, Mixed Flow, and Propeller Pumps (solids-handling type pumps)	Between 33 and 100 hp	0.32	0.35
	100 hp and above	0.34	0.35
Non-Solids Handling Centrifugal Pumps HI Types BB1, BB2, BB3, BB4, BB5, OH1, OH2, OH3, OH4, OH5, and OH7	Below 268 hp	0.15	0.19
	268 hp and above	0.19	0.22
Vertical Turbine, Mixed Flow, and Propeller Pumps HI Types VS1, VS2, VS3, VS4, VS5, VS6, VS7, and VS8	Below 268 hp	0.13	
	268 hp and above	0.17	
Slurry Pumps		0.25	0.30

HI Pump Type	Horsepower	Field Test	Factory Test
		Overall RMS	Overall RMS
Motors		See Applicable Motor Specification	See Applicable Motor Specification
Gear Reducers, Radial		Not to exceed AGMA 6000-B96 limits	Not to exceed AGMA 6000-B96 limits
Other Reducers, Axial		0.1	N/A

d. Equipment operation: Measurements are to be obtained with equipment installed and operating within capacity ranges specified and without duplicate equipment running.
e. Additional criteria:
    1) No narrow band spectral vibration amplitude components, whether sub-rotational, higher harmonic, or synchronous multiple of running speed, are to exceed 40 percent of synchronous vibration amplitude component without manufacturer's detailed verification of origin and ultimate effect of such excitation.
    2) The presence of discernable vibration amplitude peaks in Test Level 2 or 3 vibration spectra at bearing inner or outer race frequencies shall be cause for rejection of the equipment.
    3) For motors, the following shall be cause for rejection:
        a) Stator eccentricity evidenced by a spectral peak at 2 times electrical line frequency that is more than 40 percent of the peak at rotational frequency.
        b) Rotor eccentricity evidenced by a spectral peak at 2 times electrical line frequency with spectra side bands at the pole pass frequency around the 2 times line frequency peak.
        c) Other rotor problems evidenced by pole pass frequency side bands around operating speed harmonic peaks or 2 times line frequency side bands around rotor bar pass frequency or around 2 times the rotor bar pass frequency.
        d) Phasing problems evidenced by 1/3 line frequency side band spectral peaks around the 2 times electrical line frequency peak.
    4) The presence of peaks in a High Frequency Enveloping spectra plot corresponding to bearing, gear or motor rotor bar frequencies or harmonics of these frequencies shall be cause for rejection of the equipment; since inadequate lubrication of some equipment may be a cause of these peaks, lubrication shall be checked, corrected as necessary and the high frequency envelope analysis repeated.

5. Vibration testing results presentation:
    a. Provide equipment drawing with location and orientation of measurement points indicated.
    b. For each vibration measurement take and include appropriate data on equipment operating conditions at the time vibration data is taken; for pumps, compressors, and blowers record suction pressure, discharge pressure, and flow.

c. When Vibration Spectra Data required:
    1) Plot peak vibration velocity versus frequency in cycles per minute.
    2) Label plots showing actual shaft or part rotation frequency, bearing inner and outer race ball pass frequencies, gear mesh frequencies and relevant equipment excitation frequencies on the plot; label probable cause of vibration peaks whether in excess of specification limits or not.
    3) Label plots with equipment identification and operating conditions such as tag number, capacity, pressure, driver horsepower, and point of vibration measurement.
    4) Plot motor spectra on a log amplitude scale versus frequency.
d. For low speed equipment, plot peak vibration displacement versus frequency as well as velocity versus frequency.
e. Provide name of manufacturer and model number of the vibration instrumentation used, including analyzer and accelerometer used together with mounting type.

3.08 TESTING LEVELS

A. Level 1 Tests:
    1. Level 1 Performance Test:
        a. General:
            1) For equipment, operate, rotate, or otherwise functionally test for 15 minutes minimum after components reach normal operating temperatures.
            2) Operate at rated design load conditions.
            3) Confirm that equipment is properly assembled.
            4) Confirm the equipment moves or rotates in the proper direction.
            5) Confirm shafting, drive elements, and bearings are installed and lubricated in accordance with proper tolerances.
            6) Confirm that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.
        b. Pumps:
            1) Comply with general performance test requirements as specified in this Section.
            2) Measure flow and head while operating at or near the rated condition; for factory testing, testing may be at reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.
                a) Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Section 16222 - Low Voltage Motors up to 500 Horsepower or the applicable equipment section.
                b) Use actual driver for field tests.
            3) Record measured flow, suction pressure, discharge pressure, and make observations on bearing temperatures and noise levels.
    2. Level 1 Vibration Test:
        a. Test requirement:
            1) Measure filtered vibration spectra versus frequency in 3 perpendicular planes at each normally accessible bearing housing

on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component.
2) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.

b. Equipment operating condition: Test at specified maximum speed.

3. Level 1 Noise Test:
   a. Measure unfiltered overall A-weighted sound pressure level in dBA at 3 feet horizontally from the surface of the equipment and at a mid-point of the equipment height.

B. Level 2 Tests:
   1. Level 2 Performance Test:
      a. General:
         1) For equipment, operate, rotate, or otherwise functionally test for at least 2 hours after components reach normal operating temperatures.
         2) Operate at rated design load conditions.
         3) Confirm that equipment is properly assembled.
         4) Confirm the equipment moves or rotates in the proper direction.
         5) Confirm shafting, drive elements, and bearings are installed and lubricated in accordance with proper tolerances.
         6) Confirm that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.
      b. Pumps:
         1) Comply with general performance test requirements as specified in this Section.
         2) Test 2 hours minimum for flow and head at the rated condition; for factory testing, testing may be at a reduced speeds with flow and head corresponding to the rated condition when adjusted for speed using the appropriate affinity laws.
            a) Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Section 16222 - Low Voltage Motors up to 500 Horsepower.
            b) Use actual driver for field tests.
         3) Test for flow and head at 2 additional conditions; 1 at 25 percent below the rated flow and 1 at 10 percent above the rated flow.
         4) Record measured flow, suction pressure, discharge pressure, and observations on bearing temperatures and noise levels at each condition.
   2. Level 2 Vibration Test:
      a. Test requirement:
         1) Measure filtered vibration spectra versus frequency and measure vibration phase in 3 perpendicular planes at each normally accessible bearing housing on the driven equipment, any gears and on the driver; 1 plane of measurement to be parallel to the axis of rotation of the component; measure actual rotational speeds for each

vibration spectra measured using photometric or other tachometer input connected directly to the vibration data collector.
2) Vibration spectra versus frequency shall be in accordance with Vibration Acceptance Criteria.

b. Equipment operating condition: Repeat test requirements at design specified maximum speed and at minimum speed for variable speed equipment.

c. Natural frequency test of field installed equipment:
1) Excite the installed equipment and support system in 3 perpendicular planes, use same planes as operating vibration measurement planes, and determine the as-installed natural resonant frequency of the driven equipment, the driver, gears, and supports.
2) Perform test at each bearing housing, at each support pedestal, and for pumps on the suction and discharge piping.
3) Perform with equipment and attached piping full of intended service or process fluid.

3. Level 2 Noise Test:
a. Measure filtered A-weighted overall sound pressure level in dBA for each of 8 octave band mid-points beginning at 63 hertz measured at 3 feet horizontally from the surface of the equipment at mid-point height of the noise source.

C. Level 3 Tests:
1. Level 3 Performance Tests:
a. General:
1) For equipment, operate, rotate, or otherwise functionally test for at least 4 hours after components reach normal operating temperatures.
2) Operate at rated design load conditions for 1/2 the specified time; operate at each of any other specified conditions for a proportionate share of the remaining test time.
3) Confirm that equipment is properly assembled.
4) Confirm the equipment moves or rotates in the proper direction.
5) Confirm shafting, drive elements, and bearings are installed and lubricated in accordance with proper tolerances.
6) Confirm that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.
7) Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure, and temperature readings using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.
8) Bearing temperatures: During maximum speed or capacity performance testing, measure and record the exterior surface temperature of each bearing versus time.

b. Pumps:
1) Comply with general performance test requirements as specified in this Section.

2) Test 4 hours minimum for flow and head; begin tests at or near the rated condition; for factory and field-testing, test at full speed.
    a) Use of a test driver is permitted for factory tests when actual driver is given a separate test at its point of manufacture as specified in Section 16222 - Low Voltage Motors up to 500 Horsepower.
    b) Use actual driver for field tests.
3) Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 15 minutes or longer as necessary to measure required performance, vibration, and noise data at each test condition.
4) Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices are not required by the equipment section) and record observations on noise levels.
5) Perform efficiency and/or Net Positive Suction Head Required (NPSHr) and/or priming time tests when specified in the equipment section in accordance with the appropriate HI standard and as follows:
    a) Perform NPSHr testing at maximum rated design speed, head and flow with test fluids at ambient conditions; at maximum rated speed, test at 15 percent above rated design flow, and 25 percent below rated design flow.
    b) Perform efficiency testing with test fluids at maximum rated speed.
    c) Perform priming time testing with test fluids at maximum rated speed.

2. Level 3 Vibration Test:
    a. Requirements: Same as Level 2 vibration test except data taken at each operating condition tested and with additional requirements below.
    b. Perform High Frequency Enveloping Analysis for gears and bearings.
        1) Measure bearing element vibration directly on each bearing cap in a location close as possible to the bearing load zone that provides a smooth surface and direct path to the bearing to detect bearing defects.
        2) Report results in units of acceleration versus frequency in cycles per minute.
    c. Perform Time Wave Form analysis for gears, low speed equipment and reciprocating equipment; plot true peak amplitude velocity and displacement versus time and label the period between peaks with the likely cause of the periodic peaks (relate the period to a cause).
    d. Plot vibration spectra on 3 different plots; peak displacement versus frequency, peak acceleration versus frequency and peak velocity versus frequency.
3. Level 3 Noise Test: Measure filtered, un-weighted overall sound pressure level in dB at 3 feet horizontally from the surface of the equipment at mid-point height and at 4 locations approximately 90 degrees apart in plain view; report results for each of 8 octave band mid-points beginning at 63 hertz.

D. Level 4 Tests:
   1. Level 4 Performance Test:
      a. General:
         1) For equipment, operate, rotate, or otherwise functionally test for at least 8 hours after components reach normal operating temperatures.
         2) Operate at rated design load conditions for 1/2 the specified time; operate at each of any other specified conditions for a proportionate share of the remaining test time.
         3) Confirm that equipment is properly assembled.
         4) Confirm the equipment moves or rotates in the proper direction.
         5) Confirm shafting, drive elements, and bearings are installed and lubricated in accordance with proper tolerances.
         6) Confirm that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.
         7) Take appropriate capacity, power or fuel consumption, torque, revolutions per minute, pressure and temperature readings, using appropriate test instrumentation to confirm equipment meets specified performance requirements at the design rated condition.
         8) Bearing temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.
      b. Pumps:
         1) Comply with general performance test requirements as specified in this Section.
         2) Test 8 hours minimum for flow and head; begin tests at or near the rated condition; for factory and field-testing, test with furnished motor at full speed.
         3) Test each specified flow and head condition at the rated speed and test at minimum as well as maximum specified speeds; operate at each test condition for a minimum of 20 minutes or longer as necessary to measure required performance, vibration, and noise data at each test condition.
         4) Record measured shaft revolutions per minute, flow, suction pressure, discharge pressure; record measured bearing temperatures (bearing housing exterior surface temperatures may be recorded when bearing temperature devices not required by the equipment section) and record observations on noise levels.
         5) Bearing temperatures: During maximum speed or capacity testing, measure and record the exterior surface temperature of each bearing versus time.
         6) Perform efficiency and/or Net Positive Suction Head Required (NPSHr) and/or priming time tests when specified in the equipment section in accordance with the appropriate HI standard and as follows:
            a) Perform NPSHr testing at maximum rated design speed, head and flow with test fluids at ambient conditions; at maximum rated speed, test at 15 percent above rated design flow, and 25 percent below rated design flow.

b) Perform efficiency testing with test fluids at maximum rated speed.
c) Perform priming time testing with test fluids at maximum rated speed.

2. Level 4 Vibration Test: Same as Level 3 vibration test.
3. Level 4 Noise Test: Same as Level 3 Noise Test except with data taken at each operating condition tested.

END OF SECTION

SECTION 16050

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Requirements for electrical:
      a. Basic design and performance criteria.
      b. Prescriptive requirements for common components.
      c. Installation.

B. Contract Drawings:
   1. Plan drawings:
      a. The Electrical Drawings show desired locations, arrangements, and components of the electrical work in a diagrammatic manner.
      b. Locations and sizes of equipment are approximate only.
   2. Installation details:
      a. The Contract Drawings include typical installation details the Contractor is to use to complete the Electrical Work. For cases where a typical detail does not apply, develop installation details that may be necessary for completing the Work, and submit these details for review by the Engineer.
      b. Not all typical installation details are referenced within the Drawing set. Apply and use typical details where appropriate.

1.02 REFERENCES

A. National Electrical Manufacturers Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

B. National Fire Protection Association (NFPA):
   1. 70 - National Electrical Code (NEC).

C. Underwriters' Laboratories, Inc. (UL).

1.03 DEFINITIONS

A. FAT: Factory acceptance test that is also referred to as source test.

B. ICSC: Instrumentation and controls subcontractor.

C. LCP: Local control panel: Operator interface panel that may contain an HMI, pilot type control devices, operator interface devices, control relays, etc. and does not contain a PLC or RIO.

D. PCM: Process control module: An enclosure containing any of the following devices: PLC, RTU, or RIO.

E. PCIS: Process control and instrumentation system:
   1. RS-232: RS-232 is also known as TIA-232 or EIA-232, is a standard for serial communication transmission of data.
   2. RS-485: RS-485 is also known as TIA-485 or EIA-485, is a standard defining the electrical characteristics of drivers and receivers for use in serial communications system.
   3. RTU: Remote telemetry unit: A controller typically consisting of a PLC, and a means for remote communications.

F. Space: That portion of the switchgear, motor control center, panelboard, switchboard, or control panel that does not physically contain a device but is capable of accepting a device with no modifications to the equipment, i.e., provide standoffs, bus, and hardware, as part of the space.

G. Spare: That portion of the switchgear, motor control center, panelboard, switchboard, or control panel that physically contains a device with no load connections to be made.

H. Unequipped space: That portion of the switchgear, motor control center, panelboard, switchboard, or control panel that does not physically contain a device, standoff, bus, hardware, or other equipment.

I. USB: Universal Serial Bus is an industry standard that establishes specifications for cables, connectors, and protocols for connection, communication, and power supply interfacing between computer, peripherals, and other computers.

J. Vendor control panel (VCP): Control panels that are furnished with particular equipment by a vendor other than the ICSC. These panels may contain PLCs, RIO, OIT, HMI, etc.

1.04 SUBMITTALS (NOT USED)

1.05 QUALITY ASSURANCE

A. General:
   1. Furnish equipment listed by and bearing the label of UL or of an independent testing laboratory acceptable to the Engineer and the Authority Having Jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Shipping precautions:
   1. After completion of shop assembly and successful factory testing, pack all equipment in protective crates, and enclose in heavy duty polyethylene envelopes or secured sheeting to provide complete protection from damage, dust, and moisture.
   2. Place dehumidifiers, when required, inside the polyethylene coverings.
   3. Skid-mount the equipment for final transport.
   4. Provide lifting rings for moving without removing protective covering.
   5. Display boxed weight on shipping tags together with instructions for unloading, transporting, storing, and handling at the job site.

1.07 PROJECT OR SITE CONDITIONS

A. Non-conditioned spaces:
   1. Provide additional temperature conditioning equipment to maintain all equipment in non-conditioned spaces subject to these ambient temperatures, with a band of 10 degrees Fahrenheit above the minimum operating temperature and 10 degrees Fahrenheit below maximum operating temperature, as determined by the equipment manufacturer's guidelines.

B. Outdoor installations:
   1. Provide electrical, instrumentation and control equipment suitable for operation in the ambient conditions where the equipment is located.
   2. Provide heating, cooling, and dehumidifying devices incorporated into and included with electrical equipment, instrumentation and control panels to maintain the enclosures within the rated environmental operating ranges as specified in the Sections for the equipment.

1.08 ADMINISTRATIVE REQUIREMENTS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY (NOT USED)

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

A. General:
   1. Equipment manufacturer's responsibility extends to selection and mounting of gear drive units, motors or other prime movers, accessories, and auxiliaries to provide a complete, operable unit.

B. Equipment mounting and anchoring:
   1. Mount equipment on cast-iron or welded-steel bases with structural steel support frames:
      a. Utilize continuous welds to seal seams and contact edges between steel members.
      b. Grind welds smooth.
   2. Provide bases and supports with machined support pads, dowels for alignment of mating of adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits.

3. Provide jacking screws in bases and supports for equipment weighing over 1,000 pounds.
4. Design equipment anchorage, supports, and connections for dead load, running loads, loads during start-up, seismic load specified in Section 01850 - Design Criteria, and other loads as required for proper operation of equipment:
    a. For equipment with an operating weight of 400 pounds or greater and all equipment that is supported higher than 4 feet above the floor, provide calculations for:
        1) The operating weight and location of the centroid of mass for the equipment.
        2) Forces and overturning moments.
        3) Shear and tension forces in equipment anchorages, supports, and connections.
        4) The design of equipment anchorage, supports, and connections based on calculated shear and tension forces.
5. Anchorage of equipment to concrete or masonry:
    a. Perform calculations and determine number, size, type, strength, and location of anchor bolts or other connections.
    b. Unless otherwise indicated on the Drawings, select and provide anchors from the types specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
    c. Provide bolt sleeves around cast-in anchor bolts for 400 pounds or greater equipment:
        1) Adjust bolts to final location and secure the sleeve.
6. Anchorage of equipment to metal supports:
    a. Perform calculations and determine number, size, type, strength, and location of bolts used to connect equipment to metal supports.
7. Unless otherwise indicated on the Drawings, install equipment supported on concrete over non-shrink grout pads as specified in this Section.

2.02 MANUFACTURERS (NOT USED)

2.03 EXISTING PRODUCTS (NOT USED)

2.04 MATERIALS

A. Enclosures:
    1. Provide enclosures for electrical, instrumentation and control equipment, regardless of supplier or subcontractor furnishing the equipment, that meet the requirements of NEMA Standard 250.

B. Plant area electrical Work requirements:
   1. Provide electrical materials in accordance with the following table, unless otherwise specifically indicated on the Drawings:
      a. Conduit installation requirements: As specified in Section 16130 - Conduits.

Table 1. Electrical Material Requirements				
PLANT AREA	**ENVIRONMENT W = WET D = DAMP C = CLEAN/DRY X = CORROSIVE H = HAZARDOUS**	**NEMA ENCLOSURE TYPE**	**EXPOSED CONDUIT TYPE (as specified in Section 16130 - Conduits)**	**SUPPORT MATERIALS**
Recycled Water PS - Outdoor	W	4	GRC	GALV STEEL
Recycled Water PS Electrical Building - Indoor	C	1, 12	GRC	GALV STEEL
WWTP Electrical Buildings/Rooms - Indoor	C	1, 12	GRC	GALV STEEL
WWTP Electrical Buildings/Rooms - Outdoor	W	4X	PCS	STAINLESS STEEL
Carousel, PAU, and Backwash PS - Outdoor	W	4X	PCS	STAINLESS STEEL
AWT Blower Room	C	1, 12	GRC	GALV STEEL
AWT Chemical Room	X	4X	PCS	STAINLESS STEEL

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT (NOT USED)

2.07 COMPONENTS (NOT USED)

2.08 ACCESSORIES (NOT USED)

2.09 MIXES (NOT USED)

2.10 FABRICATION (NOT USED)

2.11 FINISHES (NOT USED) SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION

A. Sequencing and scheduling:
   1. Equipment anchoring: Project construction schedule must include an event for obtaining the anchor layout drawings from equipment manufacturers in adequate time for templates to be constructed and anchors to be cast in place.

3.03 INSTALLATION

A. Demolition:
   1. As specified in Technical Sections or as indicated on the Drawings.
   2. Disconnect utilities:
      a. Disconnect electrical equipment.
      b. Disconnect other utilities as specified in Section 16210 - Utility Coordination.
   3. Remove and dispose of conduit, wire, electrical equipment, controls, etc., associated with the items and/or areas to be demolished as indicated on the Drawings unless otherwise indicated.
   4. Salvage electrical equipment as specified in Section 01738 - Selective Alterations and Demolition.
   5. For each piece of equipment to be removed, remove all ancillary components (e.g., instruments, solenoid valves, disconnect switches, etc.).
   6. Conduit:
      a. Where conduit removal, other than associated with equipment to be removed, is indicated on the Drawings:
         1) Remove exposed conduit to the point of encasement or burial.
         2) Cut conduit flush and plug or cap encased or buried conduit.
      b. Where conduits are to remain in place and removal is not indicated on the Drawings:
         1) Cap conduit open ends.
         2) Re-label empty conduits as spare.
   7. Remove all wire back to the source for all conduits to be removed or abandoned in place.
   8. Provide new nameplates for modified electrical distribution equipment, motor control centers etc. to identify equipment and circuits that are no longer used as spares.
   9. Provide new typewritten schedules for all modified panelboards.

B. Portions of this Project involve installation in existing facilities and interfaces to existing circuits, power systems, controls, and equipment:
   1. Perform and document comprehensive and detailed field investigations of existing conditions (circuits, power systems, controls, equipment, etc.) before starting any Work.
   2. Determine information necessary to document, interface with, modify, upgrade, or replace existing circuits, power systems, controls, and equipment.
   3. Provide and document interface with, modifications to, upgrades, or replacement of existing circuits, power systems, controls, and equipment.

C. Equipment:
   1. Where the Drawings do not show dimensions for locating equipment, install equipment in the approximate locations indicated on the Drawings.

D. Provide NEC required working space in front of all electrical equipment as if it could be worked on energized.

E. Circuits of different service voltage:
   1. Voltage and service levels:
      a. Medium voltage: greater than 1.0 kV.
      b. Low voltage: 120 V to 480 V.
      c. Instrumentation: Less than 50 VDC.
   2. Install different service voltage circuits in separate raceways, junction boxes, manholes, hand holes, and pullboxes.
   3. In manholes, install all cables operating at less than 50 VDC in PVC coated flexible metallic conduit, with corrosion resistant fittings.

F. Conductors shall not pass through equipment they are not terminating in unless indicated on the Drawings or approved by the engineer.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION

A. When touchup or repair required, apply primer and coating systems as recommended by the equipment manufacturer.

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING – GENERAL

A. As specified in Section 01756 - Commissioning and Technical Sections.

B. Provide on-site assistance for troubleshooting and correcting electrical issues discovered during commissioning.

3.08 COMMISSIONING – SOURCE TESTING (NOT USED)

A. As specified in Attachment A. Source Testing and Owner Training Requirements.

3.09 COMMISSIONING – INSTALLATION VERIFICATION (NOT USED)

A. Inspection activities conducted during construction do not satisfy inspection or testing requirements as specified in Section 16950 - Field Electrical Acceptance Tests.

3.10 COMMISSIONING – FUNCTIONAL TESTING (NOT USED)

3.11 COMMISSIONING – SYSTEM TESTING (NOT USED)

3.12 COMMISSIONING – OWNER TRAINING

A. As specified in Attachment A - Source Testing and Owner Training Requirements.

3.13 COMMISSIONING – DOCUMENTATION (NOT USED)

3.14 FIELD QUALITY CONTROL

A. Workmanship:
   1. Leave wiring in panels, manholes, boxes, and other locations neat, clean, and organized:
      a. Neatly coil and label spare wiring lengths.
      b. Shorten, re-terminate, and re-label excessive used, as well as spare, wire, and cable lengths, as directed by the Engineer.

3.15 ADJUSTING (NOT USED)

3.16 CLEANING

A. General:
   1. Clean and vacuum all enclosures to remove all metal filings, surplus insulation and any visible dirt, dust, or other matter before energization of the equipment or system start-up:
      a. Use of compressors or air blowers for cleaning is not acceptable.
   2. Clean luminaries that were used in the areas affected by the construction.

3.17 PROTECTION (NOT USED)

3.18 SCHEDULES (NOT USED)

END OF SECTION

ATTACHMENT A - SOURCE TESTING AND OWNER TRAINING REQUIREMENTS

SOURCE TESTING AND OWNER TRAINING REQUIREMENTS

Section Number	Section Title	Source Testing	Owner Training Requirements	
		(Witnessed or Non-witnessed)	Maintenance (hrs per session)	Operation (hrs per session)
16262	Variable Frequency Drives 0.50 - 50 Horsepower	Non-witnessed	1	1
16265	Reduced Harmonic Variable Frequency Drives	Non-witnessed	1	1
16422	Motor Starters	Non-witnessed	1	1
16441	Group-Mounted Circuit Breaker Switchboards	Non-witnessed	1	1

SECTION 16060

GROUNDING AND BONDING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: Grounding materials and requirements.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. ASTM International (ASTM):
   1. B3 - Standard Specification for Soft or Annealed Copper Wire.
   2. B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

C. Institute of Electrical and Electronics Engineers (IEEE):
   1. 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.

D. Underwriters Laboratories, Inc. (UL):
   1. 467 - Ground and Bonding Equipment.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 16050 - Common Work Results for Electrical.

B. Product data:
   1. Catalog cutsheets.

1.05 QUALITY ASSURANCE

A. All grounding components and materials shall be UL listed and labeled.

1.06 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.07 PROJECT/SITE CONDITIONS (NOT USED)

1.08 SEQUENCING (NOT USED)

1.09 SCHEDULING (NOT USED)

1.10 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.11 SYSTEM START-UP (NOT USED)

1.12 OWNER'S INSTRUCTIONS (NOT USED)

1.13 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Compression connectors: One of the following or equal:
   1. Erico.
   2. Harger.
   3. Burndy.
   4. Thomas & Betts.
   5. Panduit.

B. Ground rods: One of the following or equal:
   1. Erico.
   2. Harger.
   3. Nehring
   4. Thomas & Betts.

C. Ground cable: One of the following or equal:
   1. Erico.
   2. Harger
   3. Nehring.
   4. Southwire.

D. Precast ground well boxes: One of the following or equal:
   1. Brooks Products, 3-RT Valve Box.
   2. Christy Concrete Products, G12 Valve Box.

2.02 SYSTEM DESCRIPTION

A. Ground equipment and raceway systems so that the completed installation conforms to all applicable code requirements.

B. Provide a complete electrical grounding system as indicated on the Drawings and as specified including but not limited to:
   1. Grounding electrodes.
   2. Bonding jumpers.
   3. Ground connections.

C. Provide bonding jumpers and wire, grounding bushings, clamps and appurtenances required for complete grounding system to bond equipment and raceways to equipment grounding conductors.

D. The ground system resistance (electrode to ground) of the completed installation, as determined by tests specified in Section 16950 - Field Electrical Acceptance Tests, shall be:
   1. 5 ohms or less for industrial systems.
   2. 1 ohm or less for electrical buildings.

2.03 EXISTING PRODUCTS (NOT USED)

2.04 MATERIALS

A. Ground rod:
   1. Minimum: 3/4-inch diameter, 10 feet long.
   2. Uniform 10 mil covering of electrolytic copper metallically bonded to a rigid steel core:
      a. The copper-to-steel bond shall be corrosion resistant.
   3. In accordance with UL 467.
   4. Sectional type joined by threaded copper alloy couplings.
   5. Fit the top of the rod with a threaded coupling and steel-driving stud.

B. Ground cable:
   1. Requirements:
      a. Soft drawn (annealed).
      b. Concentric lay, coarse stranded in accordance with ASTM B8.
      c. Bare copper in accordance with ASTM B3.
   2. Size is as indicated on the Drawings, but not less than required by the NEC. Use the following type of wire unless otherwise indicated on the Drawings:
      a. Size No. 6 AWG and smaller; solid conductor.
      b. Size No. 4 AWG and larger; stranded conductor.

C. Compression connectors:
   1. Manufactured of high copper alloy specifically for the particular grounding application.
   2. Suitable for direct burial in earth and concrete.
   3. Identifying compression die number inscription to be impressed on compression fitting.
   4. Barrels prefilled and sealed with oxide-inhibiting and anti-seizing compound.

D. Grounding electrode conductors:
   1. Minimum size in accordance with the NEC.

E. Main bonding jumpers and bonding jumpers:
   1. Minimum size in accordance with the NEC.

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT (NOT USED)

2.07 COMPONENTS (NOT USED)

2.08 ACCESSORIES

A. Precast ground well boxes:
   1. Minimum 10-inch interior diameter.
   2. Traffic-rated cast iron cover.
   3. Permanent “GROUND” marking on cover.

2.09 MIXES (NOT USED)

2.10 FABRICATION (NOT USED)

2.11 FINISHES (NOT USED)

2.12 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Provide a separate grounding conductor for each motor and connect at motor terminal box. Do not use bolts securing motor box to frame or cover for grounding connectors:
   1. When grounding motors driven by variable frequency drives (VFD) comply with the requirements of the VFD manufacturer.

B. Provide a grounding type bushing with lug for connection of grounding conductor for conduits that originate from each motor control center section, switchboard, or panelboard:
   1. Individually bond these raceways to the ground bus in the equipment.

C. Provide grounding type bushings with lugs for connection of grounding conductor at both ends of metallic conduit runs. Bond ground bushings to the grounding system.

D. Provide a green insulated wire-grounding jumper from the ground screw to a box grounding screw and, for grounding type devices, to equipment grounding conductor.

E. Interconnect the secondary switchgear, switchboard, or panelboard neutral bus to the ground bus in the secondary switchgear, switchboard, or panelboard compartment, only at service entrance point or after a transformer.

F. Duct bank ground system:
   1. Provide a bare copper grounding conductor the entire length of each duct bank, embedded in the concrete of the duct bank as indicated on the Drawings and specified in the Specifications.
   2. Bond duct bank ground conductors together where duct banks join, merge, intersect, or split.

G. Grounding at service (600 V or Less):
   1. Connect the neutral to ground only at one point within the enclosure of the first disconnecting means on the load side of the service transformer.

H. Ground connections:
   1. All connections to the ground grid system, the duct bank grounding system, equipment, ground rods, etc., shall be made using compression type grounding connectors as indicated on the Drawings, UL listed, and labeled for the application.
   2. Make ground connections in accordance with the manufacturer's instructions.
   3. Do not conceal or cover any ground connections until the Engineer or authorized representative has established and provided written confirmation that every grounding connection is as indicated on the Drawings and specified in the Specifications.

I. Grounding electrode system:
   1. Ground ring:
      a. Provide all trenching and materials necessary to install the ground ring as indicated on the Drawings.
      b. Ground ring conductor shall be in direct contact with the earth, or where embedded, concrete, of the size as indicated on the Drawings.
      c. Minimum burial depth 36 inches or as indicated on the Drawings.
      d. Re-compact disturbed soils to original density in 6-inch lifts.
   2. Ground rods:
      a. Locations as indicated on the Drawings.
      b. Length of rods forming an individual ground array shall be equal in length.
      c. Drive ground rods and install grounding conductors before construction of concrete slabs and duct banks.
      d. Pre-crimp all ground rods, as recommended by the manufacturer, before crimping connector to ground rod.
   3. Metal underground water pipe:
      a. Bond metal underground domestic water pipe to grounding electrode system.
   4. Metal frame of building or structure:
      a. Bond metal frame of building or structure to grounding electrode system.
   5. Extend grounding conductors through concrete to accessible points for grounding equipment and electrical enclosures.
   6. Where grounding conductors are exposed and subject to physical damage, install in Schedule 80 PVC conduit for protection.
   7. Install grounding system at each structure where switchgear, motor control centers, switchboards, panelboards, panels, or other electrical equipment are installed.

J. Shield grounding:
   1. Analog signal cables shields shall only be grounded at a single point in the loop. Unless otherwise noted, ground signal cable shields at control panel.
   2. For communication and data line signal cable shields and drain wires should be grounded at both ends of the cable run.
   3. Insulate the shielding and exposed drain wire for each signal cable with heat-shrink tubing.
   4. Terminate the signal cable shield on a dedicated grounding terminal block.

K. Antenna ground:
   1. Install individual ground rod or ground system for communication system antenna:
      a. Install a dedicated grounding electrode conductor from the antenna ground to the grounding electrode system.
      b. Do not connect any other grounds to the antenna grounding electrode conductor.
   2. Install ground rod or ground system in accordance with the radio manufacturer's requirements.

L. Where indicated on the Drawings, install ground rods in precast ground wells.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. Measure grounding electrode system resistance to ground in accordance with IEEE 81.

3.09 ADJUSTING

A. Under the direction of the Engineer, add additional parallel connected ground rods and/or deeper driven rods until the ground resistance measurement meets the specified resistance requirements:
   1. Use of salts, water, or compounds to attain the specified ground resistance is not acceptable.

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16070

HANGERS AND SUPPORTS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Mounting and supporting electrical equipment and components.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. ASTM International (ASTM):
   1. A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   2. A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. Design requirements:
   1. Conform to the requirements of the Building Code as specified in Section 01410 - Regulatory Requirements.
   2. Demonstrate the following using generally accepted engineering methods:
      a. That the anchors to the structure are adequate to resist the loads generated in accordance with the Building Code and equipment requirements.
      b. That the required load capacity of the anchors can be fully developed in the structural materials to which they are attached.
   3. Design loading and anchoring requirements:
      a. As indicated in the Building Code unless otherwise specified.
      b. Seismic loading requirements:
         1) Freestanding, suspended, or wall-hung equipment shall be anchored in place by methods that will satisfy the requirements for the seismic design specified in Section 01850 - Design Criteria.
      c. Wind loading requirements:
         1) All exterior equipment shall be anchored in place by methods that will satisfy the requirements for wind design specified in Section 01850 - Design Criteria.
      d. Minimum safety factor against overturning: 1.5.
      e. The foundation and structures to which hangers and supports are attached shall be capable of withstanding all anchor loads.

B. Performance requirements:
   1. Hangers and supports individually and as a system shall resist all weights and code-required forces without deflections and deformations that would damage the supporting elements, the equipment supported, or the surrounding construction.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Supports:
      a. Materials.
      b. Geometry.
      c. Manufacturer.
   2. Hardware:
      a. Materials.
      b. Manufacturer.

C. Shop drawings:
   1. Complete dimensioned and scalable shop drawings of all supporting structures, trapezes, wall supports, etc.
   2. Complete anchoring details for equipment, lighting and raceway, supporting structures, trapezes, and wall supports for all equipment:
      a. For free standing supports and wall supports supporting equipment weight in excess of 200 pounds:
         1) Stamped by a professional engineer licensed in the state where the Project is being constructed.
      b. Said submittals, by virtue of the fact that they bear the stamp of a registered engineer, will be reviewed for general consistency with the requirements specified in the Contract Documents, but not for context, accuracy, or method of calculation.
   3. Include data on attachment hardware and construction methods that will satisfy the design loading and anchoring criteria.

D. Installation instructions:
   1. Furnish anchorage instructions and requirements based on the seismic and wind conditions of the Site:
      a. Stamped by a professional engineer licensed in the state where the Project is being constructed.

1.06 QUALITY ASSURANCE

1.07 DELIVERY, STORAGE, AND HANDLING

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM STARTUP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Preformed channel:
      a. Thomas & Betts.
      b. Power-Strut.
      c. Unistrut.
      d. Cooper B-Line.
      e. Robroy.
      f. Tyco.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Use materials appropriate for the area as specified in Section 16050 - Common Work Results for Electrical.

B. Preformed channel:
   1. Hot dip galvanized steel:
      a. Supports:
         1) In accordance with ASTM A123 or A153.
         2) Minimum zinc coating thickness of 2.5 mils.
      b. Hardware:
         1) Electro-galvanized.
         2) In accordance with ASTM A153.
   2. Stainless steel:
      a. Supports:
         1) In accordance with ASTM A240.
         2) ANSI Type 316 material.
      b. Hardware:
         1) ANSI Type 316 material.

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Anchor bolts:
   1. As specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES

A. Paint and finish all supporting structures as specified in Section 09960 - High-Performance Coatings.

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Preformed Channel:
   1. Mount all raceways, cabinets, boxes, fixtures, instruments, and devices on Contractor-fabricated racks unless otherwise indicated on the Drawings:
      a. Provide the necessary sway bracing to keep trapeze type structures from swaying under seismic events or wind loading.
   2. Brace and anchor freestanding equipment supports using methods that provide structural support based on the seismic loads and wind loads:
      a. Lateral deflection at top of supports not to exceed support height divided by 240 unless otherwise approved by the Engineer.
   3. Provide fabricated steel support pedestals for wall mounted panels that weigh more than 200 pounds:
      a. Fabricate pedestals out of welded angle, tube sections, or preformed channel.
      b. If the supported equipment is a panel or cabinet, match the supported equipment in physical appearance and dimensions.
      c. Provide auxiliary floor supports for transformers hung from stud walls and weighing more than 200 pounds.
   4. Mount all equipment, cabinets, boxes, instruments, and devices in damp or wet locations on minimum of 7/8-inch preformed mounting channel:
      a. Mount channel vertically along the length of the device so that water or moisture may run freely behind the device.

5. Corrosion protection:
    a. Isolate dissimilar metals, except where required for electrical continuity:
        1) Use neoprene washers, 9-mil polyethylene tape, or gaskets for isolation.
6. Raceway:
    a. Furnish all racks and trapeze structures needed to support the raceway from the structure:
        1) Group raceway and position on racks to minimize crossovers.
        2) Provide the necessary bracing to keep trapeze type structures from swaying under loads from cable installation, seismic forces, or wind forces.
7. Anchoring methods:
    a. Solid concrete: Anchor bolts, anchor rods or post-installed anchors as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
    b. Metal surfaces: Machine screws or bolts.
    c. Hollow masonry units: Post installed anchors as specified in Section 05190 - Mechanical Anchoring and Fastening to Concrete and Masonry.
8. When supporting devices on metal or wood stud construction, bridge studs with preformed channel, and mount the devices to the channel.
9. Recoat or seal all drilled holes, cut or scratched surfaces or with products recommended by the manufacturer.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL (NOT USED)

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16075

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Identification of electrical equipment, devices, and components.
   2. Material, manufacturing, and installation requirements for identification devices.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Occupational Safety and Health Administration (OSHA).

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. Nameplates:
   1. Provide a nameplate for each piece of electrical equipment and devices, control panel and control panel components.
   2. Provide all nameplates of identical style, color, and material throughout the facility.
   3. Device nameplates information:
      a. Designations as indicated on the Drawings and identified on the Process and Instrumentation Drawings.

B. Wire numbers:
   1. Coordinate the wire numbering system with all vendors of equipment so that every field wire has a unique number associated with it for the entire system:
      a. Wire numbers shall correspond to the wire numbers on the control drawings or the panel and circuit numbers for receptacles and lighting.
      b. Wire numbers shall correspond to the terminal block number to which they are attached in the control panel.
      c. Internal panel wires on a common terminal shall have the same wire number.
      d. Multi-conductor cables shall be assigned a cable number that shall be attached to the cable at intermediate pull boxes and stub-up locations

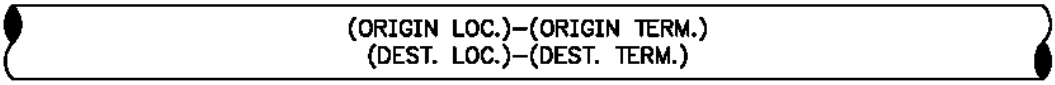
beneath freestanding equipment. All multi-conductor and instrumentation cables shall be identified at pull points as described above:

1) Label armored multi-conductor cable using the conduit number as indicated on the Drawings, following the requirements for conduit markers in Section 16130 - Conduits.

2. Provide the following wiring numbering schemes throughout the project for field wires between process control module, (PCM), vendor control panels, (VCP), motor control centers, (MCC), field starters, field instruments, etc.



OR



Where:

ORIGIN LOC .= Designation for originating panel or device
ORIGIN TERM. = Terminal designation at originating panel or device
DEST. LOC. = Designation for destination panel or device
DEST. TERM. = Terminal designation at destination panel or device or PLC I/O address at destination panel:

a. Identify equipment and field instruments as the origin.
b. PCMs are always identified as the destination.
c. Location is the panel designation for VCP, LCP, or PCM. For connections to MCCs, location is the specific starter tag and loop number. Location is the tag and loop number for motor starters, field instruments and equipment. Any hyphen in the panel designation or tag and loop number shall be omitted.
d. Terminal designation is the actual number on the terminal block where the conductor terminates at field devices and vendor control panels. For multi-conductor cables, all terminal numbers shall be shown, separated by commas.
e. Terminal designations at motor leads shall be the motor manufacturer's standard terminal designation (e.g., T1, T2, T3, etc.).
f. Terminal designations at PCMs where the field conductor connects to field terminal blocks for a PLC input or output shall be the PLC address (Note: the following PLC I/O numbering scheme is typical for Allen-Bradley, the

numbering scheme should be modified to match that of the actual PLC manufacturer used for the project):

1) Discrete Point: W:X:Y/Z.
   Analog Point: W:X:Y.Z.
   Where:
   W= I for input, O for output
   X= PLC number (1, 2, 3…)
   Y= Slot number (01, 02, 03…)
   Z= Terminal number (00, 01, 02…) for a discrete point or a word number for an analog point (1, 2, 3…)

g. Terminal designations at PCMs where the conductor does not connect to a PLC I/O point shall be the terminal number with a “C” prefix (e.g., C0010). For common power after a fuse or neutrals after a switch, the subsequent points shall have and capital letter suffix starting with “A” (e.g., C0010A).

3. **Case 1**: Vendor control panel (VCP) to process control module (PCM):
   Field wire number/label: A-B/C-D
   A = Vendor control panel number without hyphen (VCP#)
   B = Terminal number within VCP (manufacturer’s or vendor’s standard terminal number)
   C = Process control module number without hyphen (PCM#)
   D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a “C” prefix if not connected directly to a PLC I/O point (C0010)

   Examples: VCP#-10/PCM#-I: 1:01/01
   VCP#-10/PCM#-O: 1:10/07
   VCP#-10/PCM#-C0100

4. **Case 2**: Field instrument to process control module (PCM):
   Field wire number/label: E-F/C-D
   C = Process control module number without hyphen (PCM#)
   D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a “C” prefix if not connected directly to a PLC I/O point (C0010)
   E = Field mounted instrument tag and loop numbers without hyphen (EDV#)
   F = Manufacturer’s standard terminal number within instrument. Use both terminal numbers for analog points separated by a comma

   Examples: TIT#-2,3/PCM#-I: 1:01.1
   TSH#-1/PCM#-I: 2:01/00

5. **Case 3**: Motor control center (MCC) to process control module (PCM):
   Field wire number/label: G-B/C-D
   B =Terminal number within Motor Control Center (manufacturer's or vendor's standard terminal number)
   C = Process control module without hyphen (PCM#)
   D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010)
   G = Actual starter designation in the motor control center without hyphen (MMS#)

   Examples:MMS#-10/PCM#-I: 1:01/01
   MMS#-10/PCM#-O: 1:10/07
   MMS#-10/PCM#-C0100

6. **Case 4**: Motor control center (MCC) to vendor control panel (VCP):
   Field wire number/label: G-B/A-B
   A = Vendor control panel number without hyphen (VCP#)
   B = Terminal number within motor control center or vendor control panel (manufacturer's or vendors standard terminal number)
   G = Actual starter designation in the motor control center without hyphen (MMS#)

   Example: MMS#-X2/VCP#-10

7. **Case 5**: Motor leads to a motor control center (MCC):
   Field wire number/label: H-I/G-B
   B = Terminal number within motor control center (manufacturer's standard terminal number)
   G = Actual starter designation in the motor control center without hyphen (MMS#)
   H = Equipment tag and loop number without hyphen (PMP#)
   I = Motor manufacturer's standard motor lead identification (e.g., T1, T2, T3, etc.)

   Example: PMP-#-T3/MMS#-T3

8. **Case 6**: Remote or separately mounted starter or variable frequency drive (VFD) to process control module (PCM):
   Field wire number/label: J-B/C-D
   B = Terminal number within starter or variable frequency drive (manufacturer's standard terminal number)
   C = Process control module number without hyphen (VCP#)
   D = Either the PLC address if the field terminal is connected directly to a PLC input or output point or the terminal number with a "C" prefix if not connected directly to a PLC I/O point (C0010)
   J = Starter or variable frequency drive tag and loop number without hyphen (MMS#)

   Examples: MMS#-10/PCM#-I: 1:01/01
   MMS#-10/PCM#-O: 2: 10/07
   MMS#-10/PCM#-C0010

9. Identify all spare conductors as required for other field wires with an "S" prefix:

   Example: S MMS#-10/PCM#-C011

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Nameplates:
      a. Color.
      b. Size:
         1) Outside dimensions.
         2) Lettering.
      c. Material.
      d. Mounting means.
   2. Nameplate schedule:
      a. Show exact wording for each nameplate.
      b. Include nameplate and letter sizes.
   3. Wire numbers:
      a. Manufacturer's catalog data for wire labels and label printer.

C. Record documents:
   1. Update the conduit schedule to reflect the exact quantity of wire numbers including spares and destination points for all wires.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT SITE CONDITIONS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Nameplates and signs:
   1. One of the following or equal:
      a. Brady.
      b. Seton.

B. Conductor and cable markers:
   1. Heat-shrinkable tubing:
      a. One of the following or equal:
         1) Raychem.
         2) Brady.
         3) Thomas & Betts.
         4) Kroy.
         5) Panduit.

C. Conduit and raceway markers:
   1. Stainless Steel, one of the following or equal:
      a. Panduit
   2. Brass, one of the following or equal:
      a. Panduit.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Nameplates:
   1. Colors:
      a. Warning nameplates: White-center, red face.
      b. Other nameplates: Black-center, white face.
   2. Laminated plastic engraving stock:
      a. 3/32-inch-thick material.
      b. 2-ply.
   3. With chamfered edges.
   4. Lettering:
      a. Block style engraved characters of adequate size to be read easily from a distance of 6 feet:
      b. Minimum letter height: 1/8-inch.

B. Signs:
    1. Automatic equipment and high voltage signs:
        a. Suitable for exterior use.
        b. In accordance with OSHA regulations.

C. Conductor and cable markers:
    1. Lettering:
        a. Machine printed black characters on white tubing.
        b. Minimum letter height: 10-point type or larger.

D. Conduit and raceway markers:
    1. Stainless steel:
        a. Type 304 or 316.
        b. Minimum letter height: 3/16-inch
    2. Solid brass:
        a. Minimum thickness: 0.036 inches.
        b. Letter characters stamped.
        c. Minimum letter height: 3/16-inch.

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. Nameplates:
    1. Provide all nameplates for control panel operator devices (e.g., pushbuttons, selector switches, pilot lights, etc.):
        a. Same material and same color and appearance as the device nameplates, in order to achieve an aesthetically consistent and coordinated system.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Nameplates:
   1. Attach nameplates to equipment with rivets, bolts or sheet metal screws, approved waterproof epoxy-based cement or install in metal holders welded to the equipment.
   2. Provide a nameplate for each disconnecting means with the following:
      a. Equipment served, voltage, and fuse size as required.
      b. Identification of the circuit source that supplies the disconnecting means.
   3. On NEMA Type 4, NEMA Type 4X, or NEMA Type 7 enclosures, use epoxy-based cement to attach nameplates.
   4. Nameplates shall be aligned and level or plumb to within 1/64 inch over the entire length:
      a. Misaligned or crooked nameplates shall be remounted or provide new enclosures at the discretion of the Engineer.

B. Conductor and cable markers:
   1. Apply all conductor and cable markers before termination.
   2. Heat-shrinkable tubing:
      a. Tubing shall be shrunk using a heat gun that produces low temperature heated air.
      b. Tubing shall be tight on the wire after it has been heated.
      c. Characters shall face the open panel and shall read from left to right or top to bottom.
      d. Marker shall start within 1/32 inch of the end of the stripped insulation point.

C. Conduit markers:
   1. Furnish and install conduit markers for every conduit in the electrical system that is identified in the conduit schedule or part of the process system:
      a. Conduit markings shall match the conduit schedule.
   2. Mark conduits at the following locations:
      a. Each end of conduits that are greater than 10 feet in length.
      b. The middle of conduits that are 10 feet or less in length.
      c. Where the conduit penetrates a wall or structure.
      d. Where the conduit emerges from the ground, slab, etc.
   3. Mark conduits after the conduits have been fully painted.
   4. Position conduit markers so that they are easily read from the floor.
   5. Attach stainless steel tags with stainless steel cable ties.
   6. Attach brass tags with Type 316 stainless steel wires.
   7. Mark conduits before construction review by Engineer for punch list purposes.
   8. Label intrinsically safe conduits in accordance with the requirements of the NEC.

D. Signs and labeling:
   1. Furnish and install permanent warning signs at mechanical equipment that may be started automatically or from remote locations:
      a. Fasten warning signs with round head stainless steel screws or bolts.
      b. Locate and mount in a manner to be clearly legible to operations personnel.

2. Furnish and install permanent and conspicuous warning signs on equipment (front and back), doorways to equipment rooms, pull boxes, manholes, etc. where the voltage exceeds 600 volts.
3. Furnish and install warning signs on equipment that has more than one source of power:
    a. Warning signs to identify every panel and circuit number of the disconnecting means of all external power sources.
4. Place warning signs on equipment that has 120 VAC control voltage source used for interlocking:
    a. Identify panel and circuit number or conductor tag for control voltage source disconnecting means.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. Replace any nameplates, signs, conductor markers, cable markers or raceway labels that in the sole opinion of the Engineer do not meet the Engineer’s aesthetic requirements.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16123

600-VOLT OR LESS WIRES AND CABLES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. 600-volt class or less wire and cable.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. ASTM International (ASTM):
   1. B3 - Standard Specification for Soft or Annealed Copper Wire.
   2. B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.

C. CSA International (CSA).

D. National Electrical Code (NEC).

E. National Electrical Manufacturers Association /Insulated Cable Engineers Association (NEMA/ICEA):
   1. NEMA WC 57/ICEA S-73-532 - Standard for Control, Thermocouple Extension, and Instrumentation Cables.
   2. NEMA WC 66/ICEA S-116-732 - Standard for Category 6 and 6A, 100 Ohm, Individually Unshielded Twisted Pairs, Indoor Cables (With or Without an Overall Shield) for Use in LAN Communication Wiring Systems.
   3. NEMA WC 70/ICEA S-95-658-1999 - Standard for Power Cables Rated 2,000 Volts or Less for the Distribution of Electrical Energy.

F. Telecommunications Industry Association (TIA):
   1. 568.2-D - Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
   2. 569-B - Commercial Building Standards for Telecommunications Pathways and Spaces.

G. Underwriter's Laboratories Inc., (UL):
   1. 44 - Standard for Thermoset-Insulated Wires and Cables.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Specific definitions and abbreviations:
   1. AWG: American wire gauge.
   2. BCCS: Bare copper-covered steel.

3. CPE: Chlorinated polyethylene.
4. FEP: Fluorinated ethylene propylene.
5. FHDPE: Foam high-density polyethylene.
6. FPE: Foam polyethylene.
7. OD: Outside diameter.
8. PVC: Polyvinyl chloride.
9. XHHW: Cross-linked high heat water resistant insulated wire.

C. Definitions of terms and other electrical considerations as set forth in the:
1. ASTM.
2. ICEA.

1.04 SYSTEM DESCRIPTION

A. Furnish and install the complete wire and cable system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
1. Manufacturer of wire and cable.
2. Insulation:
   a. Type.
   b. Voltage class.
3. AWG size.
4. Conductor material.
5. Pulling compounds.

C. Shop drawings:
1. Show splice locations.
   a. For each proposed splice location provide written justification describing why the splice is necessary.

D. Test reports:
1. Submit test reports for meg-ohm tests.

E. Calculations:
1. Submit cable pulling calculations to the Engineer for review and comment for all cables that will be installed using mechanical pulling equipment. Show that the maximum cable tension and sidewall pressure will not exceed manufacturer recommended values:
   a. Provide a table showing the manufacturer's recommended maximum cable tension and sidewall pressure for each cable type and size included in the calculations.
   b. Submit the calculations to the Engineer a minimum of 2 weeks before conduit installation.

F. Cable lengths:
   1. Submit installed cable lengths using a conduit measuring tape for all 3-phase circuits including, but not limited to:
      a. 480 V circuits.
      b. 208 V circuits.
   2. Submit installed lengths of cable for the following single-phase circuits:
      a. Circuits feeding single-phase transformers.
      b. Circuits feeding single-phase panelboards.

1.06 QUALITY ASSURANCE

A. All wires and cables shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER`S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. 600-volt class wire and cable:
      a. General Cable.
      b. Okonite Co.
      c. Southwire Co.
      d. Service Wire.
   2. 600-volt VFD cable:
      a. General Cable.
      b. Southwire Co.
      c. Service Wire.
   3. Instrumentation class wire and cable:
      a. Alpha Wire Co.
      b. Belden CDT.
      c. General Cable.

d. Okonite Co.
e. Rockbestos Surprenant Cable Corp.

4. Network cables:
   a. General Cable.
   b. Belden.
   c. CommScope.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Conductors:
   1. Copper in accordance with ASTM B3.

2.04 MANUFACTURED UNITS

A. General:
   1. Provide new wires and cables manufactured within 1 year of the date of delivery to the Site.
   2. Permanently mark each wire and cable with the following at 24-inch intervals:
      a. AWG size.
      b. Voltage rating.
      c. Insulation type.
      d. UL symbol.
      e. Month and year of manufacture.
      f. Manufacturer's name.
   3. Identify and mark wire and cable as specified in Section 16075 - Identification for Electrical Systems:
      a. Use integral color insulation for No. 2 AWG and smaller wire.
      b. Wrap colored tape around cable larger than No. 2 AWG.

B. 600-volt class wire and cable:
   1. Provide AWG or kcmil sizes as indicated on the Drawings or in the Conduit Schedules:
      a. When not indicated on the Drawings, size wire as follows:
         1) In accordance with the NEC:
            a) Use 75 degree Celsius ampacity ratings.
            b) Ampacity rating after all derating factors, equal to or greater than rating of the overcurrent device.
         2) Provide No. 12 AWG minimum for power conductors.
         3) Provide No. 14 AWG minimum for control conductors.
   2. Provide Class B stranding in accordance with ASTM B8:
      a. Provide Class C stranding where extra flexibility is required.
   3. Insulation:
      a. XHHW-2.
      b. 90 degree Celsius rating.

C. 600-volt VFD cables:
   1. Conductor:
      a. Provide Class B stranding in accordance with ASTM B3 and B8.
      b. Copper conductor.

2. Insulation:
    a. Cross-linked Polyethylene, XLPE.
    b. 90 degree Celsius rating.
    c. UL 44 Type RHH/RHW-2 or XHHW-2.
    d. 2,000 volts.
3. Ground:
    a. Provide Class B compressed stranded bare copper in accordance with ASTM B3 and B8.
    b. 3 symmetrically placed bare copper conductors in direct contact with shield.
    c. Equivalent ground size 50 percent of the phase conductor size.
4. Filler:
    a. Cable sizes 8 and 6 use polypropylene filler.
    b. Other cable sizes use paper filler.
5. Metallic shield:
    a. Overall 5 mil bare copper tape shield with 50 percent overlap.
6. Outer jacket:
    a. UL 1277 Type PVC.
7. Cable tray rated, UL Type TC-ER.

D. Instrumentation class cable:
1. Type TC.
2. Suitable for use in wet locations.
3. Voltage rating: 600 volts.
4. Temperature rating:
    a. 90 degree Celsius rating in dry locations.
    b. 75 degree Celsius rating in wet locations.
5. Conductors:
    a. Insulation:
        1) Flame-retardant PVC, 15 mils nominal thickness, with nylon jacket 4 mils nominal thickness.
    b. No. 16 AWG stranded and tinned.
    c. Color code: ICEA Method 1:
        1) Pair: Black and white.
        2) Triad: Black, white and red.
        3) Multiple pairs or triads:
            a) Color-coded and numbered.
6. Drain wire:
    a. No. 18 AWG.
    b. Stranded, tinned.
7. Jacket:
    a. Flame retardant, moisture and sunlight resistant PVC.
    b. Ripcord laid longitudinally under jacket to facilitate removal.
8. Shielding:
    a. Individual pair/triad:
        1) Minimum 1.35-mil double-faced aluminum foil-polyester tape overlapped to provide 100 percent coverage.
    b. Multiple pair or triad shielding:
        1) Group shield: Minimum 1.35-mil double-faced aluminum foil-polyester tape overlapped to provide 100 percent coverage.

2) Completely isolate group shields from each other.
3) Cable shield: 2.35 mils double-faced aluminum and synthetic polymer backed tape overlapped to provide 100 percent coverage.

c. All shielding to be in contact with the drain wire.

E. Network cables:
1. Copper Ethernet cable:
a. Provide copper Ethernet cable types as indicated in the Drawings and Specifications.
b. General requirements:
1) All cables shall meet the standards set by TIA-568.2-D and verified by third-party testing laboratory.
2) Conductors:
a) Four balanced twisted pairs.
(1) No. 22 to No. 24 AWG thermoplastic insulated solid copper conducts enclosed by a thermoplastic jacket. Copper clad aluminum is not allowed.
3) Insulation:
a) Non-Plenum: Polyolefin.
b) Plenum: Fluoropolymer.
4) Color coded per T568B.
5) Outer jacket with ripcord.
6) Shielding:
a) Provide F/UTP cables with drain wire for cables inside any equipment, enclosures, or raceway that also contains circuits exceeding 480 VAC and as indicated on the Drawings.
7) Electrical rating:
a) Equipment cables: 600 VAC.
b) Horizontal cables: 300 VAC.
8) Approvals and listings:
a) Meets any necessary NEC and NFPA requirements for each application.
b) Riser applications: CMR in accordance with UL 1666.
c) Plenum applications: CMP in accordance with NFPA 262.
9) Certification:
a) Provide Category 6 cables with NEMA WC 66/ICEA S-116-732 certification.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Wire ties:
1. One of the following or equal:
a. T&B, "Ty-Rap" cable ties.
b. Panduit, cable ties.

B. Wire markers:
1. As specified in Section 16075 - Identification for Electrical Systems.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. Assembly and testing of cable shall comply with the applicable requirements of NEMA WC 70/ICEA S-95-658-1999.

B. Test Type XHHW-2 in accordance with the requirements of UL 44.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Color-coding:
   1. Color-coding shall be consistent throughout the facility.
   2. The following color code shall be followed for all 240/120 volt and 208/120 volt systems:
      a. Phase A: Black.
      b. Phase B: Red.
      c. Phase C: Blue.
      d. Single phase system: Black for 1 hot leg, red for the other.
      e. Neutral: White.
      f. High phase or wild leg: Orange.
      g. Equipment ground: Green.
   3. The following color code shall be followed for all 480/277 volt systems:
      a. Phase A: Brown.
      b. Phase B: Orange.
      c. Phase C: Yellow.
      d. Neutral: Gray.
      e. Equipment ground: Green.
   4. The following color code shall be followed for all 120 VAC control wiring:
      a. Power: Red.
      b. Neutral: White.
   5. The following color code shall be followed for all general purpose DC control circuits:
      a. Grounded conductors: White with blue stripe.
      b. Ungrounded conductors: Blue.
   6. Switch legs shall be violet. 3-way switch runners shall be pink.
   7. Wires in intrinsically safe circuits shall be light blue.

8. Wire colors shall be implemented in the following methods:
    a. Wires manufactured of the desired color.
    b. Continuously spiral wrap the first 6 inches of the wire from the termination point with colored tape:
        1) Colored tape shall be wrapped to overlap 1/2 of the width of the tape.

C. Install conductors only after the conduit installation is complete, and all enclosures have been vacuumed clean, and the affected conduits have been swabbed clean and dry:
    1. Install wires only in approved raceways.
    2. Do not install wire:
        a. In incomplete conduit runs.
        b. Until after the concrete work and plastering is completed.

D. Properly coat wires and cables with pulling compound before pulling into conduits:
    1. For all No. 4 AWG and larger, use an approved wire-pulling lubricant while cable is being installed in conduit:
        a. Ideal Products.
        b. Polywater Products.
        c. 3M Products.
        d. Greenlee Products.
        e. Or equal as recommended by cable manufacturer.
        f. Do not use oil, grease, or similar substances.

E. Cable pulling:
    1. Prevent mechanical damage to conductors during installation.
    2. For cables No. 1 AWG and smaller, install cables by hand.
    3. For cables larger than No. 1 AWG, power pulling winches may be used if they have cable tension monitoring equipment.
    4. Provide documentation that maximum cable pulling tension was no more than 75 percent of the maximum recommended level as published by the cable manufacturer. If exceeded, the Engineer may, at his discretion, require replacement of the cable.
    5. Ensure cable pulling crews have all calculations and cable pulling limitations while pulling cable.
    6. Make splices or add a junction box or pullbox where required to prevent cable pulling tension or sidewall pressure from exceeding 75 percent of manufacturer’s recommendation for the specified cable size:
        a. Make splices in manholes or pull boxes only.
        b. Leave sufficient slack to make proper connections.

F. Use smooth-rolling sheaves and rollers when pulling cable into cable tray to keep pulling tension and bending radius within manufacturer’s recommendations.

G. Install and terminate all wire in accordance with manufacturer's recommendations.

H. Neatly arrange and lace conductors in all switchboards, panelboards, pull boxes, and terminal cabinets by means of wire ties:
    1. Do not lace wires in gutter or panel channel.

2. Install all wire ties with a flush cutting wire tie installation tool:
    a. Use a tool with an adjustable tension setting.
3. Do not leave sharp edges on wire ties.

I. Terminate stranded conductors on equipment box lugs such that all conductor strands are confined within the lug:
    1. Use ring type lugs if box lugs are not available on the equipment.

J. Lighting circuits:
    1. Each circuit shall have a dedicated neutral.

K. Splices:
    1. Provide continuous circuits from origin to termination whenever possible:
        a. Obtain Engineer's approval prior to making any splices.
    2. Lighting and receptacle circuit conductors may be spliced without prior approval from the Engineer.
    3. Where splices are necessary because of extremely long wire or cable lengths that exceed standard manufactured lengths:
        a. Splice box NEMA rating requirements as specified in Section 16050 - Common Work Results for Electrical.
        b. Make splices in labeled junction boxes for power conductors.
        c. Make splices for control and instrument conductors in terminal boxes:
            1) Provide terminal boards with setscrew pressure connectors, with spade or ring lug connectors.
    4. Power and control conductors routed in common raceways may be spliced in common junction boxes.
    5. Clearly label junction and terminal boxes containing splices with the word "SPLICE LOCATED WITHIN".
    6. Leave sufficient slack at junction boxes and termination boxes to make proper splices and connections. Do not pull splices into conduits.
    7. Install splices with compression type butt splices and insulate using a heat-shrink sleeve:
        a. In NEMA Type 4 or NEMA Type 4X areas, provide heat-shrink sleeves that are listed for submersible applications.
    8. Splices in below grade pull boxes, in any box subject to flooding, and in wet areas shall be made waterproof using:
        a. A heat shrink insulating system listed for submersible applications.
        b. Or an epoxy resin splicing kit.

L. Apply wire markers to all wires at each end after being installed in the conduit and before meg-ohm testing and termination.

M. Instrumentation class cable:
    1. Install instrumentation class cables in separate raceway systems from power cables:
        a. Install instrument cable in metallic conduit within non-dedicated manholes or pull boxes.
        b. Install cable without splices between instruments or between field devices and instrument enclosures or panels.

2. Do not make intermediate terminations, except in designated terminal boxes as indicated on the Drawings.
3. Shield grounding requirements as specified in Section 16060 - Grounding and Bonding.

N. Copper Ethernet cables:
   1. In accordance with TIA-568.2-D.
   2. Pathways:
      a. For initial installation, the maximum fill capacity for pathways (i.e., conduit, raceways, trays, baskets) is 40 percent. The maximum fill capacity of 60 percent is allowed to accommodate future additions after initial installation.
      b. Conduit should be run in the most direct route possible with no more than two 90 degree bends between pull boxes and serve no more than 3 outlet boxes.
   3. Cable bend radius:
      a. Proper cable bend radius control must be maintained throughout the pathways. The bend radius needs to be at a minimum 10 times the cable diameter.
   4. Cable pulling:
      a. Provide cable pulling swivel system to prevent winding and tangling of rope and cables during pull.
      b. The maximum pulling tension is not to exceed manufacturer recommendations. Cable installation should not in any way deform the cable jacket.
      c. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
   5. Cable management:
      a. Organize and manage cables for quick and easy moves, adds and changes.
   6. Cable termination:
      a. Install equipment outlet connector hardware (e.g., RJ45, M12, etc.), and connect to field equipment outlet (e.g., instrument, VFD, actuator, etc.).
      b. Use shielded connectors as required by the installation.
      c. Coordinate cable termination at copper patch panels with ICSC and General Contractor.
   7. Testing:
      a. Copper Ethernet cable testing requirements as specified in Section 16950 - Field Electrical Acceptance Tests.
   8. Separation from EMI sources:
      a. Comply with TIA-569-B recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
      b. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
         1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.

2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
3) Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.

c. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
3) Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.

d. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
1) Electrical Equipment Rating Less Than 2 kVA: No requirement.
2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
3) Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.

e. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.

O. Signal cable:
1. Separate and isolate electrical signal cables from sources of electrical noise and power cables by minimum 12 inches.

P. Wiring allowances:
1. Equipment locations may vary slightly from the drawings. Include an allowance for necessary conductors and terminations for motorized equipment, electrical outlets, fixtures, communication outlets, instruments, and devices within 10 linear feet of locations indicated on the Drawings.
2. Locations for pull boxes, manholes, and duct banks may vary slightly from the drawings. Include an allowance for necessary conductors and related materials to provide conductors to all pull boxes, manholes and duct banks within 20 linear feet of locations indicated on the Drawings.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL (NOT USED)

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16125

FIBER OPTIC CABLE AND APPURTENANCES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Fiber optic cable.
   2. Fiber splices and terminations.
   3. Accessories.

1.02 REFERENCES

A. Abbreviations:
   1. N/Cm: Newtons per centimeter.
   2. OTLS: Optical Loss Test Set (Tier 1 test).
   3. OTDR: Optical Time Domain Reflectometer (Tier 2 test).

B. Definitions:
   1. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Standards:
   1. Bellcore Standards:
      a. GR-409 - Generic Requirements for Indoor Fiber.
   2. Electronic Industry Association (EIA):
      a. FOTP-25 - Impact testing of Fiber Optic Cables and Cable Assemblies.
      b. FOTP-33 - Fiber Optic Cable Tensile Loading and Bending Test.
      c. FOTP-41 - Compressive Loading Resistance of Fiber Optic Cables.
      d. FOTP-81 - Compound Flow (Drip) Test for Filled Fiber Optic Cable.
      e. FOTP-104 - Fiber Optic Cable Cyclic Flexing Test.
      f. FOTP-181 - Lightning Damage Susceptibility Test for Fiber Optic Cables with Metallic Components.
   3. Insulated Cable Engineer's Association (ICEA):
      a. S-83-596 - Optic Fiber Premises Distribution Cables.
      b. S-87-640 - Optic Fiber Outside Plant Communications Cable.
      c. S-104-696 - Indoor-Outdoor Optic Fiber Cable.
   4. TIA/EIA Standards:
      a. 598 - Optical Fiber Cable Color Coding.
      b. 11801 - Information technology - Generic cabling for customer premises.
   5. Underwriters Laboratories, Inc. (UL):
      a. 1666 - Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts.
      b. 1685 - Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables.

1.03 DELEGATED DESIGN (NOT USED)

1.04 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Complete manufacturer's brochures that identify materials and options.
   2. Completed data sheets, including catalog number and source for determining catalog number.
   3. Manufacturer's installation instructions.
   4. Include the following:
      a. Manufacturer's data on testing equipment used on this project.
      b. Manufacturer's specifications and data sheets for all fiber types.
      c. Manufacturer's specifications and data sheets for all connectors, bulkheads, splicing kits, breakout devices, and appurtenances used in connecting and terminating the fiber spans.
   5. Catalog data on all testing devices proposed for use plus certifications of accuracy, calibration, and traceability to standards of the NIST.
   6. Manufacturer's test procedures and quality assurance procedures:
      a. After review, the Engineer may require that additional tests be performed before installation.

C. Shop drawings:
   1. Interconnection cabling diagrams for the complete system including every fiber in each cable.
   2. Drawings indicating the locations of all pull boxes including pull box identifiers and lengths.
   3. Submit optical power budget calculations for all fiber segments. Include the following:
      a. Minimum transmit power of active devices.
      b. Minimum receive sensitivity.
      c. Available power, in dBm.
      d. Loss for each segment in dBm, including cable attenuation and connector losses. Use manufacturer's data for cable attenuation, at the wavelength to be used. Assume 0.5 dB per connector.
      e. Demonstrate that remaining power budget at each receiver is equal to or greater than 3.0 dBm.

D. Installation instructions:
   1. Submit a cable pulling and splicing work plan that includes the following:
      a. Pull tension calculations.
      b. Detailed description of pull operation methods for all conduit runs.
      c. Tools and equipment to be used for cable installation and testing.
      d. Physical location of equipment setup and type.
      e. Exact locations of splice points.
      f. Safety and manual assist cable-pulling operations.
      g. Detailed schedule for pulling and testing cables.
      h. The name and qualifications of the supervisory personnel directly responsible for the installation of the conduit system.
      i. Sample fiber optic cable test sheets.
      j. All signed test sheet results.

E. Commissioning submittals:
   1. As specified in Section 01756 - Commissioning, including the following:
      a. Manufacturer's representative qualifications.
      b. Certificates:
         1) Requirements as specified in this Section.
      c. Test Plans:
         1) Test requirements as specified in this Section.
      d. Test Reports.
      e. Manufacturer's representatives field notes and data.

F. Operation and maintenance manuals:
   1. Compile completed test reports, instruction manuals, and manufacturer's information into the operating manuals and submitted in accordance with Section 01782 - Operation and Maintenance Manuals.

G. Test reports:
   1. Submit the results of all specified tests to the Engineer.
   2. Submit 3 copies of all test reports showing the results of all tests specified herein or in Section 16950 - Field Electrical Acceptance Tests:
      a. Test forms shall include the following information at a minimum:
         1) Test type.
         2) Test location.
         3) Test date.
         4) Wavelength.
         5) Index of refraction.
         6) Cable identification.
         7) Fiber type.
         8) Fiber number.
         9) Fiber color.
         10) Result of the value of the tested parameter.
   3. Furnish hard copy and electronic copy for all OTDR traces.
   4. Submit certification that the fiber optic cable has passed each testing stage:
      a. Submit separate documentation for each testing stage result.

H. Record documents:
   1. Furnish updated electrical drawings, network diagrams, and fiber cable block diagrams at the end of construction and submit as Record Drawings.

I. Calculations:
   1. Cable pulling calculations for all conduit runs:
      a. Indicate on the submittal any additional pull boxes that are required, including pull box identifiers and a written description of the location.

1.05 QUALITY ASSURANCE

A. Furnish all cable and appurtenances manufactured within 1 year of installation.

B. Proof test all optical fibers by the fiber manufacturer at a minimum load of 50 kpsi.

C. Provide 100 percent attenuation testing for all optical fibers:
   1. Include with each cable reel the attenuation of each fiber.

D. Provide information on at least 5 successful fiber optic cable installations of comparable size and complexity in the past 3 years with name, address, and telephone number of facility owner, name of project with completion date, and type of conduit system and length of cable pulled.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package the cable for shipment on wooden reels:
   1. Seal both ends of the cable to prevent the ingress of moisture.
   2. Place fiber cable assemblies on reels such that both cable ends are available for testing.
   3. Weatherproof cable reel markings shall include the following:
      a. Manufacturer.
      b. Date of manufacture.
      c. Shipping date.
      d. Cable identification.
      e. Cable configuration/fiber count.
      f. Cable length.
      g. Gross weight.
      h. Cable test date.
      i. Handling instructions.
      j. Direction to unreel.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.08 ADMINISTRATIVE REQUIREMENTS

A. Sequencing:
   1. Submit a cable pulling and splicing work plan a minimum of 45 days before the planned initiation of cable pulling. The cable pulling and splicing work plan must be approved a minimum of 15 days before pulling cable.
   2. Testing sequence:
      a. Perform testing of each fiber in each cable as follows:
         1) At the factory before shipment.
         2) At the project site upon delivery.
         3) Submit copies of the test results to the Engineer within 5 days after the delivery to the site.
         4) After installation, before breakout and terminations.
         5) After installation is complete.
      b. Submit test reports following each set of tests as specified in this Section.

B. Scheduling:
   1. Schedule Engineer, 5 days before installation, to witness all cable installations.
   2. Notify the Engineer and Owner a minimum of 15 days before post-installation testing.

1.09 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL (NOT USED)

A. Furnish a complete fiber optic network as indicated on the Drawings.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Install all fiber optic system components in accordance with the recommendations of the manufacturer.

2.03 MANUFACTURERS

A. Acceptable manufacturers are indicated with each component type as listed in the remainder of this specification.

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS

A. General fiber cable requirements:
   1. Suitable for the installed environment.
   2. Color-coded fibers according to EIA/TIA-598.
   3. Color-coded buffer tubes according to EIA/TIA-598.
   4. Furnish buffer tubes of a single layer nylon construction or of a material with similar mechanical performance.
   5. Fillers may be included in the cable core to lend symmetry to the cable cross-section where needed.
   6. Apply binders with sufficient tension to secure the buffer tubes to the central member without crushing the buffer tubes:
      a. Provide binders that are:
         1) Non-hygroscopic.
         2) Non-wicking (or rendered so by the flooding compound).
         3) Dielectric with low shrinkage.
   7. Provide a minimum of 1 ripcord under the cable sheath.
   8. Provide the high tensile strength Aramid yarns, Kevlar, and/or fiberglass helically stranded evenly around the cable core:
      a. No metallic elements whatsoever are allowed in non-armored cable.
   9. The jacket or sheath shall be free of holes, splits, and blisters.
   10. Mark the jacket or sheath with:
      a. Manufacturer's name.
      b. The words “Optical Cable”.
      c. Year of manufacture.
      d. Sequential meter marks.
      e. Repeat markings every 1-meter.
      f. The actual length of the cable to be within 1 percent of the length marking.

g. The marking must be in a contrasting color to the cable jacket.
h. The height of the marking:
1) Approximately 2.5 millimeters.

11. The shipping, storage, and operating temperature range of the cable shall be -40 degrees Celsius to +70 degrees Celsius.
12. General performance characteristics:
a. The rated tensile load of the cables:
1) Indoor/outdoor:
a) Short term: 1,330 N.
b) Long term: 400 N.
b. Non-armored fiber optic cables: Compressive load withstand of 220 N/cm applied uniformly over the length of the cable.
c. Armored fiber optic cables: Compressive load withstand of 440 N/cm applied uniformly over the length of the cable.
d. The average increase in attenuation for the fibers: Less than or equal to 0.10 dB at 1,550 nm for a cable subjected to this load:
1) With no measurable increase in attenuation after load removal.
e. Test in accordance with EIA FOTP-41 except that the load must be applied at the rate of 3 millimeters to 20 millimeters per minute and maintained for 10 minutes.
f. Capable of withstanding 25 cycles of mechanical flexing at a rate of 30 within 1 cycles/minute.
g. The average increase in attenuation for the fibers: Less than or equal to 0.10 dB at 1,550 nm at the completion of the test.
h. For armored cables, any visible cracks causing separation of the armor and propagating more than 5 millimeters constitutes failure.
i. Outer cable jacket cracking or splitting observed under 10X times magnification, constitutes failure.

B. Indoor/outdoor cable:
1. Cable construction:
a. General:
1) Cable type: Indoor/Outdoor - Flame retardant, low smoke, zero halogen, UV resistant.
2) Fiber count: As indicated on the Drawings.
3) Fiber type: As indicated on the Drawings.
4) Buffer tube: Loose tube.
5) Armoring: None.
6) Waterproofing: Water blocking layer.
7) Approvals and listings: UL 1666 and UL 1685.
8) Design and test criteria: In accordance with ICEA S-104-696.
b. Testing:
1) All fibers in the cable:
a) Proof test of 100 kpsi.
b) Each optical fiber: Bellcore GR-409 strip force testing.
c) No gaps are allowed between the coating material and the buffer material visible under a 50-power microscope.
c. Outer jacket material:
1) Linear low-density polyethylene.
2) Meet all requirements of the NEC for use in all indoor/outdoor areas (excluding plenums) without being enclosed in conduit.

3) Flame retardant OFNR riser rated conforming to UL 1666.
4) Printed with all necessary UL marks and manufacturer identification.
5) Sequential printing of footage in 2-foot increments.
6) With a ripcord incorporated under the cable jacket.

C. Multimode fibers:
1. All fibers in the cable must be usable fibers and meet required specifications.
2. Each optical fiber shall consist of a doped silica core surrounded by a concentric silica cladding.
3. Multimode fiber characteristics:
a. Category: OM4 compliant with ISO/IEC 11801.
b. Jacket color: Aqua.

D. Indoor/outdoor:
1. Tight buffer:
a. Corning Cable Systems, Freedm® One.
b. Optical Cable Corporation, DX-Series.
c. CommScope, LazrSPEED/TerraSPEED.

2.06 EQUIPMENT (NOT USED)

2.07 COMPONENTS (NOT USED)

2.08 ACCESSORIES

A. Patch cords:
1. General:
a. Connector types to match supplied equipment and the patch panel terminations.
b. Maximum length of patch cords: 25 feet.
c. Provide 2 spare patch cords (or 1 duplex patch cord) of each type used at each PLC or network cabinet.
d. Factory assembled and optically tested.
e. Provide mode-conditioning cords for multimode fibers operating at 1,310 nm.
2. Manufacturers: One of the following or equal:
a. CommScope.
b. Corning Cable Systems.

B. Fiber connectors:
1. As specified in Section 17733 - Control Systems: Network Materials and Equipment.

C. Fiber optic identification/warning tags:
1. Black letters on orange or yellow background.
2. UV resistant polyethylene or other suitable material:
a. Manufacturers: The following or equal:
1) Almetek.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify the condition of the conduit system before installation of the fiber optic cable or inner duct.

B. Pass a test mandrel through all fiber optic conduits prior to pulling fiber or installing inner duct.
   1. Run the mandrel in both directions.

C. Examine all materials and equipment before installation and verify they are free from physical damage and defects.

3.02 PREPARATION

A. Equipment support and anchoring to structures:
   1. Prepare anchor setting template(s) and use to position anchors during construction of supporting structures.
   2. Install anchors of type and material indicated on approved anchoring designs.
   3. Install anchors with embedment indicated on approved anchoring designs.

B. Before fiber splicing terminating or testing activities, verify sufficient workspace is available to perform the activity without interferences from other trades.

C. Pre-installation test:
   1. Upon arrival at the site:
      a. Inspect the cable and reel for damage.
      b. Test all fibers with an optical time domain reflectometer (OTDR) for fiber integrity.
      c. Verify that the fiber lengths are consistent with the cable manufacture.
      d. Verify that all traces yield no point discontinuities.
   2. Complete test sequence and obtain approval from the Engineer of submitted test results before cable installation.

3.03 INSTALLATION

A. Install fiber optic patch cords in open network trays or in dedicated conduits no longer than 25 feet in length.

B. Install fiber optic cable in continuous lengths without intermediate splices, except where approved by the Engineer.

C. Cable installation:
   1. Properly attach the fiber optic cable’s strength elements to a 600-pound breakaway swivel containing tension or shear pins using Kellums pulling grips that are a minimum of 18 inches long.
   2. Certify that cable tensile limits do not exceed cable pull tension and bend limits using tension monitoring devices.
   3. Leave an extra loop of fiber optic cable in each pull box.

4. Conform with the cable manufacturer's specifications, practices, and the following requirements:
    a. When power equipment is used to install fiber optic cables, use low speeds and do not exceed a rate of 30 meters per minute.
    b. Do not exceed the tensile and bending limitation for fiber optic cables under any circumstances.
    c. Use large diameter wheels, pulling sheaves, and cable guides to maintain the specified bending radius.
    d. Use commercial dynamometers or load cells to monitor pulling tension.
    e. A nonfreezing type of swivel inserted between the pulling line and cable pulling grip to prevent twisting under strain.
    f. All cable to be installed using a breakaway swivel.
5. Apply to all conduits a lubricant at each conduit ingress and egress location during the pull operation:
    a. Pour or pump lubricant into the end of the conduit at the feed location at a nominal application rate of 3 gallons per 1,000 feet of cable.
    b. If the conduit is open at intermediate locations, then apply the appropriate proportion of lubricant at each opening.
    c. Continuously lubricate the cable as it is being pulled by pouring or pumping the lubricant into the conduit at the feed location and at each intermediate location.
    d. Station workers at each intermediate location as required.
    e. Remove all excess lubricant that has collected.
    f. Remove and clean the surrounding area after cable installation.
6. Install using a hydraulic capstan or winch equipped with a recording running line dynamometer graph which measures and records pulling tensions:
    a. Use pulling equipment with slip-load capability to allow the winch to maintain a constant pulling force without taking up the winch line.
    b. Use pulling equipment equipped with a hydraulic bypass set so that a maximum tension of 600 pounds is not exceeded.
    c. Use only equipment designed to prevent a preset pulling tension from being exceeded.
    d. Fiber optic cable manufacturer to provide the pulling tension setpoint.
    e. If during the pulling operation excessive tension is detected, cease all operations and notify the Engineer.
7. Position the cable reel at the feed point in alignment with the raceway and in such a position that the cable can be passed from the top of the reel in a long, smooth bend into the raceway system:
    a. The use of a cable feeder is required, unless the cable is hand-pulled.
8. Supply all bull wheels, blocks, split wheels, cable feeders, and necessary equipment required to provide a clean and safe operation:
    a. The cable shall not be allowed to travel over any wheel or block that has a radius less than the minimum radius allowed by the cable manufacturer.
9. Minimize the use of snatch blocks and rollers to guide the cable into the conduit at the feed point:
    a. Slack feed by hand the cable into the feed point and raceway without the use of rollers.
10. Tend the cable reel at all times and turn by hand to provide the required cable slack:
    a. Under no circumstances shall the cable tension be allowed to turn the cable reel.

11. Use a rim roller, with a wheel radius greater than the minimum cable bending radius placed at the manhole or vault opening to prevent the cable from dragging on the manhole rim or steps.
12. Perform a continuous thorough visual inspection for flaws, breaks, and abrasions in the cable sheath as the cable leaves the reel, and maintain a slow pulling speed to permit this inspection.
13. Damage to the sheath or finish of the cable is cause for rejecting the cable:
    a. Replace any cable damaged in any way during installation.
14. If the cable becomes damaged during installation, stop operations and notify the Engineer immediately:
    a. Engineer to determine whether to replace the entire reel of cable or to install a termination panel to eliminate the damaged section.
15. Document all pulls by a graph which is annotated with the following information:
    a. Reel number.
    b. Pull point ID.
    c. Date and time.
    d. Explanations for abnormalities in readings or interruptions.
    e. Sign-off by Contractor and Engineer.
16. Under no conditions shall the fiber optic cable be left exposed or unattended.

D. Provide inner duct in fiber optic conduits as indicated on the Drawings, cable schedule, and as specified in Section 16130 - Conduits:
    1. Provide a pull rope in each unused inner duct.

E. After the cables are installed and spliced:
    1. Rack the cables:
        a. Loosely secure in racked position with wire ties.
        b. Attach imprinted plastic-coated cloth identification/warning tags to each cable in at least 2 locations in each handhole/manhole.

F. Splices:
    1. Provide field splices in a splice tray located in a waterproof splice enclosure:
        a. Manufacturers: The following or equal:
            1) Tyco/Raychem, FOSC style splice enclosure.
    2. Loop the individual fibers a minimum of 1 full turn within the splice tray to avoid macro/micro bending.
    3. After completion of cable terminations, neatly dress all cables.
    4. Protect all splices with a thermal shrink sleeve.
    5. Provide fusion type fiber optic cable splicing meeting the following requirements:
        a. Joins multimode fibers.
        b. Establishes a permanent fusion splice.
        c. Waterproof.
        d. Re-enterable, rearrangable, and reusable.
        e. Splice loss less than 0.10 dB.
        f. Protected by a splice enclosure.
    6. Requirement for outdoor fiber splice enclosures:
        a. Seal.
        b. Bond.
        c. Anchor.

d. Protect fiber optic cable splices.
e. Stand-alone unit that does not require an outer enclosure.
f. Provide for a maximum of 6 cable entries in a butt-end configuration.
g. Used in aerial, underground, and direct buried applications.

7. Requirement for indoor fiber splice enclosures:
   a. Anchor.
   b. Protect fiber optic cable splices.
   c. Stand-alone unit that does not require an outer enclosure.
   d. Suitable for the minimum number of splices at that location plus additional capacity for reconfigurations.
8. Re-splice any splice that has a loss greater than 0.10 dB.
9. Leave a minimum of 20 feet of fiber optic cable at each end of splice.

G. Terminations:
1. Terminate all fiber inside a patch panel:
   a. Direct landing to a switch, router hub, or PLC will not be allowed.
2. Terminate outdoor cables using a breakout kit that seals the cable and provides physical protection for the fiber strands.
3. Terminate indoor cables using breakout kits with field installed terminators.
4. Labeling:
   a. Permanently label all cable terminations. Use labels produced by a wire printer using pressure sensitive polyester labels.
   b. Label patch panels as specified in Section 16075 - Identification for Electrical Systems.

3.04 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

B. Source testing:
1. Before shipment and while on the shipping reel, test 100 percent of all fibers for attenuation:
   a. Copies of the results shall be:
      1) Maintained on file.
      2) Attached to the cable reel in a waterproof pouch.
      3) Submitted before the delivery of the cable to the job site to Engineer for approval.
2. Conduct the flex test in accordance with EIA FOTP-104 test condition I and III with a maximum sheave diameter of 20 times the cable OD.
3. Verify that the cable withstands 25 impact cycles with:
   a. The average increase in attenuation for the fibers less than 0.20 dB at 1,550 nm.
   b. No evidence of cracking or splitting.
   c. Conduct the test in accordance with EIA FOTP-25.
4. Certify that the cable withstands a tensile load of 2,700 N (600 pounds):
   a. Without exhibiting an average increase in attenuation of greater than 0.10 dB.
   b. Test in accordance with EIA FOTP-33 using a maximum mandrel and sheave diameter of 560 millimeters.
   c. Apply the load for 1 hour in Test Condition II.

5. Certify that the cable withstands a simulated lightning strike:
    a. Peak value of the current pulse greater than 105kA.
    b. Use a test current with a damped oscillatory maximum time-to-peak value of 15 µs (which corresponds to a minimum frequency of 16.7 kHz) and a maximum frequency of 30 kHz.
    c. The time to half-value of the waveform envelope 40 to 70 µs.
    d. Conduct the test in accordance with the EIA FOTP-181.
    e. In addition to the analysis criterion set forth in EIA FOTP-181, the integrity of the buffer tubes (or analogous loose tube, i.e., core tube) and strength members must be intact after removal of the cable specimens from the test box.
6. Furnish test reports and Manufacturer's Certificate of Source Testing.

C. Installation Verification:
1. Furnish Manufacturer's Certificate of Installation Verification.

D. Functional Testing:
1. Conduct post-installation tests of the fiber optic system as specified in Section 16950 - Field Electrical Acceptance Tests.

3.05 FIELD QUALITY CONTROL

A. Utilize personnel certified by the manufacturer with specific knowledge of the cable manufacturer's recommended installation procedures.

B. General:
1. All test results shall meet or exceed manufacturer specifications:
    a. Test each fiber of each cable for breaks, abnormalities, and overall attenuation characteristics.
2. Pre-installation tests and post-installation tests to be witnessed and signed off by Engineer and Owner.
3. Perform OLTS test with equipment capable and calibrated to show anomalies of 0.1 dB as a minimum:
    a. Test multimode fibers at 850 nm and 1,300 nm.
4. Perform OTDR tests on fiber cables less than 100 meters with the aid of a launch cable:
    a. Adjust OTDR pulse width settings to a maximum setting of 1/1,000th of the cable length or 10 nanoseconds.

C. Manufacturer's field service:
1. Provide the services of a certified manufacturer's engineering representative for the equipment specified in this Section at the jobsite for the frequency and minimum duration (travel time excluded) as specified below to perform the following services:
    a. One 8-hour day for inspection, assistance during installation and alignment, and certification of proper installation:
        1) Submit a certificate of installation.
    b. One 8-hour-day for assistance and witnessing of system testing and any required troubleshooting.

3.06 ADJUSTING (NOT USED)

3.07 CLEANING

A. Clean all fiber optic connectors after termination and before testing. After cleaning, cover all un-terminated connectors with a protective boot.

B. At the completion of construction, touch up the finish on all fiber patch panels and enclosures.

3.08 PROTECTION

A. Protect the fiber system from physical damage and the encroachment of dust, before, during, and after installation.

3.09 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16130

CONDUITS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Metallic conduits.
   2. Nonmetallic conduits.
   3. Conduit bodies.
   4. Conduit fittings and accessories.
   5. Conduit installation.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. American National Standards Institute (ANSI):
   1. C80.1 - Electrical Rigid Steel Conduit.

C. National Electrical Manufacturer's Association (NEMA):
   1. RN-1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Steel Conduit.
   2. TC2 - Electrical Polyvinyl Chloride (PVC) Conduit.
   3. TC3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.

D. Underwriters Laboratories (UL):
   1. 1 - Standard for Flexible Metal Conduit.
   2. 6 - Standard for Electrical Rigid Metal Conduit - Steel.
   3. 360 - Standard for Liquidtight Flexible Steel Conduit.
   4. 651 - Standard for Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
   5. 1203 –Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.
   6. 1660 - Standard for Liquidtight Flexible Nonmetallic Conduit.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Specific definitions and abbreviations:
   1. Conduit bodies: A separate portion of a conduit system that provides access through a removable cover to the interior of the system at a junction of 2 or more conduit sections. Includes, but not limited to, Shapes C, E, LB, T, X, etc.
   2. Conduit fitting: An accessory that primarily serves a mechanical purpose. Includes, but not limited to, bushings, locknuts, hubs, couplings, reducers, etc.

3. GRC: Galvanized rigid steel conduit.
4. PCS: Polyvinyl chloride (PVC) coated rigid steel conduit.
5. PVC: Polyvinyl chloride rigid nonmetallic conduit.
6. SLT: Sealtight-liquidtight flexible conduit.
7. NPT: National pipe thread.

1.04 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Furnish complete manufacturer's catalog sheets for every type and size of conduit, fitting, conduit body, and accessories to be used on the Project.
   2. Furnish complete manufacturer's recommended special tools to be used for installation if required.
   3. Certified test results for PVC-coated metallic conduit showing the adhesive bond is stronger than the tensile strength of the PVC.

C. Shop drawings:
   1. Furnish conduit routing plans for conduits before the installation of any conduit.
   2. Detail the intended routing of each conduit, conduit material and include supporting methods.
   3. Number conduits in accordance with the Contract Documents.
      a. Provide conduit labels as specified in Section 16075 - Identification for Electrical Systems.

D. Certifications:
   1. Furnish PVC-coated conduit manufacturer's valid, unexpired certification for each installer.

E. Record Documents:
   1. Incorporate all changes in conduit routing on electrical plan drawings.
   2. Dimension underground and concealed conduits from building lines.
   3. Furnish hard copy drawings.

1.05 QUALITY ASSURANCE

A. All conduits, conduit bodies, and fittings shall be UL listed and labeled.

B. Every installer of PVC-coated metallic conduit shall be certified by the manufacturer for installation of the conduit, and be able to present a valid, unexpired installer certification card prior to installation beginning.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Do not expose non-metallic conduit to direct sunlight.

B. Do not store conduit in direct contact with the ground.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.08 SEQUENCING

A. Before installing any conduit or locating any device box:
   1. Examine the complete set of Drawings and Specifications, and all applicable shop drawings.
   2. Verify all dimensions and space requirements and make any minor adjustments to the conduit system as required to avoid conflicts with the building structure, other equipment, or the work of other trades.

B. Duct bank construction and direct buried conduit installation have a prerequisite of fulfilling all aspects of Section 02280 - Subsurface Utility Engineering.

C. Before performing any trenching, the following prerequisites must be met for each underground conduit routing:
   1. Review of existing civil record drawings for recorded underground utilities.
   2. Existing underground utility horizontal and vertical location by at least 1 of the following methods:
      a. Soft excavation.
      b. Local utility location service, CALL BEFORE YOU DIG or equal.
   3. Protection of any discovered existing underground utility shall remain intact until the nearby duct bank installation is complete.

1.09 SCHEDULING (NOT USED)

1.10 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.11 SYSTEM START-UP (NOT USED)

1.12 OWNER'S INSTRUCTIONS (NOT USED)

1.13 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Galvanized rigid steel conduit:
   1. One of the following or equal:
      a. Western Tube and Conduit.
      b. Allied Tube and Conduit.
      c. Wheatland Tube Co.

B. PVC-coated rigid steel conduit:
   1. One of the following or equal:
      a. Robroy Ind.
      b. Ocal, Inc.
      c. Calbond.
      d. Allied.
      e. NEC, Inc. BlackGuard.

C. Sealtight-liquidtight flexible conduit:
   1. One of the following or equal:
      a. Southwire.
      b. AFC Cable Systems.
      c. Electri-Flex Co.
      d. Anaconda.

D. Rigid nonmetallic PVC conduit:
   1. One of the following or equal:
      a. Carlon.
      b. Cantex.
      c. Triangle Conduit and Cable.

E. Conduit bodies:
   1. One of the following or equal:
      a. Crouse-Hinds.
      b. Appleton.
      c. O-Z/Gedney.
      d. Ocal, Inc.
      e. Robroy Ind.
      f. Calbond.
      g. Carlon.

F. Joint compound:
   1. The following or equal:
      a. Thomas & Betts.

G. Galvanized rigid steel conduit expansion fittings:
   1. One of the following or equal:
      a. Crouse-Hinds.
      b. Appleton.
      c. O-Z/Gedney.

H. PVC-coated rigid steel conduit expansion fittings:
   1. One of the following or equal:
      a. Ocal, Inc.
      b. Robroy Ind.
      c. NEC, Inc. BlackGuard.

I. Conduit sleeve:
   1. One of the following or equal:
      a. Crouse-Hinds.
      b. Appleton.
      c. O-Z/Gedney.

J. Conduit seals:
   1. One of the following or equal:
      a. Appleton.
      b. Crouse-Hinds.
      c. O-Z/Gedney.

K. Conduit hangers and supports:
   1. As specified in Section 16070 - Hangers and Supports.

L. Conduit through wall and floor seals:
   1. The following or equal:
      a. O-Z/Gedney:
         1) Type "WSK."
         2) Type “CSM.”

2.02 SYSTEM DESCRIPTION

A. Provide conduits, conduit bodies, fittings, junction boxes, and all necessary components, whether or not indicated on the Drawings, as required, to install a complete electrical raceway system.

B. Provide location and protection of existing underground utilities, underground conduit trenching, conduit and backfill necessary for the complete installation of underground conduits.

2.03 EXISTING PRODUCTS (NOT USED)

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT (NOT USED)

2.07 COMPONENTS

A. GRC:
   1. All threads: NPT standard conduit threads with a 3/4-inch taper per foot:
      a. Running conduit threads are not acceptable.
   2. Hot-dip galvanized inside and out:
      a. Ensures complete coverage and heats the zinc and steel to a temperature that ensures the zinc alloys with the steel over the entire surface.
      b. Electro-galvanizing is not acceptable.
   3. Manufactured in accordance with:
      a. UL-6.
      b. ANSI C80.1.

B. PCS:
   1. The steel conduit, before PVC coating, shall be new, unused, hot-dip galvanized material, conforming to the requirements for Type GRC.
   2. Coated conduit NEMA Standard RN-1:
      a. The galvanized coating may not be disturbed or reduced in thickness during the cleaning and preparatory process.
   3. Factory-bonded PVC jacket:
      a. The exterior galvanized surfaces shall be coated with primer before PVC coating to ensure a bond between the zinc substrate and the PVC coating.
      b. Nominal thickness of the exterior PVC coating shall be 0.040 inch except where part configuration or application of the piece dictates otherwise.
      c. PVC coating on conduits and associated fittings shall have no sags, blisters, lumps, or other surface defects and shall be free of holes and holidays.
      d. The PVC adhesive bond on conduits and fittings shall be greater than the tensile strength of the PVC plastic coating:
         1) Confirm bond with certified test results.
   4. A urethane coating shall be uniformly and consistently applied to the interior of all conduits and fittings:
      a. Nominal thickness of 0.002 inch.
      b. Conduits having areas with thin or no coating are not acceptable.
      c. All threads shall be coated with urethane.
   5. The PVC exterior and urethane interior coatings applied to the conduits shall afford sufficient flexibility to permit field bending without cracking or flaking at temperature above 30 degrees Fahrenheit (-1 degree Celsius).
   6. PCS conduit bodies and fittings:
      a. Malleable iron.
      b. The conduit body, before PVC coating, shall be new, unused material and shall conform to appropriate UL standards.
      c. The PVC coating on the outside of conduit bodies shall be 0.040-inch thick and have a series of ribs to protect the coating from tool damage during installation.
      d. 0.002-inch interior urethane coating.
      e. Utilize the PVC coating as an integral part of the gasket design.
      f. Stainless steel cover screw heads shall be encapsulated with plastic to ensure corrosion protection.
      g. A PVC sleeve extending 1 conduit diameter or 2 inches, whichever is less, shall be formed at each female conduit opening.
         1) The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used.
         2) The sleeve shall provide a vapor- and moisture resistant seal at every connection.
         3) Fittings shall be Form 8 and supplied with plastic encapsulated stainless steel cover screws. Fittings shall be UL Type 4X. Fittings shall be from the same manufacturer as the conduit in order to maintain system continuity and warranty.

C. SLT:
1. Temperature rated for use in the ambient temperature at the installed location but not less than the following:
a. General purpose:
1) Temperature range: -20 degrees Celsius to +80 degrees Celsius.
b. Oil-resistant:
1) Temperature range: -20 degrees Celsius to +60 degrees Celsius.
2. Sunlight-resistant, weatherproof, and watertight.
3. Manufactured from single strip steel, hot-dip galvanized on all 4 sides before conduit fabrication.
4. Strip steel spiral wound resulting in an interior that is smooth and clean for easy wire pulling.
5. Overall PVC jacket.
6. With integral copper ground wire, built in the core, in conduit trade sizes 1/2 inch through 1-1/4 inch.

D. PVC:
1. Extruded from virgin PVC compound:
a. Schedule 40 unless otherwise specified.
b. Schedule 80 extra-heavy wall where specified.
2. Rated for 90 degrees Celsius conductors or cable.
3. Rated for use in direct sunlight.

E. Conduit bodies:
1. Material consistent with conduit type:
a. Malleable iron bodies and covers when used with Type GRC.
b. PVC bodies and covers when used with Type PVC.
c. PVC-coated malleable iron bodies and covers when used with Type PCS.
2. Conduit bodies to conform to Form 8, Mark 9, or Mogul design:
a. Mogul design conforming to NEC requirements for bending space for large conductors for conduit trade sizes of 1 inch and larger with conductors No. 4 AWG and larger, or where required for wire-bending space.
3. Gasketed covers attached to bodies with stainless steel screws secured to threaded holes in conduit body.

2.08 ACCESSORIES

A. Connectors and fittings:
1. Manufactured with compatible materials to the corresponding conduit.

B. Insulated throat metallic bushings:
1. Construction:
a. Malleable iron or zinc-plated steel when used with steel conduit.
b. Positive metallic conduit end stop.
c. Integrally molded non-combustible phenolic-insulated surfaces rated at 150 degrees Celsius.
d. Use fully insulated bushings on nonmetallic conduit system made of high-impact 150 degrees Celsius rated non-combustible thermosetting phenolic.

C. Insulated grounding bushings:
   1. Construction:
      a. Malleable iron or steel, zinc-plated, with a positive metallic end stop.
      b. Integrally molded non-combustible phenolic-insulated surfaces rated at 150 degrees Celsius.
      c. Tin-plated copper grounding saddle for use with copper or aluminum conductors.

D. Electrical unions (Erickson Couplings):
   1. Construction:
      a. Malleable iron for use with steel conduit.
      b. PVC-coated malleable iron for use with PCS conduit.
      c. Concrete tight, 3-piece construction.
      d. Rated for Class I Division 1 Group D in hazardous areas.

E. SLT fittings:
   1. Construction:
      a. Malleable iron.
      b. Furnished with locknut and sealing ring.
      c. Liquidtight, raintight, oiltight.
      d. Insulated throat.
      e. Furnish as straight, 45-degree elbows, and 90-degree elbows.
      f. Designed to prevent sleeving:
         1) Verify complete bonding of the raceway jacket to the plastic gasket seal.
      g. Equipped with grounding device to provide ground continuity irrespective of raceway core construction. Grounding device, if inserted into raceway and directly in contact with conductors, shall have rolled-over edges for sizes under 5 inches.
      h. Where terminated into a threadless opening using a threaded hub fitting, a suitable moisture-resistant/oil-resistant synthetic rubber gasket shall be provided between the outside of the box or enclosure and the fitting shoulder. Gasket shall be adequately protected by and permanently bonded to a metallic retainer.
   2. Corrosion-resistant and outdoor SLT fittings:
      a. Construction:
         1) PVC-coated liquidtight fittings with a bonded 0.040-inch-thick PVC coating on the metal connector to form a seal around the SLT conduit.
         2) Insulated throat and an integral sealing ring.

F. Hubs for threaded attachment of steel conduit to sheet metal enclosures:
   1. Construction:
      a. Insulated throat.
      b. PVC-coated when used in corrosive areas.
      c. Bonding locknut.
      d. Recessed neoprene O-ring to ensure watertight and dusttight connector.
      e. 1/2-inch through 1-1/4-inch steel zinc electroplated.
      f. 1-1/2-inch through 6-inch malleable iron zinc plated.

2. Usage:
    a. All conduits in damp, wet, outdoor, and corrosive areas shall use threaded hubs for connections to sheet metal enclosures.

G. Sealing fittings:
1. Construction:
    a. 40-percent wire fill capacity.
    b. PVC-coated when used in corrosive areas.
    c. PVC Coated Hazardous (Classified) Location fittings must be UL 1203 listed after the coating is applied and have a red metal tag attached to the fitting to signify compliance.
    d. Malleable ductile iron with steel conduit.
    e. Aluminum with aluminum conduit.
    f. Type EYDX where drains are required.
    g. Type EYSX where drains are not required.
    h. UL 1203 listed for use in Class I, Division 1, Groups A, B, C, D; Class I, Division 2, Groups A, B, C, D; and Class II, Divisions 1 and 2, Groups E, F, and G.
2. Sealing compound:
    a. Fiber filler and cement as recommended by the sealing fitting manufacturer.
    b. Approved for the conditions and use.
        1) Not affected by surrounding atmosphere or liquids.
    c. Melting point shall be 200 degrees Fahrenheit minimum.

H. PVC fittings:
1. Materials:
    a. All devices shall be made of PVC, using the same materials as used for Type PVC conduit.
    b. All metal hardware shall be stainless steel.

I. Through wall and floor seals:
1. Materials:
    a. Body: Casting of malleable or ductile iron with a hot-dip galvanized finish.
    a. Grommet: Neoprene.
    b. Pressure rings: PVC-coated steel.
    c. Disc material: PVC-coated steel.

J. Expansion/deflection couplings:
1. Use to compensate for movement in any directions between 2 conduit ends where they connect.
2. Shall allow movement of 3/4 inch from the normal in all directions.
3. Shall allow angular movement for a deflection of 30 degrees from normal in any direction.
4. Constructed to maintain electrical continuity of the conduit system.
5. Materials:
    a. End couplings: Bronze or galvanized ductile iron.
    b. Sleeve: Neoprene.
    c. Bands: Stainless steel.
    d. Bonding jumper: Tinned copper braid.

K. Expansion couplings:
    1. Shall allow for expansion and contraction of conduit:
        a. Permitting 8-inch movement, 4 inches in either direction.
    2. Constructed to maintain electrical continuity of the conduit system.
    3. Materials:
        a. Head: Malleable or ductile iron.
        b. Sleeve: Steel.
        c. Insulating bushing: Phenolic.
        d. Finish: Hot-dip galvanized.
        e. PVC-coated steel when used with Type PCS.

L. Conduit markers:
    1. As specified in Section 16075 - Identification for Electrical Systems.

2.09 MIXES (NOT USED)

2.10 FABRICATION (NOT USED)

2.11 FINISHES (NOT USED)

2.12 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. General:
    1. Conduit routing:
        a. The electrical drawings are diagrammatic in nature:
            1) Install conduit runs as specified with schematic representation indicated on the Drawings and as specified.
            2) Modify conduit runs to suit field conditions, as accepted by the Engineer:
                a) Make changes in conduit locations that are consistent with the design intent but are dimensionally different, or routing to bypass obstructions.
                b) Make changes in conduit routing due to the relocation of equipment.
                c) Install conduits and equipment in such a manner as to avoid obstructions and to preserve headroom and keep openings and passageways clear.
            3) Where the Drawings do not indicate the exact mounting and/or supporting method to be used, use materials and methods similar to the mounting details indicated on the Drawings.

4) The electrical drawings do not indicate all required junction boxes and pull boxes:
a) Provide junction boxes and pull boxes to facilitate wire pulling as required:
(1) To meet cable manufacturer's pulling tension requirements.
(2) To limit total conduit bends between pull locations.
b) Install junction boxes and pull boxes at locations acceptable to the Engineer.

b. The Contractor is responsible for any deviations in general location, conduit size, routing, or changes to the conduit schedule without the express written approval or direction by the Engineer:
1) The Engineer is the sole source in determining whether the change is constituted as a deviation:
2) Perform any changes resulting in additional conduits, or extra work from such deviations.
3) Incorporate any deviations on the Record Documents.

2. Use only tools recommended by the conduit manufacturer for assembling the conduit system.
3. Provide adequate clearances from high-temperature surfaces for all conduit runs. Provide minimum clearances as follows:
a. Clearance of 6 inches from surfaces 113 degrees Fahrenheit to 149 degrees Fahrenheit.
b. Clearance of 12 inches from surfaces greater than 149 degrees Fahrenheit.
c. Keep conduits at least 6 inches from the coverings on hot water and steam pipes, 18 inches from the coverings on flues and breechings, and 12 inches from fuel lines and gas lines.
d. Where it is necessary to route conduits close to high-temperature surfaces, provide a high-reflectance thermal barrier between the conduit and the surface.
4. Support conduit runs on water-bearing walls a minimum of 7/8-inch away from wall on an accepted preformed channel:
a. Do not run conduits within water-bearing walls unless otherwise indicated on the Drawings.
5. Do not install 1-inch or larger conduits in or through structural members unless approved by the Engineer.
6. Run conduits exposed to view parallel with or at right angles to structural members, walls, or lines of the building:
a. Install straight and true conduit runs with uniform and symmetrical elbows, offsets, and bends.
b. Make changes in direction with long radius bends or with conduit bodies.
7. Install conduits with total conduit bends between pull locations less than or equal to 270 degrees.
8. Route all exposed conduits to preserve headroom, access space and workspace, and to prevent tripping hazards and clearance problems:
a. Install conduit runs so that runs do not interfere with proper and safe operation of equipment and do not block or interfere with ingress or egress, including equipment-removal hatches.
b. Route conduits to avoid drains or other gravity lines. Where conflicts occur, relocate the conduit as required.

9. Conduits may be run in concrete members or slabs with permission of the Engineer or as indicated on the Drawings:
    a. Refer to the typical details for conduit spacing and size requirements.
10. When installing conduits through existing slabs or walls, make provisions for locating any possible conflicting items where the conduit is to penetrate. Use tone signal or X-ray methods to make certain that no penetrations will be made into the existing conduits, piping, cables, post-tensioning cables, etc.
11. Plug conduits brought into pull boxes, manholes, handholes, and other openings until used to prevent entrance of moisture.
12. Install conduits through wall and floor seals where indicated on the Drawings.
13. For existing and new 2-inch and larger conduit runs, snake conduits with a conduit cleaner equipped with a cylindrical mandrel of a diameter not less than 85 percent of nominal diameter of the conduit:
    a. Remove and replace conduits through which mandrel will not pass.
14. Provide all sleeves and openings required for the passage of electrical raceways or cables even when these openings or sleeves are not specifically indicated on the Drawings.
15. Install complete conduit systems before conductors are installed.
16. Provide metallic conduits terminating in transformer, switchgear, motor control center, or other equipment conduit windows with grounding bushings and ground with a minimum No. 6 AWG ground wire.
17. Underground conduits:
    a. Install underground conduits, including conduit runs below slabs-on-grade in concrete-reinforced duct bank construction:
        1) As specified in Section 16133 - Duct Banks.
    b. Make underground conduit size transitions at handholes and manholes.
    c. Install spare conduits in underground duct banks towards top center of runs to allow for ease of installation of future cables as conduits enter underground manholes and handholes.
    d. Seal around conduit penetrations of below grade walls with a mechanical seal.
18. Underground conduit trenching:
    a. Perform trenching as specified in Section 02318 - Trenching.
    b. Trench must be uniformly graded with the bottom, rock free and covered with select material.
    c. Damage occurring to existing ducts, conduits, cables, and other utilities during underground conduit installation shall be remediated to the satisfaction of the Owner.
    d. Whenever possible, use the walls of the trench as forms for concrete encasement:
        1) Forms are required where the soil is not self-supporting.

B. Equipment grounding conductors:
    1. Provide a separate, green insulated, grounding conductor in each raceway independent of raceway material:
        a. Multi-conductor power and control cables shall include an integral green insulated grounding conductor.
        b. Provide a separate grounding conductor in each individual raceway for parallel feeders.

2. Conductors shall be the same type and insulation as the circuit conductors:
   a. Use 600-volt insulation for the equipment grounding conductors for medium voltage systems.
3. Minimum size in accordance with the NEC.

C. Lighting and receptacle conduits:
1. Provide conduit runs for lighting and receptacle circuits, whether or not indicated on the Drawings:
2. Install conduits in accordance with the requirements of this Section unless otherwise indicated.
3. Minimum conduit size:
   a. 3/4-inch for exposed conduits.
   b. 1-inch for underground or in-slab conduits.
4. Provide conduit materials for the installed location as specified in Section 16050 - Common Work Results for Electrical.

D. Conduit usage:
1. Exposed conduits:
   a. Rigid conduit:
      1) Install the rigid conduit type for each location as specified in Section 16050 - Common Work Results for Electrical.
      2) Minimum size: 3/4-inch.
   b. Flexible conduit:
      1) Use flexible conduit for final connections between rigid conduit and motors, vibrating equipment, instruments, control equipment, or where required for equipment servicing:
         a) Use Type SLT with rigid metallic conduit.
      2) Minimum size: 3/4-inch:
         a) 1/2 when required for connection to instruments.
      3) Maximum length:
         a) Fixed equipment:

Conduit Trade Size	Flexible Conduit Length (inch)
3/4	18
1	18
1-1/4	18
1-1/2	18
2	36
2-1/2	36
3	36
3-1/2	38
4	40

         b) Removable instruments or hinged equipment:
            (1) As required to allow complete removal or full movement without disconnecting or stressing the conduit.

2. Concrete-encased and embedded conduits:
    a. Straight runs and bends less than 45 degrees:
        1) Type PVC Schedule 40.
    b. Bends with total deflection greater than 45 degrees:
        1) PCS.
    c. Entering and exiting duct bank, underground or embedded conduit runs a minimum 12 inches above and below grade, finished floor, or entering equipment:
        1) PCS.
    d. Minimum size:
        1) 2-inch in duct banks.
        2) 1-inch for in-slab conduits.
        3) Provide conduit fittings to enlarge the conduit from the exposed size in the conduit schedule as required.
3. Direct-buried and sand-bedded duct bank conduits:
    a. Type PCS.
    b. Minimum size: 1-inch.
4. Below-slab conduits:
    a. Type PCS.
    b. Minimum size: 1-inch.
5. PVC-coated rigid metallic conduit:
    a. Use specifically manufactured or machined threading dies to manufacturer's specifications to accommodate the PVC jacket.
    b. Repair damage to PVC coatings with manufacturer supplied touchup compound or PVC Coating Repair Kit for PVC Coated Raceway Systems.
6. GRC:
    a. Conduit shall be cut square and reamed before threading.

E. Conduit joints and bends:
1. General:
    a. Where conduit is underground, under slabs on grade, exposed to the weather, or in NEMA Type 4 or NEMA Type 4X locations, make joints liquidtight.
    b. Keep bends and offsets in conduit runs to an absolute minimum.
    c. All bends shall be symmetrical.
    d. The following conduit systems shall use large-radius sweep elbows:
        1) Underground conduits.
    e. Provide large-radius factory-made bends for 1-1/4-inch trade size or larger.
    f. Make field bends with a radius of not less than the requirements found in the NEC:
        1) The minimum bending radius of the cable must be less than the radius of the conduit bend.
        2) Make all field bends with power bending equipment or manual benders specifically intended for the purpose:
            a) Make bends so that the conduit is not damaged and the internal diameter is not effectively reduced.
            b) For the serving utilities, make bends to meet their requirements.
    g. Replace all deformed, flattened, or kinked conduit.

2. Threaded conduit:
    a. Cut threads on rigid metallic conduit with a standard conduit-cutting die that provides a 3/4-inch per foot taper and to a length such that all bare metal exposed by the threading operation is completely covered by the couplings or fittings used. In addition, cut the lengths of the thread such that all joints become secure and wrench-tight just preceding the point where the conduit ends would butt together in couplings or where conduit ends would butt into the ends or shoulders of other fittings.
    b. Thoroughly ream conduit after threads have been cut to remove burrs.
    c. Use bushings or conduit fittings at conduit terminations.
    d. On exposed conduits, repair scratches and other defects with galvanizing repair stick, Enterprise Galvanizing “Galvabar™,” or CRC “Zinc It.”
    e. Coat conduit threads with an approved electrically conductive sealant and corrosion inhibitor that is not harmful to the conductor insulation:
        1) Apply to the male threads and tighten joints securely.
        2) Clean excess sealant from exposed threads after assembly.
    f. Securely tighten all threaded connections.
    g. Any exposed threaded surfaces must be cleaned and coated with a galvanizing solution so that all exposed surfaces have a galvanized protective coating.
3. PVC:
    a. Use approved solvent-weld cement specifically manufactured for the purpose. Spray-type cement is not allowed.
    b. Apply heat for bends so that conduit does not distort or discolor. Use a spring mandrel as required to ensure full inside diameter at all bends:
        1) Utilize a heater specifically for PVC conduit as recommended by the conduit manufacturer.

F. Conduit sealing and drainage:
1. Conduit drainage and sealing other than required for hazardous and classified areas:
    a. Provide sealing and drainage in vertical drops of long (in excess of 20 feet), exterior, above-grade conduit runs at the points at which the conduit enters buildings, switchgear, control panels, lighting panelboards, and other similar enclosures.
    b. Provide seal fittings with drains in vertical drops directly above grade for exterior and above-grade conduit runs that are extended below grade.
    c. Provide conduit seals with drains in areas of high humidity and rapidly changing temperatures:
        1) Where portions of an interior raceway pass through walls, ceilings, or floors that separate adjacent areas having widely different temperatures.
    d. Provide conduit seals similar to O-Z/Gedney (Type CSM) on all conduits between corrosive and non-corrosive areas.
    e. Seal one end only of all underground conduits at highest point with O-Z/Gedney sealing (non-hazardous) filling, or equal.
2. Install seals with drains at any location along conduit runs where moisture may condense or accumulate. This requirement includes, but is not limited to, the following locations: control panels, junction boxes, pullboxes, or low points of the conduit.

G. Conduit supports:
   1. General:
      a. Provide appropriate hangers, supports, fasteners, and seismic restraints to suit applications:
         1) As specified in Section 16070 - Hangers and Supports.
         2) Provide support materials consistent with the type of conduit being installed as specified in Section 16050 - Common Work Results for Electrical.
      b. Support conduit at the intervals required by the NEC.
      c. Perforated strap and plumbers' tape are not acceptable for conduit supports.
   2. Conduit on concrete or masonry:
      a. Use 1-hole malleable iron straps with metallic or plastic expansion anchors and screws or support from preset inserts.
      b. Use preset inserts in concrete when possible.
      c. Use pipe spacers (clamp backs) in wet locations.
   3. Suspended conduit:
      a. Use malleable-iron factory-made split-hinged pipe rings with threaded suspension rods sized for the weight to be carried (minimum 3/8-inch diameter), Kindorf, or equal.
      b. For grouped conduits, construct racks with threaded rods and tiered angle iron or preformed channel cross members. Clamp each conduit individually to a cross member. Where rods are more than 2-feet long, provide rigid sway bracing.
   4. Supports at structural steel members:
      a. Use beam clamps.
      b. Drilling or welding may be used only as specified or with approval of the Engineer.
   5. PVC-coated rigid metal systems:
      a. Provide right-angle beam clamps and "U" bolts specially formed and sized to snugly fit the outside diameter of the coated conduit. Provide "U" bolts with PVC-encapsulated nuts that cover the exposed portions of the threads.
      b. Securely fasten exposed conduits with Type 316 stainless steel clamps or straps.

H. Expansion or expansion/deflection fittings:
   1. General:
      a. Align expansion coupling with the conduit run to prevent binding.
      b. Follow manufacturer's instructions to set the piston opening.
      c. Install expansion fittings across concrete expansion joints and at other locations where necessary to compensate for thermal or mechanical expansion and contraction.
      d. Furnish fittings of the same material as the conduit system.
   2. For metallic conduit, provide expansion or expansion/deflection couplings, as appropriate, where:
      a. Install expansion fittings a minimum of every 200 feet in straight conduit runs.

I. Empty conduits:
   1. Provide a pull tape in each empty conduit more than 10 feet in length.
   2. Seal ends of all conduits with approved, manufactured conduit seals, caps, or plugs immediately after installation:
      a. Keep ends sealed until immediately before pulling conductors.

J. Miscellaneous:
   1. Seal roof penetrations for raceways and other items that penetrate the roof in accordance with roofing manufacturer's instructions and as indicated on the Drawings.
   2. Provide electrical unions at all points of union between ends of rigid conduit systems that cannot otherwise be coupled:
      a. Running threads and threadless couplings are not allowed.
   3. Replace any conduits installed that the Engineer determines do not meet the requirements of this Specification.
   4. Provide conduit housekeeping curb around all embedded or below-grade conduits exiting or entering the slab, per the Typical Details.

3.04 ERECTION, INSTALLATION, APPLICATIONS, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL (NOT USED)

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16133

DUCT BANKS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Electrical underground duct banks.
   2. Duct bank installation requirements.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. Provide location and protection of existing underground utilities, duct bank, trenching, forming, rebar, spacers, conduit, concrete, backfill, and compaction necessary for the complete installation of the duct banks.

B. Provide reinforced concrete duct banks for all conduits installed below grade, on the site, below structures, or in contact with the earth, unless otherwise indicated on the Drawings.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. PVC conduit spacers.
   2. Detectable underground marking tape.
   3. Pull line.

C. Shop drawings:
   1. Submit site plan drawings of duct banks including underground profiles indicating all underground utilities.
   2. Submit cross section of each duct bank with dimensions.
   3. For duct bank routings crossing under building footers or foundations alternative to designed routings indicated on the Drawings:
      a. Submit shop drawings detailing the new building footer crossing locations and plan drawings labeling all equipment to be installed on top of the new routing for approval by the project Structural Engineer.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

B. Duct bank sections indicated on the Drawings are an initial arrangement and may need to be modified due to existing site conditions, existing underground utilities, and infrastructure.
   1. Reorganize duct bank section with approval of Engineer.

1.09 SEQUENCING

A. Duct bank construction has a prerequisite of fulfilling all aspects of Section 02280 - Subsurface Utility Engineering.

B. Before performing any excavation, the following prerequisites must be met for each duct bank routing:
   1. Review of existing civil record drawings for recorded underground utilities.
   2. Existing underground utility horizontal and vertical location by minimum 2 of the following methods:
      a. Ground-penetrating radar.
      b. Soft excavation.
      c. Local utility location service, CALL BEFORE YOU DIG or equal.
   3. Protection of any discovered existing underground utility shall remain intact until the nearby duct bank installation is complete.

C. Make changes required to accommodate duct bank configuration and routing changes due to field conditions.
   1. Where changes in a duct bank configuration extend to a manhole or handhole, coordinate manhole/handhole blockouts and size with the new configuration.

1.10 SCHEDULING

A. Schedule a coordination meeting to adjust duct bank configurations and routing for each duct bank section after trenching and exposure of any underground utilities within the vicinity of the duct bank route. The meeting shall determine the final configuration of the duct bank before installation.

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Conduit spacers:
   1. One of the following or equal:
      a. Carlon Snap-Loc.
      b. Cantex.
      c. Osburn Associates, Inc.

B. Detectable underground marking tape:
   1. One of the following or equal:
      a. Blackburn Manufacturing Co.
      b. Pro-Line Safety Products.
      c. Panduit.

C. Pull line:
   1. One of the following or equal:
      a. Arnco.
      b. Greenlee.
      c. Osburn Associates, Inc.

D. Duct seal:
   1. The following or equal:
      a. O-Z/Gedney type DUX.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Provide conduit as specified in Section 16130 - Conduits.

B. Provide reinforcing steel as specified in Section 03200 - Concrete Reinforcing:
   1. Provide minimum Number 4 reinforcing steel.

2.04 MANUFACTURED UNITS

A. Conduit spacers:
   1. Provide conduit spacers recommended by the conduit manufacturer or specified above.
   2. Saddle type.
   3. Non-metallic, non-corrosive, non-conductive.
   4. Interlocking type:
      a. Vertical interlocking.
      b. Horizontal interlocking.
   5. Suitable for concrete encasement.

6. Molded-in rebar holder.
7. Accommodates 2-inch through 6-inch conduit sizes.
8. Relieves the conduit from both horizontal and vertical stresses.

B. Pull line:
1. Minimum 1/4-inch wide, flat design.
2. Polyester.
3. Minimum pulling strength 1,200 pounds.

C. Detectable marking tape:
1. Provide a detectable tape, locatable by a cable or metal detector from above the undisturbed grade.
2. Aluminum core laminated between polyethylene film.
3. 6-inch-wide red tape imprinted with black lettering stating "CAUTION - BURIED ELECTRIC LINE BELOW" or equivalent.

D. Duct seal:
1. Non-hardening sealing compound.
2. Flexible, can be applied by hand.
3. UL Listed for use with installed conductors.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES

A. Concrete mix requirements as specified in Section 03300 - Cast-in-Place Concrete.

B. Provide a red-oxide conduit encasement coloring agent as specified in Section 03300 - Cast-in-Place Concrete.

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Duct banks:
1. Install duct banks encased in concrete at least 24 inches below finish grade, unless otherwise indicated on the Drawings.

2. Damage minimization:
    a. Conduit should not be left exposed in an open trench longer than is necessary.
    b. Protect all underground duct banks against damage during pouring of concrete or backfilling.
3. All plastic conduit fittings to be joined should be exposed to the same temperature conditions for a reasonable length of time before assembly.
4. Provide No. 4/0 American Wire Gauge bare copper ground wire the entire length of duct bank and bond to the grounding system at each end of the duct bank and every 20 feet to steel reinforcing bar.
5. Install underground ducts to be self-draining:
    a. Slope duct banks away from buildings to manholes, handholes, or pullboxes.
    b. Slope duct banks uniformly from manholes, handholes, or pullboxes to manholes, handholes, or pullboxes or both ways from high points between manholes, handholes, or pullboxes.
    c. Slope a minimum of 1/4 inch per 10 feet.
6. Where new duct banks join to existing manholes, handholes, or pullboxes, make the proper fittings and fabricate the concrete envelopes to ensure smooth durable transitions, as indicated on the Drawings.
7. Install pull line in spare conduits:
    a. Provide adequate pull line at both ends of conduits to facilitate conductor pulling.
    b. Cap above ground spare conduit risers at each end with screw-on conduit caps.

B. Trenching:
1. Perform trenching as specified in Section 02318 - Trenching.
2. Trench must be uniformly graded with the bottom, rock free and covered with select material.
3. Whenever possible, use the walls of the trench as forms for concrete encasement:
    a. Forms are required where the soil is not self-supporting.
4. Damage occurring to existing ducts, conduits, cables, and other utilities during duct bank installation shall be remediated to the satisfaction of the Owner.

C. Duct spacing:
1. Separate conduits with manufactured plastic spacers using a minimum space between the outside surfaces of adjacent conduits of 2 inches, unless otherwise indicated on the Drawings:
    a. Separate medium voltage ducts a minimum of 7.5 inches on center.
2. Install spacers to maintain uniform spacing of duct assembly a minimum of 4 inches above the bottom of the trench during concrete pour. Install spacers on 8-foot maximum intervals:
    a. Due to some distortion of conduit from heat, and other means, it may be necessary to install extra spacers within the duct bank:
        1) Install the intermediate set of spacers within normal required spacing to maintain the proper horizontal clearance:
            a) Clearance is required to allow the proper amount of concrete to infiltrate vertically among the duct to ensure proper protection.

3. Spacers shall not be located at the center of a bend:
    a. Locate spacer in the tangent, free of the coupling on fabricated bends.
    b. Locate spacers midway between the tangent and the center bend on trench formed sweeps.

D. Terminating:
1. Use bell ends in duct at entrances into cable vaults.
2. Make conduit entrances into cable vaults tangential to walls of cable vault.
3. Form trapezoidal transitions between duct bank and cable vaults as needed in order to ensure adequate cable bending radius for the duct bank-to-vault transition.
4. Install duct seal in all conduits including spare conduits, at both ends, entrance to manholes/handholes, and building/equipment stub-ups. Form by hand to conduit and around cables to develop moisture barrier.
5. New manhole or handhole applications, provide a single opening or "window" per duct bank, sized to accommodate the duct bank envelope.

E. Concrete:
1. Install concrete as specified in Section 03300 - Cast-in-Place Concrete.
2. Provide tie wires in accordance with Section 03200 - Concrete Reinforcing to prevent displacement of the conduits during pouring of concrete:
    a. Tie wire shall not act as a substitute for spacers.
3. Install minimum 3-inch cover around conduit and rebar.
4. Consolidation of encasement concrete around duct banks shall be by hand puddling. Mechanical vibrators are acceptable for use outside of the rebar cage.
5. Conduit is subject to temperature rise. As concrete cures, allow the free end to expand by pouring the concrete from the center of the run or from one tie in point.

F. Marking tape:
1. Install a detectable marking tape 12 inches above the duct bank the entire length of the duct bank.

G. For conduit installations beneath building slabs:
1. Duct banks shall be continued under building slabs to the final destination of the conduits.
    a. Construct separate duct banks as required.
    b. Concrete for encasement under building slabs need not be colored red.
    c. For duct banks crossing under building foundation, install the top of the duct bank a minimum of 6 inches below the footer.
    d. Where duct banks enter through building walls, foundation walls, stem walls, etc. make connections as indicated on the Drawings.
    e. Where duct banks terminate with conduit risers entering building walls, install an expansion/deflection fitting or a flat-wise elbow (elbow parallel to building wall) in order to accommodate differential movement between the conduits and structure.

H. Restore all surfaces to their original condition as specified in Section 02952 - Pavement Restoration and Rehabilitation, unless otherwise specified.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL (NOT USED)

3.09 ADJUSTING (NOT USED)

3.10 CLEANING

A. Clean conduits of dirt and debris by use of an appropriately sized steel mandrel no less than 1/2 inch smaller than the inside diameter of the conduit.

3.11 PROTECTION

A. Provide shoring and pumping to protect the excavation and safety of workers.

B. Protect excavations with barricades as required by applicable safety regulations.

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16134

BOXES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Device boxes.
   2. Raceway system boxes.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. American Association of State Highway and Transportation Officials (AASHTO):
   1. Standard Specifications for Highway Bridges.

C. ASTM International (ASTM):
   1. A47 - Standard Specification for Ferritic Malleable Iron Castings.
   2. D149 - Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
   3. D495 - Standard Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation.
   4. D570 - Standard Test Method for Water Absorption of Plastics.
   5. D648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
   6. D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
   7. D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.

D. Joint Industry Conference (JIC).

E. Underwriters Laboratories, Inc. (UL):
   1. 94 - Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Specific definitions:
   1. Arcing parts: Circuit breakers, motor controllers, switches, fuses, or any device intended to interrupt current during its operation.
   2. Raceway system boxes: Boxes that are used for wire and cable pullboxes, conduit junction boxes, or terminal boxes.

1.04 SYSTEM DESCRIPTION

A. Provide outlet boxes for wiring devices, junction, and pullboxes for use in the raceway systems, etc.

B. Provide boxes as indicated on the Drawings or as needed to complete the raceway installation.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Manufacturer.
   2. Materials.
   3. Dimensions:
      a. Height.
      b. Width.
      c. Depth.
      d. Weight.
      e. NEMA rating.
   4. Conduit entry locations.
   5. Catalog cutsheets.
   6. Installation instructions.

C. Shop drawings:
   1. Include identification and sizes of pullboxes.

1.06 QUALITY ASSURANCE

A. Regulatory requirements:
   1. Outlet boxes shall comply with all applicable standards of:
      a. JIC.
      b. NEC.
      c. NEMA.
      d. UL.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Pressed steel boxes and concrete boxes:
      a. Steel City.
      b. Appleton.
      c. Crouse - Hinds.
      d. Thomas & Betts.
   2. Plastic and/or fiberglass boxes:
      a. Hoffman.
      b. Carlon.
      c. Stahlin.
   3. Cast device boxes:
      a. Appleton.
      b. Crouse - Hinds.
      c. OZ/Gedney.
   4. Formed steel enclosures:
      a. Hoffman.
      b. Thomas and Betts.
      c. Stahlin.
      d. Rittal.
   5. Stainless steel enclosures:
      a. Hoffman.
      b. Stahlin.
      c. Rittal.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. Pressed steel boxes:
   1. 1-piece galvanized pressed steel.
   2. Knockout type boxes.
   3. Minimum size 4-inch square by 2-1/8-inch deep.

B. Concrete boxes:
   1. For outlets and pullboxes in concrete construction.
   2. Pressed steel or cast construction, concrete tight.
   3. Knockout sizes range from 1/2 inch to 1 inch.

4. Depth as needed.
5. Types:
    a. Four-inch octagon.
    b. Four-inch octagon ceiling boxes with hanging bars.
    c. Gangable masonry boxes:
        1) 3-1/2-inch deep, 3-3/4-inch high, length as required:
            a) 2-1/2-inch deep boxes may be used where wall thickness precludes the use of the deeper boxes.
        2) With partitions as needed.

C. Cast device boxes:
1. Construction:
    a. With internal green ground screw.
    b. Furnished with a suitable gasketed cover.
    c. With integral cast mounting lugs when surface mounted.
    d. Conduit sizes range from 3/4 inch to 1 inch.
    e. Tapered threaded hubs with integral bushing.
2. Aluminum (copper free) boxes:
    a. High strength copper free 4/10 of 1 percent maximum alloy for use with aluminum rigid conduit.
3. Malleable iron boxes:
    a. Conforming to ASTM A47 Grade 32510.

D. Fiberglass boxes:
1. NEMA Type 4X.
2. Constructed of molded fiberglass reinforced polyester.
3. Integral neoprene gasket on cover attached with an oil-resistant adhesive.
4. Enclosures to have internal pads for mounting optional panels and terminal kits.
5. Covers:
    a. Screw cover enclosures:
        1) Covers held in place with captive, stainless steel, or Monel® screws.
        2) Covers attached to body with internal zinc-plated steel hinges.
    b. Quick release latches covers:
        1) Corrosion resistant fiberglass hinges.
        2) Spring loaded fiberglass latches with a Monel® or stainless steel bail attached with Monel® or stainless steel screws.
        3) With a Type 316 stainless steel padlock hasp.
6. With external mounting feet.
7. Meeting the following minimum standards and tests:

Physical Property	Value	ASTM Method
Flexural strength	12,000 psi	D790
Heat distortion	400° Fahrenheit	D648
Water absorption (24 hrs)	0.5 percent	D570
Tensile strength	5000 psi	D651
Specific gravity	1.8	D792
Flammability	94V-0	UL94
Dielectric strength	4000 V.P.M.	D149
Arc resistance	180 second	D495

E. Formed steel enclosures:
    1. Steel:
        a. NEMA Type 12.
        b. Fabricated from 14-gauge steel, minimum.
        c. All seams continuously welded ground smooth.
        d. Door:
            1) Rolled lip around 3 sides.
            2) Attached to enclosure by means of a continuous stainless steel hinge and pin.
        e. Neoprene door gasket to provide a watertight, dusttight, oiltight seal:
            1) Attached with an adhesive.
            2) Retained by a retaining strip.
        f. Fabricate all external removable hardware for clamping the door to the enclosure body from zinc-plated heavy gauge steel:
            1) With a hasp and staple for padlocking.
        g. Provide large enclosures with door and body stiffeners for extra rigidity.
        h. No holes or knockouts.
        i. Finish:
            1) ANSI-61 gray electrostatically applied polyester powder inside and out over cleaned and primed surfaces.
            2) White electrostatically applied polyester powder mounting plate.
        j. Heavy gauge steel external mounting brackets when surface mounted.
    2. Stainless steel:
        a. NEMA Type 4X:
            1) Boxes in locations subject to flooding or temporary submersion:
                a) NEMA Type 6.
        b. Fabricated from 14-gauge Type 316 stainless steel.
        c. All seams continuously welded.
        d. Door:
            1) Rolled lip around 3 sides.
            2) Attached to enclosure by means of a continuous stainless steel hinge and pin.
        e. Neoprene door gasket to provide a watertight seal:
            1) Attached with an adhesive.
            2) Retained by a retaining strip.
        f. Fabricate all external removable hardware for clamping the door to the enclosure body from heavy gauge stainless steel:
            1) With a hasp and staple for padlocking.
        g. Provide large enclosures with door and body stiffeners for extra rigidity.
        h. No holes or knockouts.
        i. Finish:
            1) Brushed.
        j. Stainless steel external mounting brackets when surface mounted.

F. Cast iron junction boxes:
    1. NEMA Type 4.
    2. Recessed cover boxes.
    3. Suitable for use outdoors where subject to rain, dripping, or splashing water.
    4. Designed for flush mounting in walls or floors:
        a. Can be surface mounted using mounting lugs.

5. Construction:
    a. Cast iron box.
    b. Covers:
        1) Checkered plate covers suitable for foot traffic.
        2) When used in areas subject to vehicular traffic, design to support an AASHTO Standard Specifications for Highway Bridges, H-20 vehicle loading.
    c. Hot dip galvanized.
    d. Neoprene gasket.
    e. Stainless steel screw covers.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Fasteners:
    1. Electroplated or stainless steel in boxes with wiring devices.
    2. Screws, nuts, bolts, and other threaded fasteners:
        a. Stainless steel.

B. Provide breather and drain fittings where appropriate.

C. Internal panels:
    1. Provide internal panels where required for mounting of terminal strips or other equipment.
    2. With plated steel shoulder studs.
    3. Steel with white polyester powder finish.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. General:
    1. Provide materials and construction suitable for environmental conditions at the location of the box as specified in Section 16050 - Common Work Results for Electrical.

2. Provide outlet box materials to match the conduit system:
    a. GRC - Cast ferrous boxes.
    b. PCS - PVC coated cast ferrous boxes.
    c. PVC - PVC boxes.
3. Solid type gang boxes:
    a. For more than 2 wiring devices.
    b. For barriered outlets.
4. Support all wall mounted NEMA Type 4 or NEMA Type 4X boxes to maintain a minimum of 7/8-inch free air space between the back of the enclosure and the wall:
    a. Use machined spacers to maintain air space; built-up washers are not acceptable.
    b. Use stainless steel or nylon materials for spacers.
5. Use cast malleable iron boxes when box must support other devices.
6. Boxes serving luminaires or wiring devices:
    a. Use as pullboxes wherever possible.
7. Fit all cast boxes and pressed steel boxes for flush mounting in concrete with cast, malleable box covers and gaskets.
8. In terminal boxes, furnish terminals as indicated on the Drawings, with a minimum of 50 percent spare terminals:
    a. Furnish wireways for discrete and analog/DC wiring.
    b. Separate analog wiring from 120 V discrete or power wiring.
9. Size boxes in accordance with NEC requirements and to provide sufficient room for the future components and cables indicated on the Drawings.
10. For fire-rated construction, provide materials and installation for use in accordance with the listing requirements of the classified construction.

B. Outlet boxes:
1. Locate outlet boxes as indicated on the Drawings:
    a. Adjust locations so as not to conflict with structural requirements or other trades.
2. Use deep threaded-hub stainless steel:
    a. I
    b. Where exposed to the weather.
    c. In unheated areas.
    d. Where subject to mechanical damage:
        1) Defined as exposed boxes less than 10 feet above the floor.
    e. To act as a pullbox for conductors in a conduit system.
    f. Accommodate wiring devices.
3. Use deep threaded-hub plastic coated malleable iron boxes in corrosive and NEMA Type 4X area and when the exposed conduit system is PVC coated steel.
4. Outlet boxes may be used as junction boxes wherever possible.

C. Pullboxes and junction boxes:
1. Size pullboxes in accordance with NEC requirements and to provide sufficient room for any future conduits and cables as indicated on the Drawings.
2. Install pullboxes such that access to them is not restricted.

D. For boxes not indicated:
   1. Provide types and mountings as required to suit the equipment and that will be consistent with the conduit system and environmental conditions as indicated in Section 16050 - Common Work Results for Electrical.
   2. Outlet, switch, and junction boxes for flush-mounting in general purpose locations:
      a. One-piece, galvanized, pressed steel.
   3. Outlet, switch, and junction boxes where surface mounted in exposed locations:
      a. Cast ferrous boxes with mounting lugs, zinc or cadmium plating finish.
   4. Outlet, control station, and junction boxes for installation in corrosive locations:
      a. Fiberglass reinforced polyester, stainless steel, or plastic-coated steel to match the conduit system.
      b. Furnished with mounting lugs.
   5. Fire rated construction: Use materials and methods to comply with the listing requirements for the classified construction.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 REINSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. As specified in Section 16050 - Common Work Results for Electrical.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING

A. As specified in Section 16050 - Common Work Results for Electrical.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Switches.
   2. Receptacles.
   3. Plates.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Federal Specifications (FS):
   1. W-C 596 - Connector, Electrical, Power, General Specification for.
   2. W-S 896/2 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification).

C. National Electrical Manufacturers Association (NEMA):
   1. WD1 - General Color Requirements for Wiring Devices.
   2. ICS 5 - Industrial Control and Systems, Control Circuit and Pilot Devices.
   3. OS1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
   4. WD6 - Wiring Devices Dimensional Specifications.

D. Underwriters Laboratories, Inc. (UL):
   1. 20 - General Use Snap Switches.
   2. 498 - Standard for Attachment Plugs and Receptacles.
   3. 514D - Cover Plates for Flush-Mounted Wiring Devices.
   4. 943 - Ground-Fault Circuit-Interrupters.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Specific definitions:
   1. GFCI: Ground fault circuit interrupter.

1.04 SYSTEM DESCRIPTION

A. Switches, receptacles, and plates as indicated on the Drawings wired and operable to form a complete system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Catalog cutsheets.

C. Shop drawings:
   1. Engraving schedule:
      a. Furnish complete engraving schedule for engraved nameplates.

1.06 QUALITY ASSURANCE

A. Wiring devices shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Switches:
   1. One of the following or equal:
      a. Hubbell.
      b. Leviton.
      c. Cooper Wiring Devices.

B. Receptacles:
   1. General purpose receptacles:
      a. One of the following or equal:
         1) Hubbell.
         2) Leviton.
         3) Cooper Wiring Devices.

C. Plates:
1. General location:
a. One of the following or equal:
1) Legrand.
2) Cooper Wiring Devices.
2. Wet or corrosive areas:
a. One of the following or equal:
1) Hubbell.
2) Cooper Wiring Devices.
3) Thomas & Betts.
4) Pass and Seymour.
3. In-use covers:
a. One of the following or equal:
1) TayMac.
2) Cooper Wiring Devices.
3) Pass and Seymour.
4) Thomas & Betts.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. Switches:
1. General:
a. 120-277 VAC.
b. 20 ampere.
c. Listed in accordance with UL 20.
d. Designed and constructed in accordance with FS W-S-896/2.
e. Back and side wired unless otherwise indicated.
f. Integral grounding terminal.
g. Totally enclosed:
1) Color-coded body with color corresponding to ampere rating.
h. Provide switches with the operator style and contact arrangement as indicated on the Drawings and as required for proper operation.
i. Color:
1) Ivory in finished areas.
2) Brown in all other areas.
2. General purpose switches:
a. Toggle type.

B. Receptacles:
1. General purpose receptacles:
a. Single or duplex as indicated on the Drawings.
b. 125 VAC.
c. 20 ampere or as indicated on the Drawings.
d. NEMA Type 5-20R configuration for 20 ampere receptacles.
e. Other NEMA configurations as indicated on the Drawings.
f. Listed in accordance with UL 498.
g. Designed and constructed in accordance with FS W-C-596.

h. Back and side wired.
i. 1-piece, rivet-less mounting strap.
j. Color:
1) Ivory in finished areas.
2) Brown in all other areas.
3) Orange when powered by a UPS.

2. Ground fault interrupter receptacles (GFCI):
a. 125 VAC.
b. 20 ampere.
c. Trip level 4-6 milliamperes.
d. Individual and feed through protection.
e. UL 943 and UL 498 listed.
f. NEMA Type 5-20R configuration.
g. For damp or wet locations:
1) Weather resistant, in accordance with UL 498.

C. Plates:
1. General location:
a. Type 302 or 304 stainless steel.
b. Brushed satin finish.
c. Minimum thickness: 0.032 inches.
d. Rectangular or square shape.
e. Engraving:
1) Engrave each switch plate with the following:
a) Area served.
b) Panelboard and Circuit.
2) Engrave each receptacle plate with the following:
a) Panelboard and Circuit.
3) Treat engraving to improve visibility.
4) Characters shall be block letter pantograph engraved with a minimum character height of 1/8-inch.
f. Coordinate the number of gangs, number, and type of openings with the specific location.

2. Outdoor and wet areas requiring NEMA Type 4 or NEMA Type 4X enclosures:
a. General:
1) UL listed for wet locations.
2) Gasketed.
3) Die cast metal:
a) Match material to box material.
b. Switches:
1) Lever operated:
a) Provide toggle switch.
c. Receptacles:
1) Weatherproof in-use cover:
a) Die cast metal construction with electrostatic powder coating for corrosion resistance.
b) Gasketed.
c) Lockable.
d) UL listed and in accordance with NEC.

3. Corrosive areas:
    a. Neoprene.
    b. Gasketed.
    c. Weatherproof.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Mounting heights:
    1. Process and production areas:
        a. Switches and receptacles 48 inches from finished floor to top of plate.
    2. Offices and finished areas:
        a. Switches: 48 inches from finished floor to top of plate.
        b. Receptacles: 18 inches from finished floor to center of plate.

B. Switches:
    1. Over 300 Volts:
        a. Where switches used in systems of more than 300 volts between conductors, are to be ganged in outlet boxes, provide switches having no exposed live parts or use barriers between the individual switches.

C. Receptacles:
    1. Provide GFCI receptacles as indicated on the Drawings.
        a. Provide weather resistant GFCI receptacles in all wet or damp areas.
            1) As specified in Section 16050 - Common Work Results for Electrical.
    2. Mount non-weatherproof receptacles vertically:
        a. Ground slot down.

3. Mount weatherproof receptacles horizontally:
   a. Neutral slot up.
4. 3-phase receptacles shall be consistent with respect to phase connection at the receptacle terminals. Correct errors in phasing at the source and not the receptacle.

D. Ensure all plates make a firm seal with wall for recessed mounted devices:
   1. Outside edges of plates parallel with building lines.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 REINSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL (NOT USED)

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16150

LOW VOLTAGE WIRE CONNECTIONS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Wire connecting devices.
   2. Terminations.
   3. Splices.
   4. Power Distribution Blocks

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. ASTM International (ASTM):
   1. D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape.

C. CSA International (CSA):
   1. C22.2 - No. 197-M1983 (R2208) - PVC Insulating Tape.

D. Underwriters Laboratories, Inc. (UL):
   1. 510 - Standard for Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
   2. 1953 - Outline of Investigation for Power Distribution Blocks.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. Provide a complete system of wiring connectors, terminators, fittings, etc. for a complete wiring system suitable for the cables and conductors used.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Catalog cutsheets.
   2. Installation instructions.

1.06 QUALITY ASSURANCE

A. All materials shall be UL listed.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.09 SEQUENCING

A. Conduct the initial fault current study as specified in Section 16305 - Electrical System Studies and submit results for Engineer's review.

B. After successful review of the initial fault current study, submit complete equipment submittal.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers for each type of technology are specified with the equipment in this Section.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

A. Control connections:
   1. Use insulated ring type wire terminators for connections to all screw terminals:
      a. With chamfered/funneled terminal barrel entry.
      b. Deep internal serrations.
      c. Long barrel design to reduce electrical resistance and increased insulator-barrel surface area to ensure that the insulator remains in contact with the barrel.

d. Electroplated-tin copper conductor.
e. Manufacturers: The following or equal:
1) Thomas & Betts, Sta-Kon.

2. For process equipment connections work from manufacturer's drawings.

B. Joints, splices, taps, and connections:
1. 600-volt conductors:
a. Use solderless connectors.
b. Use only plated copper alloy connectors or lugs:
1) Aluminum connectors or lugs are not acceptable for copper conductors.
c. Under those specific conditions where aluminum conductors have been allowed or are specified then the connectors for aluminum conductors shall be specifically designed for that purpose.
d. For wire No. 10 AWG and smaller use compression splice caps, with insulating caps:
1) Manufacturers: The following or equal:
a) Buchanan, 2006S or 2011S, with 2007 or 2014 insulating caps.
e. For wire No. 8 AWG and larger, use heavy duty copper compression connectors:
1) Manufacturers: One of the following or equal:
a) Burndy.
b) Thomas & Betts.
f. Heat shrink tubing:
1) Suitable for indoors, outdoors, overhead, direct burial or submerged applications.
2) Minimum shrink ratio: 4 to 1.
3) Continuous operating temperature: -55 degrees Celsius to 110 degrees Celsius.
4) Internally applied adhesive sealant.
5) Cross-linked polyolefin:
a) Manufacturers: One of the following or equal:
(1) 3M, ITCSN.
(2) Thomas & Betts, Shrink-Kon.

2. Instrumentation class cable splices:
a. Suitable for indoor, outdoors, weather exposed, direct buried, or submersed applications.
b. Utilizing an epoxy, polyurethane, and re-enterable compounds.
c. For use with shielded or unshielded plastic- and rubber-jacketed, signal, control, and power cables rated up to 1 kilovolt.
d. Two-part mold body with tongue and groove seams and built in spacer webbing.
e. Manufacturers: The following or equal:
1) 3M, Scotchcast 72-N.

C. Insulating tape:
1. General purpose insulating tape:
a. Minimum 7 mil vinyl tape.
b. Suitable for application in an ambient of -18 degrees Celsius (0 degrees Fahrenheit).
c. Operating range up to 105 degrees Celsius (220 degrees Fahrenheit).

d. Flame retardant, hot- and cold- weather resistant, UV resistant.
e. For use as a primary insulation for wire cable splices up to 600 VAC.
f. Meeting and complying with:
1) ASTM D3005 Type I.
2) UL 510.
3) CSA C22.2.
g. Manufacturers: The following or equal:
1) 3M, Scotch Number Super 33+.

2. General-purpose color-coding tape:
a. Minimum 7 mil vinyl tape.
b. Suitable for application on PVC and polyethylene jacketed cables.
c. For use indoors and outdoors in weather protected enclosures.
d. Available with the following colors:
1) Red.
2) Yellow.
3) Blue.
4) Brown.
5) Gray.
6) White.
7) Green.
8) Orange.
9) Violet.
e. For use as phase identification, marking, insulating, and harnessing.
f. Meeting and complying with:
1) UL 510.
2) CSA C22.2.
g. Manufacturers: The following or equal:
1) 3M, Scotch Number 35.

D. Power distribution blocks:
1. UL 1953 listed.
2. Interrupting ratings: Not less than the system maximum available fault current at the point of application.
3. Provide fuses or circuit breakers in enclosure as required to meet the fault current requirements.
4. Voltage rating: 600 VAC.
5. IP 20 finger safe enclosure.
6. Tin-plated aluminum or copper terminals suitable for copper conductors.
7. Manufacturers: One of the following or equal:
a. Eaton CHDB series.
b. Rockwell Automation 1492 PD series
c. Square D by Schneider Electric.

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Load connections:
   1. Connect loads to the circuits as indicated. Color-code all branch circuits as specified in Section 16123 - 600-Volt or Less Wires and Cables.

B. Zero to 600-volt systems:
   1. Make all connections with the proper tool and die as specified by the device manufacturer.
   2. Use only tooling and dies manufactured by the device manufacturer.
   3. Insulate all connections and splices with Scotch 33+ tape and Scotchfill, or pre-molded plastic covers, or heat shrink tubing and caps.
   4. Number all power and control wires before termination.

C. Motor connections (600 volts and below):
   1. Terminate all leads and wires with compression type ring lugs.
   2. Terminations on all motor leads, including leads that are connected together to accommodate the motor voltage, and the machine wires entering the motor terminal box from the power source, shall have ring type compression lugs.
   3. Cover bolted connectors with a heat shrinkable, cross-linked polyolefin material formed as a single opening boot:
      a. In damp and wet locations, use a complete kit containing mastic that shall seal out moisture and contamination.
      b. Shrink cap with low heat as recommended by manufacturer.
   4. Wire markers shall be readable after boot installation.
   5. Manufacturers: The following or equal:
      a. Raychem, MCK.

D. Power distribution terminal blocks:
   1. Connect circuit breakers on line side of power distribution terminal blocks as required to meet short circuit requirements.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL (NOT USED)

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16210

UTILITY COORDINATION

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Coordination with the utility companies to provide service.
   2. Contractor's responsibilities for connecting to utilities and providing utility service to the facilities.
   3. Descriptions of utility services required.

B. Utility contacts:
   1. Electric utility:
      a. Name: Scott Bozzoli.
      b. Utility: City of Ukiah - Electric Utility.
      c. Address: 1350 Hastings Rd, Ukiah CA 95482.
      d. Phone number: 707-467-5775.
      e. Fax number: N/A.
      f. E-mail: sbozzoli@cityofukiah.com.

1.02 REFERENCES

A. Underwriters' Laboratories, Inc. (UL).

1.03 DELEGATED DESIGN (NOT USED)

1.04 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Certification:
   1. Submit certification that the intended installation has been coordinated with the utility companies.
   2. Include a narrative description of the utility's requirements and points of connection, names and telephone numbers for contacts at the utilities.

C. Additional Requirements:
   1. Submit the following after utility coordination and before construction for engineering review:
      a. 12 kV underground conduit routing.
      b. MV vault location and dimensions.

1.05 QUALITY ASSURANCE

A. Materials and equipment used in performance of Electrical Work shall be listed or labeled by UL, or other equivalent recognized independent testing laboratory, for the class of service intended.

1.06 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.08 ADMINISTRATIVE REQUIREMENTS

A. Scheduling:
   1. General:
      a. Before start of Site Work, make arrangements for temporary electrical service as required.
   2. Electrical systems:
      a. Before bidding, Contact the utilities to determine the Work and materials that will be required from the Contractor, and all fees and permits that will be required, so that all utility systems furnished by the Contractor will be included in the bid.
      b. Coordinate Work with Engineer to minimize downtime of existing operating equipment and electrical distribution systems and to preclude unsafe operation:
         1) Notify Owner 10 days before power interruptions.
         2) Coordinate downtime with Owner and local electric utility.
      c. During the construction of the Project, the existing electrical service must remain fully functional in order to supply uninterrupted electrical power to the facility and its ancillary buildings and structures.
   3. Before commencing Site Work, coordinate underground conduit installations with other Work to eliminate conflicts and avoid interferences with other underground systems.

1.09 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL (NOT USED)

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Electrical service:
   1. Provide all Work and materials and bear all costs for providing temporary construction power and the permanent electrical service, including but not limited to:
      a. All Work and materials to complete the 12 kV system shown in drawings.

b. Contractor to cover cost of the following work to be performed by Ukiah Electric Utility (cost of work to be performed by Utility to be provided by City of Ukiah Electric Department):
    1) Installation of 12 kV conductors upon completion of conduit installation by Contractor.
    2) 12 kV switching procedures and loop configuration.
c. All permits and fees required by the electric utility.

B. General:
    1. Coordinate and obtain inspections and final installation approval from the serving utilities and other authorities having jurisdiction.

2.03 MANUFACTURERS (NOT USED)

2.04 MATERIALS

A. Provide materials in accordance with the applicable requirements of the utilities and as specified in these Specifications.

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT

A. Provide equipment in accordance with the applicable requirements of the utilities and as specified in these Specifications.

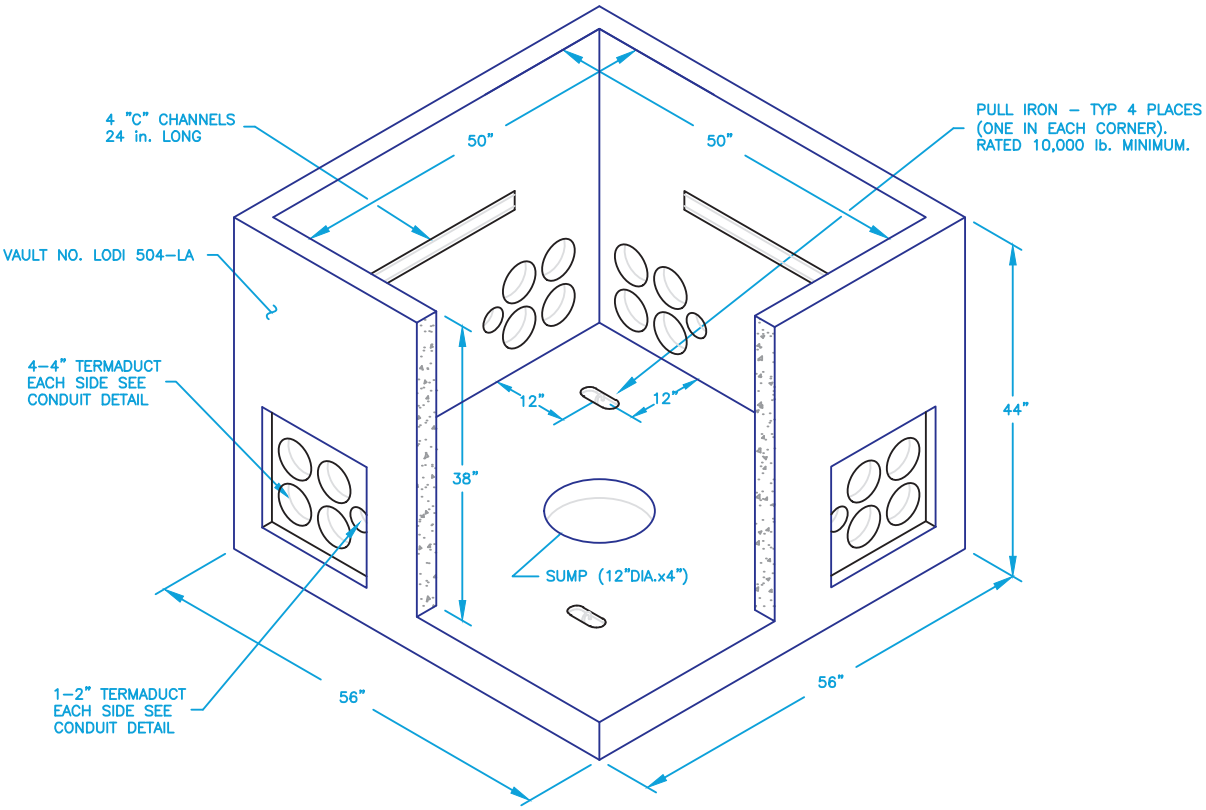
PART 3 EXECUTION

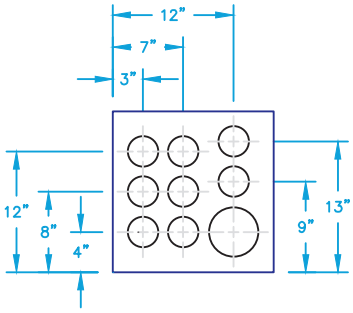
3.01 INSTALLATION

A. Reference Ukiah Electric Utility typical detail drawings provided at the end of this specification section for work on 12 kV cables and conduits.

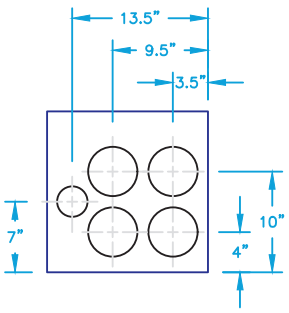
END OF SECTION

ATTACHMENT A - COUED VAULT CONSTRUCTION DETAILS





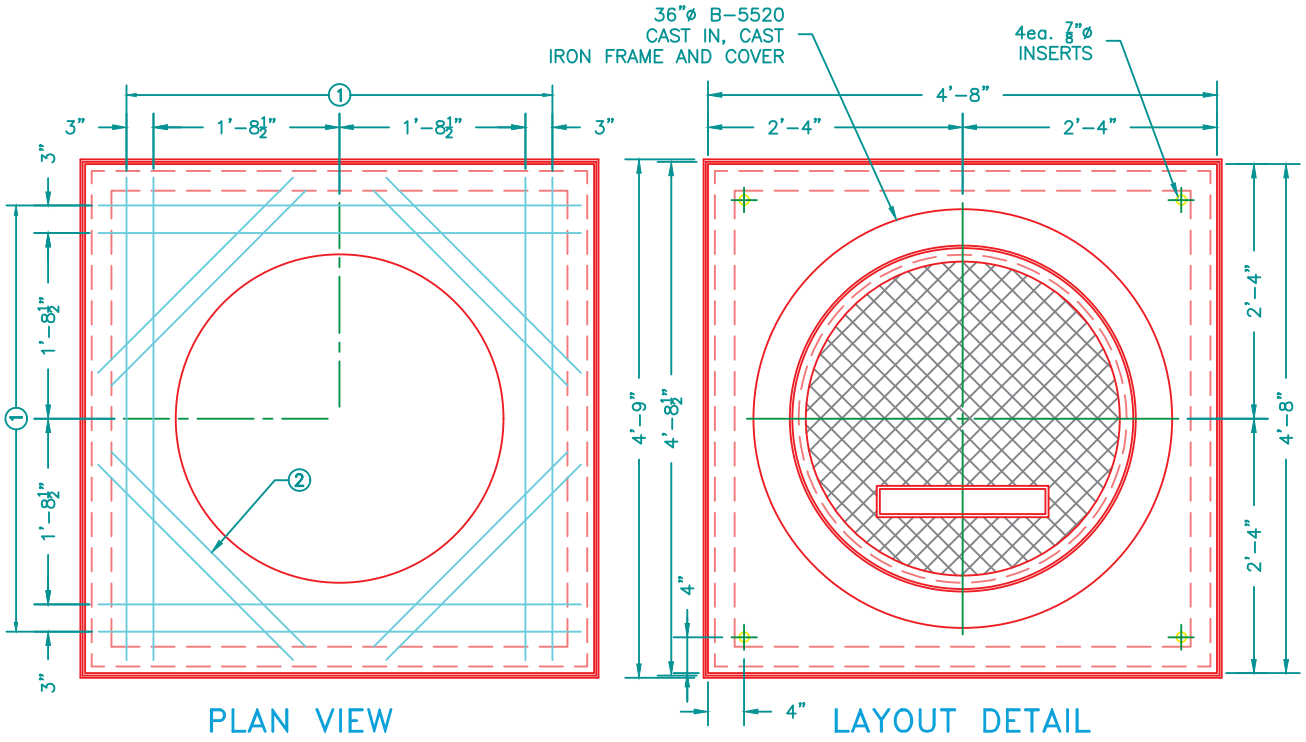
ALTERNATE CONDUIT DETAIL
8–2" AND 1–4"



STANDARD CONDUIT DETAIL
1–2" AND 4–4"

No.	REVISIONS	DATE	BY	CK'D	APP'D

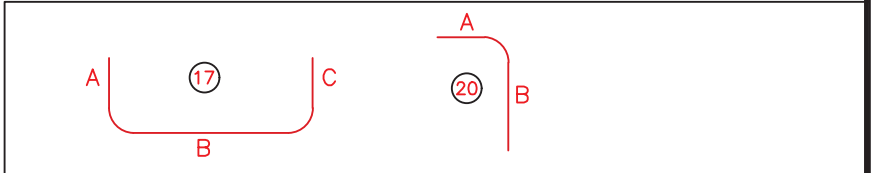
DATE: 8JUNE15	W/O #:	CONSTRUCTION STANDARD
DWG BY: SB		PRIMARY VAULT 504-LA
DESIGNED: SB	REVISION:	
APPROVED:	PAGE: 1 of 1	922 5679–2



GENERAL NOTES:

1. CONCRETE: f'c = 5,500 psi ULTIMATE COMPRESSIVE STRENGTH IN 28 DAYS.
2. REINFORCEMENT: A. REBAR: ASTM A706, GRADE 60
   B. STRENGTH Fy = 60,000 psi.
3. ALL CONCRETE JOINTS TO BE SEALED USING APPROVED JOINT SEALANT UNLESS OTHERWISE NOTED.
4. STRUCTURE DESIGNED FOR TRAFFIC H-20 LOADING PER ASTM C-857. (16,000 lb. WHEEL LOAD)

UNIT WEIGHT: 1.300#
(WITHOUT COVER)



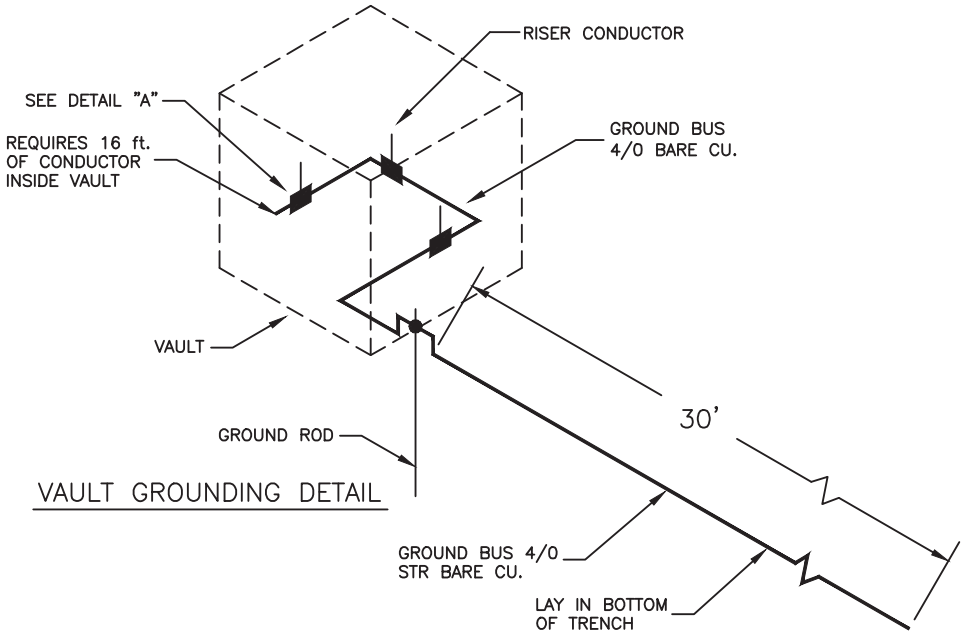
MARK	QTY	SIZE	LENGTH	TYPE	A	B	C	WEIGHT
②	8	5	2'-6"	STR				21#
①	8	6	4'-5"	STR				53#

CALL BEFORE YOU DIG USA 800-227-2600 — CITY UTILITIES, PACIFIC BELL, P.G.&E., CABLE TV

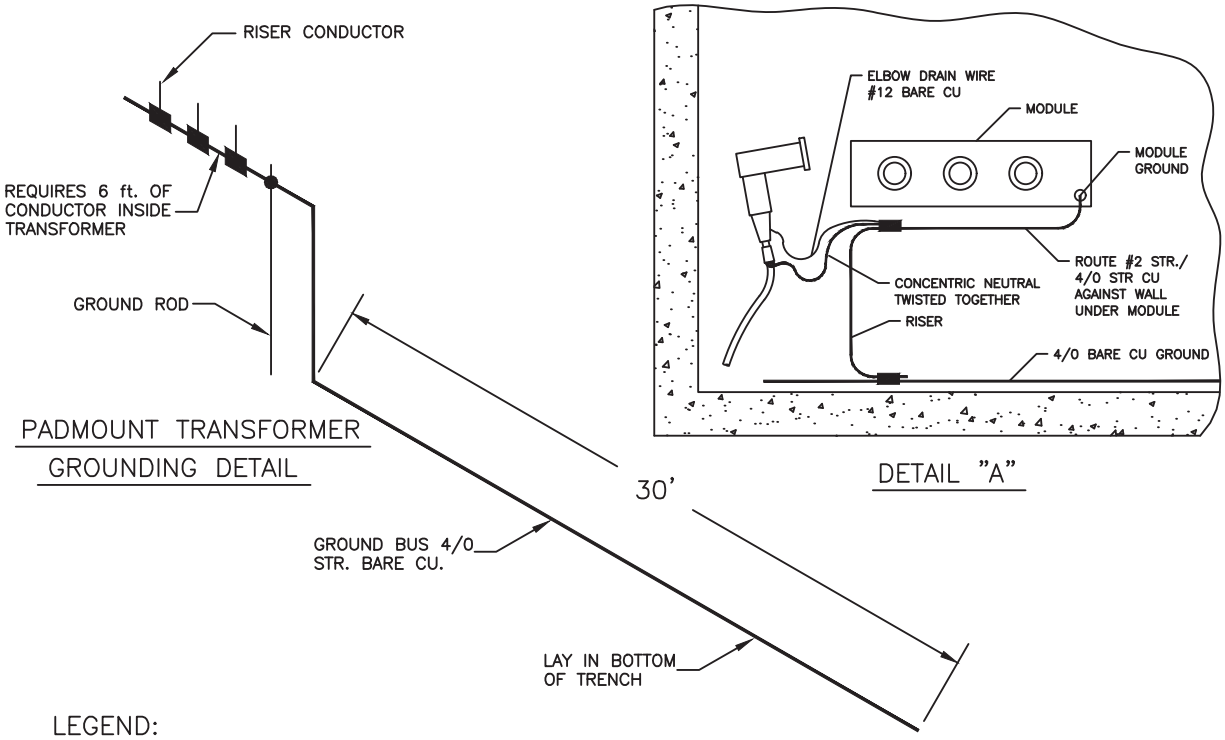
ELECTRIC UTILITY — CITY OF UKIAH — FOUNDED 1876

DATE: 8JUNE15	W/O #:	CONSTRUCTION STANDARD
DWG BY: SB		PRIMARY VAULT 504-FULL TRAFFIC
DESIGNED: SB	REVISION:	
APPROVED:	PAGE: 1 of 1	922 5683

ATTACHMENT B - COUED EQUIPMENT GROUNDING DETAILS



VAULT GROUNDING DETAIL



PADMOUNT TRANSFORMER GROUNDING DETAIL

DETAIL "A"

LEGEND:

- COPPER CRIMPIT
- GROUND ROD CLAMP

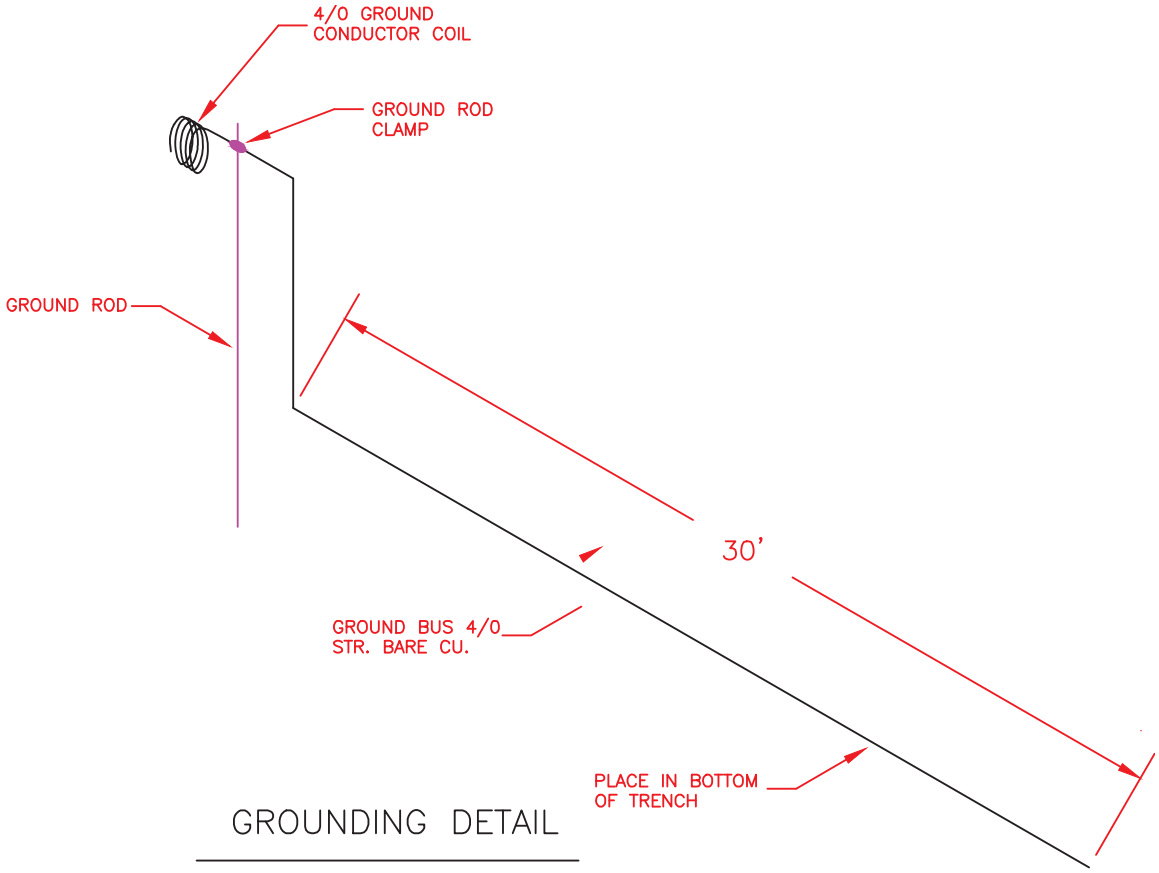
Drawing name: C:\Users\sbozzoli\appdata\local\temp\AcPublish_14856\Equipment Grounding 314 1007-1.dwg Plotted: Mar 28,2022 - 1:52pm

No.	REVISIONS	DATE	BY	CK'D	APP'D

CALL BEFORE YOU DIG 800-227-2600 (CITY UTILITIES, PACIFIC BELL, P.G.&E., CABLE TV)

ELECTRIC UTILITY (CITY OF UKIAH, FOUNDED 1876)

DATE: 04JAN11	W/O #:	CONSTRUCTION STANDARD
DWG BY: AMS		VAULT AND PADMOUNT EQUIPMENT GROUNDING
DESIGNED: AMS	REVISION:	
APPROVED:	PAGE: 1 of 1	314 1007



GROUNDING DETAIL

NOTE:

1. A COIL OF GROUND CONDUCTOR SHALL BE LEFT BEYOND THE GROUND ROD CLAMP ATTACHMENT. THE LENGTH OF GROUND CONDUCTOR NEEDED AT EACH TYPE OF EQUIPMENT LOCATION IS AS FOLLOWS:

MODULE ENCLOSURE	– 6 ft.
TRANSFORMER	– 6 ft.
VAULT	– 16 ft.
SWITCH	– 18 ft.

2. WHERE GROUND BUS IS TO BE INSTALLED AT PRIMARY VAULT LOCATIONS, THE GROUND ROD SHALL BE DRIVEN OUTSIDE OF THE PRIMARY VAULT. THE COIL OF GROUND CONDUCTOR SHALL BE PLACED INSIDE THE VAULT THROUGH A SEALED OPENING IN THE VAULT (SIDE).

3. THE GROUND ROD SHALL BE GALVANIZED STEEL OR COPPER CLAD STEEL NOT LESS THAN 5/8" IN DIAMETER AND 8 ft. IN LENGTH.

4. A GROUND ROD CLAMP SHALL BE USED TO CONNECT THE GROUND CONDUCTOR TO THE GROUND ROD. THE GROUND ROD CLAMP SHALL BE A 3/4", #8– 1/0 STR COPPER CLAMP, JOSLYN CAT. NO. J8493AB OR APPROVED EQUAL.

Drawing name: C:\Users\sbozzoli\appdata\local\temp\AcPublish_14856\Equipment Grounding 314 1008.dwg Plotted: Mar 28,2022 - 1:49pm

No.	REVISIONS	DATE	BY	CK'D	APP'D

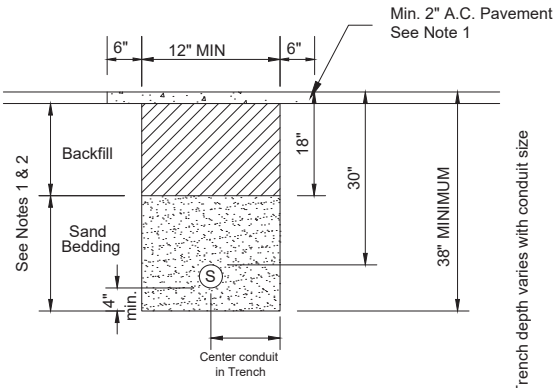
CALL BEFORE YOU DIG 800-227-2600 USA — CITY UTILITIES — PACIFIC BELL — P.G.&E. — CABLE TV

ELECTRIC UTILITY — CITY OF UKIAH — FOUNDED 1876

DATE: 30APR12	W/O #:	CONSTRUCTION STANDARD
DWG BY: AMS		PADMOUNT EQUIPMENT GROUNDING
DESIGNED: AMS	REVISION:	
APPROVED:	PAGE: 1 of 1	314 1008

ATTACHMENT C - COUED TYPICAL TRENCH DETAIL

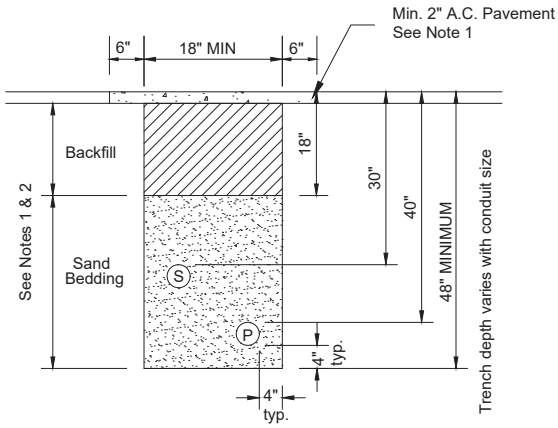
SECONDARY CONDUIT



LEGEND

S = Secondary conduit

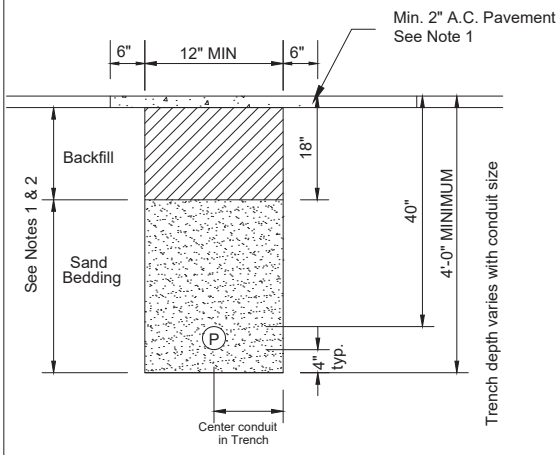
PRIMARY AND SECONDARY CONDUITS



LEGEND

S = Secondary Conduit
P = Primary conduit

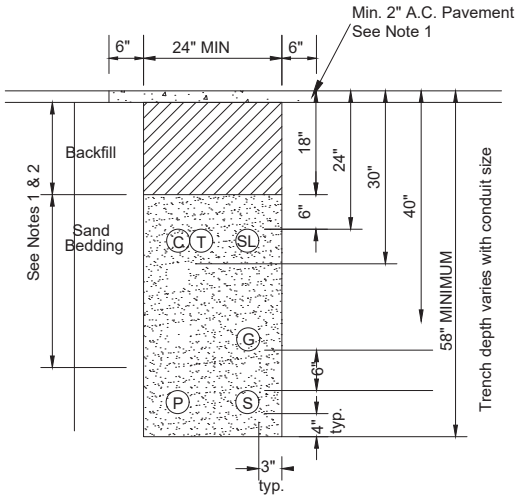
PRIMARY CONDUIT



LEGEND

P = Primary conduit

JOINT UTILITY TRENCH



NOTES:

1. USE CLASS 2 BASE AS BACKFILL IN IMPROVED AREAS. NATIVE BACKFILL MAY BE USED IN UNIMPROVED AREAS OUTSIDE CITY RIGHT-OF-WAY.

2. MINIMUM SEPARATION FROM OTHER UTILITY CONDUITS: 12" WHEN PARALLEL, 6" WHEN CROSSING.

LEGEND

C = Cable TV
G = Gas
T = Telephone
S = Secondary Conduit
P = Primary Conduit
SL = Street Light Conduit

MINIMUM CLEARANCES BETWEEN UTILITIES

UTILITY	G	T	C	S	P
G	NA	12"	12"	6"	12"
T	12"	NA	1"	1"	12"
C	12"	1"	NA	12"	12"
S	6"	12"	12"	NA	3"
P	12"	12"	12"	3"	NA
SL	6"	12"	12"	1"	3"

CODE	PART NO.	MATERIAL	QTY	INITIALS

CODE	PART NO.	MATERIAL	QTY	INITIALS

FILL OUT THE QTY COLUMN AND INITIAL.

EMPLOYEE #:

NOTE:

CONSTRUCTION STANDARD:

TYPICAL TRENCH DETAILS

APPROVED BY:

DATE	DRAWN	DESIGN	UPDATED
01-11-22	XX	XX	XX

CITY OF UKIAH
ELECTRIC UTILITY DEPARTMENT

DRAWING NO.	000-0000	0
	SHEET 0 OF 0	REVISION

SECTION 16222

LOW VOLTAGE MOTORS UP TO 500 HORSEPOWER

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Low voltage motors up to 500 horsepower (hp).

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. American Bearing Manufacturers Association (ABMA):
   1. 9 - Load Ratings and Fatigue Life for Ball Bearings.
   2. 11 - Load Ratings and Fatigue Life for Roller Bearings.

C. American Petroleum Institute (API):
   1. 670 - Machinery Protection Systems.

D. ASTM International (ASTM).
   1. B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.

E. Institute of Electrical and Electronic Engineers (IEEE):
   1. 43 - IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery.
   2. 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators.
   3. 303 - Recommended Practice for Auxiliary Devices for Rotating Electrical Machines in Class I, Division 2 and Zone 2 Locations.
   4. 841 - IEEE Standard for Petroleum and Chemical Industry-Premium-Efficiency, Severe Duty, Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors - Up to and Including 370 kW (500 hp).
   5. 1349 - Guide for Application of Electric Motors in Class I, Division 2 and Class I, Zone 2 Hazardous (Classified) Locations.

F. National Electrical Manufacturers' Association (NEMA):
   1. MG-1 - Motors and Generators.
   2. MG-2 - Safety Standard for Construction and Guide for Selection, Installation, and Use of Electric Motors and Generators.

G. Underwriters Laboratories Inc. (UL):
   1. 674 - Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. Furnish and install electric motors and accessories as specified in this Section and the Sections specifying driven equipment to provide a complete and operable installation.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Submit completed motor data sheets for each motor supplied:
   1. As specified in Attachment A - Motor Data Sheet.
   2. Manufacturer's or other data sheets are not acceptable.

C. Product data:
   1. Descriptive bulletins.
   2. Machine tag and loop number as indicated on the Drawings and in the specification section number of the driven machine.
   3. Complete electrical data.
   4. Manufacturer's storage recommendations.
   5. Torque, current, and power factor versus speed curves:
      a. At 100 percent rated voltage for all full voltage started and VFD-driven motors.
      b. For motors on reduced voltage start at 70, 80, 90, and 100 percent rated voltage.
   6. Accessories data:
      a. Power factor correction capacitors:
         1) Size in KVAR, for all motors not connected to variable frequency drives.
      b. Motor winding heaters:
         1) Voltage.
         2) Watts.
      c. Winding temperature detectors:
         1) Type.
         2) Rating.
      d. Moisture detectors.
   7. Mechanical data:
      a. Bearing design and bearing life calculations.
      b. Resonant frequencies for all VFD-driven motors 50 hp or greater.

D. Shop drawings:
   1. Motor weight.
   2. Frame size.
   3. Conduit box(es), size(s), and location(s).
   4. Outline drawings with dimensions.
   5. Installation details for the project seismic criteria.

E. Test reports:
   1. Factory test reports with test reference standard identified.

F. Certification:
   1. When motors are driven by variable speed drive systems, submit certification that selected motor:
      a. Is capable of satisfactory performance under the intended load.
      b. Meets the requirements of the latest edition of NEMA MG-1 Part 31.

G. Calculations:
   1. Where site conditions specified in Section 01850 - Design Criteria exceed manufacturer's ratings, provide derating calculations for each motor.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store motors in accordance with the manufacturer's recommendations.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTION (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. US Motors.
   2. General Electric.
   3. Reliance.
   4. Toshiba.
   5. Baldor.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

A. 3-phase induction motors - general:
   1. Voltage:
      a. All motors 1/2 hp and larger shall be rated 460 V, 3-phase unless otherwise indicated on the Drawings.
      b. Dual voltage motors rated 230/460 V, 3-phase are acceptable provided all leads are brought to the conduit box.
   2. Motors driving identical machines shall be identical.
   3. All motors greater than 1 hp and up to 500 hp shall meet the "NEMA Premium Efficiency" percent listed in NEMA MG-1.
   4. Horsepower as indicated on the Drawings:
      a. Horsepower ratings indicated on the Drawings are based on vendor's estimates. Provide motors sized for the load of the actual equipment furnished without operating in the service factor.
   5. Service factor:
      a. 1.15 service factor on sine wave power.
      b. 1.0 when driven by VFD.
   6. Torque:
      a. Provide motors that develop sufficient torque for acceleration to full speed at voltage 10 percent less than motor nameplate rating.
      b. When started using reduced voltage starters:
         1) Provide motors that develop sufficient torque for acceleration to full speed.
      c. NEMA Design B except where driven load characteristics require other than normal starting torque:
         1) In no case shall starting torque or breakdown torque be less than the values specified in NEMA MG-1.
   7. Enclosures:
      a. As specified in the individual equipment Specifications or in this Section.
      b. Totally enclosed fan cooled:
         1) Cast iron conduit box.
         2) Tapped drain holes with Type 304 stainless steel plugs for frames 286 and smaller, and automatic breather and drain devices for frames 324 and larger.
      c. Explosion-proof:
         1) Tapped drain holes with corrosion resistant plugs for frames 286 and smaller and automatic breather and drain devices for frames 324 and larger.
      d. Lifting devices: All motors weighing 265 pounds (120 kilograms) or more shall have suitable lifting devices for installation and removal.
   8. Manufactured with cast iron frames in accordance with NEMA MG-1 or manufacturer's standard material for the specified rating.
   9. Nameplates:
      a. Provide all motors with a permanent, stainless steel nameplate indelibly stamped or engraved with:
         1) NEMA standard motor data.
            a) Indicate compliance with NEMA MG-1 Part 31 for inverter duty motors.
         2) AFBMA bearing numbers and lubrication instructions.

10. Hardware:
    a. Type 304 stainless steel.
11. Conduit boxes:
    a. Cast iron or stamped steel.
    b. Split from top to bottom.
    c. Provide gaskets at the following interfaces:
        1) Frames and conduit boxes.
        2) Conduit boxes and box covers.
    d. Rotatable through 360 degrees in 90-degree increments.
        1) Where available based on the size of the conduit box.
    e. Exceeding the dimensions defined in NEMA MG-1.
    f. Provide grounding lugs inside conduit boxes for motor frame grounding.
12. Motor bearings:
    a. Antifriction.
    b. Regreasable and initially filled with grease for horizontal motors and vertical motors per manufacturer's standard design.
    c. Bearings and lubrication suitable for ambient temperature and temperature rise.
    d. Suitable for intended application and have ABMA L-10 rating life of 60,000 hours or more.
    e. Fit bearings with easily accessible grease supply, flush, drain, and relief fittings using extension tubes where necessary.
    f. Where specified in the equipment Specifications, provide split-sleeve type hydrodynamic radial bearings. Provide a bearing isolator to protect bearings from contaminants.
13. Insulation systems:
    a. Motors installed in ambient temperatures between 40 degrees Celsius and 50 degrees Celsius:
        1) Provide Class F insulation.
        2) Design temperature rise consistent with Class B insulation.
        3) Rated to operate at an ambient temperature of 50 degrees Celsius at the altitude where the motor will be installed.
14. Motor leads:
    a. Insulated leads with non-wicking, non-hydroscopic material. Class F insulation.
15. Noise:
    a. Maximum operating noise level in accordance with NEMA MG-1.

B. Vertical motors:
    1. Enclosures:
        a. Totally enclosed fan cooled (TEFC) for motors 200 hp and less installed outdoors.
    2. Thrust bearings:
        a. Selected for combined rotor and driven equipment loads.
        b. Coordinate with driven equipment supplier for maximum vertical thrust of driven equipment.
    3. Anti-reverse ratchet.

C. Motors driven by variable frequency drives:
    1. Compatible with the variable frequency drives specified.
    2. Inverter duty rated and labeled.

3. Meet the requirements of NEMA MG-1 Part 31.
4. Winding insulation meets the requirements of NEMA MG-1 Part 31.4.4.2.
5. Capable of running continuously at 1/10th of full speed, with no harmful effects or overheating.
6. Shaft grounding ring:
    a. Provide a shaft grounding ring for each VFD-driven motor.
    b. Aluminum frame and internal components.
    c. Conductive microfiber brushes.
    d. Maintenance free design.
    e. Aegis Bearing Protection ring as manufactured by Electro Static Technology or equal.

D. Motors installed in corrosive environments:
1. Nameplate indicating conformance to IEEE 841.
2. Stator double dipped in varnish and baked.
3. Stator and rotor coated with corrosion resistant epoxy.
4. Frame, brackets, fan guard and conduit box coated with minimum of 2 coats of epoxy paint.
5. Withstand salt spray tests in accordance with ASTM B117.

E. Single-phase motors:
1. Capacitor start type rated for operation at 115 volts, 60 hertz, unless otherwise specified or as indicated on the Drawings.
2. Totally enclosed fan cooled (TEFC) motors manufactured in accordance with NEMA MG 1.
3. Ball bearings: Sealed.
4. 1/2 hp or less fan motors:
    a. Split-phase or shaded pole type when standard for the equipment.
    b. Open type when suitably protected from moisture, dripping water, and lint accumulation.
5. Wound rotor or commutator type single-phase motors only when their specific characteristics are necessary for application and their use is acceptable to the Engineer.
6. Integral overload protection.

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Motor winding heaters:
1. Provide all 3-phase motors with belted or cartridge space heaters mounted within the motor enclosure.
2. Space heater rating shall be 120 volts, single-phase, unless otherwise indicated on the Drawings.
3. Power leads for heaters wired into conduit box.
4. Installed within motor enclosure adjacent to core iron.

B. Winding temperature detectors:
   1. Provide factory installed winding temperature detector with leads terminating in the conduit box:
   2. Temperature switches with normally closed contacts as indicated on the Drawings.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Install motors in accordance with manufacturer's instructions.

B. Install shaft grounding ring on VFD-driven motors in accordance with the manufacturer’s instructions.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING AND PROCESS START-UP

A. As specified in Section 01756 - Commissioning.

B. Factory testing:
   1. Motors less than 250 hp:
      a. Perform manufacturer’s standard production tests including but not limited to:
         1) No load current.
         2) High potential test.
         3) Winding resistance.
      b. Furnish copies of standard test reports on prototype or identical units.

3.08 FIELD QUALITY CONTROL

A. Before start-up, perform insulation resistance test on each motor furnished or installed on this project:
   1. Windings energized to 1,000 volts DC for 1 minute.

2. Resistance measured at the end of the test, recorded, and submitted to the Engineer for review.
3. Inform the Engineer of any unusual or unacceptable test results.
4. This test is in addition to the acceptance tests in Section 16950 - Field Electrical Acceptance Tests.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

END OF SECTION

ATTACHMENT A - MOTOR DATA SHEET

MOTOR DATA SHEET

MOTOR/ EQUIPMENT TAG _____ MOTOR NUMBER _____

SPECIFICATION NUMBER OF DRIVEN MACHINE _____

MOTOR NAMEPLATE DATA

MANUFACTURER _____ MODEL/SERIES _____ MODEL NO. _____

FRAME _____ ENCLOSURE _____ NEMA DESIGN _____

HP _____ SERVICE FACTOR _____ RPM _____

INSULATION CLASS _____ VOLTS _____ FULL LOAD AMPS _____

AMBIENT TEMP _____ PHASE _____ NO LOAD AMPS _____

DESIGN TEMP _____ HERTZ _____ LOCK ROTOR AMPS _____

INRUSH CODE LETTER _____

	100% LOAD	75% LOAD	50% LOAD
GUARANTEED MINIMUM EFFICIENCIES:			
GUARANTEED MINIMUM POWER FACTOR:			

MAXIMUM SIZE OF POWER FACTOR CORRECTION CAPACITOR: _____ KVAR

ACCESSORIES

MOTOR WINDING HEATER _____ VOLTS _____ WATTS

WINDING THERMAL PROTECTION

WINDING TEMP SWITCHES (YES/NO) _____

RTD:

TYPE _____ QUANTITY PER PHASE _____ # OF WIRES _____

NOMINAL RESISTANCE _____ NOMINAL TEMP _____ COEFFICIENT _____

RECOMMENDED ALARM _____ DEGREES CELSIUS RECOMMENDED TRIP _____ DEGREES CELSIUS

SPECIAL APPLICATIONS

INVERTER DUTY* (YES/NO) _____ PART WINDING (YES/NO) _____ WYE - DELTA (YES/NO) _____

2 SPEED, 1 WINDING (YES/NO) _____ 2 SPEED, 2 WINDING (YES/NO) _____

AREA CLASSIFICATION:

CLASS _____ DIVISION _____ GROUP _____ TEMP CODE _____

*Conforms to NEMA MG-1 Part 31.

SECTION 16262

VARIABLE FREQUENCY DRIVES 0.50 - 50 HORSEPOWER

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Variable frequency drives (VFD) 0.5 to 50 horsepower for control of NEMA Design B squirrel cage induction motors.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. International Organization for Standardization (ISO):
   1. 9001 - Quality Management Systems - Requirements.

C. National Electrical Manufacturers Association (NEMA):
   1. MGI, Part 31 – Motors with higher peak voltage capability.

D. Underwriters' Laboratories (UL):
   1. 508A - Standard for Safety for Industrial Control Panels.
   2. 508C - Standard for Power Conversion Equipment.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Specific definitions:
   1. Point of common coupling: the point of common coupling for all harmonic calculation and field measurements for both voltage and current distortions is defined as the closest directly connected bus supplying power to the VFD.

1.04 SYSTEM DESCRIPTION

A. Design requirements:
   1. Each VFD system consists of all components required to meet the performance, protection, safety, testing, and certification criteria of this Section.
   2. The VFD system:
      a. Is a fully integrated package.
      b. Includes all material necessary to interconnect all VFD system elements, even if shipped separately.
   3. Coordinate bearing protection methods with the supplier of the driven equipment.

B. Any modifications to a standard product necessary to meet this Section shall be made only by the VFD manufacturer:
   1. Each VFD shall be completely factory pre-wired, assembled, and then tested as a complete system by the VFD manufacturer to ensure a properly coordinated, fully integrated drive system.
   2. The VFD shall be capable of operating standard NEMA Design B motors. It is the responsibility of the VFD manufacturer to ensure that the drive will not damage motor insulation due to high carrier frequency, reflected wave, dv/dt or other drive electrical characteristics based upon the installed conditions:
      a. Provide equipment necessary to mitigate potential damage to motor insulation.
      b. Motors as specified in Section 16222 - Low Voltage Motors up to 500 Horsepower.

C. Performance:
   1. Operating envelope:
      a. Speed and torque requirements:
         1) Provide a variable torque or constant torque VFD as required by the driven load.
         2) The VFD shall be capable of producing a variable alternating voltage/frequency output to provide continuous operation over the 40 to 200 percent (25 to 120 hertz) speed range.
      b. Current requirements:
         1) Full rated current output on a continuous basis.
         2) Variable torque VFD:
            a) Minimum 110 percent current overload for 1 minute.
         3) Constant torque VFD:
            a) Minimum 150 percent current overload for 1 minute.
   2. Minimum VFD system efficiency:
      a. 96 percent when operating at the rated kW output.
      a. VFD system efficiency shall be calculated as follows:

$$\text{Efficiency (\%)} = \frac{\text{Power (Load)}}{\text{Power (Supply)}} \text{ x } 100$$

      Power (Load) is the total power measured at the output terminals of the drive system, including VFD, output filters, or transformers. Power (Supply) is the total power measured at the input terminals of the VFD including input filters, line reactors, isolation transformers, harmonic distortion attenuation equipment and auxiliary equipment (e.g., controls, fans) for complete system operation.

   3. Total power factor:
      a. Minimum of 0.96 lagging across the entire speed range.
      b. At no speed shall the VFD have a leading power factor.
   4. Frequency accuracy:
      a. Minimum of within 0.01 percent.
   5. Speed regulation:
      a. Minimum of within 0.5 percent across the entire speed range.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures:
   1. Custom prepared by the VFD manufacturer and specific for the equipment furnished.

B. Product data:
   1. Manufacturer of the VFD.
   2. Manufacturer of all components of the VFD.
   3. Dimensions:
      a. Height.
      b. Width.
      c. Depth.
      d. Weight.
   4. Nameplate schedule.
   5. Bill of material.
   6. Ratings:
      a. Voltage.
      b. Phase.
      c. Input current.
      d. Output current.
      e. Interrupting rating.
      f. Momentary current rating.
   7. List of recommended spare parts.
   8. Catalog cutsheets for major components.
   9. Design data:
      a. Efficiency and power factor values.
      b. Certification that the drive is sized for the full nameplate motor horsepower and current of the driven load at the installed altitude and ambient temperature.
      c. Certification that based upon VFD design, cable length to motor, and motor dielectric insulation level that the VFD will not damage motor insulation due to carrier frequency, reflected wave, dv/dt, or other VFD produced characteristics.
      d. Certification that all electronic circuits and printed circuit boards are conformally coated.
   10. For equipment installed in structures designated as seismic design category C, D, E, or F submit the following as specified in Section 01850 - Design Criteria:
      a. Manufacturer’s statement of seismic qualification with substantiating test data.
      b. Manufacturer’s special seismic certification with substantiating test data.

C. Shop drawings:
   1. Complete plan and elevation drawings showing:
      a. All dimensions.
      b. Panel, sub-panel, and component layout indexed to the bill of material.
      c. Conduit connections.
   2. Block diagram showing the basic control and protection systems specifying the protection, control, trip and alarm functions, the reference signals and commands and the auxiliary devices.

3. Complete schematic, wiring and interconnection diagrams showing connections to both internal and external devices:
    a. Include terminal number and wire numbers.
4. Complete single-line and 3-line diagrams including, but not limited to, circuit breakers, motor circuit protectors, contactors, instrument transformers, meters, relays, timers, control devices, and other equipment comprising the complete system:
    a. Clearly indicate device electrical ratings on the drawings.

D. Control descriptions and control logic program:
1. Provide control descriptions describing the full control functionality to be incorporated into the programming of the drive including the following:
    a. Functionality in local and remote.
    b. Software and hardware interlocks.
    c. Control response upon loss and restoration of power.
2. Provide complete register list of all IO available to the Plant PCS.
3. Submit the completed control logic program for each and every device supplied.
4. Submit a list of all networking address tables.
5. Submit configuration settings in accordance with actual motor and field equipment being supplied.

E. Installation instructions:
1. Detail the complete installation of the equipment including rigging, moving, and setting into place.
2. For equipment installed in structures designated as seismic design category A or B:
    a. Provide manufacturer’s installation instructions and anchoring details for connecting equipment to supports and structures.
3. For equipment installed in structures designated as seismic design category C, D, E, or F:
    a. Provide project-specific installation instructions and anchoring details based on support conditions and requirements to resist seismic and wind loads as specified in Section 01850 - Design Criteria.
    b. Submit anchoring drawings with supporting calculations.
    c. Drawings and calculations shall be stamped by a professional engineer registered in the state where the Project is being constructed.

F. Operation and maintenance manuals:
1. Spare parts list with supplier names and part numbers.
2. Startup and commissioning instructions and data.
3. Operating manuals:
    a. Submit operating instructions and a maintenance manual presenting full details for care and maintenance of each model of VFD provided under this Contract.
4. Operating instructions:
    a. Written descriptions detailing the operational functions of all controls on the front panel.

5. Maintenance manual:
    a. Furnish maintenance manuals with instructions covering all details pertaining to care and maintenance of all equipment as well as identifying all parts.
    b. Manuals shall include, but are not limited to the following:
        1) Adjustment and test instructions covering the steps involved in the initial test, adjustment, and start-up procedures.
        2) Detailed control instructions which outline the purpose and operation of every control device used in normal operation.
        3) All schematic wiring and external diagrams:
            a) Furnish drawings in a reduced 11-inch by 17-inch format that are fully legible at that size.

G. Test forms and reports.
    1. Submit complete factory acceptance test procedures and all forms used during the test.
    2. Submit complete control description checklist and IO checklist organized by VFD for use during the control logic portion of the witnessed factory acceptance testing as well as the witnessed field acceptance testing.

H. Manufacturer's Certificate of Installation and Functionality Compliance.

I. Manufacturer's field reports:
    1. Report listing the setting of all VFD adjustable parameters and their values after start-up.

J. Record Documents:
    1. Certified Record Documents of equipment with information listed above.

1.06 QUALITY ASSURANCE

A. Qualifications:
    1. Any third-party certification, safety or protection requirements shall be applied to the VFD system as a whole. Certification or protection of system elements or individual components by themselves is not acceptable.
    2. VFDs shall be UL 508C listed and labeled:
        a. UL 508C for individual units.
        b. UL 508A for VFD systems in control panels.
    3. Variable frequency drives shall be manufactured by the VFD manufacturer at its own facility which shall have a quality assurance program that is certified in conformance with ISO 9001.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Ship the VFDs and associated equipment to the job site on a dedicated air ride vehicle that will allow the Contractor to utilize onsite offloading equipment:
    1. VFDs shall be delivered to the site preassembled and wired.

B. Furnish temporary equipment heaters within the VFD to prevent condensation from forming.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.09 SEQUENCING

A. Conduct Programming and Data Exchange Coordination Meeting.

B. Conduct factory acceptance test and submit certified test results for Engineer's review.

C. Ship equipment to project site after successful completion of factory acceptance test.

D. Assemble equipment in the field.

E. Conduct field acceptance test and submit results for Engineer's review.

F. Submit Manufacturers Certificate of Installation and Functionality Compliance.

G. Conduct Owner's training sessions.

H. Commissioning and process start-up as specified in Section 01756 - Commissioning.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM START-UP

A. The VFD manufacturer shall be responsible for start-up of the VFDs in the presence of the equipment suppliers, Contractor, Engineer, and Owner.

1.13 OWNERS INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE

A. Spare parts:
   1. The following spare parts shall be furnished:
      a. 1 set of all power and control fuses for each VFD.
      b. One complete main control key pad for each type and rated size of VFD.
      c. 1 spare fan for each VFD unit.
      d. 2 sets of ventilation filters for each VFD unit (if applicable in VFD cabinet louvers).
      e. 1 set of thyristors or power electronics for each type and rated size of VFD.
      f. Any special dedicated tools for emergency service and troubleshooting.
      g. All hardware and software required for configuration, maintenance, troubleshooting, and inquiry of all drive parameters.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. ABB ACS-880.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

A. General:
   1. Sinusoidal pulse width modulated (PWM) type drive.
      a. 6-pulse insulated gate bipolar transistor (IGBT) power section.
      b. Microprocessor based controls.
      c. Line reactors.
      d. Load reactor or dv/dt filter as required by motor cable length.

B. Ratings:
   1. Voltage:
      a. Input voltage as indicated on the Drawings.

C. Operational features:
   1. Protective features:
      a. Provide the following minimum protective features:
         1) Motor overload protection.
         2) Instantaneous overcurrent.
         3) Instantaneous overvoltage.
         4) Undervoltage.
         5) Power unit overtemperature.
         6) Phase loss.
         7) VFD output short circuit.
   2. Control mode:
      a. Operation in either a constant volts/hertz or sensorless vector mode:
         1) The control mode selectable using the programming keypad.
   3. Frequency control:
      a. Minimum of 3 selectable skip frequencies with adjustable bandwidths.
      b. Programmable minimum frequency.
      c. Programmable maximum frequency.
   4. Acceleration/deceleration:
      a. Separately adjustable acceleration and deceleration rates:
         1) Each rate adjustable from 0.01 to 1,800 seconds.
   5. Spinning load:
      a. The VFD shall be capable of determining the speed and direction of a spinning load, “catch” the load and accelerate or decelerate it without damage to the load.

6. Programmable loss of signal:
    a. Upon loss of speed reference the VFD shall be programmable to either:
        1) Stop.
        2) Maintain current speed.
        3) Default to pre-selected speed.
7. Power interrupt ride-through:
    a. The VFD shall be capable of continuous operation in the event of a power loss of 5 cycles or less.
8. Inputs/Outputs:
    a. Manufacturer's standard number the following:
        1) Analog inputs:
            a) Configurable as either 0 to 10 volts or 4 to 20 milliamperes.
        2) Analog outputs:
            a) Programmable 4 to 20 milliamperes isolated.
        3) Discrete inputs:
            a) Programmable.
        4) Discrete outputs:
            a) Programmable.
            b) Form C relay contacts.
        5) Potentiometer 3-wire input.
    b. Provide additional inputs/outputs as required to meet the control functions indicated on the Drawings.
9. Communications:
    a. Provide each VFD with a EtherNet I/P communications interface module.
10. Automatic control:
    a. PID capability utilizing an internal or external setpoint:
        1) Selectable setpoint source.
11. Diagnostics:
    a. Store a minimum of 4 fault conditions in non-volatile memory on a first in-first out basis.
    b. Operational parameters stored at the time of the fault:
        1) Operating frequency.
        2) Drive status.
        3) Power mode.
    c. Fault memory accessible via RS-232, RS-422, or RS-485.
12. Automatic restart:
    a. User selectable automatic restart feature allowing the VFD to restart following a momentary power failure or other VFD fault:
        1) Programmable for up to 9 restart attempts.
        2) Adjustable time delay between restart attempts.

2.06 COMPONENTS

A. Enclosure:
    1. NEMA Type 12 free-standing or floor mounted.
    2. Provide cooling devices required to maintain the VFD within the manufacturer's specified temperature limits for the Project conditions:
        a. Provide cooling device failure alarm.

B. Power disconnect:
   1. Flange-mounted thermal magnetic circuit breaker.
   2. Lockable in the OFF position.

C. Input Reactor:
   1. 3 percent input line reactor.

D. Output Device:
   1. 3 percent output load reactor.
   2. dV/dt filter:
      a. Common mode reduction: 30 percent minimum.
      b. Motor terminal peak voltage limit: 150 percent of dc bus voltage with a motor lead length up to 1,000 feet.
      c. Carrier frequency range: up to 12 khz.
      d. Efficiency: 98 percent minimum.
      e. Class H insulation minimum.

E. Keypad:
   1. Provide each VFD with a keypad for programming and control.
   2. Keypad requirements:
      a. Password security to protect drive parameters.
      b. Mounted on the door of the VFD enclosure.
      c. Back-lit LCD:
         1) Minimum of 2 lines with a minimum of 16 characters per line.
      d. Programming and display features language: English.
      e. Capable of displaying the following parameters:
         1) Speed (percent).
         2) Output current (amperes).
         3) Output frequency (hertz).
         4) Input voltage.
         5) Output voltage.
         6) Total 3-phase kilowatt.
         7) Kilowatt-hour meter.
         8) Elapsed run time meter.
         9) Revolutions per minute.
         10) Direct current bus voltage.
   3. In addition to all keys required for programming, provide the following controls on the keypad:
      a. Auto/manual selector.
      b. Start pushbutton.
      c. Stop pushbutton.
      d. Jog pushbutton.
      e. Speed increment.
      f. Speed decrement.
      g. Forward/reverse selector.
      h. Run LED indicator.
      i. Program LED indicator.
      j. Fault LED indicator.
   4. Provide the VFD with the hardwired controls as indicated on the Drawings.

F. Control power transformer:
   1. Furnish a control power transformer mounted and wired inside the VFD enclosure.
   2. With primary and secondary fusing.
   3. Sized to power all VFD controls and options as well as any external devices indicated on the Drawings including the motor winding heater.

2.07 ACCESSORIES

A. Metal oxide varistors:
   1. Provide protection for the VFD against:
      a. Line transients: 5,000 volt peak minimum.
      b. Line to ground transients: 7,000 peak minimum.

B. Conformal coating:
   1. Provide conformal coating material applied to electronic circuitry and printed circuit boards to act as a protection against moisture, dust, temperature extremes, and chemicals such as H_2S and chlorine.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES

A. Enclosure finish shall be manufacturer's standard gray.

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Install the equipment in accordance with the accepted installation instructions and anchorage details to meet the seismic and wind load requirements at the Project site.

B. General:
   1. Furnish all cables, conduit, lugs, bolts, expansion anchors, sealants, and other accessories needed to complete the installation of the VFD (free-standing or within motor control center).
   2. Assemble and install the VFD in the locations and with the layouts indicated on the Drawings.
   3. Perform work in accordance with manufacturer's instructions and shop drawings.
   4. Furnish components and equipment as required to complete the installation.

5. Replace any hardware lost or damaged during the installation or handling to provide a complete installation.
6. Install free-standing enclosures on a raised concrete housekeeping pad:
    a. Provide structural leveling channels in accordance with the manufacturer's recommendations to provide proper alignment of the units.
    b. Weld and/or bolt the VFD frame to the leveling channels.
7. Provide openings in top or bottom of the VFD (free-standing or within motor control center) enclosure for conduit only, no additional openings will be allowed:
    a. Improperly cut holes will require that the entire panel be replaced:
        1) No hole closers or patches will be allowed.
8. Bundle circuits together and terminate in each unit:
    a. Tie with nylon wire ties.
    b. Label all wires at each end with wire numbers shown on the approved control drawings.
    c. All connections to and from the VFD (free-standing or within motor control center) enclosure must be made via terminal blocks.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

B. Source testing (Factory Acceptance Tests):
    1. Owner and Engineer will witness the Factory Acceptance Test as specified in Section 16050 - Common Work Results for Electrical.
    2. General:
        a. Incoming inspection of components and raw materials based on strategic supplier base and experience.
        b. All VFDs furnished under this Section shall be tested and inspected as specified below. Testing of VFDs based on sampling plans is not allowed.
        c. The testing procedures specified are the minimum acceptable requirements. The manufacturer may perform additional tests at its discretion.
    3. Failure of any component during testing requires repair of the faulted component and complete retest.
    4. Tests:
        a. Perform manufacturer's standard factory acceptance tests.

C. Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.

D. Owner training:
    1. As specified in Sections 01756 - Commissioning and 16050 - Common Work Results for Electrical.

3.08 FIELD QUALITY CONTROL

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Provide the services of a VFD manufacturer representative for startup assistance and training:
   1. Inspection and field adjustment:
      a. Supervise the following and submit written certification that the equipment and controls have been properly installed, aligned, adjusted, and readied for operation.
   2. Startup field testing:
      a. Provide technical direction for testing, checkout, and startup of the VFD equipment in the field.
      b. Under no circumstances are any portions of the drive system to be energized without authorization from the manufacturer's representative.

3.09 ADJUSTING

A. Make all adjustments as necessary and recommended by the manufacturer, Engineer, or testing firm.

B. Provide the services of a VFD manufacturer factory technician to make all drive parameters and protective device settings:
   1. Protective device settings provided by the VFD manufacturer in accordance with the manufacturer of the driven equipment requirements.
   2. Provide documentation of VFD settings included but not limited to:
      a. Minimum speed.
      b. Maximum speed.
      c. Skip speeds.
      d. Current limit.
      e. Acceleration time.
      f. Deceleration time.

C. Programming:
   1. Manufacturer/supplier may contract with the project Programmer for portions of the tasks below.
   2. Provide all gateway communications between the drive to the Owner's control system as required.
   3. Provide all control logic as indicated in the control descriptions.
   4. Configure all network communications with applicable security settings, IP addresses and any other addressing tables required to provide a fully functioning system.
   5. Coordinate all IP addresses with the Owner.
   6. Coordinate data exchange approach for efficient communications to the Owner's control and maintenance systems. This effort will include a coordination meeting to discuss the data exchange approach including formatting and mapping.
   7. Provide witnessed source testing to prove out all Overload control logic as well as interaction with Owner’s control and maintenance systems at the supplier's facility. ICSC/Programmer shall attend witnessed testing.

3.10 CLEANING

A. As specified in Section 16050 - Common Work Results for Electrical.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16265

REDUCED HARMONIC VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Reduced harmonic 18 pulse or active front end, variable frequency drives (VFD), 60 to 500 hp for control of standard NEMA Design B squirrel cage induction motors.

1.02 REFERENCES

A. Definitions:
   1. AFE: Active Front End.
   2. ULH: Ultra-Low Harmonics
   3. IGBT: Insulated Gate Bipolar Transistor.
   4. VFD: Variable Frequency Drive.

B. Standards:
   1. National Electrical Manufacturers Association (NEMA):
      a. 250 - Enclosures for Electrical Equipment (1,000 V Maximum).
   2. Underwriters' Laboratories, Inc. (UL):
      a. 508A - Standard for Safety for Industrial Control Panels.

1.03 DELEGATED DESIGN

A. As specified in Section 01357 - Delegated Design Procedures.

B. Anchoring and bracing.

1.04 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures:
   1. Custom prepared by the VFD manufacturer and specific for the equipment furnished.

B. Product data:
   1. Manufacturer of the VFD.
   2. Manufacturer of all components of the VFD.
   3. Dimensions:
      a. Height.
      b. Width.
      c. Depth.
   4. Weight.
   5. Nameplate schedule.
   6. Bill of material.

7. Ratings:
    a. Voltage.
    b. Phase.
    c. Input current.
    d. Output current.
    e. Interrupting rating.
    f. Momentary current rating.
8. Catalog cutsheets for major components.
9. Surge protection data.
10. Design data:
    a. Efficiency and power factor values.
    b. Certification that the drive is sized for the full nameplate motor hp and current (at rated RPM) of the driven load at the installed altitude.
    c. Certification that based upon VFD design, cable length to motor, and motor dielectric insulation level that the VFD will not damage motor insulation due to carrier frequency, reflected wave, dv/dt, or other VFD produced characteristics.
    d. Certification that all electronic circuits and printed circuit boards are conformably coated.
    e. Certification that the VFD will operate with all power sources (including alternate utilities and on-site generation when applicable).
11. List of recommended spare parts.
12. For equipment installed in structures designated as seismic design category C, D, E, or F submit the following as specified in Section 01850 - Design Criteria:
    a. Manufacturer’s statement of seismic qualification with substantiating test data.
    b. Manufacturer’s special seismic certification with substantiating test data.

C. Shop drawings:
1. Complete plan and elevation drawings showing:
    a. All dimensions.
    b. Panel, sub-panel and component layout indexed to the bill of material.
    c. Conduit connections.
    d. Required clearance around equipment.
2. Block diagram showing the basic control and protection systems identifying the protection, control, trip and alarm functions, the reference signals and commands and the auxiliary devices.
3. Complete schematic, wiring and interconnection diagrams showing connections to both internal and external devices:
    a. Wiring diagrams shall include terminal number and wire numbers.
4. Complete 1-line and 3-line diagrams including, but not limited to, circuit breakers, motor circuit protectors, contactors, instrument transformers, meters, relays, timers, control devices, and other equipment comprising the complete system:
    a. Device electrical ratings shall be clearly indicated on the Drawings.

D. Delegated design submittals:
   1. Anchoring and bracing: Provide project-specific calculations based on support conditions and requirements to resist loads specified in Section 01850 - Design Criteria:
      a. To structures for equipment installed in structures designated as seismic design category C, D, E, or F.
      b. For equipment installed outdoors.

E. Installation instructions:
   1. Detail the complete installation of the equipment including rigging, moving, and setting into place.
   2. Provide manufacturer's installation instructions.

F. Commissioning submittals:
   1. As specified in Section 01756 - Commissioning, including the following:
      a. Manufacturer's representative qualifications.
      b. Certificates:
         1) Requirements as specified in this Section.
      c. Test Plans:
         1) Test requirements as specified in this Section.
      d. Test Reports.
      e. Manufacturer's representatives field notes and data.
      f. Owner training.

G. Certifications:
   1. Certification letter from the VFD manufacturer stating that the VFD(s) are capable of operating with all new and existing sources (utility sources and on-site generation in possible operating configurations).
   2. Certification letter from the VFD manufacturer stating that the VFD(s) are capable of operating with all new and existing VFDs in the existing and new distribution system.

H. Control descriptions and control logic program:
   1. Provide control descriptions describing the full control functionality to be incorporated into the programming of the drive including the following:
      a. Functionality in local and remote.
      b. Software and hardware interlocks.
      c. Control response upon loss and restoration of power.
   2. Provide complete register list of all IO available to the Plant PCS.
   3. Submit the completed control logic program for each and every device supplied.
   4. Submit a list of all networking address tables.
   5. Submit configuration settings in accordance with actual motor and field equipment being supplied.

I. Installation instructions:
   1. Detail the complete installation of the equipment including rigging, moving, and setting into place.
   2. Provide manufacturer's installation instructions.

J. Calculations:
    1. Harmonic study:
        a. A preliminary harmonic analysis shall be performed:
            1) A power system short circuit ratio of 20 shall be used.
            2) All VFDs shall be assumed to be operating at maximum speed and maximum load.
            3) The short circuit current (ISC) utilized for the harmonic analysis calculations is defined as:
                a) ISC = 20 * (Sum Total Full Load Amps of all VFDs).
        b. A separate harmonic analysis shall be performed based on the standby generator system. Coordinate with the generator manufacturer and the VFD manufacturer so the actual characteristics for the generator supplied, or existing, for this Project are used in the harmonic analysis.
    2. Detailed calculations or details of the actual physical testing performed on the VFD to prove the VFD is suitable for the seismic conditions at the Project Site.

K. Test forms and reports:
    1. Submit complete field acceptance test procedures and all forms used during the test:
        a. Testing performed by independent organization as specified in Section 16950 - Field Electrical Acceptance Tests.
    2. Submit complete control description checklist and IO checklist organized by VFD for use during the control logic portion of the witnessed field acceptance testing.

L. Record documents:
    1. Certified record documents of all equipment with information listed above.

M. Manufacturer's field reports:
    1. Certification letter from the VFD manufacturer that the VFD(s) has been inspected and installed in accordance with the manufacturer's requirements.
    2. Report listing the setting of all VFD adjustable parameters and their values after start-up.
    3. Certification letter from the VFD manufacturer stating that the VFD(s) are programmed to avoid system resonances when connected to the standby generator and will not conflict with generator system voltage regulator.

N. Operation and maintenance manuals:
    1. Spare parts list with supplier names and part numbers.
    2. Start-up and commissioning instructions and data.
    3. Complete bill of material indexed to the drawings, identifying the catalog or part numbers, manufacturer, and quantities of components of the VFD system.
    4. Operating manuals:
        a. Submit operating instructions and a maintenance manual presenting full details for care and maintenance of each model of VFD provided under this Contract.
    5. Operating instructions:
        a. The written descriptions shall detail the operational functions of all controls on the front panel including keypad functions and parameters.

6. Maintenance manual:
    a. Furnish maintenance manuals with instructions covering all details pertaining to care and maintenance of all equipment as well as identifying all parts.
    b. Manuals shall include but are not limited to the following:
        1) Adjustment and test instructions covering the steps involved in the initial test, adjustment and start-up procedures.
        2) Detailed control instructions that outline the purpose and operation of every control device used in normal operation.
        3) All schematic wiring and external diagrams:
            a) Furnish drawings in a fully legible reduced 11-inch by 17-inch format.

1.05 QUALITY ASSURANCE

A. Qualifications:
    1. Any third-party certification, safety or protection requirements shall be applied to the VFD system as a whole. Certification or protection of system elements or individual components by themselves is not acceptable.
    2. VFDs shall be UL 508C listed and labeled.
    3. VFD systems (packaged VFD panels) shall be UL 508A listed and labeled.
    4. VFDs shall be manufactured by the VFD manufacturer at its own facility, which shall have a quality assurance program that is certified in accordance with ISO 9001.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Ship VFDs to the job site on a dedicated air ride vehicle that will allow the Contractor to utilize on site off-loading equipment:
    1. VFDs shall be delivered to the site pre-assembled and wired.
    2. Ship each VFD with 2 tamperproof accelerometers that record the maximum shock and vibration experienced by the VFD during shipping and handling.

B. Furnish temporary equipment heaters within the VFD to prevent condensation from forming.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.08 ADMINISTRATIVE REQUIREMENTS

A. Sequencing:
    1. Conduct Programming and Data Exchange Coordination Meeting.
    2. Assemble equipment in the field.
    3. Conduct field acceptance tests including harmonic testing and submit results for Engineer’s review:
        a. All utility power sources and on-site generation shall be installed and operable for field test.
    4. Submit manufacturer’s certification that equipment has been properly installed and is fully functional for Engineer’s review.

5. Conduct Owner's training sessions.
6. Commissioning and process start-up as specified in Section 01756 - Commissioning.

1.09 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

B. Extended warranty:
   1. Provide an additional 2 years manufacturer's warranty from date of startup for all equipment provided under this Section.

1.10 SYSTEM START-UP

A. The VFD manufacturer shall be responsible for start-up of the VFDs in the presence of the equipment suppliers, Contractor, Engineer, and Owner.

1.11 MAINTENANCE

A. Maintenance service: Manufacturer shall describe the field service system available to support the proposed VFD system. As a minimum describe:
   1. Type of technical support available (e.g., system engineering and technician).
   2. Location of field service personnel.
   3. Field service daily rates in dollars per hour and dollars per day.
   4. Guaranteed response times to service requests.

B. Spare parts:
   1. The following spare parts shall be furnished:
      a. 1 complete VFD of each size furnished.
      b. 1 set of all power and control fuses for each VFD.
      c. 1 spare fan for each VFD unit.
      d. 2 sets of ventilation filters for each VFD unit (if applicable in VFD cabinet louvers).
      e. Any special dedicated tools for emergency service and troubleshooting.
      f. All hardware and software required for configuration, maintenance, troubleshooting and inquiry of all drive parameters.

PART 2 PRODUCTS

2.01 GENERAL (NOT USED)

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Provide equipment and components that are fully rated for the site elevation and operating environment where the equipment will be installed as specified in Section 01850 - Design Criteria and as indicated on the Drawings.

B. Non-conditioned spaces:
   1. For equipment located in non-conditioned spaces, provide additional temperature conditioning equipment to maintain the equipment temperature

within a band of 10 degrees Fahrenheit above the minimum operating temperature and 10 degrees Fahrenheit below maximum operating temperature.

C. Outdoor installations:
   1. Provide conditioning equipment incorporated into the equipment to maintain the enclosures within the equipment manufacturer's specified operating ranges.

D. Design requirements:
   1. Each VFD system shall consist of all components required to meet the performance, protection, safety, testing and certification criteria of this Section.
   2. The VFD system:
      a. Is a fully integrated package.
      b. Includes all material necessary to interconnect VFD system elements, even if shipped separately.
   3. Any modifications to a standard product necessary to meet this Section shall be made only by the VFD manufacturer.
   4. Each VFD shall be completely factory pre-wired, assembled and then tested as a complete package by the VFD manufacturer to ensure a properly coordinated, fully integrated drive system.
   5. The VFD shall be capable of operating standard NEMA Design B motors. It is the responsibility of the VFD manufacturer to ensure that the drive will not damage motor insulation due to high carrier frequency, reflected wave, dv/dt or other drive electrical characteristics:
      a. The VFD manufacturer shall furnish equipment necessary to mitigate potential damage to motor insulation.
      b. Coordinate bearing protection methods with the supplier of the driven equipment.
      c. Motors as specified in Section 16222 - Low Voltage Motors up to 500 hp.

E. Performance:
   1. Operating envelope:
      a. Speed and torque requirements:
         1) Provide a variable torque or constant torque VFD as required by the driven load.
         2) The VFD shall be capable of producing a variable alternating voltage/frequency output to provide continuous operation over the 40 to 110 percent (25 to 66 hertz) speed range.
      b. Current requirements:
         1) Provide 100 percent of rated output current on a continuous basis.
         2) Variable torque VFD:
            a) Minimum 110 percent current overload for 1 minute.
         3) Constant torque VFD:
            a) Minimum 150 percent current overload for 1 minute.

2. Harmonics:
    a. The VFD shall meet the following distortion limits at 2 percent line voltage unbalance measured at the input terminals of the VFD:
        1) Voltage harmonics: The maximum allowable total harmonic distortion, THD, for each VFD shall not exceed 5 percent.
        2) Current harmonics: The maximum allowable total harmonic current distortion limit, TDD, for each VFD shall not exceed 5 percent as measured at the input terminals of the VFD system.
3. Efficiency:
    a. VFD system minimum efficiency shall be 93 percent at rated kilowatt output of the VFD. VFD system efficiency shall be calculated as follows:

$$Efficiency\ (\%) = \frac{Power\ (Load)}{\text{Power (Supply)}}\ X\ 100$$

    b. Power:
        1) Load power is the total 3-phase power measured at the output terminals of the drive system, including the output filter.
        2) Supply power is the total power measured at the input terminals of the VFD including phase shifting transformer or active front end components and auxiliary equipment (e.g., controls, fans) for complete system operation.
4. Total power factor:
    a. Minimum of 0.96 lagging across the entire speed range.
    b. Under no operating conditions shall the VFD have a leading power factor.
5. Frequency accuracy:
    a. Minimum of within 0.01 percent.
6. Speed regulation:
    a. Minimum of within 0.5 percent across the entire speed range.
7. Capable of working with all available power sources (utility and on-site generation) and with all new and existing VFDs.

2.03 MANUFACTURERS

A. One of the following or equal:
    1. ABB ACS880-3x (ULH Drive)

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT

A. General:
    1. Sinusoidal pulse width modulated, (PWM), voltage source type drive shall consist of the following:
        a. Rectifier section.
        b. Direct current link with capacitors.
        c. Insulated gate bipolar transistor (IGBT), inverter section.
        d. Microprocessor based controls.
        e. Output filter.

2. Rectifier section:
    a. Active front end rectifier (non-regenerative) – Ultra-low Harmonics:
        1) IGBT based converter module:
            a) Six IGBTs minimum.
        2) Inductor/capacitor/inductor, LCL, harmonic filter:
            a) Low pass filter.
            b) Installed within same enclosure as VFD.

B. Ratings:
1. Voltage:
    a. Input voltage: 480 Volts plus or minus 10 percent, 3-phase, 3-wire, 60 hertz.
    b. Solidly grounded.
2. Short-circuit rating:
    a. 65 kA RMS symmetrical.

C. Operational features:
1. Protective features:
    a. Annunciated at the keypad and available via network connection.
    b. Include the following protective features:
        1) Motor overload protection.
        2) Instantaneous overcurrent.
        3) Instantaneous overvoltage.
        4) Undervoltage.
        5) Power unit overtemperature.
        6) Phase loss.
        7) VFD output short circuit.
        8) VFD output ground fault.
        9) Blown fuse with blown fuse indication.
        10) IGBT protection.
        11) Cooling fan failure.
        12) Component failure.
        13) Motor overtemperature protection:
            a) Winding and bearing temperature:
                (1) From 100 ohm, platinum RTDS.
                (2) Quantity as specified in Section 16222 - Low Voltage Motors up to 500 hp and the driven equipment specification or as indicated on the Drawings.
2. Control mode:
    a. The VFD shall operate in either a constant volts/hertz or sensorless vector mode. Selectable using the programming keypad.
3. Frequency control:
    a. Minimum of 3 selectable skip frequencies with adjustable bandwidths.
    b. Programmable minimum frequency.
    c. Programmable maximum frequency.
4. Acceleration/Deceleration:
    a. Separately adjustable acceleration and deceleration rates.
    b. Each rate shall be adjustable from 0.01 to 1,800 seconds.
5. Spinning load:
    a. Capable of determining the speed and direction of a spinning load, “catch” the load and accelerate or decelerate it without damage to the load.

6. Programmable loss of signal:
    a. Upon loss of reference speed signal the VFD shall be programmable to either stop, maintain current speed, or default to preselected speed.
7. Power interrupt ride through:
    a. Capable of continuous operation in the event of a power loss of 5 cycles or less.
8. Hardwired inputs and outputs:
    a. Manufacturer's standard number the following:
        1) Analog inputs:
            a) Configurable as either 0 to 10 volts or 4 to 20 milliamperes.
        2) Analog outputs:
            a) Programmable 4 to 20 milliamperes isolated.
        3) Discrete inputs:
            a) Programmable.
        4) Discrete outputs:
            a) Programmable.
            b) Form C relay contacts.
        5) Potentiometer 3-wire input.
    b. Provide additional inputs and outputs as required to meet the control functions indicated on the Drawings.
9. Communications:
    a. Provide each VFD with a EtherNet/IP communications interface module.
    b. The use of gateways is not acceptable.
10. Real-time clock:
    a. Capable of providing time-stamped events.
    b. Set locally or via a remote controller.
    c. Programmable for day, month, year, local time zones in hours, minutes and seconds.
11. Diagnostics:
    a. Minimum of 4 fault conditions in memory on a first in-first out basis.
    b. Time stamped.
    c. Operating frequency, drive status and power mode shall also be stored at the time of the fault.
    d. Fault memory shall be maintained in the event of a power outage.
    e. The fault memory shall be accessible via Ethernet/IP.
12. Automatic restart:
    a. User selectable, automatic restart feature allowing the VFD to restart following a momentary power failure or other VFD fault:
        1) Programmable for up to 9 automatic restart attempts with an adjustable time delay between restart attempts.

2.07 COMPONENTS

A. Enclosure:
    1. NEMA Type 12.
    2. Provide cooling devices required to maintain the VFD within the manufacturer's specified temperature limits for the Project conditions:
        a. Provide cooling device alarm.

B. Power disconnect:
   1. Flange mounted thermal magnetic circuit breaker:
      a. Lockable in the OFF position.

C. Output filter:
   1. 3 percent load reactor.

D. Keypad:
   1. Furnished with a keypad for programming and control.
   2. Password security to protect drive parameters.
   3. Mounted on the door of the VFD.
   4. Back-lit LCD with a minimum of 2 lines of a minimum of 16 characters each.
   5. Programming and display features language: English.
   6. Capable of displaying the following parameters:
      a. Speed (percent).
      b. Input current (amperes).
      c. Output current (amperes).
      d. Output frequency (hertz).
      e. Input voltage.
      f. Output voltage.
      g. Total 3-phase kilowatt.
      h. Kilowatt hour meter.
      i. Elapsed run time meter.
      j. Revolutions per minute.
      k. Direct current bus voltage.
   7. In addition to all keys required for programming, the keypad shall have the following:
      a. Automatic/Manual selector.
      b. Start pushbutton.
      c. Stop pushbutton.
      d. Jog pushbutton.
      e. Speed increment.
      f. Speed decrement.
      g. Forward/Reverse selector.
      h. RUN indicator.
      i. PROGRAM indicator.
      j. FAULT indicator.
      k. DRIVE READY indicator.
      l. Diagnostics.
   8. Provide the VFD with the hardwired controls indicated on the Drawings.

E. Control power transformer:
   1. Furnish a control power transformer mounted and wired inside the drive enclosure:
      a. Primary and secondary fusing.
   2. Size the transformer to supply power to all VFD controls and options as well as any external devices indicated on the Drawings including the motor winding heater.

2.08 ACCESSORIES

A. Surge protection:
   1. Metal oxide varistors:
      a. Provide protection for the VFD against:
         1) Line transients: 5,000-volt peak minimum.
         2) Line to ground transients: 7,000-volt peak minimum.

B. Conformal coating:
   1. Provide conformal coating material applied to electronic circuitry and printed circuit boards to act as protection against moisture, dust, temperature extremes, and chemicals such as H_2S and chlorine.

C. Air filters:
   1. Mounted on the outside of the VFD enclosure:
      a. Replaceable without requiring that the VFD be turned off or the door opened.
   2. Located on the front or top of the VFD enclosure:
      a. Side or rear mounted air filters are not acceptable.

2.09 FABRICATION (NOT USED)

2.10 FINISHES

A. Enclosure finish shall be manufacturer's standard gray.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION

A. Anchoring and bracing to structures:
   1. Prepare equipment anchor setting template(s) and use to position anchors during construction of supporting structure(s).
   2. Install anchors of type and material indicated on approved anchoring designs.
   3. Install anchors with embedment indicated on approved anchoring designs.

3.03 INSTALLATION

A. Install the equipment in accordance with the accepted installation instructions and anchorage details.

B. General:
   1. Furnish all cables, conduit, lugs, bolts, and other accessories needed to complete installation of the VFD (free-standing or within motor control center).
   2. Assemble and install the VFD in the locations and with the layouts indicated on the Drawings.
   3. Perform Work in accordance with the manufacturer's instructions and shop drawings.

4. Furnish components, and equipment as required to complete the installation.
5. Replace any hardware lost or damaged during the installation or handling to provide a complete installation.
6. Install free-standing enclosures on a raised concrete housekeeping pad:
    a. Provide structural leveling channels in accordance with the manufacturer's recommendations to provide proper alignment of the units.
    b. Weld and/or bolt the VFD frame to the leveling channels.
7. Provide openings in top or bottom of the VFD (free-standing or within motor control center) enclosure for conduit only, no additional openings will be allowed:
    a. Improperly cut holes will require that the entire panel be replaced:
        1) No hole closers or patches will be allowed.
8. Bundle circuits together and terminate in each unit:
    a. Tie with nylon wire ties. As specified in Section 16123 - 600-Volt or Less Wires and Cables.
    b. Label all wires at each end with wire numbers shown on the approved Control Drawings.
    c. All connections to and from the VFD (free-standing or within motor control center) enclosure must be made via terminal blocks.

3.04 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

B. Installation Verification:
    1. Furnish Manufacturer's Certificate of Installation Verification.

C. Functional Testing:
    1. As specified in Section 16950 - Field Electrical Acceptance Tests.

D. Owner Training:
    1. Perform Owner training as specified in Section 01756 - Commissioning.
    2. Topics:
        a. Operation topics limited to:
            1) Auto/Manual Control of VFD's.
        b. Maintenance topics limited to:
            1) Auto/Manual Control of VFD's.
            2) Troubleshooting VFD's.
    3. Number of sessions:
        a. Operations: 1 Session – 1 Hour.
        b. Maintenance: 1 Session – 2 Hours.

3.05 FIELD QUALITY CONTROL

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Provide the services of a VFD manufacturer representative for start-up assistance and training:
    1. Inspection and field adjustment:
        a. Supervise the equipment installation and confirm controls have been properly installed, aligned, adjusted, and readied for operation.
        b. Configure AFE drives for all new and existing sources (utility sources and on-site generation in possible operating configurations).
    2. Start-up field testing:
        a. Provide technical direction for testing, checkout, and startup of the VFD equipment in the field.
        b. Under no circumstances are any portions of the drive system to be energized without authorization from the manufacturer's representative.
        c. Compliance with the following specified parameters shall be verified by the VFD manufacturer:
            1) Motor terminal voltage:
                a) Make field measurements at the motor connection box.
                b) Make measurements of the full speed range of the VFD.
                c) Make measurements with a recording type oscilloscope.
            2) Harmonics:
                a) Make field measurements at the input terminals of the VFD with and without the VFD in operation.
                b) Harmonic testing shall include utility power as well as generator standby power.
                c) Make measurements with a recording type harmonic analyzer displaying individual and total harmonic currents and voltages:
                    (1) Record currents and voltages for a minimum of 10 minutes.
                    (2) Analyzers using snapshots are not acceptable.
        d. All utility sources and on-site generation shall be operational for start-up field testing.

3.06 ADJUSTING

A. Make all adjustments as necessary and recommended by the manufacturer, Engineer, or testing firm.

B. Provide the services of a VFD manufacturer factory technician to make all drive parameter and protective device settings:
    1. Protective device settings provided by the VFD manufacturer in accordance with the manufacturer of the driven equipment requirements.
    2. Provide documentation of VFD settings included but not limited to:
        a. Minimum speed.
        b. Maximum speed.
        c. Skip speeds.
        d. Current limit.
        e. Acceleration time.
        f. Deceleration time.
        g. Carrier frequency.

C. Programming:
   1. Manufacturer/supplier may contract with the project Programmer for portions of the tasks below.
   2. Provide network communication card between the drive to the Owner's control system as required.
   3. Provide all control logic as indicated in the control descriptions.
   4. Configure all network communications with applicable security settings, IP addresses and any other addressing tables required to provide a fully functioning system.
   5. Coordinate all IP addresses with the Owner.
   6. Coordinate data exchange approach for efficient communications to the Owner's control and maintenance systems. This effort will include a coordination meeting to discuss the data exchange approach including formatting and mapping.

END OF SECTION

SECTION 16272

DRY-TYPE TRANSFORMERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Enclosed dry-type transformers:
      a. Rated 1 to 1,000 kilovolt-amperes, single and 3-phase.
      b. Primary voltage 600 volts and below.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Institute of Electrical and Electronics Engineers (IEEE):
   1. 389 - IEEE Recommended Practice for Testing Electronics Transformers and Inductors.
   2. C57.12.01 - IEEE Standard General Requirements for Dry-Type Distribution and Power Transformers Including Those with Solid Cast and/or Resin Encapsulated Windings.
   3. C57.96 - IEEE Guide for Loading Dry-Type Distribution and Power Transformers.

C. Underwriters Laboratory (UL):
   1. 1561 - Standard for Dry-Type General Purpose and Power Transformers.

D. U.S. Department of Energy (DOE):
   1. 10 CFR Part 431 - Energy Efficiency Program for Certain Commercial and Industrial Equipment.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTIONS

A. Provide 3-phase or 1-phase, 60 hertz dry-type with voltage ratings, kilovolt-ampere capacities, and connections as indicated on the Drawings:
   1. Transformers shall provide full capacity at the Project elevation and environmental conditions as specified in Section 01850 - Design Criteria after all derating factors have been applied.
   2. Suitable for continuous operation at full rating with normal life expectancy in accordance with IEEE C57.96.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Catalog cutsheets.
   2. Nameplate data.
   3. Dimensions:
      a. Height.
      b. Width.
      c. Depth.
   4. Inrush current.
   5. Insulation system and temperature constraints.
   6. Number and rating of taps.
   7. Sound levels.
   8. Connection diagrams:
      a. Primary.
      b. Secondary.
   9. BIL rating.
   10. Required clearances.
   11. Percent impedance.
   12. Efficiency.
   13. Certification of full capacity capability at the Project elevation and ambient conditions.
   14. For equipment installed in structures designated as seismic design category C, D, E, or F submit the following as specified in Section01610 - Design Criteria:
      a. Manufacturer's statement of seismic qualification with substantiating test data.
      b. Manufacturer's special seismic certification with substantiating test data.

C. Installation instructions:
   1. Detail the complete installation of the equipment including rigging, moving, and setting into place.
   2. For equipment installed in structures designated as seismic design category A or B:
      a. Provide manufacturer's installation instructions and anchoring details for connecting equipment to supports and structures.
   3. For equipment installed in structures designated as seismic design category C, D, E, or F:
      a. Provide project-specific installation instructions and anchoring details based on support conditions and requirements to resist seismic and wind loads as specified in Section 01850 - Design Criteria.
      b. Submit anchoring drawings with supporting calculations.
      c. Drawings and calculations shall be stamped by a professional engineer registered in the state where the Project is being constructed.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. GE by ABB.
   2. Jefferson.
   3. Schneider Electric.
   4. Eaton.
   5. ABB.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS

A. Cores:
   1. Non-aging, grain-oriented silicon steel.
   2. Magnetic flux densities below the saturation point.

B. Windings:
   1. High-grade magnet wire.
   2. Impregnated assembly with non-hydroscopic, thermo-setting varnish:
      a. Cured to reduce hot-spots and seal out moisture.
   3. Material electrical grade:
      a. Copper.

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

A. General:
   1. 10 kilovolts BIL for 600-volt class windings.

2. Sound levels, in accordance with IEEE 389 test conditions, not to exceed:

Kilovolt-Amperes Range	Audible Sound Level (db)
1-9	40
10-50	45
51-150	50
151-300	55
301-500	60
501-700	62
701-1000	64

3. Taps:
   a. 15 kilovolt-amperes and less:
      1) Two 5 percent full capacity primary taps below rated voltage.
   b. 25 kilovolt-amperes and larger:
      1) Four 2.5 percent full capacity primary taps below rated voltage.
      2) Two 2.5 percent full capacity primary taps above rated voltage.
   c. Operated by a tap changer handle or tap jumpers accessible through a panel.
4. Terminals:
   a. UL listed for either copper or aluminum conductors.
   b. Rated for 75 degrees Celsius.
5. Daily overload capacities, at rated voltage and without reduction in life, in accordance with IEEE C57.96.

B. Transformers less than 15 kilovolt-amperes:
   1. Insulation class: 185 degrees Celsius.
   2. Temperature rise: 115 degrees Celsius.

C. Energy efficient transformers 15 kilovolt-amperes and larger:
   1. Insulation class: 220 degrees Celsius.
   2. Temperature rise: 80 degrees Celsius, except as noted below:
      a. 150-degree Celsius rise for dry-type transformers located in motor control centers.
   3. Efficiency:
      a. In accordance with DOE 10 CFR Part 431.

D. Enclosures:
   1. Heavy gauge steel:
      a. Outdoor: Moisture and water resistant with rodent screens over all openings and in a weather-protected enclosure, NEMA Type 3R.
      b. Indoor: NEMA Type 2.
   2. Louvers to limit coil temperature rise to the value stated above, and case temperature rise to 50 degrees Celsius.
   3. Built-in vibration dampeners to isolate the core and coils from the enclosure:
      a. Neoprene vibration pads and sleeves.

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Nameplates:
   1. Non-corrosive metal or UL listed non-metallic:
      a. Stamped, engraved or printed with the following information:
         1) Phases.
         2) Frequency.
         3) Kilovolt-ampere rating.
         4) Voltage ratings.
         5) Temperature rise.
         6) Impedance.
         7) Insulation class.
         8) BIL rating.
         9) Connection diagram.
         10) Weight.
         11) Manufacturer.
         12) The identification “transformer”.
         13) Classes of cooling.
         14) Tap voltage(s).
         15) Vector diagram.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES

A. Finish to consist of de-greasing, phosphate cleaning, and an electrodeposited manufacturer’s standard gray enamel rust-inhibiting paint.

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Install the equipment in accordance with the accepted installation instructions and anchorage details to meet the seismic and wind load requirements at the Project site.

B. General:
   1. Mounted as indicated on the Drawings.
   2. Install where not in direct contact with building structure.
   3. Install on single layer vibration pad under the entire mounting surface.
      a. Manufacturers: The following or equal:
         1) Korfund.

4. Make any necessary connections to the enclosure with liquidtight flexible conduit having neoprene gaskets and insulated ground bushings.
5. Ground the enclosure:
    a. To an equipment ground conductor in the conduit.
    b. To the facility grounding electrode system.
6. Floor mounted transformers:
    a. Install transformers on a housekeeping pads.
    b. Install transformers with adequate space from walls or other enclosures for proper ventilation in accordance with the manufacturer's recommendations.

3.04 ERECTION, INSTALLATION, APPLICATIONS, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

B. Factory tests:
1. Applied voltage test to each winding and from each winding to the core:
    a. 600-volt class winding 4.5 kilovolt.
2. Induced voltage test at 2 times normal voltage and 400 hertz for 1,080 cycles.
3. Voltage ratio and polarity.
4. Sound level, performed in a test room with ambient sound level not exceeding 24 db.
5. Perform all tests in accordance with UL 1561.

3.08 FIELD QUALITY CONTROL (NOT USED)

3.09 ADJUSTING

A. Set the transformer taps as required to obtain nominal output voltage on the secondary terminals.

3.10 CLEANING

A. As specified in Section 16050 - Common Work Results for Electrical.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16285

SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. High-energy surge protective devices.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Institute of Electrical and Electronics Engineers (IEEE):
   1. C62.41.1 - Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
   2. C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
   3. C62.45 - Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.
   4. C62.62- Standard Test Specifications for Surge Protective Devices (SPDs) for Use on the Load Side of the Service Equipment in Low Voltage (1000 V and less) AC Power Circuits.

C. National Fire Protection Agency (NFPA):
   1. 20 - Standard for the Installation of Stationary Pumps for Fire Protection.
   2. 75 - Standard for the Fire Protection of Information Technology Equipment.
   3. 780 - Standard for the Installation of Lightning Protection Systems.

D. Underwriters Laboratory (UL):
   1. 1283 - Standard for Electromagnetic Interference Filters.
   2. 1449 - Standard for Surge Protective Devices.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Specific definitions:
   1. SPD: Surge protective device.
   2. SAD: Silicon avalanche diode.
   3. MOV: Metal oxide varistor.
   4. MCOV: Maximum continuous operating voltage.
   5. I_n: Nominal discharge current.
   6. VPR: Voltage protection rating.
   7. SCCR: Short circuit current rating.

1.04 SYSTEM DESCRIPTION

A. Surge protection as indicated on the Drawings.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Furnish complete product data confirming detailed compliance or exception statements to all provisions of this Section.
   2. Manufacturer's catalog cutsheets indicating:
      a. Manufacturer and model numbers.
      b. Ratings of each SPD including but not limited to:
         1) Short circuit current rating.
         2) Nominal discharge current.
         3) Maximum continuous operating voltage.
         4) Voltage protection rating.
         5) System voltage.
         6) System frequency.
         7) Surge current capacity.
   3. Submit independent test data from a nationally recognized testing laboratory verifying the following:
      a. Overcurrent protection.
      b. UL 1449.

C. Shop drawings:
   1. Provide electrical and mechanical drawings by the manufacturer that detail:
      a. Unit dimensions.
      b. Weights.
      c. Components.
      d. Field connection locations.
      e. Mounting provisions.
      f. Connection details.
      g. Wiring diagram.

D. Operation and maintenance manuals:
   1. Provide the manufacturer's manual with installation, start-up, spare parts lists, and operating instructions for the specified system.

1.06 QUALITY ASSURANCE

A. Provide SPD units that are designed, manufactured, tested and installed in compliance with the following codes and standards:
   1. Institute of Electrical and Electronics Engineers (IEEE C62.41.1, C62.41.2, C62.45, C62.62).
   2. Federal Information Processing Standards Publication 94 (FIBS PUB 94).
   3. National Electrical Manufacturers Association (NEMA).
   4. National Fire Protection Association (NFPA 20, 75 and 780).
   5. National Electric Code (NFPA 70).

6. Underwriters Laboratories (UL 1449 4th Edition and UL 1283).
7. International Electrotechnical Commission (IEC 801).

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.09 SEQUENCING

A. Coordinate with and provide SPD equipment to the electrical equipment manufacturer before final assembly and factory testing.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

B. Extended warranty:
   1. Furnish a manufacturer’s full 5-year parts and labor warranty from date of shipment against any part failure when installed in compliance with manufacturer's written instructions, UL listing requirements, and any applicable national, state, or local electrical codes.
   2. Warranty shall include:
      a. Direct, factory trained employees must be available within 48 hours for assessment of the problem.
      b. A 24-hour toll-free 800-number for warranty support.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Southern Tier Technologies.
   2. Eaton.
   3. Schneider Electric.
   4. GE by ABB.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

A. Provide Type 1 or Type 2 SPD units as required for the locations indicated on the Drawings.

B. Electrical requirements:
   1. SPD ratings are to be consistent with the nominal system operating voltage, phase, and configuration as indicated on the Drawings.
   2. MCOV:
      a. For the SPD and all components in the suppression path (including all MOVs, SADs, and selenium cells): Greater than 115 percent of the nominal system operating voltage.
   3. Operating frequency:
      a. 47 to 63 hertz.
   4. SCCR:
      a. 65 kAIC minimum, but not less than the equipment it is connected to as indicated on the Drawings.
      b. The SCCR shall be marked on the SPD in accordance with UL 1449 and the NEC.
   5. Nominal discharge current I_n:
      a. 20 kA.
   6. Maximum VPR:

Modes	240/120 3W	208Y/120	480Y/277	480V
L-N, L-G, N-G	700	700	1,200	1,800
L-L	1,200	1,200	1,800	1,800

   7. Peak surge current:
      a. Service entrance locations:
         1) 240 kA per phase minimum.
         2) 120 kA per mode minimum.
      b. Branch locations:
         1) 120 kA per phase, minimum.
         2) 60 kA per mode minimum.

C. Protection modes:
   1. Provide SPD protection modes as follows:
      a. Line to Neutral (L-N) where applicable.
      b. Line to Ground (L-G).
      c. Neutral to Ground (N-G), where applicable.

D. Environmental requirements:
   1. Storage temperature:
      a. -40 degrees to 122 degrees Fahrenheit.
   2. Operating temperature:
      a. 32 degrees to 140 Fahrenheit.
   3. Relative humidity:
      a. 5 percent to 95 percent.

4. Audible noise:
    a. Less than 45 dBa at 5 feet (1.5 m).
5. Operating altitude:
    a. Zero to 12,000 feet above sea level.

E. Provide surge protective devices that are suitable for application in IEEE C62.41.1, C62.41.2 Category A, B and C3 environments, as tested to IEEE C62.45.

2.06 COMPONENTS

A. Enclosure:
1. Located in electrical equipment as indicated on the Drawings.

B. Internal connections:
1. Provide low impedance copper plates for intra-unit connections:
    a. Attach surge modules using bolted connections to the plates for low impedance connections.
2. Size all connections, conductors, and terminals for the specified surge current capacity.

C. Surge diversion modules:
1. MOV:
    a. Where multiple MOVs are used in parallel, utilize computer matched MOVs to within 1 volt variance and tested for manufacturer's defects.

D. Overcurrent protection:
1. Individually fuse all components, including suppression, filtering, and monitoring components:
    a. Rated to allow maximum specified nominal discharge current capacity.
    b. Overcurrent protection that limits specified surge currents is not acceptable.

E. Connections:
1. Provide terminals to accommodate wire sizes up to No. 2 AWG.

2.07 ACCESSORIES

A. Unit status indicators:
1. Provide red and green solid-state indicators, with printed labels, on the front cover to redundantly indicate on-line unit status:
    a. The absence of the green light and the presence of the red light indicate that surge protection is reduced and service is needed to restore full operation.
    b. Indicates the status of protection on each mode or phase.

B. Dry contacts for remote monitoring:
1. Electrically isolated Form C dry contacts (1 A/125 VAC) for remote monitoring of system integrity, and indication of under voltage, phase and/or power loss.

C. Provide an audible alarm which activates under any fault condition.
   1. Provide an alarm On/Off switch to silence the alarm.
   2. A visible LED will confirm whether alarm is On or Disabled.
   3. Locate both switches and the audible alarm on the unit's front cover.

2.08 MIXES (NOT USED)

2.09 MIXES (NOT USED)

2.10 FABRICATION (NOT USED)

2.11 FINISHES (NOT USED)

2.12 SOURCE QUALITY CONTROL

A. Permanently affix surge rating to the SPD.

B. Perform manufacturer's standard factory test:
   1. Perform testing in accordance with UL 1449.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Follow the manufacturer's recommended installation practices and comply with all applicable codes.

B. Special techniques:
   1. Install SPDs internal to equipment with as short and straight conductors including ground conductor as practically possible:
      a. Twist the input conductors together to reduce input conductor inductance.
   2. Do not subject SPD to insulation resistance testing.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. As specified in Section 16950 - Field Electrical Acceptance Tests.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16290

ELECTRICAL POWER MONITORING

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Power meters and accessories.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. American National Standard Institute (ANSI):
   1. C12.20 - Electricity Meters - 0.2 and 0.5 Accuracy Classes.

C. Institute of Electrical and Electronics Engineers (IEEE):
   1. C57.13.6 - Standard for High Accuracy Instrument Transformers.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Specific definitions:
   1. FS - Full Scale.
   2. RDG - Of Reading.
   3. SSM - Solid State Multifunction Power Meter.
   4. THD - Total Harmonic Distortion.

1.04 SYSTEM DESCRIPTION (NOT USED)

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Power meter data including but not limited to:
      a. Power requirements.
      b. Communications protocols.
      c. Input/outputs.
      d. Dimensions.
      e. Measurement functions.
      f. Front panel controls.
      g. Display characteristics.
   2. Accessory data:
      a. Test switch dimensions and wiring diagrams.

C. Operation and maintenance manuals:
   1. Descriptive and technical bulletins and sales aids edited to reflect only the equipment to be provided and covering each of the components in the system.
   2. A maintenance section including all instruction leaflets and technical data necessary to setup, change setup and maintain the power meters.
   3. Original licensed copies of all software and software manuals.

D. Configuration files and reports:
   1. Settings including but not limited to:
      a. Device tag name.
      b. IP addresses.
      c. Alarm settings.
      d. Time synchronization settings.
      e. Security settings.
   2. Configuration files are to be provided in the selected manufacturer's native format.
   3. Configuration reports are to be submitted in .PDF format, listing each configured parameter setting and description of each parameter.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Allen-Bradley.
   2. Eaton.
   3. ABB.
   4. Schneider Electric.
   5. GE Multilin.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS

A. Power meters:
   1. Power meter type 2 (SSM2) device which shall include at a minimum:
      a. Individual phase currents, plus or minus 0.3 percent FS.
      b. Phase-to-phase and phase-to-neutral voltages, plus or minus 3 percent FS.
      c. Watts, VARs, VA, plus or minus 6 percent FS.
      d. Watt-hours 0.6 percent FS; VAR-hours 0.6 percent FS; VA-hours 0.6 percent FS.
      e. PF apparent 1 percent FS; PF displacement 1 percent FS.
      f. Frequency 0.17 percent FS.
      g. THD:
         1) Voltage - 31st harmonic.
         2) Current - 31st harmonic.
      h. Demand:
         1) Ampere, plus or minus 0.3 percent FS.
         2) Watt, VAR, VA, plus or minus 0.6 percent FS.
      i. Minimum and maximum values:
         1) Volts (L-L), volts (L-N), current (L), watts, VARs, VA.
         2) PF (apparent and displacement).
         3) Frequency.
         4) THD-amps, THD-volts.
         5) Demand:
            a) Ampere, watt, VAR, VA.
      j. Trend analysis:
         1) 2 selectable parameters.
      k. Other features:
         1) 3 form C relays, rated 10 amps.
      l. Synch-input kilowatt utility.
      m. Graphic LCD with LED backlight:
         1) Seven lines, 147 characters.
      n. Ethernet connection:
         1) Provide EtherNet/IP communication.

2.07 ACCESSORIES

A. Current transformers:
   1. Ring type current transformers:
      a. Suitable for service within low or medium voltage equipment as indicated on the Drawings.
      b. Designed to have a mechanical and thermal rating to withstand short-circuit current, stresses, and heating effects equal to the rating of the equipment of the application.
   2. Current ratio: As indicated on the Drawings.
   3. Rated in accordance with IEEE C57.13.6 with accuracy of the current transformers suitable for relay accuracy class and rated for 200 percent burden for the required connected devices.
   4. Identify polarity with standard marking or symbols.
   5. Capable of carrying rated primary current continuously without damage.
   6. Install secondary wiring from current transformers in a suitable wiring trough, or conduit to proper short-circuiting type terminal blocks for connection to relays, instruments, and other devices.

B. Test switches:
   1. Ten pole.
      a. 3 potential poles, for phase voltage.
         1) 600V rated.
      b. Four 30A, non-shorting current poles, for neutral current and let-thru phase currents.
      c. Three 30A, shorting current poles, for shorting phase currents.
   2. Base to be made of electrical grade plastic.
   3. Barriers between poles for pole isolation and separation.
   4. Clear cover encapsulating the test switch to enable visual verification of each switch position.
   5. Knife-blade type switches, accepting a horizontal gang interlocking bar.
   6. Screw type terminals on each switch.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Install power meters in the electrical equipment as indicated on the Drawings.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL (NOT USED)

3.09 ADJUSTING (NOT USED)

3.10 CLEANING

A. As specified in Section 16050 - Common Work Results for Electrical.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16305

ELECTRICAL SYSTEM STUDIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Short-circuit fault analysis study.
   2. Protective device coordination study.
   3. Arc-flash hazard study.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Institute of Electrical and Electronics Engineers (IEEE):
   1. 1584 - IEEE Guide for Specification of Scope and Deliverable Requirements for an Arc-Flash Hazard Calculations Study in Accordance with IEEE Std 1584 (TM).

C. National Fire Protection Association (NFPA).

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. General study requirements:
   1. Scope:
      a. The short-circuit fault analysis, protective device coordination, and arc-flash hazard studies shall include all new and existing equipment in the power distribution system including, but not limited to:
         1) Utility equipment.
         2) All electrical equipment including:
            a) Dry-type transformers.
            b) Switchgears.
            c) Switchboards.
            d) MCCs.
            e) 480-volt panelboards.
            f) 240 and 208 volt panelboards.
         3) Generators.
         4) Motors.
         5) Vendor control panels.
         6) HVAC equipment.

b. Study scenarios:
    1) The studies shall include all possible electrical system configurations, for example:
        a) Operation on normal (utility) source.
        b) Operation on generator source.
        c) Parallel operation on normal and generator sources.
        d) A side feeder breaker close, and B side feeder breaker open for gears with A and B feeder configuration (only for WWTP).
        e) A side feeder breaker open, and B side feeder breaker close for gears with A and B feeder configuration (only for WWTP).
        f) Obtain, for all equipment, the required data for preparation of the study including, but not limited to:
    c. Transformer kilovolt-ampere (kVA) and impedances.
    d. Generator impedances.
    e. Generator decrement curves.
    f. Bus withstand ratings.
    g. Cable and bus data.
    h. Protective device taps, time dials, instantaneous pickups, and time-delay settings.
    i. As-built lengths for all new wire and cable installations covered by the studies.
2. Obtain the Electric Utility information on the minimum and maximum available fault current, minimum and maximum utility impedances, utility protective device settings including manufacturer and model number, interrupting ratings, X/R ratios, and model information one level above the point of connection:
    a. Utility tolerances and voltage variations.
3. The individual performing the studies shall visit the site and collect all necessary field data in order to perform and complete comprehensive electrical system studies.
4. Obtain equipment layouts and configurations from the manufacturer’s final submittal requirements and project layout drawings as required.
5. Bus and conductor data:
    a. Use impedances of the actual installed or specified conductors, unless otherwise indicated.
    b. Use cable and bus impedances calculated at 25 degrees Celsius, unless otherwise indicated.
    c. Use 600-volt cable reactance based on typical dimensions of actual installed or specified conductors, unless otherwise indicated.
    d. Use bus withstand values for all equipment having buses.
    e. Use medium-voltage cable reactance based on typical dimensions of shielded cables with 133-percent insulation levels, unless otherwise indicated.
6. Motors:
    a. Each motor shall be individually modeled:
        1) Grouping of motors for fault contribution current is not acceptable.
    b. Motors with variable frequency drives (VFDs) may be assumed to have no contribution to fault current, unless VFDs are equipped with Bypass Contactors.
        1) If VFDs are equipped with bypass contactors, perform the fault current and arc flash study assuming all of bypass contactors are in the closed position.

7. Use the equipment, bus, and device designations as indicated on the Drawings for all studies.
8. Studies shall include, but not be limited to, all equipment and connections shown on Contract Drawing:
    a. 03E01: WTP MODIFIED OVERALL ONE-LINE DIAGRAM.
    b. 03E06: SWBD70281 AND SWBD70282 ONE-LINE DIAGRAM.

B. Short-circuit fault analysis study additional requirements:
1. The short-circuit fault analysis shall be performed and submitted in 2 phases:
    a. Initial short-circuit fault analysis:
        1) Based on the Contract Documents and Electric Utility information.
        2) The initial short-circuit fault analysis study shall indicate the estimated available short-circuit current at the line side terminals of each piece of equipment covered by the scope of the study.
            a) Measure conductor lengths from the Drawings. Use of arbitrary short conductor lengths is not allowed.
        3) Provide a list of assumptions used in the initial study.
    b. Final short-circuit fault analysis:
        1) The final short-circuit fault analysis shall modify the initial analysis as follows:
            a) Utilize the actual equipment provided on the project.
            b) Utilize conductor lengths based on installation.
2. Calculate 3-phase bolted fault, line-to-line fault, line-to-ground fault, double line-to-ground fault, short-circuit 1/2 cycle momentary symmetrical and asymmetrical RMS, 1-1/2 to 4 cycle interrupting symmetrical RMS, and 30-cycle steady-state short-circuit current values at each piece of equipment in the distribution system.
3. Evaluate bus bracing, short-circuit ratings, fuse interrupting capacity and circuit-breaker-adjusted interrupting capacities against the fault currents, and calculate X/R values:
    a. Identify and document all devices and equipment as either inadequate or acceptable.
4. Calculate line-to-ground and double line-to-ground momentary short-circuit values at all buses having ground-fault devices.
5. Provide calculation methods, assumptions, one-line diagrams, and source impedance data, including utility X/R ratios, typical values, recommendations, and areas of concern.

C. Protective device coordination study additional requirements:
1. Furnish protective device settings for all functions indicated on the Drawings including, but not limited to:
    a. Current.
    b. Voltage:
        1) Provide settings for all voltage relays based upon actual utility and generator tolerances and specifications.
    c. Frequency:
        1) Provide settings for all frequency relays based upon actual utility and generator tolerances and specifications.
    d. Negative sequence.
    e. Reverse power.

f. Machine protection functions:
1) Provide settings for all motor and generator protective relays based on the manufacturer's recommended protection requirements.

2. Provide log-log form time-current curves (TCCs) graphically indicating the coordination proposed for the system:
a. Include with each TCC a complete title and one-line diagram with legend identifying the specific portion of the system covered by the particular TCC:
1) Typical TCCs for identical portions of the system, such as motor circuits, are acceptable as allowed by the Engineer.
b. Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics:
1) These details can be included on the TCC.
c. Include a detailed description of each protective device tap, time dial, pickup, instantaneous, and time delay settings:
1) These details can be included on the TCC.

3. TCCs shall include all equipment in the power distribution system where required to demonstrate coordination. Include utility relay and fuse characteristics, medium-voltage equipment protective relay and fuse characteristics, low-voltage equipment circuit breaker trip device characteristics, transformer characteristics, motor and generator characteristics, and characteristics of other system load protective devices:
a. Include all devices down to the largest branch circuit and largest feeder circuit breaker in each motor control center, main breaker in branch panelboards, and fused disconnect switches.
b. Provide ground fault TCCs with all adjustable settings for ground fault protective devices.
c. Include manufacturing tolerances and damage bands in plotted fuse and circuit breaker characteristics.
d. On the TCCs, show transformer full load currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and transformer damage curves.
e. Cable damage curves.
f. Terminate device characteristic curves at a point reflecting the maximum symmetrical or asymmetrical fault current to which the device is exposed based on the short-circuit fault analysis study.
g. Coordinate time interval medium-voltage relay characteristics with upstream and downstream devices to avoid nuisance tripping.

4. Site generation: When site generation (including cogeneration, standby, and emergency generators) is part of the electrical system, include phase and ground coordination of the generator protective devices:
a. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices.

5. Suggest modifications or additions to equipment rating or settings in a tabulated form.

D. Arc-flash hazard study additional requirements:
1. Include the calculated arc-flash boundary and incident energy (calories/square centimeter) at each piece of equipment in the distribution system:
a. Perform study with 15 percent arcing fault variation as defined by IEEE 1584.

b. Perform arc-flash calculations at minimum and maximum utility and generator fault contributions.
c. Perform arc-flash calculations for both the line side and load side of the switchgear, switchboard, motor control center, and panelboard main breakers.
d. Perform arc-flash calculations for all short-circuit scenarios with all motors on for 3 to 5 cycles and with all motors off.

2. Provide executive summary of the study results:
   a. Provide summary based upon worst case results.
3. Provide a detailed written discussion and explanation of the tabulated outputs:
   a. Include all scenarios.
4. Provide alternative device settings to allow the Owner to select the desired functionality of the system:
   a. Minimize the arc-flash energy by selective trip and time settings for equipment maintenance purposes.
   b. Identify the arc-flash energy based upon the criteria of maintaining coordination and selectivity of the protective devices.

E. Electrical system study meetings:
1. The individual conducting the short-circuit fault analysis, protective device coordination, and the arc-flash hazard studies shall meet with the Owner and Engineer 3 times.
2. The purpose of the 3 meetings is as follows:
   a. Initial meeting:
      1) Meet with the Owner and Engineer to discuss the scope of the studies.
         a) Confirm assumptions to be used in the electrical system study with the Owner including but not limited to:
            (1) Maximum protective device fault clearing time.
      2) Discuss the Owner's operational requirements for both normal operation and maintenance.
   b. Preliminary results meeting:
      1) This meeting will be held after the studies have been completed, reviewed, and accepted by the Engineer.
      2) The purpose of this meeting is to inform the Owner of the results of the study and impacts on normal operation and maintenance including:
         a) Protective device coordination problems and recommended solutions.
         b) Explanation of the arc-flash hazard study results and its potential impact on operations.
         c) Recommendations for reduction of arc-flash category levels including reduction of protective device settings or changes in operational practices.
   c. Final meeting:
      1) Discuss changes to the studies based on the previous meeting.
      2) Discuss with the Owner how changes to the electrical system may change the arc-flash hazard category.
   d. Deliver the final report after substantial completion.

3. The meetings will be at the Owner's facility:
    a. Provide a minimum of 3-weeks' notice to the Owner and Engineer in advance of the projected meeting date.
    b. Submit a draft of the meeting agenda when each meeting is requested.
4. Meeting materials:
    a. Prepare and provide the following materials:
        1) Meeting agenda. Include, at a minimum, the scope of the meeting, estimated time length for the meeting, and meeting goals.
        2) 6 copies of the project one-line diagrams for the initial meeting.
        3) 6 copies of the submitted studies.

F. Owner training:
1. Training shall include, but is not limited to:
    a. Introduction and basics of NFPA 70E: At least 1 hour.
    b. Detailed review of the electrical system study for at least 2 hours.
    c. Questions and Answers period: 0.5 hours.

G. By virtue of the fact that this is a professional study, the Owner reserves the right to modify the requirements of the study to comply with its operational requirements. The protective device coordination study and the arc-flash hazard study shall be modified based on the results of the meetings with the Owner.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Initial studies and reports:
1. Include the following in the initial short-circuit current report:
    a. List of all devices included in the studies.
    b. A description of all operating scenarios.
    c. Form and format of arc-flash labels.

C. Final studies and reports:
1. Format and quantity:
    a. Provide 6 bound copies of all final reports.
    b. Provide 3 complete sets of electronic files on CD or DVD media, including the electrical system model(s), configuration files, custom libraries, and any other files used to perform the studies and produce the reports. Also provide an electronic version of the bound reports in PDF format.
    c. Provide the number of copies specified in Section 01330 - Submittal Procedures.
2. Include the sections below in the final report:
    a. Copies of correspondence and data obtained from the electric utility company.
    b. Letter certifying the inspection and verification of existing equipment.
    c. One-line diagrams:
        1) The following information shall be included at a minimum:
            a) Motor horsepower.
            b) Transformer data:
                (1) kVA.
                (2) Configuration.

c) Cable data:
(1) Insulation.
(2) Size.
(3) Length.
2) One-line diagrams shall be fully legible at 11-inch by 17-inch size.

d. Include in the short-circuit fault analysis study:
1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
2) Normal system connections and those that result in maximum fault conditions.
3) Tabulation of circuit breaker, fuse, and other protective device ratings compared to maximum calculated short-circuit duties.
4) Fault current calculations for the cases run including a definition of terms and guide for interpretation of computer software printouts.

e. Protective device coordination study shall include:
1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
2) List all requirements used in the selection and setting criteria for any protective devices.
3) Manufacturer's time-current curves for circuit breakers, fuses, motor circuit protectors, and other protective devices for all new equipment.
4) TCCs graphically indicating the coordination proposed for the system on log-log graphs:
a) All TCCs shall be in color.
5) Tabulation of relay, fuse, circuit breaker, and other protective devices in graphical form with a one-line diagram to display area coordination.
6) Where coordination could not be achieved, an explanation shall be included in the report to support the statement along with recommendations to improve coordination. Recommended equipment modifications or settings shall be in a tabulated form.

f. Include in the arc-flash hazard study:
1) Descriptions, purpose, basis, assumptions, recommendations, and scope of the study.
2) Normal system connections and those that result in maximum arc-flash conditions.
3) Arc-flash raw data, calculations, and assumptions.
4) Arc-flash label data:
a) Identifying the content of each label.
b) Identifying the location of each label.

D. Certification:
1. Submit written certification, sealed and signed by the professional engineer conducting the study, equipment supplier, and electrical subcontractor stating that the data used in the study is correct.

E. Submit the credentials of the individual(s) performing the study and the individual in responsible charge of the study.

F. The Engineer will review all studies and reports. After review, the Engineer will make recommendations and/or require changes to be made to the short-circuit fault

analysis, protective device coordination, or arc-flash hazard studies. These changes shall be provided as part of the scope of work.

G. Submit course outline for Owner's training.

1.06 QUALITY ASSURANCE

A. Qualifications of the entity responsible for electrical system studies:
   1. The studies shall be performed, stamped, and signed by a professional engineer registered in the state where the project is located.
   2. A minimum of 5 years of experience in power system analysis is required for the individual in responsible charge of the studies.
   3. The short-circuit fault analysis, protective device coordination, and arc-flash hazard studies shall be performed with the aid of a digital computer program:
      a. Point-to-point calculations are not acceptable.

B. The study shall be performed by an independent firm

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT/SITE CONDITIONS (NOT USED)

1.09 SEQUENCING

A. Below is an outline of the typical work sequence. Proposed changes to the work sequence may be reviewed and approved by the Engineer.
   1. Site visit to gather data on the existing facility systems for all studies:
      a. Make multiple trips as required to obtain all data for the short-circuit fault analysis, protection device coordination, and arc flash hazard studies.
   2. Initial electrical system study meeting.
   3. Submit the initial short-circuit fault analysis study before submittal of any electrical equipment.
      a. Only the initial short-circuit results will be reviewed.
   4. Submit the preliminary short-circuit fault analysis, protective device coordination, and arc-flash hazard studies after the approval of all electrical equipment.
   5. Second electrical system study meeting for preliminary results.
   6. Update the model with all changes to the electrical system made during start-up and commissioning.
   7. Final arc-flash meeting and final short-circuit fault analysis, protective device coordination, and arc-flash hazard studies.
   8. Submit the final electrical system studies.
   9. Label equipment with approved arc-flash labels.
   10. Owner's training.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY (NOT USED)

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Electrical system study software: One of the following or equal:
   1. Operation Technology, Inc., ETAP.
   2. SKM Systems Analysis, Powertools.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS

A. Arc-flash hazard labels:
   1. Dimensions:
      a. Minimum 5 inches by 3.5 inches.
   2. Materials:
      a. Polyester with polyvinyl polymer over-laminate.
      b. Self-adhesive.
      c. Resistant to:
         1) UV.
         2) Chemicals and common cleaning solvents.
         3) Scuffing.
         4) Wide temperature changes.
   3. Contents:
      a. Short-circuit bus identification.
      b. Calculated incident energy (calories/square centimeter) range:
         1) Based on worst-case study results.
      c. Site specific personnel protective equipment level number.
      d. Arc-flash protection boundary.
      e. Shock hazard boundary:
         1) The Contractor may provide separate labels for indication of the shock hazard boundary.
      f. Fed from:
         1) Identify the tag number of the upstream equipment providing power.
   4. Color scheme:
      a. For locations above 40 calories/square centimeter:
         1) White label with red "DANGER" strip across the top.
         2) Black lettering.

b. For locations below 40 calories/square centimeter:
    1) White label with orange “WARNING” strip across the top.
    2) Black lettering.

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. After review and acceptance of the arc-flash hazard study by the Engineer, install all arc-flash hazard labels:
    1. Install labels at all locations required by NFPA, ANSI, or IEEE standards.
    2. At a minimum, install labels in the following locations:
        a. The front of each main or incoming service compartment.
        b. The front of each low-voltage switchgear section.
        c. The front of each accessible auxiliary or conductor compartment.
        d. Each accessible rear or side vertical section.
        e. Each motor control center vertical section.
        f. Each panelboard covered by the study.
        g. Each control panel, individual starter or VFD, or other equipment covered by the scope of the study.

B. After review and acceptance of the draft arc-flash hazard study and protective device coordination study by the Engineer, adjust protective device settings per final study prior to equipment energization.
    1. Devices that require power for configuration may be set during energization, but before any subfed loads are energized.
    2. Ensure that settings for upstream equipment are set prior to energizing downstream devices.

3.04 ERECTION, INSTALLATION, APPLICATION, AND CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. The individual performing the arc-flash hazard study shall direct the installation of the arc-flash hazard labels:
   1. Remove and replace any improperly applied labels.
   2. Repair the equipment finish damaged by removal of any label.
   3. Install labels level or plumb across the entire dimension of the label.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16411

DISCONNECT SWITCHES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Fusible and non-fusible disconnect switches.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. National Electric Manufacturer’s Association (NEMA):
   1. KS 1-2001 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

C. Underwriters Laboratories Inc. (UL):
   1. 20 - General-Use Snap Switches.
   2. 98 - Enclosed and Dead-Front Switches.
   3. 508 - Standard for Industrial Control Equipment.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Specific definitions:
   1. Safety switches and disconnect switches are to be considered synonymous.

1.04 SYSTEM DESCRIPTION

A. Provide heavy-duty type disconnect switches as indicated on the Drawings and specified in the Contract Documents.

B. Provide disconnect switches with the number of poles, voltage, current, short circuit, and horsepower ratings as required by the load and the power system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Manufacturer.
   2. Manufacturer's specifications and description.
   3. Ratings:
      a. Voltage.
      b. Current.

c. Horsepower.
d. Short circuit rating.
4. Fused or non-fused.
5. NEMA enclosure type.
6. Dimensions:
a. Height.
b. Width.
c. Depth.
7. Weight.
8. Cross-referenced to the disconnect schedule indicated on the Drawings.

C. Shop drawings:
1. Manufacturer's installation instructions:
a. Indicate application conditions and limitations of use stipulated by product testing agency specified under Quality Assurance, Regulatory Requirements below.
b. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
2. For each switch, indicate nameplate inscription, including voltage, circuit, fuse size (if applicable), and equipment served.

D. Installation instructions:
1. Provide anchorage instructions and requirement based on the seismic requirements at the Project Site as specified in Section 01850 - Design Criteria and calculations:
a. Stamped by a professional engineer registered in the state where the Project is being constructed.

1.06 QUALITY ASSURANCE

A. Regulatory requirements:
1. NEMA Type KS1 - Enclosed and Miscellaneous Distribution Switches (600 V Maximum).
2. UL 98 - Enclosed and Dead-Front Switches.

B. Disconnect switches shall be UL listed and labeled.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.09 SEQUENCING

A. Conduct the initial fault current study as specified in Section 16305 - Electrical System Studies and submit results for Engineer’s review.

B. After successful review of the initial fault current study, submit complete equipment submittal.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Schneider Electric.
   2. Eaton.
   3. GE by ABB.
   4. Siemens.
   5. Appleton.
   6. Crouse-Hinds.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

A. Switch mechanism:
   1. Quick-make, quick-break heavy-duty operating mechanisms:
      a. Provisions for padlocking the switch in the Off position.
      b. A minimum of 90-degree handle travel position between Off and On positions:
         1) Provide handle position indicators to identify the handle position.
      c. Full cover interlock to prevent opening of the switch door in the On position and to prevent closing the switch mechanism with the door open:
         1) With an externally operated override.

B. Switch interior:
   1. Switch blades visible when the switch is Off and the cover is open.
   2. Lugs:
      a. Front accessible.
      b. Removable.
      c. UL listed for 60/75-degree Celsius copper conductors.
   3. Current carrying parts completely plated to resist corrosion.

4. Removable arc suppressors to facilitate easy access to line side lugs.
5. Furnish equipment ground kits for every switch.

C. Fused switches:
   1. Furnish with fuses as indicated on the Drawings:
      a. Provide fuses as specified in Section 16494 - Low Voltage Fuses.
   2. UL approved for field conversion from standard Class H fuse spacing to Class J fuse spacing:
      a. Ratings 100 amperes through 600 amperes at 240 volts.
      b. Ratings 30 amperes through 600 amperes at 600 volts.
      c. Provide spring reinforced and plated fuse clips.

D. Ratings:
   1. UL horsepower rated for AC or DC with the rating not less than the load served.
   2. Current:
      a. 30 to 1,200 amperes.
   3. Voltage:
      a. 250 volts AC, DC.
      b. 600 volts (30 A to 200 A, 600 volts DC).
   4. Poles:
      a. 2, 3, 4, and 6 poles.
   5. UL listed short circuit ratings:
   6. Where not indicated on the Drawings, provide switches with the NEMA ratings specified in Section 16050 - Common Work Results for Electrical for the installed location.

E. Size, fusing and number poles as indicated on the Drawings or as required:
   1. Provide solid neutral where indicated on the Drawings.

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES

A. Disconnect switches to have provisions for a field installable “B” type electrical interlock for position indication as indicated on the Drawings.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Install the equipment in accordance with the accepted installation instructions and anchorage details to meet the seismic and wind load requirements at the Project site.

B. General:
   1. Use Myers hubs or bolt-on hubs for all conduit penetrations on NEMA Type 12, Type 4, and Type 4X enclosures.
   2. Provide all mounting brackets, stands, supports and hardware as required:
      a. Match finish and materials for all brackets, stands, and hardware with the switch installed.
      b. Provide adequate supporting pillar(s) for disconnect switches in accordance with the approved seismic calculations, and locate aboveground or above decks, where there is no structural wall or surface for box.
   3. When possible, mount switches rigidly to exposed building structure or equipment structural members:
      a. For NEMA Type 4 and Type 4X locations, maintain a minimum of 7/8 inch air space between the enclosure and supporting surface.
      b. When mounting on preformed channel, position channel vertically so that water may freely run behind the enclosure.
   4. Provide a nameplate for each disconnect switch:
      a. Provide per requirements specified in Section 16075 - Identification for Electrical Systems.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL

A. As specified in Section 16050 - Common Work Results for Electrical.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING

A. As specified in Section 16050 - Common Work Results for Electrical.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16412

LOW VOLTAGE MOLDED CASE CIRCUIT BREAKERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Low voltage molded case circuit breakers.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Underwriter's Laboratories (UL):
   1. 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

B. In accordance with UL 489.

1.04 SYSTEM DESCRIPTION

A. Molded case thermal magnetic, solid-state, or motor circuit protector type circuit breakers as indicated on the Drawings and connected to form a completed system.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Catalog cutsheets.
   2. Manufacturer's time-current curves for all molded case circuit breakers furnished.

1.06 QUALITY ASSURANCE

A. Low voltage molded case circuit breakers shall be UL listed and labeled.

1.07 DELIVERY, STORAGE AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Eaton.
   2. GE by ABB.
   3. Schneider Electric.
   4. ABB.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. General:
   1. Conforming to UL 489.
   2. Operating mechanism:
      a. Quick-make, quick-break, non-welding silver alloy contacts.
      b. Common Trip, Open and Close for multi-pole breakers such that all poles open and close simultaneously.
      c. Mechanically trip free from the handle.
      d. Trip indicating handle - automatically assumes a position midway between the manual ON and OFF positions to clearly indicate the circuit breaker has tripped.
      e. Lockable in the "OFF" position.
   3. Arc extinction:
      a. In arc chutes.
   4. Voltage and current ratings:
      a. Minimum ratings as indicated on the Drawings.
      b. Minimum frame size 100A.

5. Interrupting ratings:
    a. Minimum ratings as indicated on the Drawings.
    b. Modify as required to meet requirements of the short circuit fault analysis - as specified in Section 16305 - Electrical System Studies.
    c. Not less than the rating of the assembly (panelboard, switchboard, motor control center, etc.).

B. Motor circuit protectors:
    1. Instantaneous only circuit breaker as part of a listed combination motor controller.
    2. Each pole continuously adjustable in a linear scale with 'LO' and 'HI' settings factory calibrated.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS

A. Terminals:
    1. Line and load terminals suitable for the conductor type, size, and number of conductors in accordance with UL 489.

B. Case:
    1. Molded polyester glass reinforced.
    2. Ratings clearly marked.

C. Trip units:
    1. Provide thermal magnetic or solid-state trip units as indicated on the Drawings.
    2. Thermal magnetic:
        a. Instantaneous short circuit protection.
        b. Inverse time delay overload.
        c. Ambient or enclosure compensated by means of a bimetallic element.
    3. Solid state:
        a. With the following settings as indicated on the Drawings.
            1) Adjustable long time current setting.
            2) Adjustable long time delay.
            3) Adjustable short time pickup.
            4) Adjustable short time delay.
            5) Adjustable instantaneous pickup.
            6) Adjustable ground fault pickup as indicated on the Drawings.
            7) Adjustable ground fault delay as indicated on the Drawings.

D. Provide ground fault trip devices as indicated on the Drawings.

E. Molded case circuit breakers for use in panelboards:
    1. Bolt-on type:
        a. Plug-in type breakers are not acceptable.
    2. Ground fault trip devices as indicated on the Drawings.

2.07 ACCESSORIES

A. Lockable handle:
   1. Provide assembly to lock operating handle in 'OPEN' position.
   2. Where a molded case circuit breaker is located in a dedicated enclosure, provide a lockable handle. Reference the Electrical Specifications for additional locking requirements associated with other mounting installations.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL

A. Test breakers in accordance with:
   1. UL 489.
   2. Manufacturer's standard testing procedures.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Install breakers to correspond to the accepted shop drawings.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL (NOT USED)

3.09 ADJUSTING

A. Adjust trip settings in accordance with Protective Device Coordination Study as accepted by the Engineer and in accordance with manufacturer's recommendations.

B. Adjust motor circuit protectors in accordance with NEC and the manufacturer's recommendation based on the nameplate values of the installed motor.

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16422

MOTOR STARTERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Motor starters and contactors.

1.02 REFERENCES

A. Abbreviations:
   1. FVNR: Full voltage non-reversing.
   2. FVR: Full voltage reversing.
   3. PWS: Part winding start.
   4. RVAT: Reduced voltage auto transformer.
   5. RVSS: Reduced voltage solid state.
   6. TS1W: 2 speed 1 winding (consequent pole).
   7. TS2W: 2 speed 2 winding.

B. Definitions:
   1. Overload relay class: A classification of an overload relay time current characteristic by means of a number which designates the maximum time in seconds at which it will operate when carrying a current equal to 600 percent of its current rating.

C. Standards:
   1. Institute of Electrical and Electronics Engineers (IEEE).
   2. International Electrotechnical Commission (IEC):
      a. 801-1 - Electromagnetic Compatibility for Industrial-Process Measurement and Control Equipment - Part 1: General Information.
      b. 947-4 - Low-Voltage Switchgear and Control Gear.
   3. National Electrical Manufacturer's Association (NEMA):
      a. 250 - Enclosures for Electrical Equipment (1000 V Maximum). ICS 2-230 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 V.
   4. Underwriters Laboratories, Inc. (UL):
      a. 508 - Standard for Industrial Control Equipment.
      b. 508A - Standard for Industrial Control Panels.

1.03 DELEGATED DESIGN

A. As specified in Section 01357 - Delegated Design Procedures.

B. Anchoring and bracing.

1.04 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures:
   1. Submit motor starter data with equipment submittal.

B. Product data:
   1. Manufacturer.
   2. Catalog cutsheets.
   3. Technical information.
   4. Complete nameplate schedule.
   5. Complete bill of material.
   6. List of recommended spare parts.
   7. Confirmation that the overload relay class for each starter meets the requirements of the equipment and motor supplier.
   8. Electrical ratings:
      a. Phase.
      b. Wire.
      c. Voltage.
      d. Ampacity.
      e. Horsepower.
   9. Furnish circuit breaker submittals as specified in Section 16412 - Low Voltage Molded Case Circuit Breakers.

C. Shop drawings:
   1. Elementary and schematic diagrams:
      a. Provide 1 diagram for every starter and contactor.
      b. Indicate wire numbers for all control wires on the diagrams:
         1) Wire numbering as specified in Section 16075 - Identification for Electrical Systems.
      c. Indicate interfaces with other equipment on the drawings.

D. Delegated design submittals:
   1. Anchoring and bracing: Provide project-specific calculations based on support conditions and requirements to resist loads specified in Section 01850 - Design Criteria:
      a. To structures for equipment installed in structures designated as seismic design category C, D, E, or F.
      b. For equipment installed outdoors.
      c. For wall mounted equipment weighing 125 pounds or more.

E. Commissioning submittals:
   1. As specified in Section 01756 - Commissioning, including the following:
      a. Manufacturer’s representative qualifications.
      b. Certificates:
         1) Requirements as specified in this Section.
      c. Test Plans:
         1) Test requirements as specified in this Section.
      d. Test Reports.
      e. Manufacturer’s representatives field notes and data.
      f. Owner training.

F. Operation and maintenance manuals:
    1. Submit complete operating and maintenance instructions presenting full details for care and maintenance of equipment furnished or installed under this Section. Including but not limited to:
        a. Electrical ratings:
            1) Phase.
            2) Wire.
            3) Voltage.
            4) Ampacity.
        b. Complete bill of material.
        c. Manufacturer's operating and maintenance instructions starter and/or contactor component parts, including:
            1) Protective devices (fuses, breakers, overload relays, heater elements, etc.).
            2) Pilot devices.
        d. Complete renewal parts list.
        e. As-built drawings:
            1) Furnish as-built drawings for each starter and contactor indicating final:
                a) Wire numbers.
                b) Interfaces with other equipment.
            2) 11-inch by 17-inch format.

1.05 QUALITY ASSURANCE

A. Regulatory requirements:
    1. All starters and components shall be UL listed and labeled:
        a. UL 508 - Industrial Control Equipment.
        b. UL 508A - Industrial Control Panels.
    2. NEMA ICS 2 - Industrial Control and System Controllers; Contactors and Overload Relays Rated: 600 Volts.
    3. Combination starters shall be UL listed and labeled.

1.06 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.08 ADMINISTRATIVE REQUIREMENTS (NOT USED)

1.09 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.10 MAINTENANCE

A. Spare parts:
    1. Provide the following spare parts, suitably packaged and labeled with the corresponding equipment number:
        a. 1 spare fuse of each size and type per starter.

PART 2 PRODUCTS

2.01 GENERAL

A. Starters for motor control centers, individual enclosed starters, or control panels.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Provide equipment and components that are fully rated for the site elevation and operating environment where the equipment will be installed as specified in Section 01850 - Design Criteria and as indicated on the Drawings.

2.03 MANUFACTURERS

A. One of the following or equal:
   1. NEMA starters and contactors:
      a. ABB.
      b. Allen-Bradley.
      c. Eaton.
      d. Schneider Electric.
   2. Manual motor starters:
      a. ABB.
      b. Cutler-Hammer.
      c. Schneider Electric.
   3. Reduced voltage solid state starters:
      a. Eaton (Westinghouse Series 2100).

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS

A. General:
   1. Provide combination type starters with motor circuit protector or thermal-magnetic circuit breaker and control power transformer with ratings as indicated on the Drawings.
   2. NEMA size, design, and rated:
      a. NEMA Size 1 minimum.
   3. Coordinate motor circuit protector, thermal magnetic circuit breaker, or fusible disconnect, and overload trip ratings with nameplate horsepower and current ratings of the installed motor:
      a. If motors provided are different in horsepower rating than those specified or indicated on the Drawings, provide starters coordinated to the actual motors furnished.
   4. Provide starters NEMA Size 2 and larger with arc quenchers on load breaking contacts.
   5. Mount extended overload reset buttons to be accessible for operation without opening starter enclosure door.

B. Full voltage starters:
   1. Across-the-line full voltage magnetic starters.
   2. Rated for 600 volts.

3. Electrical characteristics as indicated on the Drawings.
4. Provide positive, quick-make, quick-break mechanisms, pad lockable enclosure doors.
5. Furnish starter with bi-metallic overload relays.
6. Double-break silver alloy contacts.
7. Remote indicators:
    a. Provide Form C dry contacts for remote indication of:
        1) Internal fault error.
        2) Undervoltage.
        3) Overvoltage.
        4) Phase reversal.
        5) Phase loss.
        6) Overload.
        7) Frequency out of range.
        8) Excessive starts per hour.
        9) Drive electronics over temperature.
        10) Stall.
        11) Jam.
        12) System failure.
        13) Starter failure.
        14) Run status.
        15) Full speed.

C. Manual motor starters:
1. General:
    a. Provide with number of poles as indicated on the Drawings or as required by the connected load.
    b. Provide handles that clearly indicate the On and Off (with lockout), positions.
    c. Switch shall have positive, quick-make, quick-break mechanisms.
2. Thermal overload switches:
    a. Provide thermal overloads in manual motor starters where integral overloads are not furnished with the motor.
    b. Size heater elements for approximately 115 percent of the nameplate full load current, for motors with a 1.15 service factor.
    c. Thermal overload units in all phase legs.
    d. Overload conditions interrupts all ungrounded conductors.
3. Enclosure:
    a. Provide the NEMA enclosure type specified in Section 16050 - Common Work Results for Electrical for the starter location.

D. RVSS:
1. Manufactured and tested in accordance with the applicable requirements of IEEE, UL, and NEMA, including the following:
    a. Dielectric withstand per UL 508.
    b. Noise and RF immunity per NEMA ICS-2.
2. Furnish with a motor circuit protector or thermal magnetic circuit breaker as indicated on the Drawings.
3. Provide protection against internal faults and high SCR temperature during operation of the motor including starting, running (except when bypassed), and stopping modes.

4. Capable of continuously delivering full rated current of the motor plus the motor service factor in ambient temperatures from 0 degrees Celsius to 40 degrees Celsius at the installed altitude.
5. Provide a magnetically operated bypass contactor in parallel with the solid state starter:
    a. The bypass contactor to energize when the motor has reached full speed:
        1) The electronic overload protection circuits must be fully functional with the bypass contactor closed.
6. RVSS control module requirements:
    a. Microcomputer based, and contains the required circuitry to drive the power semiconductors in the power section of the starter.
    b. Integrally mounted on the power section and requires no additional panel space or wiring.
    c. Mounted for easy wiring, testing, service, and replacement.
    d. Provide 3-phase current sensing.
    e. Quick disconnect plug-in connectors for current transformer inputs, line and load voltage inputs, and SCR gate firing output circuits.
    f. Operates on power supplied from a control power transformer.
    g. Phase insensitive or with phase rotation protection.
    h. Control modes:
        1) Soft start with adjustable linear ramp time and a “kick start” or “boost” feature to provide a short time (typically 0.1 seconds) application of approximately full voltage.
        2) Soft start with adjustable linear ramp time, with a current limit:
            a) The current limit shall be adjustable over the range of 2 to 4 times normal full load current.
        3) Reverse voltage ramp (line voltage to zero voltage):
            a) Adjustable from 2 to 30 seconds to provide smooth stop.
            b) Automatic shutdown at end of voltage ramp.
    i. Protective functions:
        1) Single phase protection.
        2) Under voltage protection.
        3) Short circuit electronic trip overcurrent protection. Time not to exceed 3 cycles.
        4) Inverse time running overcurrent protection.
        5) Auxiliary trip circuitry.
        6) Gate firing circuit lockout protection on trip.
        7) Jam and stall detection.
        8) Fault relay lockout protection.
        9) 100 percent to 130 percent full load running current trip adjustment.
        10) 100 percent to 450 percent of starting current limit adjustment.
        11) Dwell time at current limit with ramp continuation after acceleration.
        12) Individual light emitting diodes (LEDs) for trip and phase loss.
        13) Minimum and maximum initial starting voltage adjustments.
        14) Initial torque adjustment.
7. RVSS power section requirements:
    a. 3 sets of back-to-back phase-controlled power semiconductors:
        1) Minimum repetitive peak inverse voltage of 1,500 volts at 480 VAC.
        2) Resistor/capacitor snubber networks to prevent false firing of the SCRs.

3) Equipped with individual heat sink assemblies.
4) Provide high-speed fuses for protection of the SCR stacks against short circuit conditions.

b. Provide metal oxide varistors for surge protection on the line and load side power terminal connections:
1) Rated for a minimum of 120 joules.

c. Capable of supplying the following current levels:
1) 600 percent of full load current for a minimum of 10 seconds.
2) 450 percent of full load for a minimum of 30 seconds.

d. Furnish ground lugs, one for incoming and one for outgoing ground connections.

e. Furnish pressure type terminals for top or bottom entry power terminations.

8. Remote indicators:
a. Provide Form C dry contacts for remote indication of:
1) Internal fault error.
2) Undervoltage.
3) Overvoltage.
4) Phase reversal.
5) Phase loss.
6) Overload.
7) Frequency out of range.
8) Excessive starts per hour.
9) Drive electronics over temperature.
10) Stall.
11) Jam.
12) System failure.
13) Starter failure.
14) Run status.
15) Full speed.

2.06 EQUIPMENT (NOT USED)

2.07 COMPONENTS

A. Molded case circuit breakers:
1. Circuit breaker type and ratings as indicated on the Drawings.
2. Provide as specified in Section 16412 - Low Voltage Molded Case Circuit Breakers.

B. Contactors:
1. NEMA size as indicated on the Drawings.
2. Electrically held:
a. For lighting loads designed to withstand the initial inrush currents of ballast and lamp loads.
3. Factory adjusted and chatter free.
4. Auxiliary contacts:
a. Contact ratings as per NEMA A 600 rating:
1) Auxiliary contacts rated 10 amps at 600 volts.

b. Provide all contacts indicated on the Drawings, and any additional contacts required for proper operation.
c. Provide at least 1 normally open and 1 normally closed spare auxiliary contact.

5. Constructed in accordance with the following standards:
   a. UL 508.
   b. IEC 947-4:
      1) Type 1 coordination when protected by a circuit breaker.
      2) Type 2 coordination when protected by a suitable UL listed fuse.
   c. IEC 801-1 parts 2 through 6.

C. Overloads:
1. Bi-metallic overload relay:
   a. Class 20 protection.
   b. Ambient compensated.
   c. Interchangeable heater pack:
      1) 1 heater per phase.
      2) Coordinate with installed motor full load amps and service factor.
   d. Visible trip indicator.
   e. Push-to-trip test.
   f. Isolated normally open alarm contact.
   g. Normally closed trip contacts.
   h. Manual reset.

D. Control power transformer:
1. Furnish integral control power transformer capacity to power:
   a. All motor controls: Motor and starter accessories indicated on the Drawings or specified.
2. Primary and secondary fusing as indicated on the Drawings:
   a. Fusing sized by the manufacturer for the rating of the transformer furnished.
3. Control power transformer secondary voltage:
   a. As indicated on the Drawings.

2.08 ACCESSORIES

A. Lugs and terminals:
1. For all external connections of No. 6 AWG and larger.
2. UL listed for either copper or aluminum conductors.

B. Surge protective devices:
1. Furnish surge protection devices across the coil of each starter, contactor, and relay.

C. Pilot devices:
1. Provide pilot lights, switches, elapsed time meters, and other devices as specified or as indicated on the Drawings.
2. As specified in Section 17710 - Control Systems: Panels, Enclosures, and Panel Components.

D. Nameplates and wire markers:
   1. As specified in Section 16075 - Identification for Electrical Systems.

E. Conformal coating:
   1. Provide conformal coating material applied to electronic circuitry and printed circuit boards to act as protection against moisture, dust, temperature extremes, and chemicals such as H_2S and chlorine.

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION

A. Anchoring and bracing to structures:
   1. Prepare equipment anchor setting template(s) and use to position anchors during construction of supporting structure(s).
   2. Install anchors of type and material indicated on approved anchoring designs.
   3. Install anchors with embedment indicated on approved anchoring designs.

3.03 INSTALLATION

A. Install the equipment in accordance with the accepted installation instructions and anchorage details.

B. Starters in motor control centers:
   1. Install as specified in Section 16444 - Low Voltage Motor Control Centers.

C. Starters in control panels:
   1. Install as specified in Section 17710 - Control Systems: Panels, Enclosures, and Panel Components.

D. Manual motor starters:
   1. Provide complete mounting brackets and hardware as necessary for complete support of manual motor starter at locations indicated on the Drawings.
   2. Mount manual motor starter rigidly to exposed building or equipment structural members.

3.04 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

B. Source Testing (NOT USED).

C. Owner Training:
   1. Perform Owner training as specified in Section 01756 - Commissioning.
   2. Topics:
      a. Operation topics limited to:
         1) Soft Starter Operation and Control
      b. Maintenance topics limited to:
         1) Soft Starter Operation and Control
   3. Number of sessions:
      a. Operations 1.
      b. Maintenance 1.

3.05 FIELD QUALITY CONTROL

3.06 ADJUSTING

A. Make all adjustments as necessary and recommended by the manufacturer, Engineer, or testing firm.

B. Set all overloads and motor circuit protectors based on the nameplate values of the installed motor.

END OF SECTION

SECTION 16441

GROUP-MOUNTED CIRCUIT BREAKER SWITCHBOARDS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Free standing, dead-front type metal-enclosed distribution, low voltage switchboards, utilizing group mounted circuit protective devices.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. National Electrical Manufacturers' Association (NEMA):
   1. PB-2 - Dead-front Distribution Switchboards.

C. Underwriters' Laboratories, Inc. (UL):
   1. 50 - Standard for Enclosures for Electrical Equipment.
   2. 891 - Switchboards.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. Factory assembled, wired, and tested switchboards, with major components being products of a single manufacturer, including but not limited to, circuit breakers, bus and enclosure with accessories and features specified in this Section and indicated on the Drawings.

B. Description of sections:
   1. Space for future devices:
      a. Where indicated on the Drawings, space for future devices shall include:
         1) All necessary bus.
         2) Device supports.
         3) Device mounting equipment.
         4) Device connections to bus work.
         5) Wire troughs or raceway space.
         6) Unused device space shall be covered with blank code gauge steel covers or doors.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Manufacturer of switchboard.
   2. Manufacturer of all component parts of switchboard.
   3. Weight of switchboard.
   4. Dimensions:
      a. Height.
      b. Length.
      c. Width.
   5. Nameplate schedule.
   6. Bill of material.
   7. Ratings:
      a. Voltage.
      b. Phase.
      c. Current.
      d. Interrupting rating (circuit breakers and fuses).
      e. Momentary current rating.
   8. List of recommended spare parts.
   9. Name and telephone number of manufacturer's authorized parts and repair provider.
   10. Furnish circuit breaker submittals as specified in:
      a. Section 16412 - Low Voltage Molded Case Circuit Breakers.
   11. For equipment installed in structures designated as seismic design category C, D, E, or F submit the following as specified in Section 01850 - Design Criteria:
      a. Manufacturer's statement of seismic qualification with substantiating test data.
      b. Manufacturer's special seismic certification with substantiating test data.

C. Shop drawings:
   1. Layout drawings:
      a. Complete, detailed, and scaled switchboard layout:
         1) Front panel.
         2) Sub-panels.
         3) Interior panels.
         4) Top and bottom conduit windows.

D. Installation instructions:
   1. Detail the complete installation of the equipment including rigging, moving, and setting into place.
   2. For equipment installed in structures designated as seismic design category A or B:
      a. Provide manufacturer's installation instructions and anchoring details for connecting equipment to supports and structures.
   3. For equipment installed in structures designated as seismic design category C, D, E, or F:
      a. Provide project-specific installation instructions and anchoring details based on support conditions and requirements to resist seismic and wind loads as specified in Section 01850 - Design Criteria.

b. Submit anchoring drawings with supporting calculations.
c. Drawings and calculations shall be stamped by a professional engineer registered in the state where the Project is being constructed.

E. Operating and maintenance manuals:
1. Submit operating instructions and a maintenance manual for the switchboard(s) furnished and/or installed under this Contract.
2. Operating instructions:
3. Maintenance manual:
a. Furnish maintenance manuals with instructions covering all details pertaining to care and maintenance of all equipment as well as data identifying all parts.
b. Manuals to include but are not limited to the following:
1) Adjustment and test instructions covering the steps involved in the initial test, adjustment, and start-up procedures.

F. Test forms and reports:
1. Submit complete factory acceptance test procedures and all forms used during the test.
2. Manufacturer to furnish a certified report after the shop tests.
3. Manufacturer to furnish a certified report after the start-up:
a. Report must state that the installation is complete and satisfactory, or list items requiring additional work and a proposal for the corrective actions.

G. Certification letters:
1. Provide a letter from the switchboard manufacturer that lists every paragraph, subparagraph etc. of this Section and states compliance or non-compliance with said paragraph. If non-compliance is indicated, provide an explanation for the deviation and alternative method to address the non-compliance.

H. Calculations:
1. Detailed calculations or details of the actual physical testing performed on the switchboard to prove the switchboard is suitable for the seismic requirements at the Project Site.

1.06 QUALITY ASSURANCE

A. Sections and devices shall be UL listed and labeled.

B. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of 5 years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.07 DELIVERY STORAGE AND HANDLING

A. Ship the switchboard to the job site on a dedicated air ride vehicle that will allow the Contractor to utilize onsite off-loading equipment:

B. Furnish temporary equipment heaters within the switchboard to prevent condensation from forming.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.09 SEQUENCING

A. Conduct the initial fault current study as specified in Section 16305 - Electrical System Studies and submit results for Engineer's review.

B. After successful review of the initial fault current study, submit complete equipment submittal.

C. Conduct factory acceptance test and submit certified test results for Engineer's review.

D. Ship equipment to Project Site after successful completion of factory acceptance test.

E. Assemble equipment in the field.

F. Conduct field acceptance test and submit results for Engineer's review.

G. Submit manufacturer's certification that equipment has been properly installed and is fully functional for Engineer's review.

H. Conduct Owner's training sessions.

I. Commissioning as specified in Section 01756 - Commissioning.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. The following, no equal, to match owner standard:
   1. GE by ABB.

B. Circuit breakers: Same manufacturer as the switchboard.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

A. Switchboard:
   1. Furnish low voltage Class 2 switchboards as specified and indicated on the Drawings.
   2. Provide complete and functional switchboards with required controls.
   3. Furnish and install devices or accessories not described in this Section but necessary for the proper installation and operation of the equipment.

B. Voltage ratings:
   1. Voltage level and configuration: As indicated on the Drawings.
   2. Frequency: 60 hertz.

C. Bus:
   1. General:
      a. Tin-plated copper.
      b. Bus cross-section in accordance with UL heat rise requirements.
      c. Current density of 1,000 amperes per square inch.
      d. Mounted on supports of high-impact, non-tracking insulators.
      e. Phase A-B-C bus arrangement:
         1) Top-to-bottom, left-to-right, front-to-back throughout the switchboard.
      f. Symmetrical short circuit current bracing of as indicated on the Drawings.
      g. Continuous current rating as indicated on the Drawings.
   2. Horizontal bus:
      a. Provisions for future connections to additional switchboard sections.
   3. Ground bus:
      a. Sized per UL 891.

D. Enclosure:
   1. General:
      a. Self-supporting structures bolted together to form the required line-up.
      b. All sections rear aligned.
      c. Dead-front.
      d. Conduit entry:
         1) Open-bottom.
         2) Removable top cover.
   2. Frame:
      a. Die-formed 12 gauge steel.
   3. Covers:
      a. Bolt-on.
      b. Code gauge steel.
      c. Removable front covers.
         1) Held in place by captive screws.
   4. Rating:
      a. NEMA Type 1.

2.06 COMPONENTS

A. Circuit breakers:
   1. General:
      a. Molded case circuit breakers as specified in Section 16412 - Low Voltage Molded Case Circuit Breakers.
   2. Main circuit breaker:
      a. Frame, trip and short circuit ratings as indicated on the Drawings.
      b. 100 percent rated.
   3. Feeder breakers:
      a. Frame, trip and short circuit ratings as indicated on the Drawings.

B. Wiring:
   1. Provide all necessary internal wiring, fuse blocks, and terminal blocks as required.
   2. Number all wires at each end and indicate wire numbers on shop drawings.
   3. Type SIS switchboard wire with at least 26 strands.
   4. Minimum wire size:
      a. No. 14 for control circuits.
      b. No. 12 for potential and current transformer circuits.
   5. Numbered and labeled in accordance with Section 16075 - Identification for Electrical Systems.

2.07 ACCESSORIES

A. Metering system:
   1. Include metering as indicated on the Drawings.
   2. Provide microprocessor based power meters as specified in Section 16290 - Electrical Power Monitoring.

B. Surge protective devices:
   1. Provide surge protective devices as indicated on the Drawings and as specified in Section 16285 - Surge Protective Devices.

C. Nameplates:
   1. Provide engraved plastic nameplates to identify:
      a. Switchboard units.
      b. Door mounted components.
      c. Interior mounted devices.
   2. As specified in Section 16075 - Identification for Electrical Systems.
   3. Engraved with the circuit number and circuit name as indicated on the Drawings.
   4. Manufacturers labels:
      a. Each vertical section shall have a label identifying:
         1) Serial number.
         2) Shop order number.
         3) Bus rating.
         4) Vertical section reference number.
         5) Date of manufacture.

D. Warning signs:
   1. Voltage:
      a. Provide a minimum of 2 warning signs on the front of the switchboard lineup and 2 on the back.
      b. Red laminated plastic engraved with white letters approximately 1/2 inch high.
      c. Signs shall read:
         1) "WARNING-HIGH VOLTAGE-KEEP OUT".
   2. Arc flash:
      a. Provide one warning sign for each switchboard compartment.
      b. Signs shall have read a minimum of:
         1) “DANGER ELECTRIC ARC FLASH HAZARD.”
         2) Signs shall meet the requirements of NFPA 70E and NEC Article 110.16.

E. Lugs:
   1. For all external connections of No. 6 AWG or larger.
   2. UL listed for copper or aluminum conductors.
   3. Rated for 75-degree Celsius conductors.
   4. Lugs shall be of the compression type in design requiring a hydraulic press and die for installation.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES

A. Chemically clean all steel surfaces before painting.

B. Exterior color manufacturer’s standard gray over phosphate-type rust inhibitor.

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Install the equipment in accordance with the accepted installation instructions and anchorage details to meet the seismic and wind load requirements at the Project site.

B. General:
   1. Furnish all cables, conduit, lugs, bolts, expansion anchors, sealants, and other accessories needed to complete the installation of the switchboard.
   2. Assemble and install the switchboard in the location and layout indicated on the Drawings.
   3. Perform work in accordance with manufacturer's instructions and shop drawings.
   4. Furnish components and equipment as required to complete the installation.
   5. Replace any hardware lost or damaged during the installation or handling to provide a complete installation.
   6. Install the switchboard on a raised concrete housekeeping pad:
      a. Provide structural leveling channels in accordance with the manufacturer's recommendations to provide proper alignment of the units.
      b. Weld and/or bolt the switchboard frame to be to the leveling channels.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 REINSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

B. Factory tests:
   1. Owner and Engineer will witness the factory acceptance test as specified in Section 16050 - Common Work Results for Electrical.
   2. Completely assemble, wire, and test the switchboard:
      a. Provide groups of wires leaving the shipping-assembled equipment with terminal blocks with suitable numbering strips.

3.08 FIELD QUALITY CONTROL

A. As specified in Section 16050 - Common Work Results for Electrical.

3.09 ADJUSTING

A. Make all adjustments as necessary and recommended by the manufacturer, Engineer, or testing firm.

3.10 CLEANING

A. As specified in Section 16050 - Common Work Results for Electrical.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16445

PANELBOARDS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Panelboards serving feeder circuits and branch circuits.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Underwriter's Laboratories, Inc. (UL):
   1. 67 - Standard for Panelboards.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

1.04 SYSTEM DESCRIPTION

A. Circuit breaker panelboards as indicated in the panelboard schedules, one-lines, and where indicated on the Drawings:
   1. Service voltage and configuration as indicated on the panel schedules.

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. Manufacturer of panelboard.
   2. Bill of material.
   3. Assembly ratings including:
      a. Voltage.
      b. Phase.
      c. Continuous current.
      d. Short circuit interrupting rating.
   4. NEMA enclosure type.
   5. Cable terminal sizes based upon actual feeder and sub-feeder conductors used.
   6. Furnish circuit breaker submittals as specified in Section 16412 - Low Voltage Molded Case Circuit Breakers.
   7. For equipment installed in structures designated as seismic design category C, D, E, or F submit the following as specified in Section 01850 - Design Criteria:
      a. Manufacturer’s statement of seismic qualification with substantiating test data.
      b. Manufacturer’s special seismic certification with substantiating test data.

C. Shop drawings:
    1. Drawings to contain:
        a. Overall panelboard dimensions, interior panel dimensions, and wiring gutter dimensions:
            1) Height.
            2) Length.
            3) Width.
        b. Weight.
        c. Anchoring locations.
        d. Breaker layout drawing with dimensions:
            1) Location of the main, branches, solid neutral, and ground.
        e. Conduit entry/exit locations:
            1) Identify all conduit entry/exit locations and restrictions.
        f. Individual panel schedules identifying breaker locations, ratings, and nameplate designations within the panelboard, for every panelboard.

D. Installation instructions:
    1. Detail the complete installation of the equipment including rigging, moving, and setting into place.
    2. For equipment installed in structures designated as seismic design category A or B:
        a. Provide manufacturer's installation instructions and anchoring details for connecting equipment to supports and structures.
    3. For equipment installed in structures designated as seismic design category C, D, E, or F:
        a. Provide project-specific installation instructions and anchoring details based on support conditions and requirements to resist seismic and wind loads as specified in Section 01850 - Design Criteria.
        b. Submit anchoring drawings with supporting calculations.
        c. Drawings and calculations shall be stamped by a professional engineer registered in the state where the Project is being constructed.

E. Operations and maintenance manual:
    1. Provide a complete manual for the operation and maintenance of the panelboard, circuit breakers, devices, and accessories:
        a. Including but not limited to:
            1) Instruction narratives and bulletins.
            2) Renewal parts lists.
            3) Time-current curves for all devices.

F. Calculations:
    1. Detailed calculations or details of the actual physical testing performed on the panelboard to prove the panelboard is suitable for the seismic requirements at the Project Site.

1.06 QUALITY ASSURANCE

A. Panelboards shall be UL listed and labeled.
    1. Where indicated as service entrance equipment, panelboards shall be UL labeled and listed "Suitable for Service Entrance."

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Eaton.
   2. GE by ABB.
   3. Schneider Electric.

B. Circuit breakers:
   1. Same manufacturer as the panelboard.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT

A. Provide panelboards with:
   1. Molded-case circuit breakers with trip ratings as shown on the panel schedules.
   2. Spares and spaces for future circuit breakers in panels as shown on the panel schedules.

B. Short circuit rating:
   1. Provide panelboards with short-circuit ratings as indicated on the Drawings:
   2. Testing method in accordance with UL 67.
   3. Mark each panelboard with its maximum short circuit rating at the supply voltage.
   4. Panelboards shall be fully rated.

2.06 COMPONENTS

A. Enclosure:
   1. NEMA enclosure type as indicated on the Drawings.
      a. Where not indicated on the Drawings, as specified in Section 16050 - Common Work Results for Electrical for the installed location.
   2. Minimum width: 20 inches.
   3. Gutter space in accordance with the NEC:
      a. Minimum of 4 inches of gutter space.
   4. Dead-front, no live parts when the panelboard is in service.
   5. Enclose entire panelboard bus assembly in a corrosion resistant galvanized steel cabinet.
   6. 4-piece front to provide ease of wiring access.
   7. Lockable, hinged door over the protective devices with a flush, cylinder tumbler-type lock with catch and door pull.
      a. Minimum 2 keys per panelboard.
      b. Key all panelboard locks alike.
         1) Match locks on existing panelboards to the extent possible.
   8. Circuit directory frame and card on the inside of the door.
   9. Door-in-door construction consists of a one-piece front with 2 doors:
      a. The smaller door provides access to all device handles and rating labels and shall be lockable.
      b. The larger door provides access to all conductors and wiring terminals.
   10. Interior design such that replacement of circuit breakers does not require disturbing adjacent units or removal of the main bus connectors.
   11. Outdoor locations: Provide NEMA Type 4X enclosures with a NEMA Type 4X stainless steel outer enclosure (with a hinged door) and a NEMA Type 1 interior panelboard, unless otherwise indicated.

B. Bus:
   1. General:
      a. Tin-plated copper.
   2. Phase bus:
      a. Full size and height without reduction.
      b. Dimensions and temperature rise in accordance with UL 67:
         1) Limit current density to less than 1,000 amps per square inch.
      c. Insulate all current carrying parts from ground and phase-to-phase with a high dielectric strength insulator.
   3. Ground bus:
      a. Copper, solidly bonded.

4. Neutral bus:
    a. Provide where indicated on the Drawings.
    b. 100 percent rated.
    c. Provide lugs for each outgoing feeder requiring a neutral connection.
5. Provide insulation barriers over the vertical bus behind the dead front shield to provide increased safety during field service.

C. Lugs:
1. UL listed for copper and aluminum wire:
    a. Provide lugs rated for 75-degree Celsius terminations.
    b. Provide bolted or compression main lug terminations as required for the incoming cable size.

D. Circuit breakers: As specified in Section 16412 - Low Voltage Molded Case Circuit Breakers and as indicated on the Drawings:
1. Provide all circuit breakers with bolt-on connections:
    a. Plug-in circuit breakers are not allowed.

2.07 ACCESSORIES

A. Surge protective devices:
1. Furnish panelboards with surge protective devices as indicated on the Drawings.
2. As specified in Section 16285 - Surge Protective Devices.

B. Nameplates:
1. As specified in Section 16075 - Identification for Electrical Systems.
2. Install on outside of door.
3. Indicating:
    a. Panel designation.
    b. Voltage.
    c. Number of phases and configuration.

C. Circuit identification labels:
1. Provide index cards behind heavy clear plastic in cardholders on the inside of the doors.
2. Type all information on the cards using designations in the panel schedules.
3. Laminated on both sides.

D. Pad locking mechanism:
1. Provide a pad locking attachment to allow circuit breakers to be locked in the off position.
2. At a minimum, provide 1 mechanism per panelboard:
    a. Provide multiple mechanisms if required to accommodate all circuit breaker frame sizes in the panelboard.

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES

A. Finish stand-alone panelboards with a primer, rust-resistant phosphate undercoat, and 2 coats of oven-baked enamel with manufacturer's standard gray.

B. Finish panelboards mounted in motor control centers to match the motor control center finish and color.

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Install the equipment in accordance with the accepted installation instructions and anchorage details to meet the seismic and wind load requirements at the Project site.

B. General:
   1. Mounted as indicated on the Drawings.
   2. Mount rigidly to structural members with exposed surfaces plumb and level to within 1/32 inch.
   3. Perform work in accordance with the manufacturer's instructions and shop drawings.
   4. Provide all brackets, hangers, supports, and hardware for mounting as required.
   5. In all NEMA Type 4 and NEMA Type 4X locations, mount panelboards on 7/8-inch deep stainless steel preformed channel, with channel running vertically from top to bottom of panelboard:
      a. Use only stainless steel mounting hardware.
   6. Mount panelboard so that top operating handle is not more than 6 feet-7 inches above the operating floor.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

B. Factory testing:
   1. Perform standard factory tests on the panelboards:
   2. Test in accordance with the latest version of NEMA and UL standards.

3.08 FIELD QUALITY CONTROL

A. As specified in Section 16050 - Common Work Results for Electrical.

3.09 ADJUSTING (NOT USED)

3.10 CLEANING

A. As specified in Section 16050 - Common Work Results for Electrical.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES

A. Circuiting within the panelboard shall match the panel schedules as indicated on the Drawings.

B. Provide typewritten schedule in each panelboard.

END OF SECTION

SECTION 16494

LOW VOLTAGE FUSES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Fuses: 600-volt class and lower.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

1.03 DELEGATED DESIGN (NOT USED)

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures.

B. Product data:
   1. Catalog cut sheets.
   2. Complete fuse schedule.
   3. Manufacturer original 11-inch by 17-inch, time current curves for all fuses furnished.

C. Shop drawings:
   1. Include drawings of spare fuse cabinets.

1.05 QUALITY ASSURANCE

A. All low voltage fuses shall be UL listed and labeled.

1.06 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.08 ADMINISTRATIVE REQUIREMENTS (NOT USED)

1.09 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.10 MAINTENANCE

A. Spare parts:
   1. Provide 3 spare fuses for each size and type used or supplied under any Section of the Contract Documents.
   2. Provide spare fuse cabinet(s):
      a. Metal cabinet with hinged door and shelves or fuse holders.
      b. Gray enamel finish.
      c. Mount near equipment and label "Spare Fuses" on face of cabinet.
      d. Suitable pocket inside door of each cabinet with typewritten spare fuse inventory in clear plastic protective insert.
      e. Provide as many cabinets as required to hold entire spare fuse inventory.

PART 2 PRODUCTS

2.01 GENERAL

A. Fuses for overcurrent protection and/or current limiting applications as indicated on the Drawings.

2.02 DESIGN AND PERFORMANCE CRITERIA (NOT USED)

2.03 MANUFACTURERS

A. One of the following or equal:
   1. Bussmann.
   2. Ferraz Shawmut.
   3. Littelfuse.

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS

A. General:
   1. Provide durable, readily visible label inside each fuse enclosure, clearly indicating the correct type, size, and ratings of replacement fuse:
      a. Label shall not cover or interfere with equipment manufacturer's instructions.
   2. Affix a label indicating recommended torque for fuse mounting bolts or studs to the inside of fuse access doors.
   3. To ensure selective coordination of protective devices:
      a. Provide fuses for new facilities by the same manufacturer.
      b. Provide fuses for renovations of the same manufacturer as existing fuses.
   4. Provide fuses rated for the voltage and available short circuit current at which they are applied.

B. Fuses for services, switchboard mains, feeders, and branch circuits:
   1. 600 amperes and less:
      a. Provide UL listed RK1 dual-element, time-delay fuses with ampere ratings as indicated on the Drawings except as may be modified by the Contract Documents.
   2. 601 to 6,000 amperes:
      a. Provide UL listed Class L fuses.

C. Fuses for motor branch circuits:
   1. Ampere ratings shall not exceed motor controller manufacturer's recommended values:
      a. If manufacturer does not have such standards, provide fuses as specified in this Section.
   2. Provide Class RK1 fuses or fuses as indicated on the Drawings and as specified in the Contract Documents, rated in accordance with the fuse manufacturer's recommendations for backup running protection of motor circuits containing overload relays.
   3. Determine fuse ratings for overload protection of motor branch circuits by actual full-load currents of motors provided.
   4. Fuses in motor control centers may be time-delay Class J or Class CC fuses, if MCC manufacturer's standard designs use these fuse types:
      a. Time-delay Class J fuse ratings shall not exceed 150 percent of motor full load current except as permitted.
      b. Follow fuse manufacturer's recommendations for Class CC fuses.
      c. A motor having starting duty or other special characteristics requiring larger fuses than specified above, may have branch circuit fuse ratings increased as necessary to meet motor's requirements, but no larger than maximum permitted by the NEC.
         1) Increased requirements for an individual motor shall not be cause for increasing size of all fuses.
   5. Provide Class L fuses for motor branch circuits requiring fuses over 600 amperes, sized at 150 percent of motor full load current except as permitted below:
      a. A motor having starting duty or other special characteristics requiring larger fuses than specified above, may have branch circuit fuse ratings increased as necessary to meet motor's requirements, but no larger than maximum permitted by the NEC.
         1) Increased requirements for an individual motor shall not be cause for increasing size of all fuses.

D. Fusing of control circuits:
   1. Provide:
      a. RK1 fuses installed in UL listed Class CC fuse blocks as specified in the Contract Documents.
   2. Provide minimum protection for control circuits in accordance with the latest revision of UL Standard 508 for Industrial Control.
   3. Fuse both the primary and secondary circuit of control power transformers:
      a. Fuse ratings shall be in accordance with NEC requirements.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. General:
   1. Install fuses properly aligned, electrically and mechanically secure.
   2. Evenly torque mounting bolts and nuts to ASTM recommendations for type and diameter of mounting bolts or studs provided.
   3. Paralleling of fuses is not permitted.
   4. Install fuses so that the fuse nameplate and rating are easily readable in the equipment.

B. Replace fuses, on all phases, for any fuses that opened during start-up and testing.

C. After completion of testing, deliver spare fuses in quantities specified:
   1. Fuses shall be new, in manufacturer's original packaging, and stored in a clean, dry location.

D. Install spare fuse cabinets where instructed by the Owner.

3.04 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

END OF SECTION

SECTION 16510

LIGHTING: LED LUMINAIRES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes: LED luminaires, drivers, poles, and accessories.

1.02 REFERENCES

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Illuminating Engineering Society (IES):
   1. LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products.
   2. LM-80 - Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules.
   3. TM-21 - Projecting Long Term Lumen, Photon, and Radiant Flux Maintenance of LED Light Sources.
   4. RP-7 - Recommended Practice for Lighting Industrial Facilities.

C. Institute of Electrical and Electronics Engineers (IEEE):
   1. C62.41 - IEEE Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

D. National Electrical Manufacturers Association (NEMA):
   1. 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.

E. Underwriters Laboratories (UL):
   1. 1598 - Luminaires.
   2. 8750 - Light Emitting Diode (LED) Equipment For Use In Lighting Products.

1.03 DEFINITIONS

A. As specified in Section 16050 - Common Work Results for Electrical.

B. Specific definitions and abbreviations:
   1. CCT: Correlated color temperature - Scientific scale to describe how “warm” or how “cool” the light source is, measured in Kelvin. The lower the Kelvin temperature, the warmer the light feels, or appears.
   2. CRI: Color Rendering Index - A quantitative measure of the ability of a light source to reveal the colors of various objects faithfully in comparison with an ideal or natural light source.
   3. Driver - Device that manages power and controls the current flow from AC to DC for an LED lighting product.

4. Efficacy - Lumen output of a light source per unit of power supplied to that source (lumens per watt).
5. EMI: Electromagnetic Interference - Electrical interference (noise) generated by electrical and electronic devices.
6. FC: Foot Candles - Measure of light level on a surface being illuminated.
7. L70 - The extrapolated life in hours of the luminaire when the luminous output depreciates 30 percent from initial values.
8. LED: Light emitting diode - A solid-state semiconductor device that produces light when electrical current flows through it.
9. LED light source - See LED luminaire.
10. LED luminaire - A complete lighting unit consisting of LED-based light emitting elements and a matched driver together with parts to distribute light, to position and protect the light emitting elements, and to connect the unit to a branch circuit.
11. Lumen - The international (SI) unit of luminous flux or quantity of light. The amount of light that is spread over a square foot of surface by one candle power when all parts of the surface are exactly one foot from the light source.
12. Lumen ambient temperature multiplier - LED light source relative lumen output when compared to a standard ambient temperature.
13. Lumen maintenance factor - How well an LED light source is able to retain its intensity when compared to new.
14. Luminaire - Lighting unit.
15. THD: Total harmonic distortion - The combined effect of harmonic Distortion on the AC waveform produced by a driver or other device.

1.04 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Product data:
   1. LED Luminaires:
      a. Catalog literature for each luminaire specified, cross-referenced to the luminaire type on the Luminaire Schedule in the Drawings.
      b. Provide for each luminaire type:
         1) Materials.
         2) Type of diffuser.
         3) Hardware.
         4) Gasketing.
         5) Reflector.
         6) Chassis.
         7) Finish and color.
         8) Driver type and protection.
         9) LED luminaire:
            a) Initial lumen output at 40 degrees Celsius ambient.
            b) Correlated color temperature.
            c) Lumen maintenance factors.
            d) Lumen ambient temperature multipliers.
            e) Drive current.
            f) Efficacy.
         10) Picture of luminaire.
         11) IES optical distributions.

12) Dimensioned drawings:
    a) Effective projected area rating for pole mounted luminaires.
13) Weight.
14) Photometric data:
    a) Coefficient of utilization tables based on the IES zonal cavity system by an approved testing laboratory.
    b) Luminaire dirt depreciation factor.
    c) Candlepower distribution curves.
    d) Average luminaire brightness.
    e) Lumen output charts.
15) Furnish support method for interior luminaires weighing more than 30 pounds and all wall-mounted luminaires:
    a) Support methods shall be based on seismic requirements at the project site as specified in Section 01850 - Design Criteria.

c. Luminaire substitutions:
    1) Provide complete literature for each luminaire substitution:
    2) Submittals for substituted luminaires shall be sufficient for competent comparison of the proposed luminaire to the originally specified luminaire:
        a) Photometric data:
            (1) IES file in standard IES format.
            (2) Coefficient of utilization tables based on the IES zonal cavity system by an approved testing laboratory.
            (3) Candlepower distribution curves.
            (4) Average luminaire brightness.
            (5) Lumen output charts.
            (6) Power requirements in watts and volt-amperes.
        b) Calculations:
            (1) Provide software generated calculations showing illuminance levels in footcandles and power usage in watts per square foot for each of the areas in which substitutions are proposed:
                (a) Use surface reflectance values in accordance with IES RP-7.
                (b) Use manufacturer Projected Lumen Maintenance factor for minimum of 60,000 hours to perform all calculations.
        c) Specification sheets:
            (1) If lacking sufficient detail to indicate compliance with contract documents, standard specification sheets will not be accepted. This includes, but is not limited to, luminaire type designation, manufacturer's complete catalog number, voltage, LED type, CCT, CRI, specific driver information, system efficacy, L70 life rating, and any modifications necessary to meet the requirements of the contract documents.
    3) Substitutions for specified luminaires will be evaluated upon quality of construction, light distribution, energy use, appearance, and maintenance.
    4) Substitutions shall comply with all applicable building and energy codes.

2. Driver: Provide for each driver type:
    a. Catalog number.
    b. Type of driver.
    c. Output wattage.
    d. Input voltage.
    e. Operating voltage range.
    f. Maximum input power.
    g. Efficiency.
    h. Operating line current.
    i. Power factor.
    j. Operating temperature range.
    k. Current output range in ambient temperatures of 30 to 55 degrees Celsius.
    l. Surge suppression data.
3. Photocell:
    a. Provide for each photocell type:
        1) Switching capacity.
        2) Life expectancy when used on LED sources.
        3) The means of adjusting the lighting pickup level.
        4) Enclosure type.
        5) Mounting method.
4. Luminaire poles:
    a. Submit complete data for each pole type including but not limited to:
        1) Material.
        2) Finish and color.
        3) Handholes.
        4) Anchoring.
        5) Luminaire attachment methods and fittings.
        6) Pole height.
        7) Pole dimensions.
        8) Bolt hole circle layout and hardware.
        9) Accessories.
        10) Provide the EPA wind load rating.

C. Calculations:
1. Provide complete design calculations and installation documents for pole mounting piers and poles mounted from structures:
    a. Include in the calculations the wind and seismic requirements at the project site.
    b. Calculations and design shall be performed by and signed by a Professional Engineer registered in the state where the project is being constructed:

D. Record documents:
1. Update the Luminaire Schedule in the Drawings to reflect the acceptable substitutions, after the substitution has been reviewed and accepted by the Engineer.

1.05 QUALITY ASSURANCE

A. Luminaires shall be UL listed and labeled.

1.06 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.08 SEQUENCING (NOT USED)

1.09 SCHEDULING

A. Exterior and outdoor lighting system operation shall be demonstrated during the hours of darkness.

B. Lighting demonstration shall occur within 2 weeks before substantial completion.

1.10 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

B. LED luminaire:
   1. 5-year warranty from the date of installation including material, workmanship, photometrics, driver, and LED modules.

1.11 SYSTEM START-UP

1.12 OWNER'S INSTRUCTIONS (NOT USED)

1.13 MAINTENANCE

A. Furnish 1 complete spare LED luminaire, with driver, of each type used.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Luminaires:
   1. The following or equal:
      a. As noted on the Luminaire Schedule.

B. Drivers:
   1. One of the following or equal:
      a. Philips Advance.
      b. Thomas Research.
      c. eldoLED.

C. Substitutions:
   1. The lighting design and luminaire selection has been based upon the photometric data of the identified luminaire. It is the Contractor's responsibility to ensure and prove to the Engineer at time of submittal the substitutions meet the quality and photometric requirements of the original design.

2.02 SYSTEM DESCRIPTION

A. Provide luminaires, and accessories for all lighting systems, complete and operable, in accordance with the requirements of the Contract Documents.

B. Individual luminaire types are indicated on the Drawings and on the Luminaire Schedule.

2.03 EXISTING PRODUCTS (NOT USED)

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS (NOT USED)

2.06 EQUIPMENT

A. LED Luminaires:
   1. General:
      a. Pre-wired with leads of 18-AWG, minimum, for connection to building circuits.
      b. Provide the luminaires furnished per the Luminaire Schedule in the Drawings:
         1) The Specifications noted in this Section are an addition or supplement to the Luminaire Schedule.
      c. Individual LEDs connected such that a catastrophic loss or the failure of 1 LED will not result in the loss of the entire luminaire.
   2. Minimum ambient temperature range of 0 degrees Celsius to 40 degrees Celsius.
   3. Minimum rated life:
      a. Process Areas: 100,000 hours when operated at 40 degrees Celsius.
   4. Minimum efficacy of 70 lumens/watt.
   5. Minimum Color Rendering Index of 70.
   6. Tested according to IES LM-79 and LM-80.
   7. Lumen maintenance projection in accordance with IES TM-21.
   8. RoHS compliant.
   9. Integral driver.
   10. Suitable for dry, damp, or wet locations as indicated on the Drawings or on the Luminaire Schedule.
      a. Wet or damp locations: UL 1598 listed.
   11. Designed as a complete LED assembly. Retrofit LED lamps in luminaires not designed specifically for LED light sources shall not be used.
   12. Exterior/outdoor luminaires:
      a. Luminaires in combination with their mounting pole and bracket shall be capable of withstanding:
         1) Wind levels at the project site without damage.
         2) Seismic levels at the project site.
      b. Corrosion-resistant hardware and hinged doors or lens retainer.
      c. Luminaires furnished with integral photoelectrical control shall be of the luminaire manufacturer's standard design.

d. California Energy Code Light Pollution Reduction Compliance:
    1) Provide all exterior luminaires with cutoff photometrics.
        a) Luminaire design shall allow no more than 0.01 horizontal footcandles to escape beyond the site boundary.
    2) Provide exterior luminaires with photocells to automatically control exterior lighting dusk to dawn to turn off or lower the lighting levels during inactive periods. Reference the Drawings for specific luminaires to be controlled.

B. Photo-electric cells:
    1. Photoelectric cell for control of a single luminaire:
        a. Integral to the luminaire.

C. Drivers:
    1. Dimmable, with dimming signal protocol of 0-10 VDC or DALI.
    2. Input power source:
        a. As indicated on the Drawings.
    3. Drive current:
        a. As indicated in the Luminaire Schedule.
    4. Power factor: greater than 0.90.
    5. Efficiency: greater than 80 percent.
    6. Total harmonic distortion (THD) of the input current less than 20 percent.
    7. Rated life of 60,000 hours in an LED luminaire operated at an ambient temperature of 40 degrees Celsius.
    8. Minimum operating temperature of 0 degrees Celsius.
    9. Sound rating: Class A+ or quieter.
    10. UL listed Class 2 Outdoor in accordance with UL 8750.
    11. In accordance with IEEE C62.41 Category A for transient protection.
    12. Driver must limit inrush current:
        a. Meet or exceed NEMA 410 driver inrush standard:
            1) 230 Amps per 10 Amp load with a maximum of 106 Amps squared-seconds at 120V.
            2) 430 Amps per 10 Amp load with a maximum of 370 Amps squared-seconds at 277V.

2.07 COMPONENTS

A. Luminaire poles:
    1. As indicated on the Luminaire Schedule.
    2. Anchor bolts:
        a. Use anchor bolts, bolts, or welded studs for anchors for resisting seismic and wind forces.
            1) Standard hex bolt head.
            2) Do not use anchor bolts fabricated from rod stock with an L or J-shape.
        b. Complete with leveling shims.
    3. Anchor base:
        a. Fabricated from the same type of material as the pole shaft.
        b. Base plate to telescope the pole shaft.
        c. Welded top and bottom along the entire perimeter.
        d. With slotted bolt holes on the bolt circles as submitted.

4. Pole shaft:
    a. As indicated on the Luminaire Schedule.
5. Handhole:
    a. Reinforced handhole located approximately 18 inches above the base.
    b. Complete with cover fabricated from the same material as the pole shaft and stainless steel attachment screws.
    c. With an integral ground connection nut, 1/2 inch by 13 inch UNC welded to the pole for connection to the grounding system.
6. Shroud:
    a. Fabricated from the same type of material as the pole shaft.
    b. 1-piece formed channel section that shall conform to the pole shaft taper.
    c. Secured by a locking device with provisions for a padlock to prevent accidental lowering.
7. Fastening hardware:
    a. All fasteners shall be stainless steel.
8. Finish:
    a. As indicated on the Luminaire Schedule.

2.08 ACCESSORIES

A. Pole mounted convenience outlet:
    1. Where indicated, furnish a 120 Volt, GFCI protected receptacle:
        a. Integrally mounted in the pole shaft at 24 inches above the base.
    2. Complete with corrosion resistant and weatherproof cover.

2.09 MIXES (NOT USED)

2.10 FABRICATION (NOT USED)

2.11 FINISHES (NOT USED)

2.12 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Install luminaires per the manufacturer’s guidelines and submitted installation calculations to meet seismic and wind requirements at the project site.

B. Special techniques:
    1. Support luminaires from structural elements capable of carrying the total weight.

2. Install luminaires plumb and square with building and wall intersections:
    a. Suspend pendant-mounted luminaries that are mounted from sloping ceilings with ball hangers, unless otherwise indicated on the Drawings.
    b. Install luminaires in machinery rooms after machines have been installed, so as to ensure no conflict with machinery, piping, or ductwork.
3. In all cases, coordinate luminaire locations with work of other trades to prevent obstruction of light from the fixtures:
    a. Locate bottom of luminaire approximately at the bottom of ductwork, unless otherwise specified or indicated on the Drawings.
4. Support luminaires weighing more than 25 pounds independently of the outlet box and the conduit.
5. Provide ceiling or pendent mounted luminaires with a safety chain connecting the lens, driver, and other components to the building structure.
6. Provide recessed luminaires with auxiliary safety supports attached directly to the building structure:
    a. The safety supports shall consist of number 12 AWG soft drawn galvanized wires.
7. Install luminaires in accordance with the architectural reflected ceiling Drawings:
    a. Center luminaires on ceiling tiles unless otherwise indicated.
8. Support luminaires installed in suspended grid ceilings, independently of the grid:
    a. Provide seismic restraint clips for all luminaires installed in suspended grid ceilings.

C. Luminaire poles:
1. Set poles on anchor bolts and secured with double nuts on each bolt.
2. Dry-pack the pole base, after the luminaire and pole has been leveled and plumbed.
3. Bond metal poles to the plant grounding system, utilizing a ground lug connection within the pole:
    a. Route ground conductor through pier and pole base sleeve using Schedule 40 PVC conduit.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.08 FIELD QUALITY CONTROL

3.09 ADJUSTING

A. Aim and verify all exterior and outdoor luminaires alignment, during dark evening hours, as directed by Owner or the Engineer.

3.10 CLEANING

A. Clean all lenses, diffusers, and reflectors.

B. Refinish all luminaires' trim, poles, and support brackets, where finish has been damaged.

C. Clean all LED luminaires (new and old), used during construction for construction lighting, before substantial completion.

D. Clean and re-lamp all existing fluorescent and HID luminaires used during construction for construction lighting, before substantial completion.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES

A. Refer to the Luminaire Schedule in the Drawings.

END OF SECTION

SECTION 16950

FIELD ELECTRICAL ACCEPTANCE TESTS

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PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Responsibilities for testing the electrical installation.
   2. Adjusting and calibration.
   3. Acceptance tests.

B. Copyright information:
   1. Some portions of this Section are copyrighted by the InterNational Electrical Testing Association, Inc. (NETA). See NETA publication ATS for details.

1.02 REFERENCES

A. General standards:
   1. As specified in Section 16050 - Common Work Results for Electrical.
   2. Specification sections for the electrical equipment being tested.
   3. Shop drawings.

B. National standards:
   1. American National Standards Institute (ANSI).
   2. Institute of Electrical and Electronics Engineers (IEEE):
      a. 43 - IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery.
      b. 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.
      c. C57.13 - IEEE Standard Requirements for Instrument Transformers.
      d. C57.13.1 - IEEE Guide for Field Testing of Relaying Current Transformers.
      e. C57.13.3 - IEEE Guide for Grounding of Instrument Transformer Secondary Circuits and Cases.
   3. Insulated Cable Engineer's Association (ICEA).
   4. InterNational Electrical Testing Association (NETA).
      a. ATS- Standard for Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems.
   5. International Electrotechnical Commission (IEC).
   6. Manufacturer's testing recommendations and instruction manuals.
   7. National Fire Protection Association (NFPA):
      a. 70 - National Electrical Code (NEC).
      b. 110 - Standard for Emergency and Standby Power Systems.
   8. National Institute of Standards and Technology (NIST).

1.03 DEFINITIONS

A. Project definitions:
   1. As specified in Sections 01756 - Commissioning and 16050 - Common Work Results for Electrical.

B. Specific definitions:
   1. Testing laboratory: The organization performing acceptance tests.

1.04 SYSTEM DESCRIPTION

A. General requirements:
   1. Testing of all electrical equipment installed under this Contract in accordance with the manufacturer's requirements and as specified in this Section.
   2. Conduct all tests in the presence of the Engineer or the Engineer's representative:
      a. Engineer will witness all visual, mechanical, and electrical tests, and inspections.
   3. The testing and inspections shall verify that the equipment is operational within the tolerances required and expected by the manufacturer, and these Specifications.

B. Responsibilities:
   1. Contractor responsibilities:
      a. Ensure that all resources are made available for testing, and that all testing requirements are met.
   2. Electrical subcontractor responsibilities:
      a. Perform routine tests during installation.
      b. Demonstrate operation of electrical equipment.
      c. Commission the electrical installation.
      d. Provide the necessary services during testing, and provide these services to the testing laboratory, Contractor, and other subcontractors, including but not limited to:
         1) Providing electrical power as required.
         2) Operating of electrical equipment in conjunction with testing of other equipment.
         3) Activating and shutting down electrical circuits.
         4) Making and recording electrical measurements.
         5) Replacing blown fuses.
         6) Installing temporary jumpers.
   3. Testing laboratory responsibilities:
      a. Perform all acceptance tests specified in this Section.
      b. Provide all required equipment, materials, labor, and technical support during acceptance tests.

1.05 SUBMITTALS

A. General submittal requirements:
   1. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. Copper Ethernet test form:
   1. Cable test reports:
      a. Submit 3 copies of test reports showing the results of all tests specified in this Section:
         1) Test type.
         2) Test location.
         3) Test date.

4) Cable number.
5) Cable length.
6) Certification that the cable meets or exceeds the specified standard.

b. Furnish hard copy and electronic copy for all traces.

C. Manufacturers' testing procedures:
1. Submit manufacturers' recommended testing procedures and acceptable test results for review by the Engineer prior to beginning testing.

D. Test report:
1. Include the following:
a. Summary of Project.
b. Description of equipment tested.
c. Description of tests performed.
d. Test results.
e. Conclusions and recommendations.
f. Completed test forms.
g. List of test equipment used and calibration dates.
h. LAN cable test reports.

E. Test data records:
1. Include the following:
a. Identification of the testing organization.
b. Equipment identification.
c. Nameplate data.
d. Humidity, temperature and or other conditions that may affect the results of the tests and or calibrations.
e. Dates of inspections, tests, maintenance and or calibrations.
f. Indication of the inspections, tests, maintenance, and or calibrations to be performed and recorded.
g. Expected results when calibrations are to be performed.
h. Indication of as-found and as-left results as applicable.
i. Indication of all test results outside specified tolerances.

F. Testing laboratory qualifications:
1. Submit a complete resume and statement of qualifications from the proposed testing laboratory detailing their experiences in performing the tests specified:
a. This statement will be used to determine whether the laboratory is acceptable, and shall include:
1) Corporate history and references.
2) Resume of individual performing test.
3) Equipment list and test calibration data.

G. Division of responsibilities:
1. Submit a list identifying who is responsible for performing each portion of the testing.

1.06 QUALITY ASSURANCE

A. Testing laboratory qualifications:
   1. The testing laboratory may be qualified testing personnel from the electrical subcontractor's staff or an independent testing company.
   2. NETA certification required.
   3. Selection of the testing laboratory and testing personnel is subject to approval by the Engineer based on testing experience and certifications of the individuals and testing capabilities of the organization.

1.07 DELIVERY, STORAGE, AND PROTECTION (NOT USED)

1.08 PROJECT OR SITE CONDITIONS

A. General site and project conditions:
   1. As specified in Section 01850 - Design Criteria.

1.09 SEQUENCING

A. Prior to testing:
   1. At least 30 days before commencement of the acceptance tests, submit the manufacturer's complete field testing procedures to the Engineer and to the testing laboratory, complete with expected test results and tolerances for all equipment to be tested.

B. Perform testing in the following sequence:
   1. Perform routine tests as the equipment is installed including:
      a. Insulation-resistance tests.
      b. Continuity tests.
      c. Rotational tests.
   2. Adjusting and preliminary calibration.
   3. Acceptance tests.
   4. Demonstration.
   5. Commissioning and plant start-up.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION

A. Test instrument calibration:
   1. Utilize a testing laboratory with a calibration program which maintains all applicable test instrumentation within rated accuracy.
      a. The calibrating standard shall be of better accuracy than that of the equipment tested.
   2. The accuracy shall be traceable to the NIST in an unbroken chain.
   3. Calibrate instruments in accordance with the following frequency schedule:
      a. Field instruments: 6 months maximum.
      b. Laboratory instruments: 12 months maximum.
      c. Leased specialty equipment where the accuracy is guaranteed by the lessor (such as Doble): 12 months maximum.
   4. Dated calibration labels shall be visible on all test equipment.
   5. Maintain an up-to-date instrument calibration record for each test instrument:
      a. The records shall show the date and results of each calibration or test.
   6. Maintain an up-to-date instrument calibration instruction and procedure for each test instrument.

B. Requirements prior to testing:
   1. Do not begin testing until the following conditions have been met:
      a. All instruments required are available and in proper operating condition.
      b. All required dispensable materials such as solvents, rags, and brushes are available.
      c. All equipment handling devices such as cranes, vehicles, chain falls and other lifting equipment are available or scheduled.
      d. All instruction books, calibration curves, or other printed material to cover the electrical devices are available.
      e. Data sheets to record all test results are available.

3.03 INSTALLATION

A. Test decal:
   1. The testing laboratory shall affix a test decal on the exterior of equipment or equipment enclosure of protective devices after performing electrical tests.

2. The test decal shall be color coded to communicate the condition of maintenance of the protective. The color scheme for condition of maintenance of overcurrent protective devices shall be:
    a. White: electrically and mechanically acceptable.
    b. Yellow; minor deficiency not affecting fault detection and operation, but minor electrical or mechanical condition exists.
3. The decal shall include the following information at a minimum:
    a. Testing organization.
    b. Project identifier.
    c. Test date.
    d. Technician identifier.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING

A. General commissioning requirements:
    1. As specified in Section 01756 - Commissioning.

B. Testing and Training Phase: Installation Testing:
    1. Also called "Field Acceptance Testing".

C. Panelboards:
    1. Cleaning:
        a. Visually inspect panelboard for evidence of discoloration, abnormal dust accumulation, metal shards, or any other indication of overheating, wear, or other abnormal conditions prior to cleaning.
        b. Clean cabinet with a brush, vacuum cleaner, or clean, dry, lint-free rags to remove any accumulation of dust, dirt, or other foreign matter. Do not use liquids, solvents or detergents when cleaning panelboards or components.
        c. Avoid blowing dust into panelboards. Do not use a blower or compressed air.
        d. Clean Supports, terminals, and other major insulating surfaces with clean, dry, lint-free rags or soft bristled brushes.
        e. Remove dust, soot, grease, moisture, and foreign material from surface of circuit breakers.
    2. General:
        a. Compare equipment nameplate data with the Contract Documents.
        b. Check panelboard circuit schedule for accuracy.
        c. Verify appropriate anchorage, required area clearances, and correct alignment.
        d. Inspect overall general condition for physical damage. Check for broken studs and loose or damaged wires, connector, terminations, etc. Check all bolts, nuts, washer, and pins for tightness. Tighten or use manufacture’s replacement parts as required.

e. Inspect cabinets for signs of rust, corrosion, or deteriorating paint. Inspect cabinets for evidence of localized heat damage to the paint. Investigate sources of heat. Repair painted surfaces.
f. Check that covers are in place and fastened. Plug any open unused knockouts.
g. Inspect panelboard for moisture. Seal off any cracks or openings which have allowed moisture to enter the cabinet. Inspect all component devices. Replace any components that show evidence of damage from moisture.
h. Look for any recent changes in sprinklers or other plumbing that might expose indoor panelboards to a source of liquids. Eliminate sources of water, moisture, or liquids, or provide adequate barriers to protect panelboards from sources of water, moisture, or liquids.
i. Inspect panelboards and internal components for evidence of overheating, arc spatter, sooty deposits, and tracking. Investigate and correct sources of arcing or overheating. Consult the panelboard manufacturer for recommendations.
j. Verify that fuse and/or circuit breaker sizes and types correspond to record drawings, if available, as well as to the circuit breaker's address for microprocessor communications packages, if equipped.
k. Set adjustable circuit breakers in accordance with engineering coordination study supplied by Contractor.

3. Terminations, Connections, and Lugs:
   a. Inspect bolted electrical connections for high resistance using one of the following methods:
      1) Use of low-resistance ohmmeter.
         a) Compare bolted connection resistance values to values of similar connections:
            (1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
      2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
         a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
   b. Inspect terminations, connection, and lugs for alignment, physical damage, burns, corrosion, discoloration, flaking, heat damage, arcing, pitting, melting, deterioration, carbonization, cracks, chips, breaks, partial discharge, or moisture. Investigate and eliminate sources of any damage.
   c. Follow manufacturer recommendations for cleaning, repairing, and replacing damaged parts.
   d. Replace overheated connections. Tighten connections to proper torque levels as specified above.
4. Conductors and raceways:
   a. Inspect supply conductors and terminations for overheating, discoloration, and oxidation. Investigate and correct any deficiencies.
   b. Ensure the conductors are protected within their ampacities.
   c. Visually check panelboard, cables, and raceways for proper bonding and grounding. Correct improper bonding and grounding.

d. Inspect conductors for discoloration, arcing, pitting, melting, flaking of insulation and/or metal parts. Repair or replace damaged components in accordance with manufacturer's recommendations.
e. Inspect for frayed or broken wires. Replace or repair damaged components in accordance with manufacturer recommendations.
f. Inspect for frayed or broken wires. Replace or repair conductors as necessary.
g. Inspect conduits for moisture. Seal conduits which are a source of moisture and provide means to drain moisture away from the panelboard.

5. Circuit breakers:
   a. Breakers rated less than 100 A:
      1) Operate circuit breakers several times in order to exercise the mechanisms and the contacts, and to ensure smooth operation. Do not oil or grease parts of molded case circuit breakers.
      2) Visually check circuit breakers for evidence of overheating and thermal damage. Investigate and eliminate sources of overheating.
      3) Check circuit breakers for visual defects, chipping, cracks, breaks, burns, and deterioration. Replace damaged circuit breakers.
      4) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and antipump function.
      5) Inspect interchangeable trip-unit circuit breakers for tightness of trip units.
      6) Check circuit breaker terminals and connections for tightness as specified above.
   b. Breakers rated 100 A and higher:
      1) Perform visual and mechanical inspection as specified in this Section.
      2) Perform electrical tests as specified in this Section.

D. Switchgear and switchboard:
   1. Visual and mechanical inspection:
      a. Compare equipment nameplate data with the Contract Documents.
      b. Inspect physical and mechanical condition.
      c. Inspect anchorage, alignment, grounding and required area clearances.
      d. Verify the unit is clean and all shipping bracing, loose parts, and documentation shipped inside cubicles have been removed.
      e. Verify that circuit breaker/fuse sizes and types correspond to the approved submittals and the coordination study as well as to the circuit breakers address for microprocessor-communication packages.
      f. Verify that current and voltage transformer ratios correspond to those indicated on the Drawings.
      g. Verify that wiring connections are tight and that wiring is secure to prevent damage during routine operation of moving parts.
      h. Inspect bolted electrical connections for high resistance using one of the following methods:
         1) Use of low-resistance ohmmeter.
         2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
            a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.

i. Verify operation and sequencing of interlocking systems:
   1) Attempt closure on locked-open devices.
   2) Attempt to open locked-closed devices.
   3) Make/attempt key-exchanges in all positions.
j. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
k. Inspect insulators for evidence of physical damage or contaminated surfaces.
l. Verify correct barrier and shutter installation and operation.
m. Exercise all active components.
n. Inspect mechanical indicating devices for correct operation.
o. Verify that filters are in place and/or vents are clear.
p. Perform visual and mechanical inspection of instrument transformers as specified in this Section.
q. Perform visual and mechanical inspection of surge arresters as specified in this Section.
r. Inspect control power transformers:
   1) Inspect for physical damage, cracked insulation, broken leads, tightness of connections, defective wiring, and overall general condition.
   2) Verify that primary and secondary fuse/circuit breaker ratings match the submittal drawings.
   3) Verify correct functioning of drawout disconnecting contacts, grounding contacts, and interlocks.

2. Electrical tests:
   a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
   b. Perform insulation-resistance tests on each bus section, phase-to-phase and phase-to-ground for 1 minute.
      1) Perform test in accordance with NETA ATS tables.
   c. Perform electrical tests on instrument transformers as specified in this Section.
   d. Perform ground-resistance tests:
      1) Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral and derived neutral points.
   e. Test metering devices as specified in this Section.
   f. Control power transformers:
      1) Perform insulation-resistance tests. Perform measurements from winding-to-winding and each winding-to-ground:
         a) Test voltages shall be in accordance with NETA ATS tables or as specified by the manufacturer.
         b) Perform a turns-ratio test on all tap positions.
      2) Perform secondary wiring integrity test:
         a) Disconnect transformer at secondary terminals and connect secondary wiring to a rated secondary voltage source:
            (1) Verify correct potential at all devices.
      3) Verify correct secondary voltage by energizing primary winding with system voltage:
         a) Measure secondary voltage with the secondary wiring disconnected.

g. Perform current injection tests on the entire current circuit of each switchgear or switchboard:
    1) Perform current tests by secondary injection with magnitudes such that a minimum current of 1.0 ampere flows in the secondary circuit:
        a) Verify the correct magnitude of current at each device in the circuit.
h. Perform system function tests.
i. Verify operation of space heaters.
j. Perform electrical tests of surge arresters as specified in this Section.

3. Test values:
    a. Compare bolted connection resistance values to values of similar connections:
        1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    b. Bolt-torque levels shall be in accordance with manufacturer's published data:
        1) Refer to NETA ATS tables in the absence of manufacturer's published data.
    c. Insulation-resistance values of bus insulation shall be in accordance with manufacturer's published data:
        1) Refer to NETA ATS tables in the absence of manufacturer's published data.
        2) Investigate insulation values less than the allowable minimum.
        3) Do not proceed with dielectric withstand voltage tests until insulation-resistance values are above minimum values.
    d. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.
    e. Instrument transformer test values shall be as specified in this Section.
    f. Meter test values shall be as specified in this Section.
    g. Investigate grounding system point-to-point resistance values that exceed 0.5 ohm.
    h. Control power transformers:
        1) Insulation-resistance values of control power transformers shall be in accordance with manufacturer's published data:
            a) Refer to NETA ATS tables in the absence of manufacturer's published data.
            b) Investigate insulation values less than the allowable minimum.
        2) Turns-ratio test results shall not deviate by more than 1/2 percent from either the adjacent coils or the calculated ratio.
            a) Do not proceed with dielectric withstand voltage tests until insulation-resistance values are above minimum values.
        3) Secondary wiring shall be as indicated on the Drawings and specified in the Specifications.
        4) Secondary voltage shall be as indicated on the Drawings.
    i. Current-injection tests shall prove current wiring is as indicated on the Drawings and specified in the Specifications.
    j. Results of system function tests shall match the drawings and Specifications.
    k. Heaters shall be operational.

l. Phasing checks shall prove the switchgear or switchboard phasing is correct and in accordance with the system design.
m. Results of electrical tests on surge arresters shall be as specified in this Section.

E. Dry type transformers:
1. Visual and mechanical inspection:
a. Compare equipment nameplate data with the Contract Documents.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, and grounding.
d. Verify that resilient mounts are free and that any shipping brackets have been removed.
e. Inspect equipment for cleanliness.
f. Inspect bolted electrical connections for high resistance using one of the following methods:
1) Use of low-resistance ohmmeter.
2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
g. Verify that as-left tap connections are as specified.
2. Electrical tests:
a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground:
1) Apply voltage in accordance with manufacturer's published data.
a) Refer to NETA ATS tables in the absence of manufacturer's published data.
c. Calculate dielectric absorption ration or polarization index.
d. Verify correct secondary voltage, phase-to-phase and phase-to-neutral after energization and before loading.
3. Test values:
a. Compare bolted connection resistance values to values of similar connections:
1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
b. Bolt-torque levels shall be in accordance with manufacturer's published data:
1) Refer to NETA ATS tables in the absence of manufacturer's published data.
c. Tap connections are left as found unless otherwise specified.
d. Minimum insulation-resistance values of transformer insulation shall be in accordance with manufacturer's published data:
1) Refer to NETA ATS tables in the absence of manufacturer's published data.
2) Investigate insulation values less than the allowable minimum.
e. The dielectric absorption ratio or polarization index shall not be less than 1.0.

f. Turns-ratio results should not deviate more than 1/2 percent from either the adjacent coils or calculated ratio.
g. Phase-to-phase and phase-to-neutral secondary voltages shall be in agreement with nameplate data.

F. Low voltage cables, 600 volt maximum:
1. Visual and mechanical inspection:
a. Compare cable data with the Drawings and Specifications.
b. Inspect exposed sections of cable for physical damage and correct connection as indicated on the Drawings.
c. Inspect bolted electrical connections for high resistance by one of the following methods:
1) Use of low-resistance ohmmeter.
2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
d. Inspect compression applied connectors for correct cable match and indentation.
e. Inspect for correct identification and arrangement.
f. Inspect cable jacket insulation and condition.
2. Electrical tests:
a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
b. Perform insulation resistance test on each conductor sized No. 8 AWG or larger with respect to ground and adjacent conductors:
1) Applied potential shall be 500 volts dc for 300 volt rated cable and 1,000 volts dc for 600 volt rated cable.
2) Test duration shall be 1 minute.
c. Perform continuity tests on all power and control conductors to insure correct cable connection.
d. Verify uniform resistance of parallel conductors.
3. Test values:
a. Compare bolted connection resistance values to values of similar connections:
1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
b. Insulation-resistance values shall be in accordance with manufacturer's published data:
1) Refer to NETA ATS tables in the absence of manufacturer's published data.
2) Investigate values of insulation-resistance less than the allowable minimum.
c. Cable shall exhibit continuity.
d. Deviations in resistance between parallel conductors shall be investigated.

G. Low voltage molded case and insulated case circuit breakers:
1. Visual and mechanical inspection:
a. Compare equipment nameplate data with the Contract Documents.
b. Inspect physical and mechanical condition.

c. Inspect anchorage and alignment.
d. Verify the unit is clean.
e. Operate the circuit breaker to ensure smooth operation.
f. Inspect bolted electrical connections for high resistance by one of the following methods:
    1) Use of low-resistance ohmmeter.
    2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
        a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
g. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical tests:
    a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
    b. Perform insulation-resistance tests for 1 minute on each pole, phase-to-phase and phase-to-ground with the circuit breaker closed and across each open pole:
        1) Apply voltage in accordance with manufacturer's published data.
        2) Refer to NETA ATS tables in the absence of manufacturer's published data.
    c. Perform a contact/pole-resistance test.
    d. Determine long-time pickup and delay by primary current injection.
    e. Determine short-time pickup and delay by primary current injection.
    f. Determine ground-fault pickup and delay by primary current injection.
    g. Determine instantaneous pickup value by primary current injection.
    h. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data.
    i. Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, anti-pump function and trip unit battery condition:
        1) Reset all trip logs and indicators.
    j. Verify operation of charging mechanism.

3. Test values:
    a. Compare bolted connection resistance values to values of similar connections:
        1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    b. Bolt-torque levels shall be in accordance with manufacturer's published data:
        1) Refer to NETA ATS tables in the absence of manufacturer's published data.
    c. Insulation-resistance values shall be in accordance with manufacturer's published data:
        1) Refer to NETA ATS tables in the absence of manufacturer's published data.
        2) Investigate values of insulation-resistance less than the allowable minimum.

d. Microhm or dc millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data:
    1) If manufacturer's data is not available, investigate any values which deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.
e. Long-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current characteristic tolerance band including adjustment factors:
    1) If manufacturer's curves are not available, trip times shall not exceed the value shown in NETA ATS tables.
f. Short-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.
g. Ground fault pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.
h. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances:
    1) Refer to NETA ATS tables in the absence of manufacturer's published data.
i. Pickup values and trip characteristics shall be within manufacturer's published tolerances.
j. Determine energy reducing maintenance switch pickup value by primary current injection.
k. Breaker open, close, trip, trip-free, anti-pump, and auxiliary features shall function as designed.
l. The charging mechanism shall operate in accordance with manufacturer's published data.

H. Instrument transformers - current transformers:
1. Visual and mechanical inspection:
    a. Compare equipment nameplate data with the Contract Documents.
    b. Inspect physical and mechanical condition.
    c. Verify correct connection of transformers with system requirements.
    d. Verify that adequate clearances exist between primary and secondary circuit wiring.
    e. Verify the unit is clean.
    f. Inspect bolted electrical connections for high resistance using one of the following methods:
        1) Use of low-resistance ohmmeter.
        2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
            a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
    g. Verify that all required grounding and shorting connections provide contact.
    h. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
2. Electrical tests:
    a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

b. Perform insulation-resistance test of each current transformer and its secondary wiring with respect to ground at 1,000 VDC for 1 minute:
    1) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.
c. Perform a polarity test of each current transformer in accordance with IEEE C57.13.1.
d. Perform a ratio verification test using the voltage or current method in accordance with IEEE C57.13.1.
e. Perform an excitation test on current transformers used for relaying applications in with accordance with IEEE C57.13.1.
f. Measure current circuit burdens at transformer terminals in accordance with IEEE C57.13.1.
g. When applicable perform insulation-resistance tests on the primary winding with the secondary grounded:
    1) Test voltages shall be in accordance with NETA ATS tables.
h. Perform power-factor or dissipation-factor tests in accordance with test equipment manufacturer's published data.
i. Verify that current transformer secondary circuits are grounded and have only 1 grounding point in accordance with IEEE C57.13.3:
    1) That grounding point should be located as specified by the Engineer in the Contract Documents.

3. Test values:
    a. Compare bolted connection resistance values to values of similar connections:
        1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    b. Bolt-torque levels shall be in accordance with manufacturer's published data:
        1) Refer to NETA ATS tables in the absence of manufacturer's published data.
    c. Insulation-resistance values of instrument transformers shall be in accordance with manufacturer's published data:
        1) Refer to NETA ATS tables in the absence of manufacturer's published data.
    d. Polarity results shall agree with transformer markings.
    e. Ratio errors shall be in accordance with IEEE C57.13.
    f. Excitation results for current transformers shall match the curve supplied by the manufacturer or be in accordance with IEEE C57.13.1.
    g. Measured burdens shall be compared to instrument transformer ratings.
    h. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the primary winding is considered to have passed the test.
    i. Power-factor or dissipation-factor values shall be compared to manufacturer's published data:
        1) In the absence manufacturer's published data, use the test equipment manufacturer's published data.
    j. Test results shall indicate that the circuits have only 1 grounding point.

I. Instrument transformers - voltage transformers:
   1. Visual and mechanical inspection:
      a. Compare equipment nameplate data with the Contract Documents.
      b. Inspect physical and mechanical condition.
      c. Verify correct connection of transformers with system requirements.
      d. Verify that adequate clearances exist between primary and secondary circuit wiring.
      e. Verify the unit is clean.
      f. Inspect bolted electrical connections for high resistance using one of the following methods:
         1) Use of low-resistance ohmmeter.
         2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
            a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
      g. Verify that all required grounding and connections provide contact.
      h. Verify correct primary and secondary fuse sizes for voltage transformers.
      i. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
      j. Perform as-left tests.
   2. Electrical tests - voltage transformers:
      a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
      b. Perform insulation-resistance tests winding-to-winding and winding-to-ground:
         1) Test voltage shall be applied for 1 minute in accordance with NETA ATS requirements.
         2) For solid state devices that cannot tolerate the applied voltage, follow the manufacturer's recommendation.
      c. Perform a polarity test on each voltage transformer to verify the polarity marks on H_1- X_1 relationship as applicable.
      d. Perform a turns ratio test on all tap positions.
      e. Measure voltage circuit burdens at transformer terminals.
      f. Perform a dielectric withstand test on the primary windings with the secondary windings grounded:
         1) The dielectric voltage shall be in accordance with NETA ATS tables.
         2) Apply the test voltage for 1 minute.
      g. Perform power-factor or dissipation-factor tests in accordance with test equipment manufacturers published data.
      h. Verify that voltage transformer secondary circuits are grounded and have only 1 grounding point in accordance with IEEE C57.13.3:
         1) That grounding point should be located as specified by the Engineer in the Contract Documents.
   3. Test values:
      a. Compare bolted connection resistance values to values of similar connections:
         1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer’s published data:
    1) Refer to NETA ATS tables in the absence of manufacturer’s published data.
c. Insulation-resistance values of instrument transformers shall be in accordance with manufacturer’s published data:
    1) Refer to NETA ATS tables in the absence of manufacturer’s published data.
d. Polarity results shall agree with transformer markings.
e. Ratio errors shall be in accordance with IEEE C57.13.
f. Measured burdens shall be compared to instrument transformer ratings.
g. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the primary winding is considered to have passed the test.
h. Power-factor or dissipation-factor values shall be compared to manufacturer’s published data:
    1) In the absence manufacturer’s published data, use the test equipment manufacturer's published data.
i. Test results shall indicate that the circuits have only 1 grounding point.

J. Metering devices, microprocessor based:
1. Visual and mechanical inspection:
    a. Compare equipment nameplate data with the Contract Documents.
    b. Inspect meters and cases for physical damage.
    c. Clean front panel.
    d. Verify tightness of electrical connections.
    e. Record the following:
        1) Model number.
        2) Serial number.
        3) Firmware revision.
        4) Software revision.
        5) Rated control voltage.
    f. Verify operation of display and indicating devices.
    g. Record passwords.
    h. Verify the unit is grounded in accordance with the manufacturer's instructions.
    i. Set all required parameters including instrument transformer ratios, system type, frequency, power demand methods/intervals, and communications requirements.
2. Electrical tests:
    a. Apply voltage or current as appropriate to each analog input and verify correct measurement and indication.
    b. Confirm correct operation and setting of each auxiliary input/output feature including mechanical relay, digital and analog.
    c. After initial system energization, confirm measurements and indications are consistent with loads present.
3. Test values:
    a. Nameplate data shall match the Contract Documents.
    b. Tightness of electrical connections shall ensure a low resistance connection.

c. Display and indicating devices shall operate per manufacturer's published data.
d. Measurement and indication of applied voltages and currents shall be within the manufacturer's published tolerances for accuracy.
e. All auxiliary input/output features shall operate per settings and manufacturer's published data.
f. Measure and indications shall be consistent with energized system loads.

K. Metering devices electromechanical and solid state:
1. Visual and mechanical inspection:
a. Compare equipment nameplate data with the Contract Documents.
b. Inspect physical and mechanical condition.
c. Inspect bolted electrical connections for high resistance using one of the following methods:
1) Use of low-resistance ohmmeter.
2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
a) Refer to manufacturer’s instructions for proper foot-pound levels or NETA ATS tables.
d. Record model number, serial number, firmware revision, software revision, and rated control voltage.
e. Verify operation of display and indicating devices.
f. Record passwords.
g. Verify unit is grounded in accordance with manufacturer’s instructions.
h. Set all required parameters including instrument transformer ratios, system type, frequency, power demand methods/intervals, and communications requirements.
i. Inspect cover gasket, cover glass, condition of spiral spring, disk clearance, contacts, and case shorting contacts as applicable.
j. Verify the unit is clean.
2. Electrical tests:
a. Apply voltage or current as appropriate to each analog input and verify correct measurement and indication.
b. Confirm correct operation and setting of each auxiliary input/output feature including mechanical relay, digital, and analog.
c. After initial system energization, confirm measurements and indications are consistent with loads present.
d. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
e. Verify accuracy of meter at all cardinal points.
f. Calibrate meters in accordance with manufacturer’s published data.
g. Verify that current transformer, and voltage transformer secondary circuits are intact.
3. Test values:
a. Compare bolted connection resistance values to values of similar connections:
1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.

b. Bolt-torque levels shall be in accordance with manufacturer's published data:
    1) Refer to NETA ATS tables in the absence of manufacturer's published data.
c. Meter accuracy shall be in accordance with manufacturer's published data.
d. Calibration results shall be within manufacturer's published tolerances.
e. Instrument multipliers shall be in accordance with system design specifications.
f. Test results shall confirm the integrity of the secondary circuits of current and voltage transformers.

L. Grounding systems:
1. Visual and mechanical inspection:
    a. Inspect ground system for compliance with the Contract Documents, and the NEC.
    b. Inspect physical and mechanical condition.
    c. Inspect bolted electrical connections for high resistance using one of the following methods:
        1) Use of low-resistance ohmmeter.
        2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
            a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
    d. Inspect anchorage.
2. Electrical tests:
    a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
    b. Perform fall of potential test or alternative test in accordance with IEEE 81 on the main grounding electrode or system.
    c. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, the system neutral and any derived neutral points.
3. Test values:
    a. Grounding system electrical and mechanical connections shall be free of corrosion.
    b. Compare bolted connection resistance values to values of similar connections:
        1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    c. Bolt-torque levels shall be in accordance with manufacturer's published data:
        1) Refer to NETA ATS tables in the absence of manufacturer's published data.
    d. The resistance between the main grounding electrode and ground shall be as specified in Section 16060 - Grounding and Bonding.
    e. Investigate point-to-point resistance values that exceed 0.5 ohm.

M. Rotating machinery, ac induction motors and generators:
1. Visual and mechanical inspection:
    a. Compare equipment nameplate information with the Contract Documents.

b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, and grounding.
d. Inspect air baffles, filter media, cooling fans, slip rings, brushes, and brush rigging.
e. Inspect bolted electrical connections for high resistance using one or more of the following methods:
    1) Use of low-resistance ohmmeter.
    2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
        a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
f. Manually rotate the rotor and check for problems with the bearings or shaft.
g. Rotating equipment:
    1) Operate at rated design load conditions.
    2) Confirm that equipment is properly assembled.
    3) Confirm the equipment moves or rotates in the proper direction.
    4) Confirm shafting, drive elements, and bearings are installed and lubricated in accordance with proper tolerances.
    5) Confirm that no unusual power consumption, lubrication temperatures, bearing temperatures, or other conditions are observed.
h. Verify correct application of appropriate lubrication and lubrication systems.
i. Verify that resistance temperature detector (RTD) circuits conform to that indicated on the Drawings.

2. Electrical tests - AC Induction:
    a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
    b. Perform insulation-resistance test in accordance with IEEE 43:
        1) On motors 200 horsepower and smaller, test duration shall be 1 minute. Calculate dielectric absorption ratio for 60/30 second periods.
    c. Perform insulation-resistance test on insulated bearings in accordance with manufacturer's published data.
    d. Test surge protection devices as specified in this Section.
    e. Test motor starter as specified in this Section.
    f. Perform resistance tests on resistance temperature detector (RTD) circuits.
    g. Verify operation of motor space heater, if applicable.
3. Test values:
    a. Inspection:
        1) Air baffles shall be clean and installed in accordance with the manufacturer's published data.
        2) Filter media shall be clean and installed in accordance with the manufacturer's published data.
        3) Cooling fans shall operate.
        4) Slip ring alignment shall be within manufacturer's published tolerances.
        5) Brush alignment shall be within manufacturer's published tolerances.
        6) Brush rigging shall be within manufacturer's published tolerances.

b. Compare bolted connection resistance values to values of similar connections:
    1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
c. Bolt-torque levels shall be in accordance with manufacturer's published data:
    1) Refer to NETA ATS tables in the absence of manufacturer's published data.
d. Airgap spacing and machine alignment shall be in accordance with manufacturer's published data.
e. The recommended minimum insulation-resistance ($IR_{1\ min}$) test results in megohms shall be in accordance with NETA ATS tables.
    1) The polarization index value shall not be less than 2.0.
    2) The dielectric absorption ratio shall not be less than 1.4.
f. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.
g. Investigate phase-to-phase stator resistance values that deviate by more than 5 percent.
h. Power factor or dissipation factor values shall be compared to manufacturer's published data:
    1) In the absence of manufacturer's published data, compare values of similar machines.
i. Tip-up values shall indicate no significant increase in power factor.
j. If no evidence of distress, insulation failure, or waveform nesting is observed by the end of the total time of voltage application during the surge comparison test, the test specimen is considered to have passed the test.
k. Bearing insulation-resistance measurements shall be within manufacturer's published tolerances:
    1) In the absence of manufacturer's published data, compare values of similar machines.
l. Test results of surge protection devices shall be as specified in this Section.
m. Test results of motor starter equipment shall be as specified in this Section.
n. RTD circuits shall conform to the design intent and machine protection device manufacturer's published data.
o. Heaters shall be operational.
p. Vibration amplitudes of the uncoupled and unloaded machine shall be in accordance with manufacturer's published data:
    1) In the absence of manufacturer's published data, vibration amplitudes shall not exceed values in NETA ATS tables.
    2) If values exceed those in the NETA ATS tables, perform a complete vibration analysis.

N. Motor starters, low voltage:
    1. Visual and mechanical inspection:
        a. Compare equipment nameplate information with the Contract Documents.
        b. Inspect physical and mechanical condition.
        c. Inspect anchorage, alignment, and grounding.

d. Verify the unit is clean.
e. Inspect contactors:
    1) Verify mechanical operation.
    2) Verify contact gap, wipe, alignment, and pressure is in accordance with manufacturer's published data.
f. Motor-running protection:
    1) Verify overload element rating/motor protection settings are correct for its application.
    2) If motor running protection is provided by fuses, verify correct fuse rating.
g. Inspect bolted electrical connections for high resistance using one of the following methods:
    1) Use of low-resistance ohmmeter.
    2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
        a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
h. Lubrication requirements:
    1) Verify appropriate lubrication on moving current-carrying parts.
    2) Verify appropriate lubrication on moving and sliding surfaces.

2. Electrical tests:
    a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
    b. Perform insulation-resistance tests for 1 minute on each pole, phase-to-phase and phase to ground with the starter closed, and across each open pole for 1 minute:
        1) Test voltage shall be in accordance with manufacturer's published data.
        2) Refer to NETA ATS tables in the absence of manufacturer's published data.
    c. Test motor protection devices in accordance with manufacturer's published data.
    d. Test circuit breakers as specified in this Section.
    e. Perform operational tests by initiating control devices.
3. Test values:
    a. Compare bolted connection resistance values to values of similar connections:
        1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    b. Bolt-torque levels shall be in accordance with manufacturer's published data:
        1) Refer to NETA ATS tables in the absence of manufacturer's published data.
    c. Insulation-resistance values shall be in accordance with manufacturer's published data:
        1) Refer to NETA ATS tables in the absence of manufacturer's published data.
        2) Investigate values of insulation-resistance less than the allowable minimum.

d. Motor protection parameters shall be in accordance with manufacturer's published data.
e. Circuit breaker test results shall as be specified in this Section.
f. Control devices shall perform in accordance with system design requirements.

O. Variable frequency drive systems:
1. Visual and mechanical inspection:
a. Compare equipment nameplate data with the Contract Documents.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, and grounding.
d. Verify the unit is clean.
e. Ensure vent path openings are free from debris and that heat transfer surfaces are clean.
f. Verify correct connections of circuit boards, wiring, disconnects, and ribbon cables.
g. Motor running protection:
1) Verify drive overcurrent setpoints are correct for their application.
2) If drive is used to operate multiple motors, verify individual overload element ratings are correct for their application.
3) Apply minimum and maximum speed setpoints. Verify setpoints are within limitations of the load coupled to the motor.
h. Inspect bolted electrical connections for high resistance using one of the following methods:
1) Use of low-resistance ohmmeter.
2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
i. Verify correct fuse sizing in accordance with manufacturer's published data.
j. Perform visual and mechanical inspection of input circuit breaker as specified in this Section.
2. Electrical tests:
a. Perform resistance measurements through bolted connections with low resistance ohmmeter.
b. Test the motor overload relay elements by injecting primary current through the overload circuit and monitoring trip time of the overload element.
c. Test for the following parameters in accordance with relay calibration procedures specified in NETA ATS or as recommended by the manufacturer:
1) Input phase loss protection.
2) Input overvoltage protection.
3) Output phase rotation.
4) Overtemperature protection.
5) Direct current overvoltage protection.
6) Overfrequency protection.
7) Drive overload protection.
8) Fault alarm outputs.

d. Harmonic distortion measurements for both voltage and current is within the specification limits at the installed site.
e. Peak voltage at the motor terminations is less than 90 percent of the motor insulation dielectric withstand level.
f. Perform continuity tests on bonding conductors as specified in accordance with NETA ATS.
g. Perform start-up of drive in accordance with manufacturer's published data. Calibrate drive to the system's minimum and maximum speed control signals.
h. Perform operational tests by initiating control devices:
1) Slowly vary drive speed between minimum and maximum. Observe motor and load for unusual noise or vibration.
2) Verify operation of drive from remote start/stop and speed control signals.
i. Perform electrical tests of input circuit breaker as specified in this Section.
j. Measure fuse resistance.

3. Test values:
a. Compare bolted connection resistance values to values of similar connections:
1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
b. Bolt-torque levels shall be in accordance with manufacturer's published data:
1) Refer to NETA ATS tables in the absence of manufacturer's published data.
c. Overload test trip times at 300 percent of overload element rating shall be in accordance with manufacturer's published time-current curve.
d. Test values for input circuit breaker shall be as specified in this Section.
e. Relay calibration results shall be as specified in this Section.
f. Continuity of bonding conductors shall be in accordance with NETA ATS.
g. Control devices shall perform in accordance with system requirements.
h. Operational tests shall conform to system design requirements.
i. Investigate fuse resistance values that deviate from each other by more than 15 percent.

P. Surge arresters, low-voltage:
1. Visual and mechanical inspection:
a. Compare equipment nameplate data with the Contract Documents.
b. Inspect physical and mechanical condition.
c. Inspect anchorage, alignment, grounding, and clearances.
d. Verify the arresters are clean.
e. Inspect bolted electrical connections for high resistance using one of the following methods:
1) Use of low-resistance ohmmeter.
2) Verify tightness of accessible bolted electrical connections by the calibrated torque wrench method:
a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
f. Verify that the ground lead on each device is individually attached to a ground bus or ground electrode.

g. Verify that stroke counter is correctly mounted and electrically connected, if applicable.
h. Record stroke counter reading.

2. Electrical tests:
   a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
   b. Perform an insulation-resistance test on each arrester, phase terminal-to-ground:
      1) Apply voltage in accordance with manufacturers published data.
      2) Refer to NETA ATS tables in the absence of manufacturer's published data.
   c. Test grounding connection as specified in this Section.
3. Test values:
   a. Compare bolted connection resistance values to values of similar connections:
      1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
   b. Bolt-torque levels shall be in accordance with manufacturer's published data:
      1) Refer to NETA ATS tables in the absence of manufacturer's published data.
   c. Insulation-resistance values shall be in accordance with manufacturer's published data:
      1) Refer to NETA ATS tables in the absence of manufacturer's published data.
      2) Investigate insulation values less than the allowable minimum.
   d. Resistance between the arrester ground terminal and the ground system shall be less than 0.5 ohm.

Q. Switches, air, medium-voltage, metal-enclosed:
1. Visual and mechanical inspection:
   a. Compare equipment nameplate data with the Contract Documents.
   b. Inspect physical and mechanical condition.
   c. Inspect anchorage, alignment, grounding, and required clearances.
   d. Verify the unit is clean.
   e. Verify correct blade alignment, blade penetration, travel stops, arc interrupter operation, and mechanical operation.
   f. Verify that fuse sizes and types are as indicated on the Drawings, short-circuit study, and coordination study.
   g. Verify that expulsion-limiting devices are in place on all holders having expulsion-type elements.
   h. Verify that each fuseholder has adequate mechanical support and contact integrity.
   i. Inspect bolted electrical connections for high resistance using one of the following methods:
      1) Use of a low resistance ohmmeter.
      2) Verify tightness of accessible bolted electrical connections by calibrated torque wrench method:
         a) Refer to manufacturer's instructions for proper foot-pound levels or NETA ATS tables.
   j. Verify operation and sequencing of interlocking systems.

k. Verify correct phase barrier installation.
l. Verify correct operation of all indicating and control devices.
m. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.

2. Electrical tests:
   a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
   b. Measure contact resistance across each switchblade and fuseholder.
   c. Perform insulation-resistance tests for 1 minute on each pole, phase-to-phase and phase-to ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data:
      1) In the absence of manufacturer's published data, use NETA ATS requirements.
   d. Perform a dielectric withstand voltage test on each pole with switch closed. Test each pole-to-ground with all other poles grounded. Test voltage shall be in accordance with manufacturer's published data:
      1) In the absence of manufacturer's published data, use NETA ATS requirements.
   e. Measure fuse resistance.
   f. Verify cubicle space heater operation.
3. Test values:
   a. Compare bolted connection resistance values to values of similar connections:
      1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
   b. Bolt-torque levels shall be in accordance with manufacturer's published data:
      1) Refer to NETA ATS tables in the absence of manufacturer's published data.
4. Test values - electrical:
   a. Compare bolted connection resistance values to values of similar connections:
      1) Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
   b. Microhm or dc millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data.
      1) If manufacturer's published data is not available, investigate values which deviate from those of similar bus connections and sections by more than 50 percent of the lowest value.
   c. Insulation-resistance values shall be in accordance with manufacturer's published data:
      1) Refer to NETA ATS tables in the absence of manufacturer's published data.
      2) Investigate insulation values less than the allowable minimum.
      3) Do not proceed with dielectric withstand voltage tests until insulation-resistance values are above minimum values.
   d. If no evidence of distress or insulation failure is observed by the end of the total time of voltage application during the dielectric withstand test, the test specimen is considered to have passed the test.

e. Investigate fuse resistance values that deviate from each other by more than 15 percent.
f. Heaters shall be operational.

R. Fiber-optic cables:
1. Visual and mechanical inspection:
a. Compare cable, connector, and splice data with the Contract Documents.
b. Inspect cable and connections for physical and mechanical damage.
c. Verify that all connectors and splices are correctly installed.
2. Optical tests:
a. Perform cable length measurement, fiber fracture inspection, and construction defect inspection using an optical time domain reflectometer (OTDR):
1) OTDR test performed on fiber cables less than 100 meters shall be performed with the aid of a launch cable.
2) Adjust OTDR pulse width settings to a maximum setting of 1/1,000th of the cable length or 10 nanoseconds.
b. Perform connector and splice integrity test using an optical time domain reflectometer.
c. Perform cable attenuation loss measurement with an optical power loss test set:
1) Perform attenuation tests with an Optical Loss Test Set capable and calibrated to show anomalies of 0.1 dB as a minimum.
2) Test multimode fibers at 850 nanometer and 1,300 nanometer.
3) Test single mode fibers at 1,310 nanometer and 1,550 nanometer.
d. Perform connector and splice attenuation loss measurement from both ends of the optical cable with an optical power loss test set:
1) At the conclusion of all outdoor splices at 1 location, and before they are enclosed and sealed, all splices shall be tested with OTDR at the optimal wavelengths (850 and 1,300 for multimode, 1,310 and 1,550 for single mode), in both directions. The splices shall be tested for integrity as well as attenuation.
e. Perform fiber links integrity and attenuation tests using each link shall be an OTDR and an Optical Loss Test Set:
1) OTDR traces shall be from both directions on each fiber at the 2 optimal wavelengths, 850 nanometer, and 1,300 nanometer for multimode fibers.
2) Optical loss testing shall be done with handheld test sets in 1 direction at the 2 optimal wavelengths for the appropriate fiber type. Test equipment shall equal or exceed the accuracy and resolution of Agilent/HP 8147 high performance OTDR.
3. Test values:
a. Cable and connections shall not have been subjected to physical or mechanical damage.
b. Connectors and splices shall be installed in accordance with industry standards.
c. The optical time domain reflectometer signal should be analyzed for excessive connection, splice, or cable backscatter by viewing the reflected power/distance graph.

d. Attenuation loss measurement shall be expressed in dB/km. Losses shall be within the manufacturer's recommendations when no local site specifications are available.
e. Individual fusion splice losses shall not exceed 0.1 dB. Measurement results shall be recorded, validated by trace, and filed with the records of the respective cable runs.

S. Copper Ethernet cable installation testing:
1. Pre-installation:
a. Immediately prior to installation, verify that cable to be installed matches that which was submitted.
b. Verify that no damage has been done to the cable during shipping or handling.
c. Inspect cable for physical and mechanical damage.
d. Engineer shall be notified if a cable fails to meet inspection and the cable shall not be installed unless otherwise directed by the Engineer.
2. Post-installation:
a. Prior to copper Ethernet cable termination, perform cable end-to-end continuity validation testing on all installed cables, conductor pairs and cable shields using toner and probe kit. Any cable that fails testing shall be removed and replaced.
b. Inspect equipment outlet connectors for damage and ensure connectors hold tightly in field device ports.
3. Test equipment:
a. Certification equipment used for the testing shall be capable of verifying twisted pair cable installation with end-to-end continuity testing.
b. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
c. Manufacturers: The following or equal:
1) Fluke Networks, IntelliTone Pro 200 Toner and Probe Kit, MT-8200-60-KIT.
d. Refer to Section 17950 - Commissioning for Instrumentation and Controls for Permanent Link testing requirements.

3.08 FIELD QUALITY CONTROL (NOT USED)

3.09 ADJUSTING (NOT USED)

3.10 CLEANING

A. As specified in Section 16050 - Common Work Results for Electrical.

B. After the acceptance tests have been completed, dispose of all testing expendables, vacuum all cabinets, and sweep clean all surrounding areas.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 16990

CONDUIT SCHEDULE

PART 1 GENERAL

1.01 SUMMARY

A. Specific definitions:

1. Conduits:

a.	ARM:	Armored cable.
b.	GRC:	Galvanized rigid conduit.
c.	PCS:	PVC jacketed rigid steel conduit.
d.	IMC:	Intermediate metallic conduit.
e.	EMT:	Electrical metallic steel tubing.
f.	PVC:	Polyvinyl chloride rigid plastic conduit.
g.	SLT:	Sealtight - liquidtight flexible conduit.
h.	RAC:	Rigid aluminum conduit.
i.	FLX:	Flexible metallic conduit.
j.	NFC:	Non-metallic flexible conduit.

2. Cables:

a.	DN Thick:	DeviceNet “thick” cable.
b.	DN Thin:	DeviceNet “thin” cable.
c.	PBPA:	Profibus PA cable.
d.	PBDP:	Profibus DP cable.
e.	PBDPP:	Profibus DP cable with 24VDC power.
f.	FFBUS:	Foundation Fieldbus cable.
g.	RS-485	RS-485 cable.
h.	CAT5e:	Category 5 enhanced Ethernet cable.
i.	CAT6:	Category 6 Ethernet cable.
j.	CNET:	ControlNet cable.
k.	DH+:	Data Highway Plus cable.
l.	RIO:	Remote I/O cable.
m.	DF1:	Serial cable.
n.	MODB:	Modbus cable.
o.	MODB+:	Modbus Plus cable.
p.	*/FO:	Fiber optic cable (* indicates number of fibers).
q.	2/C#16S:	2 conductor, 16 gauge, twisted shielded pair. (*/2/C#16S * indicates number of pairs).
r.	3/C#16S:	3 conductor, 16 gauge, twisted shielded triplet. (*/3/C#16S * indicates number of triplets).
s.	*/C#Y:	Multiconductor cable (* indicates number of conductors, Y indicates conductor size and insulation).
t.	MFR:	Manufacturer or vendor furnished cable.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CONDUIT SCHEDULE

A. As specified in Attachment A - Conduit Schedule.

END OF SECTION

ATTACHMENT A - CONDUIT SCHEDULE

SECTION 16990

CONDUIT SCHEDULE
AREA WTP RECYCLED WATER PS

PART 1 GENERAL

1.01 SUMMARY

A. Conduit requirements:
   1. As defined in Section 16050 and Section 16130.

B. Cable requirements and definitions:
   1. As defined in Section 16050 and Section 16123.
   2. 2/CS#16: 2 conductor, 16 gauge, twisted shielded pair.
   3. 3/CS#16: 3 conductor, 16 gauge, twisted shielded triplet.
   4. */C#Y: Multiconductor cable (* indicates number of conductors, Y indicates conductor size and insulation).
   5. CAT6: Category 6 Ethernet cable.
   6. MFR: Manufacturer or vendor furnished cable.
   7. PULL: Pull Rope.
   8. VFD: Shielded VFD cable with integral ground.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 CONDUIT SCHEDULE

A. Conduit Schedule is presented on the following pages.

CONDUIT SCHEDULE AREA WTP RECYCLED WA

Ukiah Recycled Water Project

ENGINEER	AMM
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CONDUIT			CONDUCTORS			GROUND							
NUMBER	DWG	SIZE	#	SIZE	TYPE	#	SIZE	TYPE	DESCRIPTION				CONNECTING SEGMENTS
C-2011	10E03	0.75"	2	#12	XHHW-2	1	#12	XHHW-2	FR:			PMP-99411	C-2015
			2	#14	XHHW-2				TO:			J-BOX	
										2	#14	>> TSH-99411 CONTROL	
										2	#12	>> MWH-99411 POWER	
C-2012	10E03	0.75"	2	#14	XHHW-2	1	#14	XHHW-2	FR:			DISC-99411	C-2015
									TO:			J-BOX	
										2	#14	>> AUX3-99411 CONTROL	
C-2013	10E03	0.75"	8	#14	XHHW-2	1	#14	XHHW-2	FR:			LCP-99411	C-2015
									TO:			J-BOX	
										8	#14	>> LCP-99411 CONTROL	
C-2015	10E02	2"	2	#12	XHHW-2	1	#12	XHHW-2	FR:			J-BOX	
	10E03		16	#14	XHHW-2				TO:			VFD-99411	
										2	#14	>> TSH-99411 CONTROL	C-2011
										2	#12	>> MWH-99411 POWER	C-2011
										2	#14	>> AUX3-99411 CONTROL	C-2012
										8	#14	>> LCP-99411 CONTROL	C-2013
										4	#14	>> FSL-99411 CONTROL	C-2019
C-2019	10E03	0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR:			FSL-99411	C-2015
									TO:			J-BOX	
										4	#14	>> FSL-99411 CONTROL	C-2018
C-2021	10E03	0.75"	2	#12	XHHW-2	1	#12	XHHW-2	FR:			PMP-99412	C-2025
			2	#14	XHHW-2				TO:			J-BOX	
										2	#14	>> TSH-99412 CONTROL	
										2	#12	>> MWH-99412 POWER	
C-2022	10E03	0.75"	2	#14	XHHW-2	1	#14	XHHW-2	FR:			DISC-99412	C-2025
									TO:			J-BOX	
										2	#14	>> AUX3-99412 CONTROL	
C-2023	10E03	0.75"	8	#14	XHHW-2	1	#14	XHHW-2	FR:			LCP-99412	C-2025
									TO:			J-BOX	
										8	#14	>> LCP-99412 CONTROL	
C-2025	10E02	2"	2	#12	XHHW-2	1	#12	XHHW-2	FR:			J-BOX	
	10E03		16	#14	XHHW-2				TO:			VFD-99412	
										2	#14	>> TSH-99412 CONTROL	C-2021
										2	#12	>> MWH-99412 POWER	C-2021
										2	#14	>> AUX3-99412 CONTROL	C-2022
										8	#14	>> LCP-99412 CONTROL	C-2023
										4	#14	>> FSL-99412 CONTROL	C-2029
C-2029	10E03	0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR:			FSL-99412	C-2025
									TO:			J-BOX	
										4	#14	>> FSL-99412 CONTROL	C-2028
C-2031	10E03	0.75"	2	#12	XHHW-2	1	#12	XHHW-2	FR:			PMP-99413	C-2035
			2	#14	XHHW-2				TO:			J-BOX	
										2	#14	>> TSH-99413 CONTROL	
										2	#12	>> MWH-99413 POWER	
C-2032	10E03	0.75"	2	#14	XHHW-2	1	#14	XHHW-2	FR:			DISC-99413	C-2035
									TO:			J-BOX	
										2	#14	>> AUX3-99413 CONTROL	
C-2033	10E03	0.75"	8	#14	XHHW-2	1	#14	XHHW-2	FR:			LCP-99413	C-2035
									TO:			J-BOX	
										8	#14	>> LCP-99413 CONTROL	
C-2035	10E02	2"	2	#12	XHHW-2	1	#12	XHHW-2	FR:			J-BOX	
	10E03		16	#14	XHHW-2				TO:			VFD-99413	
										2	#14	>> TSH-99413 CONTROL	C-2031
										2	#12	>> MWH-99413 POWER	C-2031
										2	#14	>> AUX3-99413 CONTROL	C-2032
										8	#14	>> LCP-99413 CONTROL	C-2033
										4	#14	>> FSL-99413 CONTROL	C-2039
C-2039	10E03	0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR:			FSL-99413	C-2035
									TO:			J-BOX	
										4	#14	>> FSL-99413 CONTROL	C-2038
C-2041	10E03	0.75"	2	#12	XHHW-2	1	#12	XHHW-2	FR:			PMP-99414	C-2045
			2	#14	XHHW-2				TO:			J-BOX	
										2	#14	>> TSH-99414 CONTROL	
										2	#12	>> MWH-99414 POWER	
C-2042	10E03	0.75"	2	#14	XHHW-2	1	#14	XHHW-2	FR:			DISC-99414	C-2045
									TO:			J-BOX	
										2	#14	>> AUX3-99414 CONTROL	

CONDUIT SCHEDULE AREA WTP RECYCLED WA

Ukiah Recycled Water Project

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CONDUIT			CONDUCTORS			GROUND							
NUMBER	DWG	SIZE	#	SIZE	TYPE	#	SIZE	TYPE			DESCRIPTION		CONNECTING SEGMENTS
C-2043	10E03	0.75"	8	#14	XHHW-2	1	#14	XHHW-2	FR:		LCP-99414		C-2045
									TO:		J-BOX		
										8 #14	>> LCP-99414 CONTROL		
C-2045	10E02	2"	2	#12	XHHW-2	1	#12	XHHW-2	FR:		J-BOX		
	10E03		16	#14	XHHW-2				TO:		VFD-99414		
										2 #14	>> TSH-99414 CONTROL		C-2041
										2 #12	>> MWH-99414 POWER		C-2041
										2 #14	>> AUX3-99414 CONTROL		C-2042
										8 #14	>> LCP-99414 CONTROL		C-2043
										4 #14	>> FSL-99414 CONTROL		C-2049
C-2049	10E03	0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR:		FSL-99414		C-2045
									TO:		J-BOX		
										4 #14	>> FSL-99414 CONTROL		C-2048
C-3001	10E04	0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR:		ZSOC-99402		C-3005
									TO:		J-BOX		
										4 #14	>> ZSOC-99402 CONTROL		
C-3002	10E04	0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR:		SV1-99402		C-3005
									TO:		J-BOX		
										4 #14	>> SV1-99402 CONTROL		
C-3003	10E04	0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR:		SV2-99402		C-3005
									TO:		J-BOX		
										4 #14	>> SV2-99402 CONTROL		
C-3005	10E04	2"	12	#14	XHHW-2	1	#14	XHHW-2	FR:		J-BOX		C-3105
									TO:		HH-4		
										4 #14	>> ZSOC-99402 CONTROL		C-3001
										4 #14	>> SV1-99402 CONTROL		C-3002
										4 #14	>> SV2-99402 CONTROL		C-3003
C-3100	10E04	0.75"	2	MFR	CABLE	1	#14	XHHW-2	FR:		LSLL-99403/LSHH-99403		
									TO:		J-BOX		
										1 MFR	>> LSLL-99403 CONTROL		
										1 MFR	>> LSHH-99403 CONTROL		
C-3102	10E04	2"	4	#14	XHHW-2	1	#14	XHHW-2	FR:		J-BOX		
									TO:		PCM-99400 (VIA HH-4)		
										2 #14	>> LSLL-99403 CONTROL		
										2 #14	>> LSHH-99403 CONTROL		
C-3105	10E02	2"	12	#14	XHHW-2	1	#14	XHHW-2	FR:		HH-4		
									TO:		PCM-99400		
										4 #14	>> ZSOC-99402 CONTROL		C-3005
										4 #14	>> SV1-99402 CONTROL		C-3005
										4 #14	>> SV2-99402 CONTROL		C-3005
L-1000	10E02	1.5"	4	#3	XHHW-2	1	#8	XHHW-2	FR:		PNL-RWPS-L		
									TO:		XFMR-RWPS-L		
										4 #3	>> PNL-RWPS-L POWER		
L-1100	10E02	0.75"	2	#12	XHHW-2	1	#12	XHHW-2	FR:		FCU-99421		
									TO:		CU-99421		
										2 #12	>> FCU-99421 POWER		
L-1101	10E02	0.75"	2	#8	XHHW-2	1	#10	XHHW-2	FR:		CU-99421		L-1102
									TO:		DISC-99421		
										2 #8	>> CU-99421 POWER		
L-1102	10E02	0.75"	2	#8	XHHW-2	1	#10	XHHW-2	FR:		DISC-99421		
									TO:		PNL-RWPS-L		
										2 #8	>> CU-99421 POWER		L-1101
L-1110	10E02	0.75"	2	#12	XHHW-2	1	#12	XHHW-2	FR:		FCU-99422		
									TO:		CU-99422		
										2 #12	>> FCU-99422 POWER		
L-1111	10E02	0.75"	2	#8	XHHW-2	1	#10	XHHW-2	FR:		CU-99422		L-1112
									TO:		DISC-99422		
										2 #8	>> CU-99422 POWER		
L-1112	10E02	0.75"	2	#8	XHHW-2	1	#10	XHHW-2	FR:		DISC-99422		
									TO:		PNL-RWPS-L		
										2 #8	>> CU-99422 POWER		L-1111
L-1200	10E02	0.75"	2	#12	XHHW-2	1	#12	XHHW-2	FR:		PCM-99400		
									TO:		PNL-RWPS-L		
										2 #12	>> PCM-99400 POWER NO. 1		

CONDUIT SCHEDULE AREA WTP RECYCLED WA

Ukiah Recycled Water Project

ENGINEER	AMM
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DATE	4/4/23

CONDUIT			CONDUCTORS			GROUND				
NUMBER	DWG	SIZE	#	SIZE	TYPE	#	SIZE	TYPE	DESCRIPTION	CONNECTING SEGMENTS
L-1201	10E02	0.75"	2	#12	XHHW-2	1	#12	XHHW-2	FR: PCM-99400 TO: PNL-RWPS-L 2 #12 >> PCM-99400 POWER NO. 2	
L-2100	10E03	2"	4	#12	XHHW-2	1	#12	XHHW-2	FR: PUMP STATION LIGHTING AND RECEPTACLE TO: PNL-RWPS-L 4 #12 >> LIGHTING AND RECEPTACLE	
L-2431	10E02 10E03	2"	2	#12	XHHW-2	1	#12	XHHW-2	FR: FIT-99431 TO: PCM-99400 2 #12 >> FIT-99431 POWER	
L-3100	10E04	2"	4	#12	XHHW-2	1	#12	XHHW-2	FR: TANK LIGHT AND RECEPTACLE TO: HH-4 4 #12 >> TANK LIGHTING AND RECEPTACLE	L-3102
L-3101	10E04	2"	4	#12	XHHW-2	1	#12	XHHW-2	FR: ROAD LIGHT TO: HH-4 4 #12 >> ROAD LIGHTING AND RECEPTACLE	L-3102
L-3102	10E02	2"	8	#12	XHHW-2	1	#12	XHHW-2	FR: HH-4 TO: PNL-RWPS-L 4 #12 >> ROAD LIGHTING AND RECEPTACLE 4 #12 >> TANK LIGHTING AND RECEPTACLE	 L-3101 L-3100
L-3200	10E02 10E04	2"	2	#12	XHHW-2	1	#12	XHHW-2	FR: FIT-99406 TO: PCM-99400 2 #12 >> FIT-99406 POWER	
N-1000	10E02	0.75"	1		CAT6	1	#14	XHHW-2	FR: RAD2-99400 TO: PLC-99400 1 CAT6 >> RAD2-99400 NETWORK	
N-2001	10E02	0.75"	1		CAT6	1	#14	XHHW-2	FR: SWBD-RWPS TO: PCM-99400 1 CAT6 >> SWBD-RWPS METER NETWORK	
N-2011	10E02	1"	1		CAT6	1	#14	XHHW-2	FR: VFD-99411 TO: PCM-99400 1 CAT6 >> VFD-99411 NETWORK	
N-2021	10E02	1"	1		CAT6	1	#14	XHHW-2	FR: VFD-99412 TO: PCM-99400 1 CAT6 >> VFD-99412 NETWORK	
N-2031	10E02	1"	1		CAT6	1	#14	XHHW-2	FR: VFD-99413 TO: PCM-99400 1 CAT6 >> VFD-99413 NETWORK	
N-2041	10E02	1"	1		CAT6	1	#14	XHHW-2	FR: VFD-99414 TO: PCM-99400 1 CAT6 >> VFD-99414 NETWORK	
N-3100	10E02 10E04	2"	1	MFR	CABLE	1	#14	XHHW-2	FR: ANT2-99400 TO: RAD2-99400 1 MFR >> ANT2-99400 NETWORK	
N-5000	11E01	1"	1		CAT6	1	#14	XHHW-2	FR: RAD2-99400 TO: PLC12199 1 CAT6 >> RAD2-99400 NETWORK	
N-5100	11E01	1"	1	MFR	CABLE	1	#14	XHHW-2	FR: ANT2-99400 TO: RAD2-99400 1 MFR >> ANT2-99400 NETWORK	
P-0001	10E01	4"	3	350	XHHW-2	1	#1	XHHW-2	FR: PNL-RWPS TO: MCC-E 3 350 >> PNL-RWPS POWER NO. 1	
P-0002	10E01	4"	3	350	XHHW-2	1	#1	XHHW-2	FR: PNL-RWPS TO: MCC-E 3 350 >> PNL-RWPS POWER NO. 2	
P-0010	10E01 10E02	4"	3	500	XHHW-2	1	#2/0	XHHW-2	FR: SWBD-RWPS TO: PNL-RWPS (VIA HH-1, HH-2, HH-3) 3 500 >> SWBD-RWPS POWER NO. 1	
P-0011	10E01 10E02	4"	3	500	XHHW-2	1	#2/0	XHHW-2	FR: SWBD-RWPS TO: PNL-RWPS (VIA HH-1, HH-2, HH-3) 3 500 >> SWBD-RWPS POWER NO. 1	

CONDUIT SCHEDULE AREA WTP RECYCLED WA

Ukiah Recycled Water Project

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CONDUIT			CONDUCTORS			GROUND				
NUMBER	DWG	SIZE	#	SIZE	TYPE	#	SIZE	TYPE	DESCRIPTION	CONNECTING SEGMENTS
P-1000	10E02	1.5"	3	#3	XHHW-2	1	#8	XHHW-2	FR: XFMR-RWPS-L TO: SWBD-RWPS 3 #3 >> XFMR-RWPS-L POWER	
P-2011	10E03	2"	1	3/C-#1:VFD	VFD			INTEGRAL	FR: PMP-99411 TO: DISC-99411 1 3/C-#1:VFD >> PMP-99411 POWER	P-2012
P-2012	10E02 10E03	2"	1	3/C-#1:VFD	VFD			INTEGRAL	FR: DISC-99411 TO: VFD-99411 1 3/C-#1:VFD >> PMP-99411 POWER	P-2011
P-2013	10E02	1.5"	3	#1/0	XHHW-2	1	#6	XHHW-2	FR: VFD-99411 TO: SWBD-RWPS 3 #1/0 >> VFD-99411 POWER	
P-2021	10E03	2"	1	3/C-#1:VFD	VFD			INTEGRAL	FR: PMP-99412 TO: DISC-99412 1 3/C-#1:VFD >> PMP-99412 POWER	P-2022
P-2022	10E02 10E03	2"	1	3/C-#1:VFD	VFD			INTEGRAL	FR: DISC-99412 TO: VFD-99412 1 3/C-#1:VFD >> PMP-99412 POWER	P-2021
P-2023	10E02	1.5"	3	#1/0	XHHW-2	1	#6	XHHW-2	FR: VFD-99412 TO: SWBD-RWPS 3 #1/0 >> VFD-99412 POWER	
P-2031	10E03	2"	1	3/C-#1:VFD	VFD			INTEGRAL	FR: PMP-99413 TO: DISC-99413 1 3/C-#1:VFD >> PMP-99413 POWER	P-2032
P-2032	10E02 10E03	2"	1	3/C-#1:VFD	VFD			INTEGRAL	FR: DISC-99413 TO: VFD-99413 1 3/C-#1:VFD >> PMP-99413 POWER	P-2031
P-2033	10E02	1.5"	3	#1/0	XHHW-2	1	#6	XHHW-2	FR: VFD-99413 TO: SWBD-RWPS 3 #1/0 >> VFD-99413 POWER	
P-2041	10E03	2"	1	3/C-#1:VFD	VFD			INTEGRAL	FR: PMP-99414 TO: DISC-99414 1 3/C-#1:VFD >> PMP-99414 POWER	P-2042
P-2042	10E02 10E03	2"	1	3/C-#1:VFD	VFD			INTEGRAL	FR: DISC-99414 TO: VFD-99414 1 3/C-#1:VFD >> PMP-99414 POWER	P-2041
P-2043	10E02	1.5"	3	#1/0	XHHW-2	1	#6	XHHW-2	FR: VFD-99414 TO: SWBD-RWPS 3 #1/0 >> VFD-99414 POWER	
S-2011	10E02 10E03	2"	1	3/CS-#16		1	#14	XHHW-2	FR: LCP-99411 TO: VFD-99411 1 3/CS-#16 >> HSS-99411 SIGNAL	
S-2021	10E02 10E03	2"	1	3/CS-#16		1	#14	XHHW-2	FR: LCP-99412 TO: VFD-99412 1 3/CS-#16 >> HSS-99412 SIGNAL	
S-2031	10E02 10E03	2"	1	3/CS-#16		1	#14	XHHW-2	FR: LCP-99413 TO: VFD-99413 1 3/CS-#16 >> HSS-99413 SIGNAL	
S-2041	10E02 10E03	2"	1	3/CS-#16		1	#14	XHHW-2	FR: LCP-99414 TO: VFD-99414 1 3/CS-#16 >> HSS-99414 SIGNAL	
S-2429	10E03	0.75"	1	2/CS-#16		1	#14	XHHW-2	FR: PIT-99432 TO: JUNCTION BOX 1 2/CS-#16 >> PIT-99432 SIGNAL	S-2431
S-2430	10E03	0.75"	1	2/CS-#16		1	#14	XHHW-2	FR: FIT-99431 TO: JUNCTION BOX 1 2/CS-#16 >> FIT-99431 SIGNAL	S-2431
S-2431	10E02 10E03	2"	2	2/CS-#16		1	#14	XHHW-2	FR: JUNCTION BOX TO: PCM-99400 1 2/CS-#16 >> PIT-99432 SIGNAL 1 2/CS-#16 >> FIT-99431 SIGNAL	S-2429 S-2430

CONDUIT SCHEDULE AREA WTP RECYCLED WA

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ENGINEER	AMM
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CONDUIT			CONDUCTORS			GROUND				
NUMBER	DWG	SIZE	#	SIZE	TYPE	#	SIZE	TYPE	DESCRIPTION	CONNECTING SEGMENTS
S-3100	10E04	0.75"	1	2/CS-#16		1	#14	XHHW-2	FR: LIT-99405 TO: DESIC-99405 1 2/CS-#16 >> LIT-99405 SIGNAL	S-3101
S-3101	10E04	2"	1	2/CS-#16		1	#14	XHHW-2	FR: DESIC-99405 TO: PCM-99400 (VIA HH-4) 1 2/CS-#16 >> LIT-99405 SIGNAL	S-3100
S-3102	10E02	2"	1	2/CS-#16		1	#14	XHHW-2	FR: HH-4 TO: PCM-99400 1 2/CS-#16 >> FIT-99406 SIGNAL	S-3200
S-3200	10E04	2"	1	2/CS-#16		1	#14	XHHW-2	FR: FIT-99406 TO: HH-4 1 2/CS-#16 >> FIT-99406 SIGNAL	S-3102
X-0010	10E01 10E02	4"	1	PULL	ROPE				FR: STUB-UP BY WATER TREATMENT BUILDING TO: STUB-UP AT RWPS ELECTRICAL BUILDING (VIA HH-1, HH-2, HH-3 1 PULL >> SPARE	
X-0011	10E01 10E02	4"	1	PULL	ROPE				FR: STUB-UP BY WATER TREATMENT BUILDING TO: STUB-UP AT RWPS ELECTRICAL BUILDING (VIA HH-1, HH-2, HH-3 1 PULL >> SPARE	
X-1500	10E02	2"	1	PULL	ROPE				FR: HH-4 TO: STUB-UP AT RWPS ELECTRICAL BUILDING 1 PULL >> SPARE	
X-1501	10E02	2"	1	PULL	ROPE				FR: HH-4 TO: STUB-UP AT RWPS ELECTRICAL BUILDING 1 PULL >> SPARE	
X-1502	10E02	2"	1	PULL	ROPE				FR: HH-4 TO: STUB-UP AT RWPS ELECTRICAL BUILDING 1 PULL >> SPARE	
X-2011	10E02 10E03	2"	1	PULL	ROPE				FR: PMP-99411 TO: VFD-99411 1 PULL >> SPARE	
X-2021	10E02 10E03	2"	1	PULL	ROPE				FR: PMP-99412 TO: VFD-99412 1 PULL >> SPARE	
X-2031	10E02 10E03	2"	1	PULL	ROPE				FR: PMP-99413 TO: VFD-99413 1 PULL >> SPARE	
X-2041	10E02 10E03	2"	1	PULL	ROPE				FR: PMP-99414 TO: VFD-99414 1 PULL >> SPARE	
X-2051	10E02 10E03	2"	1	PULL	ROPE				FR: PMP-99415 TO: VFD-99415 1 PULL >> SPARE	
X-2052	10E02 10E03	2"	1	PULL	ROPE				FR: PMP-99415 TO: VFD-99415 1 PULL >> SPARE	
X-2053	10E02 10E03	2"	1	PULL	ROPE				FR: PMP-99415 TO: VFD-99415 1 PULL >> SPARE	
X-2054	10E02 10E03	2"	1	PULL	ROPE				FR: PMP-99415 TO: VFD-99415 1 PULL >> SPARE	
X-2055	10E02	2"	1	PULL	ROPE				FR: VFD-99415 TO: SWBD-RWPS 1 PULL >> SPARE	
X-2056	10E02	2"	1	PULL	ROPE				FR: VFD-99415 TO: PCM-99400 1 PULL >> SPARE	
X-2100	10E02 10E03	2"	1	PULL	ROPE				FR: STUB-UP AT PUMP STATION TO: ELECTRICAL ROOM 1 PULL >> SPARE	
X-2101	10E02 10E03	2"	1	PULL	ROPE				FR: STUB-UP AT PUMP STATION TO: ELECTRICAL ROOM 1 PULL >> SPARE	

CONDUIT SCHEDULE AREA WTP RECYCLED WA

Ukiah Recycled Water Project

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CONDUIT			CONDUCTORS			GROUND				
NUMBER	DWG	SIZE	#	SIZE	TYPE	#	SIZE	TYPE	DESCRIPTION	CONNECTING SEGMENTS
X-3100	10E02 10E04	2"	1	PULL	ROPE				FR: STUB-UP BY TANK TO: ELECTRICAL ROOM 1 PULL >> SPARE	
X-3101	10E02 10E04	2"	1	PULL	ROPE				FR: STUB-UP BY TANK TO: ELECTRICAL ROOM 1 PULL >> SPARE	
X-3102	99E04	2"	1	PULL	ROPE				FR: STUB-UP BY CONTROL VALVE TO: HH-4 1 PULL >> SPARE	
X-3103	99E04	2"	1	PULL	ROPE				FR: STUB-UP BY CONTROL VALVE TO: HH-4 1 PULL >> SPARE	
X-3104	99E02	2"	1	PULL	ROPE				FR: HH-4 TO: ELECTRICAL ROOM 1 PULL >> SPARE	
X-3200	10E02	2"	1	PULL	ROPE				FR: HH-4 TO: ELECTRICAL ROOM 1 PULL >> SPARE	

END OF CONDUIT SCHEDULE

END OF SECTION

SECTION 16990

CONDUIT SCHEDULE
AREA 85

PART 1 GENERAL

1.01 SUMMARY

A. Conduit requirements:
   1. As defined in Section 16050 and Section 16130.

B. Cable requirements and definitions:
   1. As defined in Section 16050 and Section 16123.
   2. 2/CS#16: 2 conductor, 16 gauge, twisted shielded pair.
   3. CAT6: Category 6 Ethernet cable.
   4. MFR: Manufacturer or vendor furnished cable.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 CONDUIT SCHEDULE

A. Conduit Schedule is presented on the following pages.

CONDUIT SCHEDULE AREA

RECYCLE WATER PROJECT

AWT BUILDING

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CONDUIT			CONDUCTORS			GROUND				
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**	**DESCRIPTION**	**CONNECTING SEGMENTS**
C-85-100		1.5"	28	#14	XHHW-2	1	#14	XHHW-2	FR: PB-8511	C-85-201
									TO: CONDUIT TEE	
									10 #14 >> FV-85217 CONTROL	P-85-100
									8 #14 >> FCV-85218 CONTROL	P-85-105
									10 #14 >> FV-85219 CONTROL	P-85-110
C-85-110		0.75"	1	MFR	CABLE	1	#14	XHHW-2	FR: LSL-85101	C-85-112
									TO: JUNCTION BOX	
									1 MFR >> LSL-85101 CONTROL	
C-85-111		0.75"	1	MFR	CABLE	1	#14	XHHW-2	FR: LSH-85101	C-85-112
									TO: JUNCTION BOX	
									1 MFR >> LSH-85101 CONTROL	
C-85-112		0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR: JUNCTION BOX	C-85-123
									TO: CONDUIT TEE	
									2 #14 >> LSH-85101 CONTROL	C-85-111
									2 #14 >> LSL-85101 CONTROL	C-85-110
C-85-120		0.75"	1	MFR	CABLE	1	#14	XHHW-2	FR: LSL-85102	C-85-122
									TO: JUNCTION BOX	
									1 MFR >> LSL-85102 CONTROL	
C-85-121		0.75"	1	MFR	CABLE	1	#14	XHHW-2	FR: LSH-85102	C-85-122
									TO: CONDUIT TEE	
									1 MFR >> LSH-85102 CONTROL	
C-85-122		0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR: CONDUIT TEE	C-85-123
									TO: CONDUIT TEE	
									2 #14 >> LSH-85102 CONTROL	C-85-121
									2 #14 >> LSL-85102 CONTROL	C-85-120
C-85-123		0.75"	8	#14	XHHW-2	1	#14	XHHW-2	FR: CONDUIT TEE	C-85-133
									TO: CONDUIT TEE	
									2 #14 >> LSH-85101 CONTROL	C-85-112
									2 #14 >> LSL-85101 CONTROL	C-85-112
									2 #14 >> LSH-85102 CONTROL	C-85-122
									2 #14 >> LSL-85102 CONTROL	C-85-122
C-85-130		0.75"	2	#14	XHHW-2	1	#14	XHHW-2	FR: LSL-85103	C-85-132
									TO: CONDUIT TEE	
									2 #14 >> LSL-85103 CONTROL	
C-85-131		0.75"	2	#14	XHHW-2	1	#14	XHHW-2	FR: LSH-85103	C-85-132
									TO: CONDUIT TEE	
									2 #14 >> LSH-85103 CONTROL	
C-85-132		0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR: CONDUIT TEE	C-85-133
									TO: CONDUIT TEE	
									2 #14 >> LSH-85103 CONTROL	C-85-131
									2 #14 >> LSL-85103 CONTROL	C-85-130
C-85-133		1"	12	#14	XHHW-2	1	#14	XHHW-2	FR: CONDUIT TEE	C-85-145
									TO: CONDUIT TEE	
									2 #14 >> LSH-85101 CONTROL	C-85-123
									2 #14 >> LSL-85101 CONTROL	C-85-123
									2 #14 >> LSH-85102 CONTROL	C-85-123
									2 #14 >> LSL-85102 CONTROL	C-85-123
									2 #14 >> LSH-85103 CONTROL	C-85-132
									2 #14 >> LSL-85103 CONTROL	C-85-132
C-85-140		0.75"	2	#14	XHHW-2	1	#14	XHHW-2	FR: LSL-85104	C-85-142
									TO: CONDUIT TEE	
									2 #14 >> LSL-85104 CONTROL	
C-85-141		0.75"	2	#14	XHHW-2	1	#14	XHHW-2	FR: LSH-85104	C-85-142
									TO: CONDUIT TEE	
									2 #14 >> LSH-85104 CONTROL	
C-85-142		0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR: CONDUIT TEE	C-85-145
									TO: CONDUIT TEE	
									2 #14 >> LSH-85104 CONTROL	C-85-141
									2 #14 >> LSL-85104 CONTROL	C-85-140
C-85-145		1"	16	#14	XHHW-2	1	#14	XHHW-2	FR: CONDUIT TEE	C-85-402
									TO: PB-8501	
									2 #14 >> LSH-85101 CONTROL	C-85-133
									2 #14 >> LSL-85101 CONTROL	C-85-133
									2 #14 >> LSH-85102 CONTROL	C-85-133
									2 #14 >> LSL-85102 CONTROL	C-85-133
									2 #14 >> LSH-85103 CONTROL	C-85-133
									2 #14 >> LSL-85103 CONTROL	C-85-133
									2 #14 >> LSH-85104 CONTROL	C-85-142
									2 #14 >> LSL-85104 CONTROL	C-85-142

CONDUIT SCHEDULE AREA

RECYCLE WATER PROJECT

AWT BUILDING

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CONDUIT			CONDUCTORS			GROUND				
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**	**DESCRIPTION**	**CONNECTING SEGMENTS**
C-85-150		1.5"	28	#14	XHHW-2	1	#14	XHHW-2	FR: PB-8521	C-85-251
									TO: CONDUIT TEE	
									8 #14 >> FCV-85211 CONTROL	
									10 #14 >> FV-85212 CONTROL	
									10 #14 >> FV-85214 CONTROL	
C-85-200		1.5"	28	#14	XHHW-2	1	#14	XHHW-2	FR: PB-8512	C-85-201
									TO: CONDUIT TEE	
									10 #14 >> FV-85227 CONTROL	P-85-200
									8 #14 >> FCV-85228 CONTROL	P-85-205
									10 #14 >> FV-85229 CONTROL	P-85-210
C-85-201		2"	56	#14	XHHW-2	1	#14	XHHW-2	FR: CONDUIT TEE	C-85-301
									TO: CONDUIT TEE	
									10 #14 >> FV-85217 CONTROL	C-85-100
									8 #14 >> FCV-85218 CONTROL	C-85-100
									10 #14 >> FV-85219 CONTROL	C-85-100
									10 #14 >> FV-85227 CONTROL	C-85-200
									8 #14 >> FCV-85228 CONTROL	C-85-200
									10 #14 >> FV-85229 CONTROL	C-85-200
C-85-250		1.5"	28	#14	XHHW-2	1	#14	XHHW-2	FR: PB-8522	C-85-251
									TO: CONDUIT TEE	
									8 #14 >> FCV-85221 CONTROL	
									10 #14 >> FV-85222 CONTROL	
									10 #14 >> FV-85224 CONTROL	
C-85-251		2"	56	#14	XHHW-2	1	#14	XHHW-2	FR: CONDUIT TEE	C-85-351
									TO: CONDUIT TEE	
									8 #14 >> FCV-85221 CONTROL	C-85-250
									10 #14 >> FV-85222 CONTROL	C-85-250
									10 #14 >> FV-85224 CONTROL	C-85-250
									8 #14 >> FCV-85211 CONTROL	C-85-150
									10 #14 >> FV-85212 CONTROL	C-85-150
									10 #14 >> FV-85214 CONTROL	C-85-150
C-85-300		1.5"	28	#14	XHHW-2	1	#14	XHHW-2	FR: PB-8513	C-85-301
									TO: CONDUIT TEE	
									10 #14 >> FV-85239 CONTROL	P-85-310
									8 #14 >> FCV-85238 CONTROL	P-85-305
									10 #14 >> FV-85237 CONTROL	P-85-300
C-85-301		2.5"	84	#14	XHHW-2	1	#14	XHHW-2	FR: CONDUIT TEE	C-85-401
									TO: CONDUIT TEE	
									10 #14 >> FV-85239 CONTROL	C-85-300
									8 #14 >> FCV-85238 CONTROL	C-85-300
									10 #14 >> FV-85237 CONTROL	C-85-300
									10 #14 >> FV-85217 CONTROL	C-85-201
									8 #14 >> FCV-85218 CONTROL	C-85-201
									10 #14 >> FV-85219 CONTROL	C-85-201
									10 #14 >> FV-85227 CONTROL	C-85-201
									8 #14 >> FCV-85228 CONTROL	C-85-201
									10 #14 >> FV-85229 CONTROL	C-85-201
C-85-350		1.5"	28	#14	XHHW-2	1	#14	XHHW-2	FR: PB-8523	C-85-351
									TO: CONDUIT TEE	
									8 #14 >> FCV-85231 CONTROL	
									10 #14 >> FV-85232 CONTROL	
									10 #14 >> FV-85234 CONTROL	
C-85-351		2.5"	84	#14	XHHW-2	1	#14	XHHW-2	FR: CONDUIT TEE	C-85-455
									TO: CONDUIT TEE	
									8 #14 >> FCV-85221 CONTROL	C-85-251
									10 #14 >> FV-85222 CONTROL	C-85-251
									10 #14 >> FV-85224 CONTROL	C-85-251
									8 #14 >> FCV-85211 CONTROL	C-85-251
									10 #14 >> FV-85212 CONTROL	C-85-251
									10 #14 >> FV-85214 CONTROL	C-85-251
									8 #14 >> FCV-85231 CONTROL	C-85-350
									10 #14 >> FV-85232 CONTROL	C-85-350
									10 #14 >> FV-85234 CONTROL	C-85-350
C-85-400		1.5"	28	#14	XHHW-2	1	#14	XHHW-2	FR: PB-8514	C-85-401
									TO: CONDUIT TEE	
									10 #14 >> FV-85247 CONTROL	P-85-400
									8 #14 >> FCV-85248 CONTROL	P-85-405
									10 #14 >> FV-85249 CONTROL	P-85-410

CONDUIT SCHEDULE AREA

RECYCLE WATER PROJECT

AWT BUILDING

ENGINEER	**HADI**
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CONDUIT			CONDUCTORS			GROUND				
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**	**DESCRIPTION**	**CONNECTING SEGMENTS**
C-85-401		2.5"	112	#14	XHHW-2	1	#14	XHHW-2	FR: CONDUIT TEE	C-85-402
									TO: PB-8501	
									10 #14 >> FV-85247 CONTROL	C-85-400
									8 #14 >> FCV-85248 CONTROL	C-85-400
									10 #14 >> FV-85249 CONTROL	C-85-400
									10 #14 >> FV-85239 CONTROL	C-85-301
									8 #14 >> FCV-85238 CONTROL	C-85-301
									10 #14 >> FV-85237 CONTROL	C-85-301
									10 #14 >> FV-85217 CONTROL	C-85-301
									8 #14 >> FCV-85218 CONTROL	C-85-301
									10 #14 >> FV-85219 CONTROL	C-85-301
									10 #14 >> FV-85227 CONTROL	C-85-301
									8 #14 >> FCV-85228 CONTROL	C-85-301
									10 #14 >> FV-85229 CONTROL	C-85-301
C-85-402		3"	138	#14	XHHW-2	1	#14	XHHW-2	FR: PB-8501	
									TO: VCP-3	
									10 #14 >> FV-85247 CONTROL	C-85-401
									8 #14 >> FCV-85248 CONTROL	C-85-401
									10 #14 >> FV-85249 CONTROL	C-85-401
									10 #14 >> FV-85239 CONTROL	C-85-401
									8 #14 >> FCV-85238 CONTROL	C-85-401
									10 #14 >> FV-85237 CONTROL	C-85-401
									10 #14 >> FV-85217 CONTROL	C-85-401
									8 #14 >> FCV-85218 CONTROL	C-85-401
									10 #14 >> FV-85219 CONTROL	C-85-401
									10 #14 >> FV-85227 CONTROL	C-85-401
									8 #14 >> FCV-85228 CONTROL	C-85-401
									10 #14 >> FV-85229 CONTROL	C-85-401
									2 #14 >> LSH-85101 CONTROL	C-85-145
									2 #14 >> LSL-85101 CONTROL	C-85-145
									2 #14 >> LSH-85102 CONTROL	C-85-145
									2 #14 >> LSL-85102 CONTROL	C-85-145
									2 #14 >> LSH-85103 CONTROL	C-85-145
									2 #14 >> LSL-85103 CONTROL	C-85-145
									2 #14 >> LSH-85104 CONTROL	C-85-145
									2 #14 >> LSL-85104 CONTROL	C-85-145
									10 #14 >> FV-87130 CONTROL	
C-85-450		1.5"	28	#14	XHHW-2	1	#14	XHHW-2	FR: PB-8524	C-85-455
									TO: CONDUIT TEE	
									8 #14 >> FCV-85241 CONTROL	
									10 #14 >> FV-85242 CONTROL	
									10 #14 >> FV-85244 CONTROL	
C-85-455		2.5"	112	#14	XHHW-2	1	#14	XHHW-2	FR: CONDUIT TEE	C-85-457
									TO: PB-8501	
									8 #14 >> FCV-85221 CONTROL	C-85-351
									10 #14 >> FV-85222 CONTROL	C-85-351
									10 #14 >> FV-85224 CONTROL	C-85-351
									8 #14 >> FCV-85211 CONTROL	C-85-351
									10 #14 >> FV-85212 CONTROL	C-85-351
									10 #14 >> FV-85214 CONTROL	C-85-351
									8 #14 >> FCV-85231 CONTROL	C-85-351
									10 #14 >> FV-85232 CONTROL	C-85-351
									10 #14 >> FV-85234 CONTROL	C-85-351
									8 #14 >> FCV-85241 CONTROL	C-85-450
									10 #14 >> FV-85242 CONTROL	C-85-450
									10 #14 >> FV-85244 CONTROL	C-85-450
C-85-457		2.5"	112	#14	XHHW-2	1	#14	XHHW-2	FR: PB-8501	
									TO: VCP-3	
									8 #14 >> FCV-85221 CONTROL	C-85-455
									10 #14 >> FV-85222 CONTROL	C-85-455
									10 #14 >> FV-85224 CONTROL	C-85-455
									8 #14 >> FCV-85211 CONTROL	C-85-455
									10 #14 >> FV-85212 CONTROL	C-85-455
									10 #14 >> FV-85214 CONTROL	C-85-455
									8 #14 >> FCV-85231 CONTROL	C-85-455
									10 #14 >> FV-85232 CONTROL	C-85-455
									10 #14 >> FV-85234 CONTROL	C-85-455
									8 #14 >> FCV-85241 CONTROL	C-85-455
									10 #14 >> FV-85242 CONTROL	C-85-455
									10 #14 >> FV-85244 CONTROL	C-85-455
C-85-501		0.75"	2	#12	XHHW-2	1	#12	XHHW-2	FR: BLO-85106	C-85-510
			2	#14	XHHW-2				TO: JUNCTION BOX	
									2 #12 >> BLO-85106 MWH	
									2 #14 >> BLO-85106 TSH	
C-85-503		0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR: PDSH-85106	C-85-510
									TO: JUNCTION BOX	
									4 #14 >> PDSH-85106 CONTROL	

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CONDUIT			CONDUCTORS			GROUND				
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**	**DESCRIPTION**	**CONNECTING SEGMENTS**
C-85-505		0.75"	2	#14	XHHW-2	1	#14	XHHW-2	FR: PSH-85106	C-85-510
									TO: JUNCTION BOX	
									2 #14 >> PSH-85106 CONTROL	
C-85-507		0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR: LCP-85106	C-85-510
									TO: JUNCTION BOX	
									6 #14 >> LCP-85106 CONTROL	
C-85-510		1"	2	#12	XHHW-2	1	#12	XHHW-2	FR: JUNCTION BOX	C-85-545
			14	#14	XHHW-2				TO: PB-8530	
									6 #14 >> LCP-85106 CONTROL	C-85-507
									2 #14 >> PSH-85106 CONTROL	C-85-505
									4 #14 >> PDSH-85106 CONTROL	C-85-503
									2 #12 >> BLO-85106 MWH	C-85-501
									2 #14 >> BLO-85106 TSH	C-85-501
C-85-511		0.75"	2	#12	XHHW-2	1	#12	XHHW-2	FR: BLO-85107	C-85-520
			2	#14	XHHW-2				TO: JUNCTION BOX	
									2 #12 >> BLO-85107 MWH	
									2 #14 >> BLO-85107 TSH	
C-85-513		0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR: PDSH-85107	C-85-520
									TO: JUNCTION BOX	
									4 #14 >> PDSH-85107 CONTROL	
C-85-515		0.75"	2	#14	XHHW-2	1	#14	XHHW-2	FR: PSH-85107	C-85-520
									TO: JUNCTION BOX	
									2 #14 >> PSH-85107 CONTROL	
C-85-517		0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR: LCP-85107	C-85-520
									TO: JUNCTION BOX	
									6 #14 >> LCP-85107 CONTROL	
C-85-520		1"	2	#12	XHHW-2	1	#12	XHHW-2	FR: JUNCTION BOX	C-85-545
			14	#14	XHHW-2				TO: PB-8530	
									6 #14 >> LCP-85107 CONTROL	C-85-517
									2 #14 >> PSH-85107 CONTROL	C-85-515
									4 #14 >> PDSH-85107 CONTROL	C-85-513
									2 #12 >> BLO-85107 MWH	C-85-511
									2 #14 >> BLO-85107 TSH	C-85-511
C-85-521		0.75"	2	#12	XHHW-2	1	#12	XHHW-2	FR: BLO-85108	C-85-530
			2	#14	XHHW-2				TO: JUNCTION BOX	
									2 #12 >> BLO-85108 MWH	
									2 #14 >> BLO-85108 TSH	
C-85-523		0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR: PDSH-85108	C-85-530
									TO: JUNCTION BOX	
									4 #14 >> PDSH-85108 CONTROL	
C-85-525		0.75"	2	#14	XHHW-2	1	#14	XHHW-2	FR: PSH-85108	C-85-530
									TO: JUNCTION BOX	
									2 #14 >> PSH-85108 CONTROL	
C-85-527		0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR: LCP-85108	C-85-530
									TO: JUNCTION BOX	
									6 #14 >> LCP-85108 CONTROL	
C-85-530		1"	2	#12	XHHW-2	1	#12	XHHW-2	FR: JUNCTION BOX	C-85-545
			14	#14	XHHW-2				TO: PB-8530	
									6 #14 >> LCP-85108 CONTROL	C-85-527
									2 #14 >> PSH-85108 CONTROL	C-85-525
									4 #14 >> PDSH-85108 CONTROL	C-85-523
									2 #12 >> BLO-85108 MWH	C-85-521
									2 #14 >> BLO-85108 TSH	C-85-521
C-85-540		0.75"	2	#14	XHHW-2	1	#14	XHHW-2	FR: PSL-85100	C-85-542
									TO: PB-8530	
									2 #14 >> PSL-85100 CONTROL	
C-85-542		0.75"	2	#14	XHHW-2	1	#14	XHHW-2	FR: PB-8530	
									TO: VCP-3	
									2 #14 >> PSL-85100 CONTROL	C-85-540

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C-85-545		2"	6	#12	XHHW-2	1	#12	XHHW-2	FR: PB-8530	
			42	#14	XHHW-2				TO: MCC-C	
									6 #14 >> LCP-85108 CONTROL	C-85-530
									2 #14 >> PSH-85108 CONTROL	C-85-530
									4 #14 >> PDSH-85108 CONTROL	C-85-530
									2 #12 >> BLO-85108 MWH	C-85-530
									2 #14 >> BLO-85108 TSH	C-85-530
									6 #14 >> LCP-85107 CONTROL	C-85-520
									2 #14 >> PSH-85107 CONTROL	C-85-520
									4 #14 >> PDSH-85107 CONTROL	C-85-520
									2 #12 >> BLO-85107 MWH	C-85-520
									2 #14 >> BLO-85107 TSH	C-85-520
									6 #14 >> LCP-85106 CONTROL	C-85-510
									2 #14 >> PSH-85106 CONTROL	C-85-510
									4 #14 >> PDSH-85106 CONTROL	C-85-510
									2 #12 >> BLO-85106 MWH	C-85-510
									2 #14 >> BLO-85106 TSH	C-85-510
C-85-550		1.5"	39	#14	XHHW-2	1	#14	XHHW-2	FR: MCC-C	
									TO: VCP-3	
									10 #14 >> BLO-85106 CONTROL	
									3 #14 >> FAN-85109 CONTROL	
									10 #14 >> BLO-85107 CONTROL	
									3 #14 >> FAN-85110 CONTROL	
									10 #14 >> BLO-85108 CONTROL	
									3 #14 >> FAN-85111 CONTROL	
C-85-610		0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR: LCP-85104	C-85-612
									TO: JUNCTION BOX	
									6 #14 >> LCP-85104 CONTROL	
C-85-612		0.75"	2	#12	XHHW-2	1	#12	XHHW-2	FR: JUNCTION BOX	
			8	#14	XHHW-2				TO: CONDUIT TEE	
									2 #12 >> PMP-85104 MWH	P-85-610
									2 #14 >> PMP-85104 TSH	P-85-610
									6 #14 >> LCP-85104 CONTROL	C-85-610
C-85-614		0.75"	2	#12	XHHW-2	1	#12	XHHW-2	FR: CONDUIT TEE	
			2	#14	XHHW-2				TO: MCC-C	
									2 #12 >> PMP-85104 MWH	
									2 #14 >> PMP-85104 TSH	
C-85-616		0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR: CONDUIT TEE	
									TO: PLC-4	
									6 #14 >> LCP-85104 CONTROL	
C-85-620		0.75"	10	#14	XHHW-2	1	#14	XHHW-2	FR: MCC-C	
									TO: PLC-4	
									10 #14 >> PMP-85104 CONTROL	
N-85-500		0.75"	1		CAT6	1	#14	XHHW-2	FR: VCP-3	
									TO: PLC-4	
									1 CAT6 >> VCP-3 NETWORK	
N-85-510		0.75"	1		CAT6	1	#14	XHHW-2	FR: HMI WORK STATION	
									TO: PLC-4	
									1 CAT6 >> HMI WORK STATION NETWORK	
P-85-100		1"	3	#12	XHHW-2	1	#12	XHHW-2	FR: FV-85217	C-85-100
			10	#14	XHHW-2				TO: PB-8511	
									3 #12 >> FV-85217 POWER	
									10 #14 >> FV-85217 CONTROL	
P-85-101		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85217	
									TO: PB-8511	
									6 #12 >> FV-85217 POWER	
P-85-105		1"	3	#12	XHHW-2	1	#12	XHHW-2	FR: FCV-85218	C-85-100
			8	#14	XHHW-2				TO: PB-8511	
									3 #12 >> FCV-85218 POWER	
									8 #14 >> FCV-85218 CONTROL	
P-85-106		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85218	
									TO: PB-8511	
									6 #12 >> FCV-85218 POWER	
P-85-110		1"	3	#12	XHHW-2	1	#12	XHHW-2	FR: FV-85219	C-85-100
			10	#14	XHHW-2				TO: PB-8511	
									3 #12 >> FV-85219 POWER	
									10 #14 >> FV-85219 CONTROL	

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NUMBER	DWG	SIZE	#	SIZE	TYPE	#	SIZE	TYPE	DESCRIPTION	CONNECTING SEGMENTS
P-85-111		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85219 TO: PB-8511 6 #12 >> FV-85219 POWER	
P-85-120		0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: PB-8511 TO: CONDUIT TEE 3 #10 >> FV-85217, FCV-85218, FV-85219 POWER	P-85-221
P-85-150		1"	3 8	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FCV-85211 TO: PB-8521 3 #12 >> FCV-85211 POWER 8 #14 >> FCV-85211 CONTROL	
P-85-151		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85211 TO: PB-8521 6 #12 >> FCV-85241 POWER	
P-85-155		1"	3 10	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FV-85212 TO: PB-8521 3 #12 >> FV-85212 POWER 10 #14 >> FV-85212 CONTROL	
P-85-156		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85212 TO: PB-8521 6 #12 >> FV-85212 POWER	
P-85-160		1"	3 10	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FV-85214 TO: PB-8521 3 #12 >> FV-85214 POWER 10 #14 >> FV-85214 CONTROL	
P-85-161		0.75"	6	#10	XHHW-2	1	#10	XHHW-2	FR: DISC-85214 TO: PB-8521 6 #10 >> FV-85214 POWER	
P-85-170		0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: PB-8521 TO: CONDUIT TEE 3 #10 >> FCV-85211, FV-85212, FV-85214 POWER	P-85-275
P-85-200		1"	3 10	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FV-85227 TO: PB-8512 3 #12 >> FV-85227 POWER 10 #14 >> FV-85227 CONTROL	C-85-200
P-85-201		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85227 TO: PB-8512 6 #12 >> FV-85227 POWER	
P-85-205		1"	3 8	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FCV-85228 TO: PB-8512 3 #12 >> FCV-85228 POWER 8 #14 >> FCV-85228 CONTROL	C-85-200
P-85-206		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85228 TO: PB-8512 6 #12 >> FCV-85228 POWER	
P-85-210		1"	3 10	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FV-85229 TO: PB-8512 3 #12 >> FV-85229 POWER 10 #14 >> FV-85229 CONTROL	C-85-200
P-85-211		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85229 TO: PB-8512 6 #12 >> FV-85229 POWER	
P-85-220		0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: PB-8512 TO: CONDUIT TEE 3 #10 >> FV-85227, FCV-85228, FV-85229 POWER	P-85-221
P-85-221		0.75"	6	#10	XHHW-2	1	#10	XHHW-2	FR: CONDUIT TEE TO: PB-8501 3 #10 >> FV-85217, FCV-85218, FV-85219 POWER 3 #10 >> FV-85227, FCV-85228, FV-85229 POWER	P-85-222 P-85-120 P-85-220
P-85-222		0.75"	6	#10	XHHW-2	1	#10	XHHW-2	FR: PB-8501 TO: DP2 3 #10 >> FV-85217, FCV-85218, FV-85219 POWER 3 #10 >> FV-85227, FCV-85228, FV-85229 POWER	P-85-221 P-85-221

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NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**	**DESCRIPTION**	**CONNECTING SEGMENTS**
P-85-250		1"	3 8	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FCV-85221 TO: PB-8522 3 #12 >> FCV-85221 POWER 8 #14 >> FCV-85221 CONTROL	
P-85-251		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85221 TO: PB-8522 6 #12 >> FCV-85221 POWER	
P-85-255		1"	3 10	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FV-85222 TO: PB-8521 3 #12 >> FV-85222 POWER 10 #14 >> FV-85222 CONTROL	
P-85-256		0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85222 TO: PB-8522 3 #12 >> FV-85222 POWER	
P-85-260		1"	3 10	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FV-85224 TO: PB-8522 3 #12 >> FV-85224 POWER 10 #14 >> FV-85224 CONTROL	
P-85-261		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85224 TO: PB-8522 6 #12 >> FV-85224 POWER	
P-85-270		0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: PB-8522 TO: CONDUIT TEE 3 #10 >> FCV-85221, FV-85222, FV-85224 POWER	P-85-275
P-85-275		0.75"	6	#10	XHHW-2	1	#10	XHHW-2	FR: CONDUIT TEE TO: PB-8501 3 #10 >> FCV-85221, FV-85222, FV-85224 POWER 3 #10 >> FCV-85211, FV-85212, FV-85214 POWER	P-85-277 P-85-270 P-85-170
P-85-277		0.75"	6	#10	XHHW-2	1	#10	XHHW-2	FR: PB-8501 TO: DP2 3 #10 >> FCV-85221, FV-85222, FV-85224 POWER 3 #10 >> FCV-85211, FV-85212, FV-85214 POWER	P-85-275 P-85-275
P-85-300		1"	3 10	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FV-85237 TO: PB-8513 3 #12 >> FV-85237 POWER 10 #14 >> FV-85237 CONTROL	C-85-300
P-85-301		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85237 TO: PB-8513 6 #12 >> FV-85237 POWER	
P-85-305		1"	3 8	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FCV-85238 TO: PB-8513 3 #12 >> FCV-85238 POWER 8 #14 >> FCV-85238 CONTROL	C-85-300
P-85-306		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85238 TO: PB-8513 6 #12 >> FCV-85238 POWER	
P-85-310		1"	3 10	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FV-85239 TO: PB-8513 3 #12 >> FV-85239 POWER 10 #14 >> FV-85239 CONTROL	C-85-300
P-85-311		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85239 TO: PB-8513 6 #12 >> FV-85239 POWER	
P-85-320		0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: PB-8513 TO: CONDUIT TEE 3 #10 >> FV-85237, FCV-85238, FV-85239 POWER	P-85-421
P-85-350		1"	3 8	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FCV-85231 TO: PB-8523 3 #12 >> FCV-85231 POWER 8 #14 >> FCV-85231 CONTROL	
P-85-351		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85231 TO: PB-8523 6 #12 >> FCV-85231 POWER	

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P-85-355		1"	3 10	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FV-85232 TO: PB-8521 3 #12 >> FV-85232 POWER 10 #14 >> FV-85232 CONTROL	
P-85-356		0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85232 TO: PB-8523 3 #12 >> FV-85232 POWER	
P-85-360		1"	3 10	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FV-85234 TO: PB-8523 3 #12 >> FV-85234 POWER 10 #14 >> FV-85234 CONTROL	
P-85-361		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85234 TO: PB-8523 6 #12 >> FV-85234 POWER	
P-85-370		0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: PB-8523 TO: CONDUIT TEE 3 #10 >> FCV-85231, FV-85232, FV-85234 POWER	P-85-475
P-85-400		1"	3 10	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FV-85247 TO: PB-8514 3 #12 >> FV-85247 POWER 10 #14 >> FV-85247 CONTROL	C-85-400
P-85-401		0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85247 TO: PB-8514 3 #12 >> FV-85247 POWER	
P-85-405		1"	3 8	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FCV-85248 TO: PB-8514 3 #12 >> FCV-85248 POWER 8 #14 >> FCV-85248 CONTROL	C-85-400
P-85-406		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85248 TO: PB-8514 6 #12 >> FCV-85248 POWER	
P-85-410		1"	3 10	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FV-85249 TO: PB-8514 3 #12 >> FV-85249 POWER 10 #14 >> FV-85249 CONTROL	C-85-400
P-85-411		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85249 TO: PB-8514 6 #12 >> FV-85249 POWER	
P-85-420		0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: PB-8514 TO: CONDUIT TEE 3 #10 >> FV-85247, FCV-85248, FV-85249 POWER	P-85-421
P-85-421		0.75"	6	#10	XHHW-2	1	#10	XHHW-2	FR: CONDUIT TEE TO: PB-8501 3 #10 >> FV-85247, FCV-85248, FV-85249 POWER 3 #10 >> FV-85237, FCV-85238, FV-85239 POWER	P-85-422 P-85-420 P-85-320
P-85-422		0.75"	6	#10	XHHW-2	1	#10	XHHW-2	FR: PB-8501 TO: DP2 3 #10 >> FV-85247, FCV-85248, FV-85249 POWER 3 #10 >> FV-85237, FCV-85238, FV-85239 POWER	P-85-421 P-85-421
P-85-450		1"	3 8	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FCV-85241 TO: PB-8524 3 #12 >> FCV-85241 POWER 8 #14 >> FCV-85241 CONTROL	
P-85-451		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85241 TO: PB-8524 6 #12 >> FCV-85241 POWER	
P-85-455		1"	3 10	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FV-85242 TO: PB-8521 3 #12 >> FV-85242 POWER 10 #14 >> FV-85242 CONTROL	
P-85-456		0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85242 TO: PB-8524 3 #12 >> FV-85242 POWER	

CONDUIT SCHEDULE AREA

RECYCLE WATER PROJECT

AWT BUILDING

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CONDUIT			CONDUCTORS			GROUND				
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**	**DESCRIPTION**	**CONNECTING SEGMENTS**
P-85-460		1"	3 10	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: FV-85244 TO: PB-8524 3 #12 >> FV-85244 POWER 10 #14 >> FV-85244 CONTROL	
P-85-461		0.75"	6	#12	XHHW-2	1	#12	XHHW-2	FR: DISC-85244 TO: PB-8524 6 #12 >> FV-85244 POWER	
P-85-470		0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: PB-8524 TO: CONDUIT TEE 3 #10 >> FCV-85241, FV-85242, FV-85244 POWER	P-85-475
P-85-475		0.75"	6	#10	XHHW-2	1	#10	XHHW-2	FR: CONDUIT TEE TO: PB-8501 3 #10 >> FCV-85231, FV-85232, FV-85234 POWER 3 #10 >> FCV-85241, FV-85242, FV-85244 POWER	P-85-477 P-85-370 P-85-470
P-85-477		1"	9	#10	XHHW-2	1	#10	XHHW-2	FR: PB-8501 TO: DP2 3 #10 >> FCV-85231, FV-85232, FV-85234 POWER 3 #10 >> FCV-85241, FV-85242, FV-85244 POWER 3 #10 >> FV-87130 POWER	 P-85-475 P-85-475
P-85-501		1"	3 3	#6 #12	XHHW-2 XHHW-2	1	#8	XHHW-2	FR: BLO-85106 TO: MCC-C 3 #12 >> FAN-85109 POWER 3 #6 >> BLO-85106 POWER	
P-85-511		1"	3 3	#6 #12	XHHW-2 XHHW-2	1	#8	XHHW-2	FR: BLO-85107 TO: MCC-C 3 #12 >> FAN-85110 POWER 3 #6 >> BLO-85107 POWER	
P-85-521		1"	3 3	#6 #12	XHHW-2 XHHW-2	1	#8	XHHW-2	FR: BLO-85108 TO: MCC-C 3 #12 >> FAN-85111 POWER 3 #6 >> BLO-85108 POWER	
P-85-610		0.75"	5 2	#12 #14	XHHW-2 XHHW-2	1	#12	XHHW-2	FR: PMP-85104 TO: JUNCTION BOX 3 #12 >> PMP-85104 POWER 2 #12 >> PMP-85104 MWH 2 #14 >> PMP-85104 TSH	C-85-612
P-85-612		0.75"	3	#12	XHHW-2	1	#12	XHHW-2	FR: JUNCTION BOX TO: MCC-C 3 #12 >> PMP-85104 POWER	
P-85-710		1.5"	3	#2	XHHW-2	1	#8	XHHW-2	FR: DP2 TO: MCC-C 3 #2 >> DP2 POWER	
S-85-100		0.75"	1	2/CS-#16		1	#14	XHHW-2	FR: LIT-85211 TO: JUNCTION BOX 1 2/CS-#16 >> LIT-85211 SIGNAL	S-85-110
S-85-105		0.75"	2	2/CS-#16		1	#14	XHHW-2	FR: FCV-85218 TO: JUNCTION BOX 2 2/CS-#16 >> FCV-85218 SIGNAL	S-85-110
S-85-110		1"	3	2/CS-#16		1	#14	XHHW-2	FR: JUNCTION BOX TO: CONDUIT TEE 2 2/CS-#16 >> FCV-85218 SIGNAL 1 2/CS-#16 >> LIT-85211 SIGNAL	S-85-211 S-85-105 S-85-100
S-85-150		0.75"	2	2/CS-#16		1	#14	XHHW-2	FR: FCV-85211 TO: JUNCTION BOX 2 2/CS-#16 >> FCV-85211 SIGNAL	S-85-170
S-85-170		0.75"	2	2/CS-#16		1	#14	XHHW-2	FR: JUNCTION BOX TO: CONDUIT TEE 2 2/CS-#16 >> FCV-85211 SIGNAL	S-85-271 S-85-150
S-85-200		0.75"	1	2/CS-#16		1	#14	XHHW-2	FR: LIT-85221 TO: JUNCTION BOX 1 2/CS-#16 >> LIT-85221 SIGNAL	S-85-210
S-85-205		0.75"	2	2/CS-#16		1	#14	XHHW-2	FR: FCV-85228 TO: JUNCTION BOX 2 2/CS-#16 >> FCV-85228 SIGNAL	S-85-210

CONDUIT SCHEDULE AREA

RECYCLE WATER PROJECT

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CONDUIT			CONDUCTORS			GROUND				
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**	**DESCRIPTION**	**CONNECTING SEGMENTS**
S-85-210		1"	3	2/CS-#16		1	#14	XHHW-2	FR: JUNCTION BOX	S-85-211
									TO: CONDUIT TEE	
									2 2/CS-#16 >> FCV-85228 SIGNAL	S-85-205
									1 2/CS-#16 >> LIT-85221 SIGNAL	S-85-200
S-85-211		1.5"	6	2/CS-#16		1	#14	XHHW-2	FR: CONDUIT TEE	S-85-311
									TO: CONDUIT TEE	
									2 2/CS-#16 >> FCV-85218 SIGNAL	S-85-110
									1 2/CS-#16 >> LIT-85211 SIGNAL	S-85-110
									2 2/CS-#16 >> FCV-85228 SIGNAL	S-85-210
									1 2/CS-#16 >> LIT-85221 SIGNAL	S-85-210
S-85-250		0.75"	2	2/CS-#16		1	#14	XHHW-2	FR: FCV-85221	S-85-270
									TO: JUNCTION BOX	
									2 2/CS-#16 >> FCV-85221 SIGNAL	
S-85-270		0.75"	2	2/CS-#16		1	#14	XHHW-2	FR: JUNCTION BOX	S-85-271
									TO: CONDUIT TEE	
									2 2/CS-#16 >> FCV-85221 SIGNAL	S-85-250
S-85-271		1"	4	2/CS-#16		1	#14	XHHW-2	FR: CONDUIT TEE	
									TO: CONDUIT TEE	
									2 2/CS-#16 >> FCV-85211 SIGNAL	S-85-170
									2 2/CS-#16 >> FCV-85221 SIGNAL	S-85-270
S-85-300		0.75"	1	2/CS-#16		1	#14	XHHW-2	FR: LIT-85231	S-85-310
									TO: JUNCTION BOX	
									1 2/CS-#16 >> LIT-85231 SIGNAL	
S-85-305		0.75"	2	2/CS-#16		1	#14	XHHW-2	FR: FCV-85238	S-85-310
									TO: JUNCTION BOX	
									2 2/CS-#16 >> FCV-85238 SIGNAL	
S-85-310		1"	3	2/CS-#16		1	#14	XHHW-2	FR: JUNCTION BOX	S-85-311
									TO: CONDUIT TEE	
									2 2/CS-#16 >> FCV-85238 SIGNAL	S-85-305
									1 2/CS-#16 >> LIT-85231 SIGNAL	S-85-300
S-85-311		1.5"	9	2/CS-#16		1	#14	XHHW-2	FR: CONDUIT TEE	S-85-411
									TO: CONDUIT TEE	
									2 2/CS-#16 >> FCV-85218 SIGNAL	S-85-211
									1 2/CS-#16 >> LIT-85211 SIGNAL	S-85-211
									2 2/CS-#16 >> FCV-85228 SIGNAL	S-85-211
									1 2/CS-#16 >> LIT-85221 SIGNAL	S-85-211
									2 2/CS-#16 >> FCV-85238 SIGNAL	S-85-310
									1 2/CS-#16 >> LIT-85231 SIGNAL	S-85-310
S-85-350		0.75"	2	2/CS-#16		1	#14	XHHW-2	FR: FCV-85231	S-85-370
									TO: JUNCTION BOX	
									2 2/CS-#16 >> FCV-85231 SIGNAL	
S-85-370		0.75"	2	2/CS-#16		1	#14	XHHW-2	FR: JUNCTION BOX	S-85-371
									TO: CONDUIT TEE	
									2 2/CS-#16 >> FCV-85231 SIGNAL	S-85-350
S-85-371		1.5"	6	2/CS-#16		1	#14	XHHW-2	FR: CONDUIT TEE	S-85-471
									TO: CONDUIT TEE	
									2 2/CS-#16 >> FCV-85211 SIGNAL	P-85-271
									2 2/CS-#16 >> FCV-85221 SIGNAL	P-85-271
									2 2/CS-#16 >> FCV-85231 SIGNAL	S-85-370
S-85-400		0.75"	1	2/CS-#16		1	#14	XHHW-2	FR: LIT-85241	S-85-410
									TO: JUNCTION BOX	
									1 2/CS-#16 >> LIT-85241 SIGNAL	
S-85-405		0.75"	2	2/CS-#16		1	#14	XHHW-2	FR: FCV-85248	S-85-410
									TO: JUNCTION BOX	
									2 2/CS-#16 >> FCV-85248 SIGNAL	
S-85-410		1"	3	2/CS-#16		1	#14	XHHW-2	FR: JUNCTION BOX	S-85-411
									TO: CONDUIT TEE	
									2 2/CS-#16 >> FCV-85248 SIGNAL	S-85-405
									1 2/CS-#16 >> LIT-85241 SIGNAL	S-85-400

CONDUIT SCHEDULE AREA

RECYCLE WATER PROJECT

AWT BUILDING

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CONDUIT			CONDUCTORS			GROUND				
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**	**DESCRIPTION**	**CONNECTING SEGMENTS**
S-85-411		2"	12	2/CS-#16		1	#14	XHHW-2	FR: CONDUIT TEE	S-85-415
									TO: PB-8502	
									2 2/CS-#16 >> FCV-85218 SIGNAL	S-85-311
									1 2/CS-#16 >> LIT-85211 SIGNAL	S-85-311
									2 2/CS-#16 >> FCV-85228 SIGNAL	S-85-311
									1 2/CS-#16 >> LIT-85221 SIGNAL	S-85-311
									2 2/CS-#16 >> FCV-85238 SIGNAL	S-85-311
									1 2/CS-#16 >> LIT-85231 SIGNAL	S-85-311
									2 2/CS-#16 >> FCV-85248 SIGNAL	S-85-410
									1 2/CS-#16 >> LIT-85241 SIGNAL	S-85-410
S-85-415		2"	12	2/CS-#16		1	#14	XHHW-2	FR: PB-8502	
									TO: VCP-3	
									2 2/CS-#16 >> FCV-85218 SIGNAL	S-85-411
									1 2/CS-#16 >> LIT-85211 SIGNAL	S-85-411
									2 2/CS-#16 >> FCV-85228 SIGNAL	S-85-411
									1 2/CS-#16 >> LIT-85221 SIGNAL	S-85-411
									2 2/CS-#16 >> FCV-85238 SIGNAL	S-85-411
									1 2/CS-#16 >> LIT-85231 SIGNAL	S-85-411
									2 2/CS-#16 >> FCV-85248 SIGNAL	S-85-411
									1 2/CS-#16 >> LIT-85241 SIGNAL	S-85-411
S-85-450		0.75"	2	2/CS-#16		1	#14	XHHW-2	FR: FCV-85241	S-85-470
									TO: JUNCTION BOX	
									2 2/CS-#16 >> FCV-85241 SIGNAL	
S-85-470		0.75"	2	2/CS-#16		1	#14	XHHW-2	FR: JUNCTION BOX	S-85-471
									TO: CONDUIT TEE	
									2 2/CS-#16 >> FCV-85241 SIGNAL	S-85-450
S-85-471		1.5"	8	2/CS-#16		1	#14	XHHW-2	FR: CONDUIT TEE	S-85-475
									TO: PB-8502	
									2 2/CS-#16 >> FCV-85211 SIGNAL	S-85-371
									2 2/CS-#16 >> FCV-85221 SIGNAL	S-85-371
									2 2/CS-#16 >> FCV-85231 SIGNAL	S-85-371
									2 2/CS-#16 >> FCV-85241 SIGNAL	S-85-470
S-85-475		1.5"	8	2/CS-#16		1	#14	XHHW-2	FR: PB-8502	
									TO: VCP-3	
									2 2/CS-#16 >> FCV-85211 SIGNAL	S-85-471
									2 2/CS-#16 >> FCV-85221 SIGNAL	S-85-471
									2 2/CS-#16 >> FCV-85231 SIGNAL	S-85-471
									2 2/CS-#16 >> FCV-85241 SIGNAL	S-85-471
S-85-510		0.75"	1	2/CS-#16		1	#14	XHHW-2	FR: PIT-85106	S-85-540
									TO: JUNCTION BOX	
									1 2/CS-#16 >> PIT-85106 SIGNAL	
S-85-520		0.75"	1	2/CS-#16		1	#14	XHHW-2	FR: PIT-85107	S-85-540
									TO: JUNCTION BOX	
									1 2/CS-#16 >> PIT-85107 SIGNAL	
S-85-530		0.75"	1	2/CS-#16		1	#14	XHHW-2	FR: PIT-85108	S-85-540
									TO: JUNCTION BOX	
									1 2/CS-#16 >> PIT-85108 SIGNAL	
S-85-540		1"	3	2/CS-#16		1	#14	XHHW-2	FR: JUNCTION BOX	
									TO: VCP-3	
									1 2/CS-#16 >> PIT-85108 SIGNAL	S-85-530
									1 2/CS-#16 >> PIT-85107 SIGNAL	S-85-520
									1 2/CS-#16 >> PIT-85106 SIGNAL	S-85-510
C-87-100		0.75"	6	#14	XHHW-2	1	#14	XHHW-2	FR: LCP-87134	
									TO: JUNCTION BOX	
									6 #14 >> LCP-87134 CONTROL	
C-87-101		2"	2	#12	XHHW-2	1	#12	XHHW-2	FR: JUNCTION BOX	C-87-115
			8	#14	XHHW-2				TO: PB-8530	
									2 #14 >> PMP-87134 TSH	
									2 #12 >> PMP-87134 MWH	
									6 #14 >> LCP-87134 CONTROL	
C-87-105		0.75"	1	MFR	CABLE	1	#14	XHHW-2	FR: VCP-87130	
									TO: FV-87130	
									1 MFR >> VCP-87130 CONTROL	
C-87-110		2"	10	#14	XHHW-2	1	#14	XHHW-2	FR: FV-87130	C-87-115
									TO: PB-8530	
									10 #14 >> FV-87130 CONTROL	

CONDUIT SCHEDULE AREA

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CONDUIT			CONDUCTORS			GROUND						
NUMBER	DWG	SIZE	#	SIZE	TYPE	#	SIZE	TYPE			DESCRIPTION	CONNECTING SEGMENTS
C-87-115		1.5"	2	#12	XHHW-2	1	#12	XHHW-2	FR:		PB-8530	C-87-117
			18	#14	XHHW-2				TO:		PB-8501	
										10 #14	>> FV-87130 CONTROL	C-87-110
										2 #14	>> PMP-87134 TSH	C-87-101
										2 #12	>> PMP-87134 MWH	C-87-101
										6 #14	>> LCP-87134 CONTROL	C-87-101
C-87-117		0.75"	2	#12	XHHW-2	1	#12	XHHW-2	FR:		PB-8501	
			8	#14	XHHW-2				TO:		MCC-C	
										2 #14	>> PMP-87134 TSH	C-87-115
										2 #12	>> PMP-87134 MWH	C-87-115
										6 #14	>> LCP-87134 CONTROL	C-87-115
C-87-119		0.75"	10	#14	XHHW-2	1	#14	XHHW-2	FR:		MCC-C	
									TO:		PLC-4	
										10 #14	>> PMP-87134 CONTROL	
P-87-100		0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR:		PMP-87134	
			2	#12	XHHW-2				TO:		JUNCTION BOX	
			2	#14	XHHW-2					3 #10	>> PMP-87134 POWER	
										2 #14	>> PMP-87134 TSH	
										2 #12	>> PMP-87134 MWH	
P-87-101		2"	3	#10	XHHW-2	1	#10	XHHW-2	FR:		JUNCTION BOX	P-87-115
									TO:		PB-8530	
										3 #10	>> PMP-87134 POWER	
P-87-110		0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR:		FV-87130	
									TO:		JUNCTION BOX	
										3 #10	>> FV-87130 POWER	
P-87-112		2"	7	#10	XHHW-2	1	#10	XHHW-2	FR:		JUNCTION BOX	P-87-115
									TO:		PB-8530	
										2 #10	>> FIT-88101 POWER	L-88-101
										2 #10	>> FIT-88102 POWER	L-88-102
										3 #10	>> FV-87130 POWER	P-88-100
P-87-115		1"	10	#10	XHHW-2	1	#10	XHHW-2	FR:		PB-8530	
									TO:		PB-8501	
										3 #10	>> PMP-87134 POWER	P-87-101
										2 #10	>> FIT-88101 POWER	P-87-112
										2 #10	>> FIT-88102 POWER	P-87-112
										3 #10	>> FV-87130 POWER	P-87-112
P-87-117		0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR:		PB-8501	
									TO:		MCC-C	
										3 #10	>> PMP-87134 POWER	
S-87-100		2"	1	2/CS-#16		1	#14	XHHW-2	FR:		AIT-87130	S-88-110
									TO:		PB-8535	
										1 2/CS-#16	>> AIT-87130 SIGNAL	
L-88-101		0.75"	2	#10	XHHW-2	1	#10	XHHW-2	FR:		FIT-88101	P-87-112
									TO:		JUNCTION BOX	
										2 #10	>> FIT-88101 POWER	
L-88-102		0.75"	2	#10	XHHW-2	1	#10	XHHW-2	FR:		FIT-88102	P-87-112
									TO:		JUNCTION BOX	
										2 #10	>> FIT-88102 POWER	
L-88-105		0.75"	4	#10	XHHW-2	1	#10	XHHW-2	FR:		PB-8501	
									TO:		PLC-4	
										2 #10	>> FIT-88101 POWER	
										2 #10	>> FIT-88102 POWER	
S-88-101		0.75"	1	2/CS-#16		1	#14	XHHW-2	FR:		FIT-88101	S-88-105
									TO:		JUNCTION BOX	
										1 2/CS-#16	>> FIT-88101 SIGNAL	
S-88-102		0.75"	1	2/CS-#16		1	#14	XHHW-2	FR:		FIT-88102	S-88-105
									TO:		JUNCTION BOX	
										1 2/CS-#16	>> FIT-88102 SIGNAL	
S-88-105		2"	2	2/CS-#16		1	#14	XHHW-2	FR:		JUNCTION BOX	S-88-110
									TO:		PB-8535	
										1 2/CS-#16	>> FIT-88102 SIGNAL	S-88-102
										1 2/CS-#16	>> FIT-88101 SIGNAL	S-88-101
S-88-110		1"	3	2/CS-#16		1	#14	XHHW-2	FR:		PB-8535	S-88-112
									TO:		PB-8502	
										1 2/CS-#16	>> AIT-87130 SIGNAL	S-87-100
										1 2/CS-#16	>> FIT-88102 SIGNAL	S-88-105
										1 2/CS-#16	>> FIT-88101 SIGNAL	S-88-105

CONDUIT SCHEDULE AREA

RECYCLE WATER PROJECT

AWT BUILDING

ENGINEER	**HADI**
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CONDUIT			CONDUCTORS			GROUND				
NUMBER	**DWG**	**SIZE**	**#**	**SIZE**	**TYPE**	**#**	**SIZE**	**TYPE**	**DESCRIPTION**	**CONNECTING SEGMENTS**
S-88-112		1"	3	2/CS-#16		1	#14	XHHW-2	FR: PB-8502	
									TO: PLC-4	
									1 2/CS-#16 >> AIT-87130 SIGNAL	S-88-110
									1 2/CS-#16 >> FIT-88102 SIGNAL	S-88-110
									1 2/CS-#16 >> FIT-88101 SIGNAL	S-88-110

END OF CONDUIT SCHEDULE

END OF SECTION

SECTION 16990

CONDUIT SCHEDULE
AREA WWTP Pump Stations

PART 1 GENERAL

1.01 SUMMARY

A. Conduit requirements:
   1. As defined in Section 16050 and Section 16130.

B. Cable requirements and definitions:
   1. As defined in Section 16050 and Section 16123.
   2. 2/CS#16: 2 conductor, 16 gauge, twisted shielded pair.
   3. 3/CS#16: 3 conductor, 16 gauge, twisted shielded triplet.
   4. */C#Y: Multiconductor cable (* indicates number of conductors, Y indicates conductor size and insulation).
   5. */FO: Fiber optic (* indicates strand count).
   6. CAT6: Category 6 Ethernet cable.
   7. MFR: Manufacturer or vendor furnished cable.
   8. PULL: Pull Rope.
   9. VFD: Shielded VFD cable with integral ground.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.01 CONDUIT SCHEDULE

A. Conduit Schedule is presented on the following pages.

CONDUIT SCHEDULE AREA

Ukiah Recycle Water Project

Waste Water Treatment Plant

ENGINEER	HR
REVISION	
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CONDUIT			CONDUCTORS			GROUND				
NUMBER	DWG	SIZE	#	SIZE	TYPE	#	SIZE	TYPE	DESCRIPTION	CONNECTING SEGMENTS
C-60-100		0.75"	1	MFR	CABLE	1	#14	XHHW-2	FR: CONDUIT TEE TO: LCP-60102 1 MFR >> LCP-60102 CONTROL	P-60-100
C-60-105		0.75"	1	MFR	CABLE	1	#14	XHHW-2	FR: CONDUIT TEE TO: LCP-60100 1 MFR >> LCP-60100 CONTROL	P-60-105
L-60-109		0.75"	2	#14	XHHW-2	1	#14	XHHW-2	FR: NJB-60001 TO: PB-6001 2 #14 >> NETWORK COMM'S POWER	L-60-111
L-60-110		0.75"	4	#10	XHHW-2	1	#10	XHHW-2	FR: DECNLORINATION LIGHTING AND RECEPT. TO: PB-6001 4 #10 >> DECNLORINATION LIGHTING AND RECE	L-60-111
L-60-111		2"	4 2	#10 #14	XHHW-2 XHHW-2	1 1	#10 #14	XHHW-2 XHHW-2	FR: PB-6001 TO: PB-8901 4 #10 >> DECNLORINATION LIGHTING AND RECE 2 #14 >> NJB-60001	L-60-110
N-60-100		0.75"	1		CAT6	1	#14	XHHW-2	FR: FV-60102 TO: NJB-60001 1 CAT6 >> FV-60102 NETWORK	
N-60-105		1"	1		CAT6	1	#14	XHHW-2	FR: FV-60100 TO: NJB-60001 1 CAT6 >> FV-60100 NETWORK	
N-60-110		2"	1		12/FO	1	#14	XHHW-2	FR: NJB-60001 TO: PB-8901 1 12/FO >> NJB-60001 NETWORK	N-60-111
N-60-111		2"	1		12/FO	1	#14	XHHW-2	FR: PB-8901 TO: HH-11 1 12/FO >> NJB-60001 NETWORK	N-60-112 N-60-110
N-60-112		2"	1		12/FO	1	#14	XHHW-2	FR: HH-11 TO: HH-13 1 12/FO >> NJB-60001 NETWORK	N-60-113 N-60-111
N-60-113		2"	1		12/FO	1	#14	XHHW-2	FR: HH-13 TO: PB-7002 1 12/FO >> NJB-60001 NETWORK	N-60-114 N-60-112
N-60-114		2"	1		12/FO	1	#14	XHHW-2	FR: PB-7002 TO: PLC70299 1 12/FO >> NJB-60001 NETWORK	N-60-113
P-60-100		0.75"	3 1	#10 MFR	XHHW-2	1	#10	XHHW-2	FR: FV-60102 TO: CONDUIT TEE 3 #10 >> FV-60102 POWER 1 MFR >> LCP-60102 CONTROL	C-60-100
P-60-101		0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: CONDUIT TEE TO: DISC-60102 3 #10 >> FV-60102 POWER	P-60-102
P-60-102		0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: DISC-60102 TO: PB-6001 3 #10 >> FV-60102 POWER	P-60-120 P-60-101
P-60-105		1"	3 1	#10 MFR	XHHW-2 CABLE	1	#10	XHHW-2	FR: FV-60100 TO: CONDUIT TEE 3 #10 >> FV-60100 POWER 1 MFR >> LCP-60100 CONTROL	C-60-105
P-60-106		0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: CONDUIT TEE TO: DISC-60100 3 #10 >> FV-60100 POWER	
P-60-107		0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR: DISC-60100 TO: PB-6001 3 #10 >> FV-60100 POWER	P-60-120
P-60-120		2"	6	#10	XHHW-2	1	#10	XHHW-2	FR: PB-6001 TO: PB-8901 3 #10 >> FV-60100 POWER 3 #10 >> FV-60102 POWER	P-89-131 P-60-107 P-60-102
X-60-100		2"	1	PULL	ROPE				FR: CONDUIT STUBUP-DECHLOR STRUCTURE TO: CONDUIT STUBUP-CAROUSEL PS 1 PULL >> SPARE	

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NUMBER	DWG	SIZE	#	SIZE	TYPE	#	SIZE	TYPE	DESCRIPTION	CONNECTING SEGMENTS
X-60-105		2"	1	PULL	ROPE				FR: CONDUIT STUBUP-DECHLOR STRUCTURE TO: CONDUIT STUBUP-CAROUSEL PS 1 PULL >> SPARE	
N-70-100		0.75"	1		CAT6	1	#14	XHHW-2	FR: VFD-91100 TO: JUNCTION BOX 1 CAT6 >> VFD-91100 NETWORK	N-70-104
N-70-101		0.75"	1		CAT6	1	#14	XHHW-2	FR: VFD-89102 TO: JUNCTION BOX 1 CAT6 >> VFD-89102 NETWORK	N-70-104
N-70-102		0.75"	1		CAT6	1	#14	XHHW-2	FR: VFD-89101 TO: JUNCTION BOX 1 CAT6 >> VFD-89101 NETWORK	N-70-104
N-70-103		0.75"	1		CAT6	1	#14	XHHW-2	FR: VFD-89100 TO: JUNCTION BOX 1 CAT6 >> VFD-89100 NETWORK	N-70-104
N-70-104		1.5"	4		CAT6	1	#14	XHHW-2	FR: JUNCTION BOX TO: PLC70299 1 CAT6 >> VFD-89100 NETWORK 1 CAT6 >> VFD-89101 NETWORK 1 CAT6 >> VFD-89102 NETWORK 1 CAT6 >> VFD-91100 NETWORK	 N-70-103 N-70-102 N-70-101 N-70-100
S-80-100		0.75"	1	2/CS-#16		1	#14	XHHW-2	FR: LIT-80100 TO: PB-8001 1 2/CS-#16 >> LIT-80100 SIGNAL	S-80-101
S-80-101		2"	1	2/CS-#16		1	#14	XHHW-2	FR: PB-8001 TO: PLC70299 1 2/CS-#16 >> LIT-80100 SIGNAL	S-80-100
X-80-100		2"	1	PULL	ROPE				FR: PB-8001 TO: STUB UP 1 PULL >> SPARE	
X-80-101		2"	1	PULL	ROPE				FR: PB-8001 TO: STUB UP 1 PULL >> SPARE	
C-89-100		0.75"	3	#14	XHHW-2	1	#14	XHHW-2	FR: FSL-89102 TO: JUNCTION BOX 3 #14 >> FSL-89102 CONTROL	C-89-102
C-89-101		0.75"	5 1	#14 3/CS-#16	XHHW-2	1	#14	XHHW-2	FR: LCP-89102 TO: JUNCTION BOX 5 #14 >> LCP-89102 CONTROL 1 3/CS-#16 >> LCP-89102 SPEED CONTROL	C-89-102
C-89-102		1"	8 1	#14 3/CS-#16	XHHW-2	1	#14	XHHW-2	FR: JUNCTION BOX TO: CONDUIT TEE 5 #14 >> LCP-89102 CONTROL 1 3/CS-#16 >> LCP-89102 SPEED CONTROL 3 #14 >> FSL-89102 CONTROL	C-89-108 C-89-101 C-89-101 C-89-100
C-89-106		0.75"	2	MFR	CABLE	1	#14	XHHW-2	FR: LSLL-89100/LSHH-89100 TO: JUNCTION BOX 1 MFR >> LSLL-89100 CONTROL 1 MFR >> LSHH-89100 CONTROL	
C-89-107		0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR: JUNCTION BOX TO: CONDUIT TEE 2 #14 >> LSLL-89100 CONTROL 2 #14 >> LSHH-89100 CONTROL	C-89-108
C-89-108		1"	12 1	#14 3/CS-#16	XHHW-2	1	#14	XHHW-2	FR: CONDUIT TEE TO: JUNCTION BOX 2 #14 >> LSLL-89100 CONTROL 2 #14 >> LSHH-89100 CONTROL 5 #14 >> LCP-89102 CONTROL 1 3/CS-#16 >> LCP-89102 SPEED CONTROL 3 #14 >> FSL-89102 CONTROL	C-89-113 C-89-107 C-89-107 C-89-102 C-89-102 C-89-102
C-89-110		0.75"	3	#14	XHHW-2	1	#14	XHHW-2	FR: FSL-89101 TO: JUNCTION BOX 3 #14 >> FSL-89101 CONTROL	C-89-113

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NUMBER	DWG	SIZE	#	SIZE	TYPE	#	SIZE	TYPE			DESCRIPTION		CONNECTING SEGMENTS
C-89-111		0.75"	5	#14	XHHW-2	1	#14	XHHW-2	FR:		LCP-89101		C-89-113
			1	3/CS-#16					TO:		JUNCTION BOX		
										5	#14	>> LCP-89101 CONTROL	
										1	3/CS-#16	>> LCP-89101 SPEED CONTROL	
C-89-113		1.5"	20	#14	XHHW-2	1	#14	XHHW-2	FR:		JUNCTION BOX		C-89-120
			2	3/CS-#16					TO:		JUNCTION BOX		
										5	#14	>> LCP-89101 CONTROL	C-89-111
										1	3/CS-#16	>> LCP-89101 SPEED CONTROL	C-89-111
										3	#14	>> FSL-89101 CONTROL	C-89-110
										2	#14	>> LSLL-89100 CONTROL	C-89-108
										2	#14	>> LSHH-89100 CONTROL	C-89-108
										5	#14	>> LCP-89102 CONTROL	C-89-108
										1	3/CS-#16	>> LCP-89102 SPEED CONTROL	C-89-108
										3	#14	>> FSL-89102 CONTROL	C-89-108
C-89-115		0.75"	3	#14	XHHW-2	1	#14	XHHW-2	FR:		FSL-89100		C-89-120
									TO:		JUNCTION BOX		
										3	#14	>> FSL-89100 CONTROL	
C-89-116		0.75"	5	#14	XHHW-2	1	#14	XHHW-2	FR:		LCP-89100		C-89-120
			1	3/CS-#16					TO:		JUNCTION BOX		
										5	#14	>> LCP-89100 CONTROL	
										1	3/CS-#16	>> LCP-89100 SPEED CONTROL	
C-89-120		2"	15	#12	XHHW-2	1	#12	XHHW-2	FR:		JUNCTION BOX		C-89-130
			25	#14	XHHW-2				TO:		JUNCTION BOX		
			3	3/CS-#16						5	#14	>> LCP-89100 CONTROL	C-89-116
										1	3/CS-#16	>> LCP-89100 SPEED CONTROL	C-89-116
										3	#12	>> FSL-89100 POWER/CONTROL	C-89-115
										5	#14	>> LCP-89101 CONTROL	C-89-113
										1	3/CS-#16	>> LCP-89101 SPEED CONTROL	C-89-113
										3	#12	>> FSL-89101 POWER/CONTROL	C-89-113
										2	#14	>> LSLL-89100 CONTROL	C-89-113
										2	#14	>> LSHH-89100 CONTROL	C-89-113
										5	#14	>> LCP-89102 CONTROL	C-89-113
										1	3/CS-#16	>> LCP-89102 SPEED CONTROL	C-89-113
										3	#12	>> FSL-89102 POWER/CONTROL	C-89-113
										2	#14	>> PMP-89100 TSH	P-89-100
										2	#12	>> PMP-89100 MWH	P-89-100
										2	#14	>> PMP-89101 TSH	P-89-110
										2	#12	>> PMP-89101 MWH	P-89-110
										2	#14	>> PMP-89102 TSH	P-89-120
										2	#12	>> PMP-89102 MWH	P-89-120
C-89-130		1"	5	#12	XHHW-2	1	#12	XHHW-2	FR:		JUNCTION BOX		
			7	#14	XHHW-2				TO:		VFD-89100		
			1	3/CS-#16						5	#14	>> LCP-89100 CONTROL	C-89-120
										1	3/CS-#16	>> LCP-89100 SPEED CONTROL	C-89-120
										3	#12	>> FSL-89100 POWER/CONTROL	C-89-120
										2	#14	>> PMP-89100 TSH	C-89-120
										2	#12	>> PMP-89100 MWH	C-89-120
C-89-131		1"	5	#12	XHHW-2	1	#12	XHHW-2	FR:		JUNCTION BOX		
			7	#14	XHHW-2				TO:		VFD-89101		
			1	3/CS-#16						5	#14	>> LCP-89101 CONTROL	C-89-120
										1	3/CS-#16	>> LCP-89101 SPEED CONTROL	C-89-120
										3	#12	>> FSL-89101 POWER/CONTROL	C-89-120
										2	#14	>> PMP-89101 TSH	C-89-120
										2	#12	>> PMP-89101 MWH	C-89-120
C-89-132		1"	5	#12	XHHW-2	1	#12	XHHW-2	FR:		JUNCTION BOX		
			7	#14	XHHW-2				TO:		VFD-89102		
			1	3/CS-#16						5	#14	>> LCP-89102 CONTROL	C-89-120
										1	3/CS-#16	>> LCP-89102 SPEED CONTROL	C-89-120
										3	#12	>> FSL-89102 POWER/CONTROL	C-89-120
										2	#14	>> PMP-89102 TSH	C-89-120
										2	#12	>> PMP-89102 MWH	C-89-120
C-89-140		0.75"	4	#14	XHHW-2	1	#14	XHHW-2	FR:		JUNCTION BOX		
									TO:		PLC70299		
										2	#14	>> LSLL-89100 CONTROL	
										2	#14	>> LSHH-89100 CONTROL	
L-89-110		0.75"	4	#10	XHHW-2	1	#10	XHHW-2	FR:		CAROUSEL PUMP STATION LIGHTING AND RECEP.		
									TO:		PB-8901		
										4	#10	>> AREA 89 LIGHTING AND RECEPTACLE	
L-89-111		2"	4	#8	XHHW-2	1	#10	XHHW-2	FR:		PB-8901		
			2	#14	XHHW-2	1	#14	XHHW-2	TO:		HH-10		
										4	#8	>> AREA 89 & 60 LTG. AND RECPT.	
										2	#14	>> NJB-60001	

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NUMBER	DWG	SIZE	#	SIZE	TYPE	#	SIZE	TYPE			DESCRIPTION		CONNECTING SEGMENTS
L-89-112		2"	4	#6	XHHW-2	1	#8	XHHW-2	FR:		HH-10		L-89-113
			2	#14	XHHW-2	1	#14	XHHW-2	TO:		MH-12		
										4	#6	>> AREA 89 & 60 & 91 LTG. AND RECPT.	
										2	#14	>> NJB-60001	
L-89-113		2"	4	#6	XHHW-2	1	#8	XHHW-2	FR:		MH-12		L-89-114
			2	#14	XHHW-2	1	#14	XHHW-2	TO:		PB-7001		
										4	#6	>> AREA 89 & 60 & 91 LTG. AND RECPT.	L-89-112
										2	#14	>> NJB-60001	
L-89-114		1.5"	4	#6	XHHW-2	1	#8	XHHW-2	FR:		PB-7001		
			2	#14	XHHW-2	1	#14	XHHW-2	TO:		MCC70291		
										4	#6	>> AREA 89 & 60 & 91 LTG. AND RECPT.	L-89-113
										2	#14	>> NJB-60001	
L-89-120		0.75"	2	#10	XHHW-2	1	#10	XHHW-2	FR:		DISCONNECT		P-89-131
									TO:		PB-8901		
										2	#10	>> FIT-99105 POWER	
P-89-100		2"	1	3/C-#4:VFD	VFD			INTEGRAL	FR:		PMP-89100		C-89-120
			2	#12	XHHW-2				TO:		PB-8901		
			2	#14	XHHW-2					1	3/C-#4:VFD	>> PMP-89100 POWER	
										2	#14	>> PMP-89100 TSH	
										2	#12	>> PMP-89100 MWH	
P-89-101		2"	1	3/C-#4:VFD	VFD			INTEGRAL	FR:		PB-8901		
									TO:		VFD-89100		
										1	3/C-#4:VFD	>> PMP-89100 POWER	P-89-100
P-89-105		1"	3	#6	XHHW-2	1	#8	XHHW-2	FR:		VFD-89100		
									TO:		MCC70291		
										3	#6	>> VFD-89100 POWER	
P-89-110		1.5"	1	3/C-#6:VFD	VFD			INTEGRAL	FR:		PMP-89101		C-89-120
			2	#12	XHHW-2				TO:		PB-8901		
			2	#14	XHHW-2					1	3/C-#6:VFD	>> PMP-89101 POWER	
										2	#14	>> PMP-89101 TSH	
										2	#12	>> PMP-89101 MWH	
P-89-111		2"	1	3/C-#6:VFD	VFD			INTEGRAL	FR:		PB-8901		
									TO:		VFD-89101		
										1	3/C-#6:VFD	>> PMP-89101 POWER	P-89-110
P-89-115		1"	3	#6	XHHW-2	1	#8	XHHW-2	FR:		VFD-89101		
									TO:		MCC70292		
										3	#6	>> VFD-89101 POWER	
P-89-120		1.5"	1	3/C-#6:VFD	VFD			INTEGRAL	FR:		PMP-89102		C-89-120
			2	#12	XHHW-2				TO:		PB-8901		
			2	#14	XHHW-2					1	3/C-#6:VFD	>> PMP-89102 POWER	
										2	#14	>> PMP-89102 TSH	
										2	#12	>> PMP-89102 MWH	
P-89-121		2"	1	3/C-#6:VFD	VFD			INTEGRAL	FR:		PB-8901		
									TO:		VFD-89102		
										1	3/C-#6:VFD	>> PMP-89102 POWER	P-89-120
P-89-125		1"	3	#6	XHHW-2	1	#8	XHHW-2	FR:		VFD-89102		
									TO:		MCC70293		
										3	#6	>> VFD-89102 POWER	
P-89-130		0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR:		DISCONNECT		P-89-131
									TO:		PB-8901		
										3	#10	>> EDR-99101 & EDR-99102 POWER	
P-89-131		2"	11	#10	XHHW-2	1	#10	XHHW-2	FR:		PB-8901		P-89-132
									TO:		HH-10		
										3	#10	>> FV-60100 POWER	P-60-120
										3	#10	>> FV-60102 POWER	P-60-120
										3	#10	>> EDR-99101 & EDR-99102 POWER	P-89-130
										2	#10	>> FIT-99105 POWER	L-89-120
P-89-132		2"	11	#10	XHHW-2	1	#10	XHHW-2	FR:		HH-10		P-89-133
									TO:		MH-12		
										3	#10	>> FV-60100 POWER	P-89-131
										3	#10	>> FV-60102 POWER	P-89-131
										3	#10	>> EDR-99101 & EDR-99102 POWER	P-89-131
										2	#10	>> FIT-99105 POWER	P-89-131

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NUMBER	DWG	SIZE	#	SIZE	TYPE	#	SIZE	TYPE			DESCRIPTION		CONNECTING SEGMENTS
P-89-133		2"	11	#10	XHHW-2	1	#10	XHHW-2	FR:		MH-12		P-89-134
									TO:		PB-7001		
										3 #10	>> FV-60100 POWER		P-89-132
										3 #10	>> FV-60102 POWER		P-89-132
										3 #10	>> EDR-99101 & EDR-99102 POWER		P-89-132
										2 #10	>> FIT-99105 POWER		P-89-132
P-89-134		1.5"	11	#10	XHHW-2	1	#10	XHHW-2	FR:		PB-7001		P-89-135
									TO:		CONDUIT TEE		
										3 #10	>> FV-60100 POWER		P-89-133
										3 #10	>> FV-60102 POWER		P-89-133
										3 #10	>> EDR-99101 & EDR-99102 POWER		P-89-133
										2 #10	>> FIT-99105 POWER		P-89-133
P-89-135		0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR:		CONDUIT TEE		
									TO:		MCC70293		
										3 #10	>> EDR-99101 & EDR-99102 POWER		P-89-134
P-89-136		1"	8	#10	XHHW-2	1	#10	XHHW-2	FR:		CONDUIT TEE		
									TO:		MCC70291		
										3 #10	>> FV-60100 POWER		P-89-134
										3 #10	>> FV-60102 POWER		P-89-134
										2 #10	>> FIT-99105 POWER		P-89-134
S-89-100		0.75"	1	2/CS-#16		1	#14	XHHW-2	FR:		LIT-89103		S-89-101
									TO:		PB-8901		
										1 2/CS-#16	>> LIT-89103 SIGNAL		
S-89-101		2"	1	2/CS-#16		1	#14	XHHW-2	FR:		PB-8901		S-89-102
									TO:		HH-11		
										1 2/CS-#16	>> LIT-89103 SIGNAL		S-89-100
S-89-102		2"	1	2/CS-#16		1	#14	XHHW-2	FR:		HH-11		S-89-103
									TO:		PB-7002 (VIA PB-HH-13)		
										1 2/CS-#16	>> LIT-89103 SIGNAL		S-89-101
S-89-103		0.75"	1	2/CS-#16		1	#14	XHHW-2	FR:		PB-7002 (VIA PB-HH-13)		
									TO:		PLC70299		
										1 2/CS-#16	>> LIT-89103 SIGNAL		S-89-102
X-89-100		2"	1	PULL	ROPE				FR:		PB-8901		
									TO:		HH-10		
										1 PULL	>> SPARE		
X-89-101		2"	1	PULL	ROPE				FR:		PB-8901		
									TO:		HH-11		
										1 PULL	>> SPARE		
X-89-110		2"	1	PULL	ROPE				FR:		HH-10		
									TO:		MH-12		
										1 PULL	>> SPARE		
X-89-111		2"	1	PULL	ROPE				FR:		MH-12		
									TO:		PB-7001		
										1 PULL	>> SPARE		
X-89-112		2"	1	PULL	ROPE				FR:		HH-10		
									TO:		MH-12		
										1 PULL	>> SPARE		
X-89-113		2"	1	PULL	ROPE				FR:		MH-12		
									TO:		PB-7001		
										1 PULL	>> SPARE		
X-89-120		2"	1	PULL	ROPE				FR:		PB-8901		
									TO:		HH-10		
										1 PULL	>> SPARE		
X-89-125		2"	1	PULL	ROPE				FR:		PB-8901		
									TO:		HH-11		
										1 PULL	>> SPARE		
C-91-100		1"	5	#14	XHHW-2	1	#14	XHHW-2	FR:		LCP-91100		C-91-110
			1	3/CS-#16					TO:		PB-9101		
										5 #14	>> LCP-91100 CONTROL		
										1 3/CS-#16	>> LCP-91100 SPEED CONTROL		
C-91-104		0.75"	1	MFR	CABLE	1	#14	XHHW-2	FR:		LSHH/LSL-91101		
									TO:		JUNCTION BOX		
										1 MFR	>> LSHH/LSL-91101 CONTROL		

CONDUIT SCHEDULE AREA

Ukiah Recycle Water Project

Waste Water Treatment Plant

ENGINEER	HR
REVISION	
DATE	4/4/23

CONDUIT			CONDUCTORS			GROUND							
NUMBER	DWG	SIZE	#	SIZE	TYPE	#	SIZE	TYPE			DESCRIPTION		CONNECTING SEGMENTS
C-91-105		1"	4	#14	XHHW-2	1	#14	XHHW-2	FR:		JUNCTION BOX		C-91-110
									TO:		PB-9101		
										4 #14	>> LSHH/LSL-91101 CONTROL		
C-91-106		1"	3	#12	XHHW-2	1	#12	XHHW-2	FR:		FSL-91100		C-91-110
									TO:		PB-9101		
										3 #12	>> FSL-91100 POWER/CONTROL		
C-91-110		2"	5	#12	XHHW-2	1	#12	XHHW-2	FR:		PB-9101		C-91-111
			11	#14	XHHW-2				TO:		HH-10		
			1	3/CS-#16						3 #12	>> FSL-91100 POWER/CONTROL		C-91-106
										4 #14	>> LSHH/LSL-91101 CONTROL		C-91-105
										5 #14	>> LCP-91100 CONTROL		C-91-100
										1 3/CS-#16	>> LCP-91100 SPEED CONTROL		C-91-100
										2 #14	>> PMP-91100 TSH		P-91-100
										2 #12	>> PMP-91100 MWH		P-91-100
C-91-111		2"	5	#12	XHHW-2	1	#12	XHHW-2	FR:		HH-10		C-91-112
			11	#14	XHHW-2				TO:		PB-7001		
			1	3/CS-#16						3 #12	>> FSL-91100 POWER/CONTROL		C-91-110
										4 #14	>> LSHH/LSL-91101 CONTROL		C-91-110
										5 #14	>> LCP-91100 CONTROL		C-91-110
										1 3/CS-#16	>> LCP-91100 SPEED CONTROL		C-91-110
										2 #14	>> PMP-91100 TSH		C-91-110
										2 #12	>> PMP-91100 MWH		C-91-110
C-91-112		1.5"	5	#12	XHHW-2	1	#12	XHHW-2	FR:		PB-7001		
			11	#14	XHHW-2				TO:		VFD-91100		
			1	3/CS-#16						3 #12	>> FSL-91100 POWER/CONTROL		C-91-111
										4 #14	>> LSHH/LSL-91101 CONTROL		C-91-111
										5 #14	>> LCP-91100 CONTROL		C-91-111
										1 3/CS-#16	>> LCP-91100 SPEED CONTROL		C-91-111
										2 #14	>> PMP-91100 TSH		C-91-111
										2 #12	>> PMP-91100 MWH		C-91-111
L-91-100		2"	4	#8	XHHW-2	1	#10	XHHW-2	FR:		PAU PS LIGHTING AND RECEPTACLE		
									TO:		HH-10		
										4 #8	>> PAU PS LIGHTING AND RECEPTACLE		
P-91-100		2"	1	3/C-#8:VFD	VFD			INTEGRAL	FR:		PMP-91100		C-91-110
			2	#12	XHHW-2				TO:		PB-9101		
			2	#14	XHHW-2					1 3/C-#8:VFD	>> PMP-91100 POWER		
										2 #14	>> PMP-91100 TSH		
										2 #12	>> PMP-91100 MWH		
P-91-101		2"	1	3/C-#8:VFD	VFD			INTEGRAL	FR:		PB-9101		
									TO:		PB-7001		
										1 3/C-#8:VFD	>> PMP-91100 POWER		P-91-100
P-91-102		1.5"	1	3/C-#8:VFD	VFD			INTEGRAL	FR:		PB-7001		
									TO:		VFD-91100		
										1 3/C-#8:VFD	>> PMP-91100 POWER		
P-91-105		0.75"	3	#10	XHHW-2	1	#10	XHHW-2	FR:		VFD-91100		
									TO:		MCC70293		
										3 #10	>> VFD-91100 POWER		
X-91-100		2"	1	PULL	ROPE				FR:		PB-9101		
									TO:		HH-10		
										1 PULL	>>		
X-91-102		2"	1	PULL	ROPE				FR:		STUB UP		
									TO:		HH-11		
										1 PULL	>>		

END OF CONDUIT SCHEDULE

END OF SECTION

SECTION 17050

COMMON WORK RESULTS FOR PROCESS CONTROL AND INSTRUMENTATION SYSTEMS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Process control and instrumentation systems requirements for common components including installation.
   2. Loop drawings:
      a. Provide complete loop drawings for all systems, including packaged equipment furnished as part of a vendor furnished package, and pre-purchased equipment.
      b. The form, minimum level of detail, and format for the loop drawings must match that of the sample loop drawings included in the Contract Documents.
      c. The Owner and Engineer are not responsible for providing detailed loop diagrams for Contractor furnished equipment.
   3. The requirements of the Instrumentation and Control Specifications apply to all Instrumentation and Control Work specified in Technical Sections, including packaged mechanical systems, LCPs, VCPs, etc.

B. Contract Documents:
   1. Contract drawings:
      a. Schematic diagrams:
         1) Use schematic diagrams in conjunction with the descriptive operating sequence in the Technical Sections to furnish a coordinated and fully functional control system.
         2) Schematic diagrams show control function only.
            a) Incorporate other necessary functions for proper operation and protection of the system.
         3) Controls are indicated on the Drawings as de-energized.
         4) Mount devices shown on motor controller schematic diagrams in the controller compartment enclosure, unless otherwise noted or indicated on the Drawings.

1.02 REFERENCES

A. Code compliance:
   1. As specified in Section 01410 - Regulatory Requirements:
   2. The publications are referenced in this Section by basic designation only without a specified publish date.

B. American Petroleum Institute (API):
   1. RP 550 - Manual on Installation of Refinery Instruments and Control Systems; Part II-Process Stream Analyzers; Section 5-Oxygen Analyzers.
   2. RP 551 - Process Measurement Instrumentation.

C. International Organization for Standardization (ISO):
   1. 9001 - Quality Management Systems - Requirements.

D. International Society of Automation (ISA):
   1. 5.1 - Instrumentation Symbols and Identification.
   2. 5.4 - Instrument Loop Diagrams.

E. National Electrical Code (NEC).

F. National Electrical Manufacturers Association (NEMA).

G. Underwriters Laboratories, Inc. (UL):
   1. 508 - Standard of Safety for Industrial Control Equipment.
   2. 508A - Standard of Safety for Industrial Control Panels.

1.03 DEFINITIONS

A. Control circuit: Any circuit operating at 120 volts alternating current (VAC) or direct current (VDC) or less, whose principal purpose is the conveyance of information (including performing logic) and not the conveyance of energy for the operation of an electrically powered device.

B. Digital bus: A communication network, such as PROFIBUS, Foundation Fieldbus, or DeviceNet, allowing instruments and devices to transmit data, control functions, and diagnostic information.

C. Modifications: Changing, extending, interfacing to, removing, or altering an existing circuit.

D. Panel: An instrument support system that may be a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems.

E. Power circuit: Any circuit operating at 90 volts (AC or DC) or more, whose principal purpose is the conveyance of energy for the operation of an electrically powered device.

F. Powered transmitters: A transmitter that requires a separate power source (120 VAC, 240 VAC, etc.) in order for the transmitter to develop its signal. As used in this Section, the produced signal may be a 4 to 20 mA 24 VDC signal, a digital bus communications signal, or both.

G. RS-232: RS-232 is also known as TIA-232 or EIA-232, is a standard for serial communication transmission of data. When compared to RS-485 it has lower transmission speed, short maximum cable length, large voltage swing, large

standard connectors and no multipoint capability. USB has displaced RS-232 from most of its peripheral interface roles.

H. RS-485: RS-485 is also known as TIA-485 or EIA-485, is a standard defining the electrical characteristics of drivers and receivers for use in serial communications system. Electrical signaling is balanced, and multipoint systems are supported, can be used with data rates up to 10 Mbit/s or at lower speeds distances up to 1,000 meters (4,000 feet).

I. Signal circuit: Any circuit operating at less than 50 VAC or VDC, which conveys analog information or digital communications information.

J. 2-Wire transmitter (loop powered): A transmitter that derives its operating power supply from the signal transmission circuit and requires no separate power supply connections. As used in this Section, 2-wire transmitter refers to a transmitter that provides a signal such as 4 to 20 mA 24 VDC regulation of a signal in a series circuit with an external 24 VDC driving potential:
   1. Fieldbus communications signal or both.

K. USB: Universal Serial Bus is an industry standard that establishes specifications for cables, connectors, and protocols for connection, communication, and power supply interfacing between computer, peripherals, and other computers, it has largely replaced interfaces such as serial and parallel ports.

L. Acronym definitions:
   1. ACB: Automatic current balance.
   2. ATS: Automatic Transfer Switch.
   3. CCS: The PCS central computer system (CCS) consisting of computers and software. The personal computer-based hardware and software system that includes the operator interface, data storage, data retrieval, archiving, alarming, historian, reports, trending, and other higher level control system software and functions.
   4. DPDT: Double-pole, double-throw.
   5. ECP: Electronic circuit protector.
   6. ES: Ethernet Switch.
   7. FAT: Factory acceptance test also known as Source Test.
   8. HART: Highway addressable remote transducer.
   9. HOA: Hand-Off-Auto control function that is totally PLC based. In the Hand mode, equipment is started or stopped, valves are opened or closed through operator direction under the control of the PLC software. In the Auto mode, equipment is started or stopped and valves are opened or closed through a control algorithm within the PLC software. In the Off mode, the equipment is prohibited from responding from the PLC control.
   10. HMI: Human machine interface is a software application that presents information to an operator or user about the state of a process, and to accept and implement the operators control instructions. Typically information is displayed in a graphical format.
   11. ICSC: Instrumentation and control system contractor: Subcontractor who specializes in the design, construction, fabrication, software development, installation, testing, and commissioning of industrial instrumentation and control systems.

12. IJB: Instrument junction boxes: A panel designed with cord sets to easily remove, replace, or relocate instrument signals.
13. I/O: Input/Output.
14. IP: Internet protocol or ingress protection.
15. LCP: Local control panel: Operator interface panel that may contain an HMI, pilot type control devices, operator interface devices, control relays, etc. and does not contain a PLC or RIO.
16. LAN: Local area network: A control or communications network that is limited to the physical boundaries of the facility.
17. LOI: Local Operator Interface is an operator interface device consisting of an alphanumeric or graphic display with operator input functionality. The LOI is typically a flat panel type of display mounted on the front of an enclosure with either a touch screen or tactile button interface.
18. LOR: Local-Off-Remote control function. In the Remote mode, equipment is started or stopped, and valves are opened or closed through the PLC based upon the selection of the HOA. In the Local mode, equipment is started or stopped, valves are opened or closed based upon hardwired control circuits completely independent of the PLC with minimum interlocks and permissive conditions. In the Off mode, the equipment is prohibited from responding to any control commands.
19. NJB: Network junction box. An enclosure that contains multiple access points to various networks within the facility. Networks could be Ethernet, Ethernet/IP, Fieldbus, RIO, etc.
20. P&ID: Process and instrumentation diagram.
21. PC: Personal computer.
22. PCIS: Process control and instrumentation system: Includes the entire instrumentation system, the entire control system, and all of the Work specified in the Instrumentation and Control Specifications and depicted on the Instrumentation Drawings. This includes all the PCS and instruments and networking components as well as the various servers, workstations, thin clients, etc.
23. PCM: Process control module: An enclosure containing any of the following devices: PLC, RTU, or RIO.
24. PCS: Process Control System: A general name for the computerized system that gathers and processes data from equipment and sensors and applies operational controls to the process equipment. It includes the PLCs and/or RIOs, LOIs, HMIs, both LCPs, VCPs and all data management systems accessible to staff.
25. PJB: Power junction box: An enclosure with terminal blocks that distribute power to multiple instruments.
26. PLC: Programmable logic controller.
27. PS: Power supply.
28. RIO: Remote I/O device for the PLC consisting of remote I/O racks, or remote I/O blocks.
29. RTU: Remote telemetry unit: A controller typically consisting of a PLC, and a means for remote communications. The remote communications devices typically are radios, modems, etc.
30. SCADA: Supervisory control and data acquisition system: A general name for the computerized system that gathers and processes data from sensors and equipment located outside of the facility, such as wells, lift stations, metering stations, etc.

31. SELV: Safety extra-low voltage.
32. SFP: Small form-factor pluggable.
33. SPDT: Single-pole, double-throw.
34. SPST: Single-pole, single-throw.
35. UPS: Uninterruptible power supply.
36. VCP: Vendor control panel: Control panels that are furnished with particular equipment by a vendor other than the ICSC. These panels may contain PLCs, RIO, LOI, HMI, etc.
37. WAN: Wide area network: A control or communications network that extends beyond the physical boundaries of the facility.

1.04 SUBMITTALS

A. General:
   1. Adhere to the wiring numbering scheme specified in Section 16075 - Identification for Electrical Systems throughout the Project:
      a. Uniquely number each wire.
      b. Wire numbers must appear on Equipment Drawings.
   2. Some items of Work are represented schematically, and are designated for the most part by numbers, as derived from criteria in ISA-5.1:
      a. Employ the nomenclature and numbers designated in this Section and indicated on the Drawings exclusively throughout shop drawings, data sheets, and similar submittals.
      b. Replace any other symbols, designations, and nomenclature unique to a manufacturer's, suppliers, or subcontractor's standard methods with those identified in this Section and indicated on the Drawings.

B. Specific submittal requirements:
   1. Control Panel Drawings:
      a. General Requirements:
         1) Submit panel, enclosure, console, furniture, and cabinet layout drawings for all items provided.
         2) Use equipment and instrument tags as depicted on the P&IDs for all submittals.
         3) Nameplates and Wire Labeling:
            a) Nameplate legend including text, letter size, materials, and colors.
            b) As specified in Section 16075 - Identification for Electrical Systems or as indicated on the Drawings.
         4) Structural Requirements:
            a) Anchoring method and leveling criteria, including manufacturer's recommendations for the Project site seismic criteria.
            b) Weight.
         5) Clearly show all modifications to existing circuits:
            a) Show all existing unmodified wiring to clearly depict the functionality and electrical characteristics of the complete modified circuits.
      b. Required for materials and equipment listed in this and other Technical Sections.

c. Front, side, rear, internal, external elevations and top and bottom views, showing all dimensions and all to scale.
    1) Locations of conduit entrances and access plates.
    2) Component layout and identification.
    3) Complete and detailed bills of materials:
        a) Including quantity, description, manufacturer, and part number for each assembly or component for each control panel.
        b) Include all items within an enclosure.
    4) Requirements for physical separation between control system components and 120 VAC, 480 VAC, and medium-voltage power cables.
    5) Complete grounding requirements for each system component including any requirements for PLCs, process LANs, and Control System equipment.
    6) PLC rack and card layout:
        a) Provide a count of current I/O allocation.
        b) Future I/O allocation.
        c) Quantity of spares provided.
    7) NEMA rating.
    8) Material and finish.

2. Schematics and Wiring Diagrams:
    a. General Requirements:
        1) Submit panel wiring diagrams for every panel that contains wiring.
        2) Use equipment and instrument tags as depicted on the P&IDs for all submittals.
        3) Nameplates and Wire Labeling:
            a) As specified in Section 16075 - Identification for Electrical Systems or as indicated on the Drawings.
        4) Clearly show all modifications to existing circuits:
            a) Show all existing unmodified wiring to clearly depict the functionality and electrical characteristics of the complete modified circuits.
    b. Include the following information:
        1) Name of panel.
        2) Wiring sizes and types.
        3) Terminal strip numbers.
        4) Terminal identification for device and field connections.
        5) Wire tags and labels.
        6) Functional name and manufacturer's designation for items to which wiring are connected.
        7) Set points for relays and control or alarm contact settings.
    c. Incorporate equipment manufacturer’s shop drawing information into the schematic diagrams in order to document the entire control system.
3. Loop Drawings:
    a. General Requirements:
        1) Submit loop drawings for every analog, discrete, fieldbus signal, vendor supplied equipment packages, and control panels:
            a) Includes all monitoring, alarming, interlocks, and control devices.
        2) Use equipment and instrument tags as depicted on the P&IDs for all submittals.

3) Show and identify each component of each loop or system using requirements and symbols from ISA-5.4.
4) Provide drawings for every instrumentation loop system:
a) Furnish a separate drawing sheet for each system or loop diagram.
5) Nameplates and Wire Labeling:
a) As specified in Section 16075 - Identification for Electrical Systems or as indicated on the Drawings.
6) Clearly show all modifications to existing circuits:
a) Show all existing unmodified wiring to clearly depict the functionality and electrical characteristics of the complete modified circuits.
7) Provide loop drawings in the format indicated in the contract drawings.

b. Provide a complete index in the front of each bound volume:
1) Index the loop drawings by systems or process areas.

c. In addition to the ISA-5.4 requirements, show the following details:
1) Functional name of each loop.
2) Reference name, drawing, and loop diagram numbers for any signal continuing off the loop diagram sheet.
3) Show all terminal numbers, regardless of the entity providing the equipment.
4) MCC panel, circuit, and breaker numbers for all power feeds to the loops and instrumentation.
5) Terminal assignments associated with every manhole, pull-box, junction box, conduit, and panel through which the loop circuits pass.
6) Show vendor control panel, instrument panel, conduit, junction box, equipment and PCS terminations, termination identification, wire numbers and colors, power circuits, and ground identifications.
7) Cables required for communication requirements.

4. PLC I/O List:
a. A complete listing of the PCS system point I/O database:
1) Include for each data point relevant parameters such as range, contact orientation, limits, incremental limits, I/O hardware address, and PLC assignment.
2) Organize on a site-by-site basis and separate by point type.
3) In addition to the active I/O points, list the implemented spare I/O points and the available I/O points remaining on each card, as well as other defined future points specified or shown.
4) Upon completion of the Work, update all I/O lists to indicate the final as-built configuration of the systems:
a) Organize as-built I/O list on a site-by-site basis, separated by equipment and point type.

5. Control Descriptions:
a. For each control loop, provide programming logic in the form of a written functional description of the operation of the equipment, signals, and controls based on the requirements specified in Section 17100 - Control Strategies, and Section 17101 - Specific Control Strategies, and as shown on the P&IDs:
1) Functional descriptions shall be modified to reflect the actual programming to be implemented in the PLCs.

2) Include each function depicted or described in the Contract Documents.
3) Include within the Control Description content:
a) Specific requirements.
b) Common requirements that pertain in general to all loops.
c) Listing ranges, setpoints, timers, values, counter values, etc.
d) Manual keyboard entries.
e) Entry codes.
f) System responses.
g) Modes:
(1) Startup.
(2) Routine and normal operation.
(3) Regulation and control.
(4) Shutdown under specified modes of operation.
(5) Emergency operating shutdown.

6. Instrument Data Sheets:
a. The data sheets provided with the instrument specifications are preliminary and are not complete but are provided to assist with the completion of final instrument data sheets. Additional data sheets may be required.
b. Furnish fully completed data sheets for each instrument and component according to ISA-20 Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
c. Format: Provide data sheets in Microsoft Word or Microsoft Excel.
1) Features and options that are furnished.
d. Provide completed data sheet as specified in the Technical Sections and for each control system component.

7. Instrument Installation Drawings:
a. Provide instrument installation, mounting, and anchoring details for all components and assemblies, including access requirements and conduit connection or entry details.
b. Each installation shall be identified by the equipment or instrument by tag number.
c. Provide certification by the instrument manufacturer that the proposed installation is in accordance with the instrument manufacturer's recommendations and is fully warrantable.
d. Provide, at a minimum, the following contents for each detail:
1) Necessary sections and elevation views required to define instrument location by referencing tank, building, or equipment names and numbers, and geographical qualities such as north, south, east, west, basement, first floor, etc.
2) Ambient temperature and humidity where the instrument is to be installed.
3) Corrosive qualities of the environment where the instrument is to be installed.
4) Hazardous rating of the environment where the instrument is to be installed.
5) Process line pipe or tank size, service, and material.
6) Process tap elevation and location.
7) Upstream and downstream straight pipe lengths between instrument installation and pipe fittings and valves.

8) Routing of tubing and identification of supports.
9) Mounting brackets, stands, anchoring devices, and sunshades.
10) Conduit entry size, number, location, and delineation between power and signal.
11) NEMA ratings of enclosures and all components.
12) Clearances required for instrument servicing.
13) List itemizing all manufacturer makes, model numbers, quantities, lengths required, and materials of each item required to support the implementation of the detail.

8. Product data:
   a. Provide a technical brochure or bulletin (“cutsheet”) for each instrument or equipment on the project labeled with equipment and instrument tags as depicted on the P&IDs.
      1) Submit with the corresponding data sheets:
      2) Organization: Index product data in the submittal by systems or loops.
   b. Engineering data:
      1) Test data and performance curves, when applicable.
   c. Manufacturer's technical reference manuals.
9. Commissioning Submittals:
   a. As specified in Section 01756 - Commissioning.
   b. Manufacturer representative qualifications.
   c. Manufacturer certificates.
   d. Test plans.
   e. Test reports.
   f. Owner training submittals.
   g. Operation and maintenance manuals.
      1) Organize the operation and maintenance manuals for each process in the following manner:
         a) Section A - Process and Instrumentation Diagrams.
         b) Section B - Control Panel Drawings.
         c) Section D - Schematics and Wiring Diagrams.
         d) Section E - Loop Drawings.
         e) Section F - Network Diagrams.
         f) Section G - PLC I/O List.
         g) Section H - Control Descriptions.
         h) Section I - Instrument Data Sheets.
         i) Section J - Instrument Installation Drawings.
         j) Section K - Product Data.
         k) Section L - Sizing Calculations.
         l) Section M - Test Results.
         m) Section N - Operational Manual.
         n) Section O - Spare Parts List.
         o) Section P - PLC Programs.
10. Meetings:
    a. As specified in Section 01312 - Project Meetings and in this Section.

1.05 QUALITY ASSURANCE

A. Manufacture instruments at facilities certified to the quality standards of ISO 9001.

B. Provide equipment listed by and bearing the label of UL or of an independent testing laboratory acceptable to the Engineer and the Authority Having Jurisdiction.

C. The ICSC must have their own operating UL listed panel fabrication facility.
   1. Panels must be fabricated at this facility and meet UL 508/508A requirements.

1.06 DELEGATED DESIGN (NOT USED)

1.07 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt of instruments in the field:
   1. Outside of the package: Prominently display tag number identification.
   2. On each instrument: Provide a nameplate as specified in this Section.

1.08 PROJECT OR SITE CONDITIONS

A. Project conditions:
   1. Area classifications:
      a. Furnish enclosures that match the area classifications as specified in Section 16050 - Common Work Results for Electrical.

B. Non-conditioned spaces:
   1. Provide additional temperature conditioning equipment to maintain all equipment in non-conditioned spaces subject to these ambient temperatures, with a band of 10 degrees Fahrenheit above the minimum operating temperature and 10 degrees Fahrenheit below maximum operating temperature, as determined by the equipment manufacturer’s guidelines.

C. Outdoor installations:
   1. Provide electrical, instrumentation and control equipment suitable for operation in the ambient conditions where the equipment is located.
   2. Provide heating, cooling, and dehumidifying devices incorporated into and included with electrical equipment, instrumentation and control panels to maintain the enclosures within the rated environmental operating ranges as specified in the Sections for the equipment.

1.09 SEQUENCING

A. As specified in Section 01312 - Project Meetings.

B. Project PCIS overview conference:
   1. Contractor leads the meeting.
   2. Timing:
      a. Prior to start of ICSC and Programmer Work.
   3. Attendees:
      a. Engineer, Owner, ICSC, and Programmer.
      b. Contractor.

c. Electrical subcontractor.
d. Manufacturers furnishing major pieces of equipment must attend, including but not limited to:
1) Vendor control panels.
2) Chemical feed systems.
3) Motor control centers.
4) Switchgear.
5) Variable frequency drives.
6) Lighting.
7) Engine generators.

4. Agenda:
a. Meeting purpose:
1) Review the entire project, equipment, control philosophy, schedules, and submittal requirements.
b. Review entire project.
c. Review equipment lists.
d. Review control philosophy.
e. Review schedules.
f. Review submittal requirements.
g. Safety and security.
h. Action items.
i. Next meeting.

C. System configuration meetings: Meet on at least the following occasions:
1. Preliminary meeting:
a. Contractor leads the meeting.
b. Timing:
1) Before configuration work is begun.
c. Attendees:
1) Engineer, Owner, ICSC, and Programmer.
d. Agenda:
1) Meeting purpose:
a) Review the system configuration, the HMI system database, control schemes, displays, report formats, etc.
2) Review the ICSC provided examples of displays, display symbols, reports, etc. to show the capabilities of the system software.
3) Safety and security.
4) Action items.
5) Next meeting.

2. Development review meeting:
a. Contractor leads the meeting.
b. Timing:
1) After the initial database is entered and typical screens and reports have been entered.
c. Attendees:
1) Engineer, Owner, ICSC, and Programmer.
d. Agenda:
1) Meeting purpose:
a) Review the system configuration, the HMI system database, control schemes, displays, report formats, etc.
2) Review the system configuration.

3) Review the HMI system database.
4) Review the control schemes.
5) Review the displays.
6) Review the report formats.
7) Safety and security.
8) Action items.
9) Next meeting.

3. Pre-submittal review meeting:
   a. Contractor leads the meeting.
   b. Timing:
      1) Before producing any submittals.
   c. Attendees:
      1) Engineer, Owner, ICSC, and Programmer.
   d. Agenda:
      1) Meeting purpose:
         a) Review the system configuration, the HMI system database, control schemes, displays, report formats, etc.
         b) Review an informal hardcopy of developed HMI screens for review by the Engineer.
      2) Review the system configuration.
      3) Review the HMI system database.
      4) Review the control schemes.
      5) Review the displays.
      6) Review the report formats.
      7) Review an informal hardcopy of developed HMI screens.
      8) Review the submittal schedule.
      9) Safety and security.
      10) Action items.
      11) Next meeting.
4. Final review meeting:
   a. Contractor leads the meeting.
   b. Timing:
      1) After initial completion of configuration work.
      2) Prior to the Source Test.
   c. Attendees:
      1) Engineer, Owner, ICSC, and Programmer.
   d. Agenda:
      1) Meeting Purpose:
         a) Review the system configuration, the HMI system database, control schemes, displays, report formats, etc.
      2) Review the system configuration.
      3) Review the HMI system database.
      4) Review the control schemes.
      5) Review the displays.
      6) Review the report formats.
      7) Safety and security.
      8) Action items.
      9) Next meeting.
   e. Make final format revisions after this review.

5. Additional requirements as specified in the following:
    a. Section 17100 - Control Strategies.
    b. Section 17101 - Specific Control Strategies.
    c. Section 17720 - Control Systems: Programmable Logic Controllers.

D. Control logic meetings: Meet on at least the following occasions:
    1. Preliminary meeting:
        a. Contractor leads the meeting.
        b. Timing:
            1) Before configuration work is begun on any PLCs programmed by the Contractor (including those provided through subcontractors and suppliers).
        c. Attendees:
            1) Owner, Engineer, ICSC, and Programmer.
            2) Individuals responsible for programming PLCs and other programmable devices supplied by Contractor may attend by telephone conference call.
        d. Agenda:
            1) Meeting purpose:
                a) Discuss overall control logic.
            2) Review list of each PLC and other programmable devices that will interface to the rest of the control system, including make, model, and a description of the interface.
            3) Review contact information for each individual responsible for programming each said PLC and other programmable device.
            4) Review schedule of submittals that will contain HMI/LOI interface information.
            5) Safety and security.
            6) Action items.
            7) Next meeting.
    2. Development review meeting:
        a. Contractor leads the meeting.
        b. Timing:
            1) After approximately one-half of the HMI/LOI interface submittals have been submitted.
        c. Attendees:
            1) Owner, Engineer, ICSC, and Programmer.
            2) Individuals responsible for programming PLCs and other programmable devices supplied by Contractor may attend by telephone conference call.
        d. Agenda:
            1) Meeting purpose:
                a) Discuss progress on control logic.
            2) Discuss HMI/LOI interface submittals to date.
            3) Discuss HMI/LOI interface future submittals and their requirements.
            4) Discuss half of the screens "drafted" but not submitted.
            5) Review list of each PLC and other programmable devices that will interface to the rest of the control system, including make, model, and a description of the interface.
            6) Review contact information for each individual responsible for programming each said PLC and other programmable device.

7) Review schedule of submittals that will contain HMI/LOI interface information.
8) Safety and security.
9) Action items.
a) Document Vendor Control Panel programming requirements.
10) Next meeting.

3. Pre-submittal review meeting:
a. Contractor leads the meeting.
b. Timing:
1) Before producing any submittals.
c. Attendees:
1) Engineer, Owner, ICSC, and Programmer.
d. Agenda:
1) Meeting purpose:
a) Coordinate submittals.
2) Review the system configuration, the HMI system database, control schemes, displays, report formats, etc.
3) Review an informal hardcopy of developed HMI screens for review by the Engineer to determine that requirements are being sufficiently met.
4) Review the submittal schedule.
5) Safety and security.
6) Action items.
7) Next meeting.

4. Vendor control panel programming meetings:
a. Contractor leads the meeting.
b. Timing:
1) Prior to start of vendor control panel programming Work.
c. Attendees:
1) Owner, Engineer, ICSC, and Programmer.
2) Individuals responsible for programming PLCs and other programmable devices supplied by Contractor may attend by telephone conference call.
3) Each equipment supplier who is providing equipment with a PLC and/or LOI.
d. Agenda:
1) Meeting purpose:
a) Coordinate control logic requirements for specific equipment.
2) Review minimum Vendor Control Panel programming requirements:
a) PLC to PLC global data mapping.
b) PLCs to HMI tags mapping.
c) Communication methods.
3) Review advanced Vendor Control Panel programming requirements, as applicable:
a) Tag naming conventions.
b) LOI screen colors and navigation.
c) Interlock and permissive definitions.
d) Alarms: Clearing, formats, colors, and status.
e) Standard code blocks for common control functionality.
4) Safety and security.

5) Action items.
6) Next meeting.

5. Final review meeting:
   a. Contractor leads the meeting.
   b. Timing:
      1) After all HMI/LOI interface submittals have been submitted.
   c. Attendees:
      1) Owner, Engineer, and Programmer.
      2) Individuals responsible for programming PLCs and other programmable devices supplied by Contractor may attend by telephone conference call.
   d. Agenda:
      1) Meeting purpose:
         a) Discuss HMI/LOI interface submittals and requirements.
      2) Review minimum programming requirements:
         a) PLC to PLC global data mapping.
         b) PLCs to HMI tags mapping.
         c) Communication methods.
      3) Review advanced requirements, as applicable:
         a) Tag naming conventions.
         b) LOI screen colors and navigation.
         c) Interlock and permissive definitions.
         d) Alarms: Clearing, formats, colors, and status.
         e) Standard code blocks for common control functionality.
      4) Safety and security.
      5) Action items.
      6) Next meeting.
6. Additional requirements as specified in the following:
   a. Section 17100 - Control Strategies.
   b. Section 17101 - Specific Control Strategies.
   c. Section 17720 - Control Systems: Programmable Logic Controllers.

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY (NOT USED)

1.12 SYSTEM PROCESS START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS (NOT USED)

2.02 DESIGN AND PERFORMANCE REQUIREMENTS (NOT USED)

2.03 SYSTEM DESCRIPTION (NOT USED)

2.04 EXISTING PRODUCTS (NOT USED)

2.05 MATERIALS (NOT USED)

2.06 MANUFACTURED UNITS (NOT USED)

2.07 EQUIPMENT (NOT USED)

2.08 COMPONENTS

A. Furnish meters, instruments, and other components that are the most recent field proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise specified to match existing equipment.

B. Unless otherwise specified, furnish individual instruments that have a minimum accuracy of within 0.5 percent of full scale and a minimum repeatability of within 0.25 percent of full scale.

C. Signal transmission:
   1. Analog signals:
      a. Furnish analog measurements and control signals that vary in direct linear proportion to the measured variable, unless otherwise indicated.
      b. Furnish electrical analog signals outside control panels that are 4-to-20 milliamperes 24 VDC, except as indicated.
      c. Electrically or optically isolate all analog signals from other signals.
      d. Furnish regulated analog signals that are not affected by changes in supply voltage or load resistance within the unit's rating.
      e. Maintain the total 4-to-20 milliamperes loop impedance to 10 percent below the published value at the loop operating voltage.
      f. Where necessary, reduce loop impedance by providing current-to-current (I/I) isolation amplifiers for signal re-transmission.
   2. Discrete input signals:
      a. As indicated in the controller hardware specification.
   3. Discrete output signals:
      a. Dry contacts or TRIAC outputs (with express written approval by the Engineer) as needed to coordinate with the field device.
      b. Provide external terminal block mounted fuse with blown fuse indication for all discrete outputs.
      c. Provide interposing relays for all discrete outputs for voltage and/or current compatibilities.
      d. Provide interposing relays as required for functionality of the control circuit.
   4. Signal performance and design criteria:
      a. Stability:
         1) After controls have taken corrective action, oscillation of the final control element shall not exceed 2 cycles per minute or a magnitude of motion of 0.5 percent of full travel.

b. Response:
    1) Any change in setpoint or controlled variable shall produce a corrective change in position of the final control element and stabilized within 30 seconds.
c. Agreement:
    1) Setpoint indication of controlled variable and measured indication of controlled variable shall agree within 3 percent of full scale over a 6:1 operating range.
d. Repeatability:
    1) For any repeated magnitude of control signal, from either an increasing or decreasing direction, the final control element shall take a repeated position within 0.5 percent of full travel regardless of force required to position the final element.
e. Sensitivity:
    1) Controls shall respond to a setpoint deviations and measured variable deviations within 1.0 percent of full scale.
f. Performance:
    1) All instruments and control devices shall perform in accordance with the manufacturers' specifications.

D. Discrete circuit configuration:
    1. Configure discrete control circuits to fail safe, on loss of continuity or loss of power.
    2. Alarm contacts: Fail to the alarm condition.
    3. Control contacts fail to the inoperative condition unless otherwise indicated on the Drawings.

E. Grounding:
    1. Analog signal cables shields shall only be grounded at a single point in the loop. Unless otherwise noted, ground signal cable shields at control panel.
    2. For communication and data line signal cable shields and drain wires should be grounded at both ends of the cable.
    3. Insulate the shielding and exposed drain wire for each signal cable with heat-shrink tubing.
    4. Terminate the signal cable shield on a dedicated grounding terminal block.
    5. Provide isolating amplifiers within control panels for field equipment possessing a grounded input or output, except when the panel circuit is galvanically isolated.

2.09 ACCESSORIES

A. Provide flow conditioning devices or other required accessories as needed to meet the accuracy requirements in the Contract Documents.

2.10 MIXES (NOT USED)

2.11 FABRICATION (NOT USED)

2.12 FINISHES (NOT USED)

2.13 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. The PCIS configurations are diagrammatic:
   1. The locations of equipment are approximate unless dimensioned.
   2. Where Project conditions require, make reasonable changes in locations and arrangements.

B. Field instruments installation:
   1. Install field instruments as specified in the Contract Documents, API RP 550 and RP 551, and the manufacturer's instructions.
   2. Mount field instruments so that they can be easily read, readily approached, and easily serviced, and so they do not restrict access to mechanical equipment:
      a. Mount field instruments on a pipe stand or local panel, if they are not directly mounted, unless otherwise indicated on the Drawings.
      b. Provide sun shields for field electronic instruments located outdoors.
   3. Make connections from rigid conduit systems to field instruments with PVC coated flexible conduit:
      a. Type of flexible conduit required for the area classification:
         1) Area classification as specified in Section 16050 - Common Work Results for Electrical.
      b. Maximum length of 18 inches.
   4. Connect field instruments with cable as specified in the Electrical Specifications, except when the manufacturer requires the use of special cable, or otherwise specified in this Section:
      a. Special cable applications shall be in accordance with the NEC.
   5. Verify the correctness of each installation:
      a. Polarity of electric power and signal connections.
   6. Ensure all process connections are free of leaks.

C. Existing instrumentation:
   1. Clean, recondition and re-calibrate each existing instrument to be reused, removed, or reinstalled using an authorized service facility of the instrument manufacturer.
   2. Provide certification of this Work before reinstallation of each instrument.

D. Cable and conductor termination:
   1. Terminate all cables and conductors on terminal blocks.
   2. Terminal block enclosures:
      a. Suitable for the area classification as specified in Section 16050 - Common Work Results for Electrical.

E. Surge protection:
   1. Provide outdoor field instrument loops with voltage surge protection units installed on the instruments and the panel.
   2. Individually fuse each 4 to 20 milliamperes direct current loop with a 1/2-ampere fuse between power supplies and receiver surge protectors.
   3. Provide voltage surge protection for 4 wire transmitters and analyzers:
      a. Protect both power source and signal loop.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 COMMISSIONING - GENERAL

A. As specified in Section 01756 - Commissioning and Technical Sections.

3.08 COMMISSIONING - SOURCE TESTING (NOT USED)

3.09 COMMISSIONING - INSTALLATION VERIFICATION (NOT USED)

3.10 COMMISSIONING - FUNCTIONAL TESTING

A. Assist with troubleshooting and correcting instrumentation and control issues.

3.11 COMMISSIONING - SYSTEM TESTING (NOT USED)

3.12 COMMISSIONING - OWNER TRAINING (NOT USED)

3.13 COMMISSIONING - DOCUMENTATION (NOT USED)

3.14 FIELD QUALITY CONTROL (NOT USED)

3.15 ADJUSTING

A. Control valves:
   1. Stroke control valves, cylinders, drives and connecting linkages from the control system as well as local control devices and adjust to verify proper control action, hand switch action, limit switch settings, torque settings, remote control actions, and remote feedback of valve status and position.
   2. Check control valve actions and positioner settings with the valves in place to ensure that no changes have occurred since the bench calibration.

B. Make revisions necessary to the control system software, as directed by the Engineer.
   1. It is understood that the Contractor knows and agrees that changes will be required in the control system software during commissioning.

3.16 CLEANING

A. Vacuum clean control panels and enclosures before process start-up and again after final completion of the project.

B. Clean panel surfaces.

C. Return to new condition any scratches and/or defects.

D. Wipe instrument faces and enclosures clean.

E. Leave wiring in panels, manholes, boxes, and other locations in a neat, clean, and organized manner:
   1. Neatly coil and label all spare wiring lengths.
   2. Shorten, re-terminate, and re-label excessive spare wire and cable lengths, as determined by the Engineer.

3.17 PROTECTION (NOT USED)

3.18 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17100

CONTROL STRATEGIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Contractor-developed loop description submittal requirements.
   2. General programming requirements.
   3. Common control functions:
      a. General control and monitoring functions to be provided throughout the PCS syste:
         1) These requirements apply to all systems and supplement the specific loop descriptions in Section 17101 - Specific Control Strategies and information indicated on the Drawings.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Clamp: Imposed upper and lower limits on setpoints to eliminate entries outside the allowable control parameters.

C. Hardwired control: Control circuitry that does not utilize software to initiate functionality.

D. Hardwired interlocks: A safety or protective feature that will interrupt operation of the equipment in all operating modes with no required operator intervention.

E. Historize: To store data collected by a Supervisory Control and Data Acquisition system or Distributed Control system in a Historical Server or Historian for later use in trends and reports.

F. Software interlocks: A safety or protective feature that will interrupt operation of the equipment when the PLC has control.

G. Slew rate: Rate of change in respect to time.

H. Watchdog timer: Timers imposed to test components such as discrete I/O to verify the health of the card.

1.04 SYSTEM DESCRIPTION (NOT USED)

1.05 SUBMITTALS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS (NOT USED)

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS (NOT USED)

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION (NOT USED)

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. General programming requirements:
   1. Use variable names or aliases derived from tag and loop identification on the P&IDs for all process values.
      a. Submit names for Owner approval.
      b. Unless otherwise noted, utilize floating-point format for all PLC algorithms and calculations.
      c. Provide PLC logic to convert raw input values into engineering units in a floating-point format.
   2. Store all adjustable parameters in the PLC and configure so that an operator with sufficient security access can change the parameters from the LOI or HMI. Update and display the current value at all locations, regardless of where the last change was made.
   3. Reusable PLC code blocks:
      a. Develop and use new standard user defined function blocks (UDFBs) and user defined types (UDTs) where appropriate. One instance of each standard code block shall reside in each PLC and shall be referenced in main routines and subroutines.
      b. New code blocks that the Contractor would like to use as a standard shall be submitted to Owner for review and approval.
      c. Provide complete library of standard code blocks to Owner as part of O&M documentation.
   4. Documentation:
      a. All control logic shall be completely annotated including all rungs, instructions, and tags.
      b. Each routine shall have a title and a detailed description of the control strategy represented by the control logic. Where parameters are passed to the routine, all parameters shall be defined in the routine description.
      c. Analog tag descriptions representing process variables shall include the engineering unit range of the analog variable.
      d. Digital tag descriptions shall include the On and Off state labels.
      e. Complete, grammatically correct sentences and terminology, consistent with water treatment processes, shall be utilized in the development of rung and routine descriptions.
      f. All equations developed in the process logic shall be fully documented in the rung or routine description. A description of each constant and

variable utilized in the equation shall be defined including engineering units.

5. Program slew rates for setpoints as needed to limit the effect of updated setpoints on the process:
    a. Provide for control setpoints and manual speed and position selections.
    b. Store new setpoints in one register, and gradually ramp the actual setpoint register at the slew rate until it reaches the new value.
    c. Provide operator access to change slew rates from the HMI.
6. Saved setpoints:
    a. Provide an operator selection to save all setpoint values.
    b. Furnish 1 or more screens at the HMI that display the initial values for all setpoints defined during start-up and the value for each setpoint the last time they were saved.
    c. Where possible use a DFB or AOI to provide an operator selection to restore all setpoints to the initial start-up value.
    d. Provide an operator selection to restore all setpoints to the last saved value.
7. Store a copy of all adjustable parameters and accumulated and integrated totals in PCS:
    a. Upon re-loading of the PLC program, re-load these values to the PLC from PCS or processor memory card.
    b. PLCs provide a minimum 2-week data storage to provide for data accumulation and later communication to the Historian in the event of a network interruption.
8. Calculated values:
    a. Program calculations such that division by zero errors cannot occur.
    b. Prevent calculations from generating values that exceed the limits of the equipment or data type structures (integers) internal to the PLC.
    c. Configure counting functions (start counts and operation counts) to allow a minimum of 10,000 counts, and to roll-over to zero at an even decimal interval (1 followed by 4 or more zeros).
    d. Configure integrating functions to accurately accumulate the maximum rate from the instrument/equipment (totalizers, run time meters) for 30 years. Utilize manufacturer AOI/DFBs etc. where possible.
9. Timers:
    a. Provide programmable settling and proving timers in control sequences as required for starting and stopping of equipment to allow the process to settle to a steady state before proceeding with any additional control functions.
        1) The settling timers may be overridden by setting the timer to 0 seconds.
10. Control Panel status:
    a. Design the PLC system to function as a stand-alone unit that performs all of the control functions described in this Section completely independent from the functions of the PCS system PC-based operator interfaces:
        1) Failure of the PCS system shall not impact data acquisition, control, scaling, alarm checking, or communication functions of the PLC.
    b. Furnish a minimum of 1 screen that depicts the status of all enclosures containing PLCs, communication equipment, UPS or I/O in the control system, including but not limited to the following:
        1) PLC cabinet over-temperatures from high temperature switch.

2) Intrusion status on all enclosures equipped with intrusion switches.
3) AC power failure:
    a) Monitor ahead of UPS.
4) DC power supply failure:
    a) For redundant power supplies, alarm when either power supply or the diode bridge fails.
5) UPS failure signal.
6) UPS Low Battery signal.
7) Digital bus network Coupler and or Gateway failure signal.
8) Ethernet Switch failure signal.

11. PLC system communication status:
    a. Furnish a minimum of 1 screen to display all communication errors and status within the PCS:
        1) Communication between PCS and PLCs, PLC to PLC, PLC to RIO and PLC and or PCS to VCP.
        2) 4-20 mA HART interface cards.
        3) Digital bus network status:
            a) Profibus scanners.
        4) Modbus Gateway modules.
        5) Display status of each node, and summary of failures over the past 60 minutes.
    b. Generate a communications alarm if any communication fault is detected or there is no response from a node for more than a user specified time.
    c. In the event of communications loss:
        1) Continue normal operation at each PLC.
        2) Where control parameters are received over a communications link:
            a) If a link fails where process elements use the remote value for closed-loop control, hold operating status, speed and position, of the process elements at their last state before the communication alarm, unless other I/O local to that PLC indicates shutdown or over-ride conditions:
                (1) Ensure that the operator can control the process using PCI\S HAND mode at the local LOI.
            b) If a link fails where process elements use the remote value to determine setpoints, continue to operate using the last value received:
                (1) Provide a manual over-ride entry at the local LOI to allow an operator to enter a different value for any such remote signal.
                (2) Generate an alarm whenever an over-ride value is in use.
12. 4-20 mA Hart interface cards:
    a. Provide the following HART protocol information for each populated channel on the card:
        1) Process variable values:
            a) Primary process variable (analog): 4-20 mA current signal.
            b) Primary process variable (digital): Digital value in engineering units.
            c) Percent range: Primary process variable expressed as percent of calibrated range.

d) Loop current: Loop current value in milliamps.
e) Secondary process Variable 1: Digital value in engineering units available from multivariable devices (if applicable).

2) Host commands:
a) Set primary variable units.
b) Set upper range.
c) Set lower range.
d) Set damping value.
e) Set message.
f) Set tag.
g) Set date.
h) Set descriptor.
i) Perform loop test: Force loop current to specific value.
j) Initiate self-test: Start device self-test.
k) Get more status available information.

3) Status and diagnostic alerts:
a) Device malfunction: Indicated device self-diagnostic has detected a problem in device operation.
b) Configuration changed: Indicates device configuration has been changed.
c) Cold start: Indicates device has gone through power cycle.
d) More status available: Indicates additional devices status data available.
e) Primary variable analog output fixed: Indicates device in fixed current mode.
f) Primary variable analog output saturated: Indicates 4-20 mA signal is saturated.
g) Secondary variable out of limits: Indicates secondary variable value outside the sensor limits.
h) Primary variable out of limits: Indicates primary variable value outside the sensor limits.

4) Device identification:
a) Instrument tag: User defined, up to 8 characters.
b) Descriptor: User defined, up to 16 characters.
c) Manufacturer name (code): Code established by HCF and set by manufacturer.
d) Device type and revision: Set by manufacturer.
e) Device serial number: Set by manufacturer.
f) Sensor serial number: Set by manufacturer.

5) Calibration information:
a) Date: Date of last calibration, set by user.
b) Upper range value: Primary variable value in engineering units for 20 mA point, set by user.
c) Lower range value: Primary variable value in engineering units for 4 mA point, set by user.
d) Upper sensor limit: Set by manufacturer.
e) Lower sensor limit: Set by manufacturer.
f) Sensor minimum span: Set by manufacturer.
g) PV damping: Primary process variable damping factor, set by user.

h) Message: Scratch pad message area (32 characters), set by user.
i) Loop current transfer function: Relationship between primary variable digital value and 4-20 mA current signal.
j) Loop current alarm action: Loop current action on device failure (upscale/downscale).
k) Write protect status: Device write-protect indicator.

C. Common control functions:
1. Incorporate common control functions into all control loops and devices and into the control programming, whether or not specifically shown in the specific control descriptions or elsewhere in the Contract Documents.
2. Alarms:
a. Generate alarms within the PLC logic.
b. Indicate alarms at the LOI and HMI. Enable acknowledgement from either the HMI or the LOI.
c. Generate high, high-high, low, and low-low level alarms where indicated:
1) Provide an alarm reset deadband for each analog value to prevent excessive repeated alarms.
2) Provide logic and timers to inhibit analog alarms based on process events. For example, inhibit low flow alarms when a pump is stopped, or has not been running long enough to establish flow.
d. Flash all alarm and fail conditions and their respective indicators on the PCS graphic screens and local indicating lights until the condition is acknowledged by the operator, even if the alarm condition is no longer present.
e. Once the alarm is acknowledged by an operator, display alarm conditions in a steady state (not flashing) while the alarm condition is still present:
1) Flash with a cycle rate of 1/2 second on and 1/2 second off.
f. Once the alarm has been cleared and the operator has acknowledged the alarm or fail condition, turn the graphic alarm indicator off.
g. For all alarms that do not have inherent timers, provide an operator-adjustable proving timer to limit nuisance alarms, continuously adjustable from zero seconds to 100 minutes. The initial setting of proving timers shall be zero seconds:
1) The PLC shall start the timer when it first detects an alarm condition and shall only activate the alarm after the timer has expired.
2) If the alarm condition clears while the timer is running, the timer shall reset, and the alarm shall not be activated.
h. Use interlocks and proving timers to prevent alarms from operating due to power loss, except for loss of power alarms.
i. Furnish an alarm silence pushbutton at each PCM, LOI, or LCP with an audible alarm to signal the PLC to turn off the audible alarm until the next alarm occurs.
j. Lamp test: Furnish lamp test pushbuttons at each control panel with more than 10 pilot lights, that illuminates all pilot lights on the panel:
1) The lamp test may sequence through blocks of lights.
2) Minimum on time for each lamp during lamp test 15 seconds.
k. Horns and Beacons:
1) Activate PCM horn and beacon on all critical alarms and on other alarms as defined by the Facility Alarm Philosophy.

2) Deactivate PCM horn and beacon when PCM reset pushbutton is activated.
3) Silence PCM horn when PCM silence pushbutton is activated.

l. Dual analog instruments:
1) For applications where 2 or more analog instruments are measuring the same process variable:
a) Generate an operator adjustable percent deviation alarm.
b) Allow operator to take each instrument out of service when an instrument is out of service.

3. Where a reset is shown for counts, totals and times maintained in the PLC:
a. Provide a reset selection on the HMI screen that displays the value.
b. Provide a preset function on the HMI to allow an operator-entered value to become the current accumulated total.
c. Limit access to the reset and preset functions to operators with suitable security level.
d. Log the value before reset, operator, time, and date of reset in the PCS archive.
e. Log the value before preset, preset value, operator, time, and date of preset in the PCS archive.

4. Where start counts are indicated on the Drawings, or required in this Section, count starts for each piece of equipment (off to on transitions of running status) in the PLC:
a. Display total starts on PCS screens and provide a reset function.
b. Where indicated, calculate number of starts for each day:
1) Display current day and previous day starts on PCS displays.
2) Do not reset daily start count when overall count is reset.
3) Archive starts for each day through PCS.

5. Where run time accumulation is indicated on the Drawings, or required in this Section, integrate accumulated run time to the nearest 0.1 hour whenever the running status input indicates that the equipment is running:
a. Display total run time in hours on PCS screens.
b. Where indicated, calculate total run time for each day:
1) Display current day and previous day run time on the HMI to the nearest 0.1 hour.
2) Do not reset daily run time when overall time is reset.
3) Archive run time for each day through PCS.

6. For all monitored analog values:
a. Convert all values to engineering units in floating-point format within the PLC.
b. Maintain trends in PCS.
1) Display minima and maxima on the HMI, and archive through PCS.
c. Flows and Weights:
1) Totalize flows in the PLC logic:
2) Where totalized flows are input to a discrete input, count input pulses and multiply by the volume per pulse.
3) Where no totalizer input is shown, integrate the analog input over time.
4) Display totals on the HMI and LOI.
5) Archive totals to the historical database through PCS.
d. Generate an alarm whenever an over-ride value is in use.

e. Calculate hourly, daily, and monthly averages:
    1) Calculations shall be performed by the PLC.
    2) Display averages on the HMI, and archive through PCS.
    3) Display minima and maxima on the HMI, and archive through PCS.
f. Calculate minimum and maximum values each day, and month:
    1) Calculations may be performed by the PLC or PCS.
    2) Display minima and maxima on the HMI, and archive through PCS.

7. Analog data processing:
    a. Engineering units conversion:
        1) Use engineering units for all analog point values. Convert analog inputs to engineering units.
    b. Analog magnitude checking:
        1) Provide upper and lower limits to prevent operator-entered values (setpoints, etc.) from falling outside acceptable limits.
    c. Analog value quality:
        1) Monitor analog values received at each PLC from analog inputs or communications from another PLC or RIO specific to critical analog values, and generate alarms for the following conditions:
            a) Rate of change in excess of acceptable limit:
                (1) Provide a separate rate limit for each value.
            b) Stale value:
                (1) For analog signals that come from analog inputs or calculations using analog inputs, which are expected to have some variation each time the input is read, alarm when there is no change in the value for 10 times the normal expected scan or communication update.

8. Analog device override (LOI and HMI):
    a. Provide the following functions from the HMI and the local LOI all controlling analog input:
        1) An over-ride value to be used in place of the analog input:
            a) Enter in engineering units:
                (1) Display the calibrated range in engineering units.
                (2) Only allow entries within the calibrated range of the instrument.
            b) When the analog input is enabled, track the analog input so that the over-ride matches the analog input value when the input is initially disabled.
            c) Maintain over-ride status and value in the PLC.
            d) Only allow access to over-ride selections and settings to operators with sufficient security.
        2) An enable/disable selection:
            a) When enabled, the value used by the PCS system is equal to the analog input value.
            b) When disabled, the analog input is ignored, and the over-ride value is used for all control and display functions.
            c) Generate an alarm whenever an analog input is disabled.
            d) Enter a value for the analog input from the PCS system to the PLC.
        3) Use the over-ride value for all display and control functions instead of the actual analog input value.

b. Provide the following functions in the PLC, with selections and value entry from the HMI and/or LOI:
    1) An over-ride value to be used in place of the normal output value:
        a) Enter in percent of output span.
        b) When the analog output is enabled, track the analog input so that the over-ride matches the analog output value when the output is initially disabled.
    2) An enable/disable selection:
        a) When enabled, the value sent to the output is the value determined by the PLC based on the control logic or operator-entered value in PCS HAND.
        b) When disabled, the calculated PCS HAND values are ignored, and the over-ride value is sent to the output.
        c) Generate an alarm whenever an analog output is disabled.

9. Tank and vessel levels:
    a. Display all tank and vessel levels as both a level (typically in feet) and a volume (typically in gallons):
        1) Some individual displays may be only level or volume, when agreed to by the Owner and Engineer during screen review meetings.
    b. Monitor rate of change of volume on all tanks and vessels:
        1) Establish the maximum withdraw rate at which the volume should decrease (all pumps or feeders operating at maximum output). Generate an alarm whenever the volume decreases faster than this rate.
        2) Establish the maximum fill rate at which the volume should increase when filling. Generate an alarm whenever the volume increases faster than this rate. Verify tank and vessel level is fluctuating to verify the validity of the IO register. If it is determined the register is not active or failed in a manner that leaves a stagnant value generate an alarm.
10. I/O filtering and processing:
    a. Analog input filtering:
        1) For each analog input provide an adjustable first order filter, for the purpose of smoothing out spikes and other noise for analog transmitter input signals. By default, configure analog inputs with no filtering affect.
        2) Monitor analog input signal quality:
            a) Over range: The input value is above the normal range (typically over 21 mA).
            b) Under range: The input value is below the normal range (typically under 3 mA, indicating a probable broken connection).
            c) Generate alarms for over or under range inputs.
            d) Do not use over or under range values for control or calculation purposes:
                (1) Where a second instrument is provided to monitor the same condition (a redundant instrument, or additional instruments furnished for averaging or different operating modes), and has a valid signal, use that input for control.

3) Digital input filtering (proving timer):
a) Provide an adjustable time delay function (0-10 seconds) on discrete input for the purpose of de-bouncing.
b) By default, discrete inputs shall be configured with de-bounce timers set to zero seconds.

11. Instrument scaling (HMI/LOI):
a. Provide 1 or more maintenance screens to display ranges and trigger points for all field instruments:
1) For analog instruments, use input scaling values in the PLC to determine minimum and maximum calibration points.
2) For discrete instruments, display calibrated pick-up and drop-out values.
12. PCS HAND-OFF-AUTO:
a. Where indicated, provide HAND-OFF-AUTO and START-STOP selections in the PCS, accessed from an LOI or HMI for operators with sufficient security, to provide the following operating modes:
1) PCS AUTO: The normal, automatic control mode of the strategy which allows full PLC control in response to process conditions and programmed sequences.
2) PCS HAND: Enables PCS Manual control where control decisions are made by an operator through the PCS START-STOP, OPEN/CLOSE, or other selections as indicated.
3) PCS OFF: Automated PCS control is disabled, and PLC calls for all associated equipment to stop and valves to close or go to their identified safe state.
4) Program the PLC so that switching a strategy between AUTO and HAND (either direction) occurs with a smooth transition. Keep running or position status unchanged when control is switched to HAND until a change is requested using the operator selections (START, STOP, OPEN, CLOSE). Keep running and position status unchanged when control is switched to AUTO until the control logic determines a change is required.
13. Display the current status of all operator selections (PCS HAND/AUTO, PCS START/STOP, etc.) on LOI and HMI.
14. Interlocks:
a. Implement software interlocks where indicated to place equipment in a safe condition in response to impending hazardous process conditions. Apply software interlocks when equipment is operating in PCS AUTO or PCS HAND:
15. Permissives:
a. Implement software permissives where indicated to prevent equipment from starting in an unsafe condition.
b. Apply software permissives when equipment is operating in PCS AUTO or PCS HAND.
16. Process control algorithms:
a. Jog and hold:
1) When the error between process variable and setpoint is beyond a setpoint deadband:
a) Jog valve or ramp speed in the required direction for a preset “Jog Time” or until the process variable reaches or passes the setpoint.

b) Then hold speed or position through a setpoint “Hold Time.”
c) Continue alternating jog and hold until the error is less than the deadband.

2) Provide operator access to Jog Time and Hold Time setpoints from the HMI.

b. PID algorithms:

1) Provide a PID faceplate with the following displays and functions for each PID control algorithm:
a) Display Output, CV.
b) Display Setpoint, SP.
c) Display Process Variable, PV.
d) Allow for operator selection of Automatic or Manual control of the output.
e) Under Manual control of output allow the operator to enter the desired output value.
f) Allow for input of the 3 Proportional, Integral, and Derivative tuning parameters.
g) Configure PID loops to prevent reset windup when controlled equipment is operating in Manual (local or PCS), or when the equipment has reached a physical limit.
h) When controlled equipment is being operated in remote PCS HAND, configure the PID function to track the process variable to provide a smooth transfer between Manual and Automatic modes.
i) Provide selectable slew rates with adjustable setpoints to allow the PID algorithm to slowly ramp to its final value to minimize system disturbance.

17. Equipment alternating and sequencing:

a. Distribute number of starts and run time equally between identical equipment.

b. Where multiple pieces of equipment are used to control a single process variable, alternating of lead and lag equipment assignments is done as follows:

1) Automatic Lead/Lag equipment selection:
a) The control system automatically selects the lead equipment and next lag equipment based on the lowest run time hours of the equipment.
b) When multiple equipment are running, the control system determines which equipment to stop next based on the running equipment with the highest run time hours.
c) A weighted run time factor can be assigned to each individual piece of equipment.
(1) The weighting factor is a percentage from 1-100 percent that is multiplied by the actual run time hours of the equipment to create a weighted run time hours of the equipment.
(2) The weighted run time hours of each piece of equipment are then used by the algorithms that select the equipment that will start or stop next.

(3) This is to allow for specific equipment to accrue more run time hours so that all pumps do not reach their maximum run time hours at approximately the same time.
(a) Display both the weighted and actual runtime hours on the PCS screen.

2) Manual Lead/Lag selection:
a) The operator will assign the Lead, “Next Lag” equipment through a selection matrix in the HMI.
b) When modifying this matrix, modifications shall not become active until an “ACCEPT ALL” software pushbutton is activated.
c) Provide a “CANCEL ALL” software pushbutton to clear all modification of the selection matrix and revert them to the last accepted changes.

18. Motor control:
a. Monitor the device’s LOCAL-OFF-REMOTE (LOR) switch (the hard-wired switch at the MCC, drive or equipment) to determine when the PLC has control of the associated equipment:
1) Display current REMOTE status on the PCS screens.
b. Monitor the device’s running status from the starter auxiliary or run status input:
1) Display the current status (running or stopped) on the PCS screens.
2) Use status to calculate total run time and daily run time, and to count total starts and daily starts.
3) Provide time stamp for each start.
4) For motors 200 HP and greater, provide software to prevent exceeding the manufacturer’s recommended maximum starts per hour.
c. When equipment control has been given to the PLC as reported by the LOCAL-OFF-REMOTE switch, allow selection of PCS AUTO or PCS HAND control modes based upon operator selection using the PCS screens.
d. Starting, stopping and running when the device LOR is in LOCAL:
1) With the LOR switch in the LOCAL position, the motor is controlled by the START and STOP pushbuttons.
2) With the LOR switch in the OFF position, the motor is prohibited from running.
3) With the LOR switch in the REMOTE position, the motor is controlled remotely.
e. Starting, stopping and running when the device LOR is in REMOTE:
1) When the motor is expected to be running (PLC has issued a START or RUN due to process conditions or operator selection), LOR is in REMOTE, and the device is not reported to be running, start an operator adjustable “Control Activation” timer:
a) Provide “Control Activation” timers for each piece of controlled equipment:
(1) If the LOR and required running status do not change, and the PLC does not receive running status within the “Control Activation” time period:
(a) De-activate the output.
(b) Place the device in a “Failed” state.
(c) Generate a “Failed to Respond” alarm.

2) When the motor is not expected to be running (PLC has issued a STOP or removed the RUN output), LOR is in REMOTE, and the device is reported to be running, start the “Control Activation” timer:
    a) If the LOR and required stopped status do not change, and the PLC does not lose the running status within the “Control Activation” time period:
        (1) Keep the RUN output off or the STOP output on.
        (2) Place the device in a “Failed” state.
        (3) Generate a “Failed to Respond” alarm.
3) Re-establish PLC control of a device in a “Failed” state only after the following:
    a) An operator turns the device’s LOR switch out of REMOTE, and back to REMOTE (i.e., REMOTE input to the PLC cycles off and back on).
    b) An operator acknowledges the fault from PCS.

f. Where motor winding high temperature switches or RTD temperature elements are shown, generate an alarm when high temperature is sensed (contact opens or temperature above the high alarm setpoint), but do not stop the motor unless otherwise indicated.

g. Motor equipped with current detection shall shut down and report a “failed” status on detection of high current.

h. Control two-speed motors similar to other motors, except as listed below:
1) Motor states are RUN-FAST, RUN-SLOW, and STOP.
2) Start all two-speed motors in the RUN-SLOW state. If or when the high speed is required (RUN-FAST operator selection or process conditions), transition to RUN-FAST after a designated time.
3) When transitioning from RUN-FAST to RUN-SLOW, remove the RUN-FAST output or issue a STOP, then wait for a “Fast to Slow” time delay before energizing the RUN-SLOW or START-SLOW output.

i. Simultaneous starts:
1) Prevent more than one motor-driven load 25 HP or larger in the same facility from starting concurrently:
    a) When starting one load, inhibit start logic for all other such equipment until the load being started is up to speed (RVSS or VFD), or after a setpoint time delay (full-voltage starters and miscellaneous equipment).

j. Speed control:
1) Modulate speed on VFD-driven motors using jog and hold, or PID control algorithms to maintain process conditions as described in the specific loop descriptions.
2) Operate speed control within a pre-defined range:
    a) Minimum speed as determined by equipment manufacturer. The higher of:
        (1) Minimum motor speed to maintain adequate cooling for the type of load driven (constant or variable torque).
        (2) Minimum equipment speed, such as minimum speed to deliver flow or to deliver minimum flow for equipment cooling or lubrication.
    b) Maximum speed 100 percent (60 hertz) or as identified by equipment manufacturer.

3) Where multiple equipment may operate together to maintain the same process condition, alternatively referred to as “Lead/Lag”:
    a) Start the first equipment at a preset starting speed.
    b) When 1 or more equipment is running and the speed control algorithm reaches a preset “Start Next” speed value (initially 95 percent of speed range) through a preset time delay:
        (1) Start the next available equipment at the preset starting speed.
        (2) Ramp up the started equipment and ramp down the previously running equipment to the mid operating speed (adjustable in the PLC). Determine preset values for each condition based on equipment and system characteristics to provide approximately the same total flow or process condition with the new load running at the mid speed (for example if one pump is running and the second pump will be added, then the total flow of both pumps running at mid operating speed should be approximately the same as flow of one pump at Start Next speed).
        (3) Once both equipment reach the mid operating speed, resume the speed control algorithm for those equipment.
        (4) Operate all equipment at the same speed following the output of the speed control algorithm.
    c) When two or more pieces of equipment are running, monitor for a “Stop Next” condition:
        (1) Where flow rate is monitored, use a preset “Stop Next” flow rate for each possible number and combination of equipment:
            (a) Determine initial “Stop Next” speed based on the flow that can be provided with one fewer piece of equipment running at a speed slightly below the “Start Next” speed.
        (2) When the “Stop Next” condition exists through a preset time delay:
            (a) Ramp speed of running equipment except for the equipment to be stopped up to a preset value based on the number of items running. Determine preset values for each condition based on equipment and system characteristics to provide approximately the same total flow or process condition with one fewer load running (typically slightly below the preset “Start Next” speed) while ramping speed of equipment to be stopped down to the preset minimum speed.
            (b) Operate all remaining equipment at the same speed following the output of the speed control algorithm. Stop the load once it reaches minimum speed.

19. Gate and valve control:
    a. Monitor the device’s LOCAL-STOP-REMOTE (LSR) switch(es) (the integral switch in the actuator or hard-wired switch at the local control station):
        1) Display current REMOTE status on PCS screens.

b. Start an “Open Activation” timer whenever the device is expected to be open (PLC has issued an OPEN command in PCS AUTO, or OPEN was selected in PCS HAND):
    1) Initially set “Open Activation” time to twice the normal opening time.
    2) If the LSR position and open command do not change, and the PLC does not receive fully open status feedback within the “Open Activation” time period:
        a) De-activate the open output.
        b) Place the device in a “Failed” state.
        c) Generate a “Failed to Open” alarm.
c. Start a “Close Activation” timer whenever the device is expected to be closed (PLC has issued a CLOSE command in PCS AUTO, or CLOSE was selected in PCS HAND):
    1) Initially set “Close Activation” time to twice the normal closing time.
    2) If the LSR position and close command do not change, and the PLC does not receive fully closed status feedback within the “Close Activation” time period:
        a) De-activate the close output.
        b) Place the device in a “Failed” state.
        c) Generate a “Failed to Close” alarm.
d. Limit the number of open/close /commands so that it does not exceed the manufacturer requirements.
e. For modulating valves (valves controlled from either a 4-20 mA signal or digital communications command) with position feedback, start a “Position Error” timer whenever the position feedback differs from the required position command by more than a setpoint error when the LSR is in REMOTE:
    1) For analog modulating devices, error is determined by position feedback differing from position command by more than the setpoint error.
    2) For discrete modulating devices, error is determined by feedback not changing in the correct direction, or changing at less than a setpoint rate, when the OPEN or CLOSE PLC output is active.
    3) Initially set the “Position Error” time to 60 seconds.
    4) If the LSR position does not change, and position error stays outside of the setpoint error through the “Position Error” time period:
        a) Place the device in a “Failed” state.
        b) Generate a “Position Fail” alarm.
f. Provide separate time delay settings for each function and for each device.
g. If the valve position inputs indicate an invalid state (i.e., valve open and closed at the same time), place the device in a “Failed” state and generate an “Invalid State” alarm.
h. Re-establish PLC control of a device in a “Failed” state only after the following:
    1) An operator turns the device’s LSR switch out of REMOTE and back to REMOTE (i.e., REMOTE input to the PLC cycles off and back on).
    2) An operator acknowledges the fault from PCS.
i. For all alarm conditions, control other devices (as stopping pumps, etc.) as stated in the individual loop descriptions to make the system safe.

j. For discrete modulating valves (valves positioned to intermediate positions to control process values through discrete OPEN and CLOSE outputs), count the number of actuations (OPEN or CLOSE commands) per hour in the PLC:
    1) Display count on the HMI.

20. Chemical systems (LOI/HMI):
    a. Provide the following chemical system screens:
        1) Where one LOI manages more than one chemical system, a main menu screen that will allow the operator to access the individual chemical system screens using software keys.
        2) One or more screens for each individual chemical system controlled at that location, containing:
            a) All status displays (running, failed, etc.).
            b) Selections (lead/lag, which process flow to pace to, etc.).
            c) Setpoint entry and display.
            d) Calculated feed requirement (result of flow pacing calculation) in engineering units (typically milligrams of chemical per minute).
            e) Output signal to feeder in percent of full span.
            f) Actual chemical flow rate from flowmeter (where shown).
            g) Process flow rate(s) used to pace each chemical on the individual chemical screens (PROC FLOW):
                (1) Where different process flows can be selected for flow pacing, display and identify the selected source.
    b. Chemical system calculations: Perform calculations as indicated on the Drawings and in the individual loop descriptions. Use the following assumptions, unless otherwise noted:
        1) Where chemical flow feedback is not used, assume feeder output is linear in response to control signal.
        2) Zero signal (typically 4 milliamperes) produces zero flow.
        3) Perform flow-pacing calculations using as indicated on the Drawings or described in the individual loop descriptions.
    c. Provide the setpoints and selections indicated on the Drawings and in the individual loop descriptions. Typical setpoints include:
        1) QMAX: Maximum calibration value:
            a) Chemical flow rate measured from calibration column at maximum feeder output (typically in gallons of solution per hour or milliliters of solution per minute).
        2) CONC: Chemical concentration:
            a) The concentration of the chemical in the solution to be fed, in engineering units (typically milligrams of chemical per liter of chemical solution).
        3) DENSITY:
            a) Density of the chemical solution to be fed in engineering units or as a specific gravity.
            b) Used to calculate the concentration of the chemical in the solution.
        4) DOSE: Desired dosage:
            a) Desired chemical concentration in the process stream in engineering units (typically milligrams of chemical per liter of process fluid).
        5) FLOW SEL: Selection of process stream(s) for flow pacing.

6) OPEN/CLOSED LOOP:
   a) Selection of method of controlling chemical flow-paced feed rate.
   b) OPEN LOOP: Signal to feeder is based on feeder calibration (QMAX) to deliver calculated chemical solution feed rate. Chemical solution flowmeter is not used for control.
   c) CLOSED LOOP: Chemical feed rate is directly controlled using the calculated chemical solution feed rate as the setpoint, and the flow rate from the chemical solution flowmeter as the process variable.
7) TRIM FACTOR: refer to the equations below.

d. Chemical control algorithms:
   1) Flow pacing algorithm: Operator selects a desired dose and the control system adjusts the chemical feed rate to dose based on process flow, chemical concentration, and feeder calibration. The calculation is as follows (units may vary from those shown in the calculation below):

$$Q_C = \frac{D \cdot Q_f \cdot 8.34}{24 \cdot C \cdot p}$$

Where,
Q_C = Chemical Pump flow Rate command (gal/hr)
Q_f = Process Flow (MGD) Measurement
D = Dose setpoint (mg/L) User Adjustable
p = Chemical Density (lbs/gal)
C = Chemical Concentration (ratio in decimal format. For example, use 0.25 for 25 percent chemical solution)
8.34 = conversion factor ([lbs • L]/[MG • day • mg])
24 = conversion factor days to hours

$$S = \frac{Q_C}{Q_{max}}$$

Where,
S = Pump Speed control setpoint (0 to 100 percent)
Q_C = Flow setpoint from equation above (gal/hr)
Q_{max} = Maximum Pump Flow *setpoint* (gal/hr) based on calibration column test.

   2) Flow pacing with closed loop algorithm: Operator selects a desired dose and the control system adjusts the speed of the chemical feeder through a speed control signal to match the measured chemical feed rate to a flow rate setpoint. This flow rate setpoint shall be derived from the process flow and operator setpoints for dosage and concentration. The calculation is as follows (units may vary from those shown in the calculation below):

$$Q_C = \frac{D \cdot Q_f \cdot 8.34}{24 \cdot C \cdot p}$$

Where,
Q_C = Chemical Pump flow Rate command (gal/hr)
Q_f = Process Flow Measurement (MGD)
D = Dose setpoint (mg/L) User Adjustable
p = Chemical Density (lbs/gal)
C = Chemical Concentration (ratio in decimal format. For example, use 0.25 for 25 percent chemical solution)
8.34 = conversion factor ([lbs • L]/[MG • day • mg])
24 = conversion factor days to hours

a) The speed of the chemical feed pump shall be determined by the output of a PID controller. The setpoint of the PID controller shall be the result of the equation in the paragraph above. The process variable (feedback) shall be the chemical flow (not process flow) as measured by a flow meter.

3) Flow pacing with analyzer trim algorithm: Operator selects a desired dose and desired analyzer setpoint band and the control system adjusts the chemical feed rate to dose based on process flow, chemical concentration, process analyzer output, and feeder calibration. The calculation is as follows (units may vary from those shown in the calculation below):

$$Q_C = \left(\frac{D \cdot Q_f \cdot 8.34}{24 \cdot C \cdot p}\right) T$$

Where,
Q_C = Chemical Pump flow Rate command (gal/hr)
Q_f = Process Flow Measurement (MGD)
T = Trim Factor (ratio)
D = Dose setpoint (mg/L) User Adjustable
p = Chemical Density (lbs/gal)
C = Chemical Concentration (ratio in decimal format. For example, use 0.25 for 25 percent chemical solution)
8.34 = conversion factor ([lbs • L]/[MG • day • mg])
24 = conversion factor days to hours

$$S = \frac{Q_{CL2}}{Q_{max}}$$

Where,
S = Pump Speed control setpoint (0 to 100 percent)
Q_{CL2} = Flow setpoint from equation above (gal/hr)
Q_{max} = Maximum Pump Flow (gal/hr) based on calibration column test.

a) The trim multiplier shall be controlled by the output of a PID controller initially scaled between 0.8 and 1.2, adjustable. The setpoint of the PID controller shall be an operator adjustable target residual or desired analytical value. The process variable (feedback) of the PID controller shall be measured residual or analytical value.

4) Flow pacing with closed loop and analyzer trim algorithm: Operator selects a desired dose and desired analyzer setpoint band and the control system adjusts the speed of the chemical feeder through a speed control signal to match the measured chemical feed rate to a flow rate setpoint. An additional control algorithm is used in the calculation to fine-tune the feed based on an analytical measurement as measured by the process analyzer.

$$Q_C = \left(\frac{D \cdot Q_f \cdot 8.34}{24 \cdot C \cdot p}\right) T$$

Where,
Q_C = Chemical Pump flow Rate command (gal/hr)
Q_f = Process Flow Measurement (MGD)
T = Trim Factor (ratio)
D = Dose setpoint (mg/L) User Adjustable
p = Chemical Density (lbs/gal)
C = Chemical Concentration (ratio in decimal format. For example, use 0.25 for 25 percent chemical solution)
8.34 = conversion factor ([lbs • L]/[MG • day • mg])
24 = conversion factor days to hours

a) The trim multiplier shall be controlled by the output of a PID controller initially scaled between 0.8 and 1.2, adjustable. The setpoint of the PID controller shall be an operator adjustable target residual or desired analytical value. The process variable (feedback) of the PID controller shall be measured residual or analytical value.

b) The speed of the chemical feed pump shall be determined by the output of a PID controller. The setpoint of the PID controller shall be the result of the equation in the paragraph above. The process variable (feedback) shall be the chemical flow (not process flow) as measured by a flow meter.

e. Virtual day tanks:

1) Chemical systems without actual day tanks will have their own “virtual” day tank, which will use either a pre-set volume (operator adjustable) or a calculated daily use rate based on the totalized flow (volume) of the chemical magnetic flowmeters over the virtual day tank cycle. The “virtual” day tank will start at the pre-set volume or the calculated volume (operator-selectable) and based on the storage tank level, the volume in the “virtual” day tank will decrease until the total “volume” in the virtual day tank is used. The virtual day tank will automatically compensate for any changes in the system due to the use of the dilution system (revised solution concentration). Once this occurs, the operator will be provided with a “pop-up” screen stating that the “virtual” day tank volume is used. Once this occurs, the operator will be provided with a “pop-up” screen stating that the virtual day tank needs to be refilled. The pop-up screen will contain the following information:

a) Time {hours and minutes} since the last day tank filling.

b) Volume utilized in the “virtual” day tank (based on the level transmitter measuring the chemical storage tank).
c) Dose {mg/L} based on the average flow rate over the “virtual” day tank cycle.
d) Target dose {mg/L} based on operator input.

2) Provide a double check using the actual flowmeter values to compare with the calculated dose. Compared the magnetic flowmeter value with the calculated dose. The magnetic flowmeter value will be based on an hourly average of chemical flow rate over the day tank cycle.
3) As an added level of control any chemical system that has an analyzer used for feedback will be tracked and alarmed if outside the operating parameters.
4) Alarm if any condition falls outside of the flow, or level parameters.

21. Breaker status:
    a. Display the following data to the extent it is available from the specified device:
        1) Open.
        2) Closed.
        3) Tripped.
        4) Ground fault.
        5) Settings.
        6) Racked out.
22. Power Data:
    a. Retrieve data from:
        1) Power Quality Meters (PQMs) at 480V.
        2) Main Breaker Protective Relays on 12.47 kV Switchgear.
        3) Generator Master Control Panel.
        4) Digital bus networks, as indicated.
        5) Where available, use EtherNet IP communications.
    b. Display the following data (to the extent it is available) from the specified device.
        1) Current XXXX.X A:
            a) A-Phase.
            b) B-Phase.
            c) C-Phase.
        2) Volts: XXXX.X V:
            a) A-Phase.
            b) B-Phase.
            c) C-Phase.
        3) Reactive power: XXXX.X kVAR.
        4) Real power: XXXX.X kW.
        5) Apparent power: XXXX.X kVA.
        6) Power factor: 0.XX.
        7) Energy: XXXXXXX kW*hr.
        8) Demand peak: XXXX Amp.
        9) Demand peak: XXXX kW.
    c. For engine/generator system monitoring, also display percent of rated output.

23. Power Supply and Distribution displays Power Quality Meters display:
    a. In addition to the Power Data listed above, display the following (where available) from PQMs, Protective Relays, and Generator Master Control Panel:
        1) Frequency: Hertz.
        2) THD (current and voltage): up to 31st harmonic.
    b. Calculate, indicate, historize, and trend data in a 12.47 kV Meter Table that lists measurements from the following Protection Relays:
        1) Protection Relay on 52-G1.
        2) Protection Relay on 52-G2.
        3) Protection Relay on 52-M1.
        4) Protection Relay on 52-M2.
        5) Protection Relay on 52-M3.
        6) Display calculated values for "Load At 12.47 kV", which sums the current, kW, and kW-hr values for all five Protection Relays.
        7) Display calculated values for "Load At 480V", which sums the current, kW, and kW-hr values for all PQM meters.
        8) Display calculated values for "Transformer and Line Losses", which subtracts "Load at 480V" from "Load At 12.47 kV" for current, kW, and kW-hr values for all PQM meters.
    c. Display the data in a 480V Meter Table that lists measurements from all power quality meters on the plant.
24. Digital bus Starters, RVSS and VFDs equipped with EtherNet IP communications:
    a. Communicate and display all values listed in the equipment specifications, indicated on the Drawings, or listed below.
    b. Communicate start and stop commands and receive running feedback over the fieldbus network.
    c. Provide data entry screen for the cost of electricity in dollars per (kw*hr), which will be used in calculations for display.
    d. Monitor the following additional values, and display on the HMI:
        1) Motor current, phase A, B, and C.
        2) Over current alarm.
        3) Under current alarm.
        4) Running status.
        5) Phase loss.
        6) Stall.
        7) Number of starts.
        8) History of past 5 trips.
    e. Calculate, indicate, historize, and trend, the following additional values:
        1) Full Load Amps (static value, Engineer will provide).
        2) Average Motor Operating Current.
        3) Run Time (Hours).
        4) Operating Hours (Hours/Year).
        5) Average Load Factor (equals Average Motor Current Operating Current/Full Load Amps) - *display as a percentage.*
        6) Annual Energy Use (kW*hr).
        7) Annual Operating Cost (dollars).
        8) Percent of Site Electric Use (equals Annual Energy Use/Sum of Annual Energy (kW*hr) values for all PQM meters).

f. For Variable Frequency Drives:
   1) Speed command.
   2) Speed feedback.

g. For RVSS, Variable Frequency Drives, and where otherwise shown or available, monitor the following over the digital bus network:
   1) Line voltage.
   2) Power.
   3) Power factor.
   4) Over voltage alarm.
   5) Under voltage alarm.
   6) Over current alarm.
   7) Under current alarm.
   8) Indicate, historize, trend, and alarm data as indicated in the ACS I/O Tables on the Drawings.

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL (NOT USED)

3.08 ADJUSTING (NOT USED)

3.09 CLEANING (NOT USED)

3.10 DEMONSTRATION AND TRAINING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17101

SPECIFIC CONTROL STRATEGIES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Loop descriptions:
      a. Specific control requirements and functional descriptions for individual control loops.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.04 SYSTEM DESCRIPTION (NOT USED)

1.05 SUBMITTALS

A. Develop detailed loop descriptions based on the information in the Contract Documents and submit as specified in Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.
   1. For each control loop, provide a detailed functional description of the operation of the equipment, signals, and controls shown on the P&IDs:
      a. Include all functions depicted or described in the Contract Documents.
      b. Include the following within each loop description:
         1) All requirements specific to that loop.
         2) Common control requirements applicable to that loop.
         3) List of all ranges, setpoints, timers, values, counters, etc.
   2. Where there are similar loops with identical control, such as multiple loops for individual raw water pumps, only 1 loop description need be developed, and the remaining loops may reference that loop description.
   3. Loop description format: As specified in this Section.

B. Loop number and title:
   1. References:
      a. List P&IDs that are specifically referenced.
   2. Abstract:
      a. General description of how the loop works, what devices are involved, and how the process will be controlled.

b. Process values, setpoints, and limits, including units and ranges:
    1) Show span and range values for analog inputs and outputs, and operating point and deadband for discrete inputs.

3. Hardwired control:
    a. Detailed description of the control functions at the local level.
    b. Function of local operator interfaces.
    c. Operation of hardwired field pilot controls:
        1) Pushbuttons.
        2) Selector switches.
        3) Potentiometers.
        4) Pilot lights, indicators, and other displays.
4. Hardwired interlocks:
    a. Explanation of the operation of system interlocks and hardwired permissive conditions.
5. PCS control:
    a. Detailed description of the control functions that are under control of the PLC and operator controls.
    b. Operator controls and automatic controls.
    c. Setpoints, alarms, etc.:
        1) Include units and ranges for analog values.
        2) Include span and range for analog inputs and outputs.
        3) Include operating point and deadband for discrete inputs, and identify conditions where contacts are open, and when they close.
    d. Control sequences.
    e. Software interlocks:
        1) Operation of system software interlocks.
6. Indicators and alarms:
    a. List any indicators and alarms specific to the loop that are not covered in the common control strategies.
7. Failure modes:
    a. List any failure modes specific to the loop that are not covered in the common control strategies.

1.06 QUALITY ASSURANCE (NOT USED)

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY (NOT USED)

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE (NOT USED)

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION (NOT USED)

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION

A. Dechlorination Structure Valves:
   1. References:
      a. 60N01.
   2. Abstract:
      a. On-spec water goes through the dechlorination structure and out to the Russian river. If off-spec water is detected during dechlorination mode, the valve within the dechlorination structure will automatically close, and the valve west of the dechlorination structure will automatically open, diverting the off-spec water to the Carousel Pump Station.
   3. Hardwired control:
      a. At the LCP, a LOCAL-STOP-REMOTE switch with OPEN-STOP-CLOSE switch operates as follows:
         1) With the LSR switch in the LOCAL position, an operator may open or close the valve by using the OSC switch. The valve will open when the OSC is in the OPEN position, and the valve will close when the OSC is in the CLOSE position. The OSC is spring-returned to the STOP position.
         2) With the LSR switch in the STOP position, the valve will stop.
         3) With the LSR switch in the REMOTE position, the PCS shall control the valve.
   4. Hardwired interlocks/overload programmed interlocks:
      a. None.
   5. PCS control:
      a. PCS HAND mode:
         1) The dechlorination structure valve is controlled manually by the Operator with the following commands:
            a) Open.
            b) Close.
      b. PCS AUTO mode:
         1) The water quality in the chlorination and dechlorination structures are monitored by the chlorine residual analyzer.

2) Dechlorination Mode:
    a) For 45 minutes out of every hour, the 4-way valve is positioned so that the chlorine residual analyzer samples from the dechlorination structure.
    b) In this mode, when chlorine residual reaches an Operator adjustable setpoint, the PCS shall alarm (initial setpoint 0.02 mg/L), latch out, and the two vales shall switch positions so that DCL Structure Valve 1 will be open and DCL Structure Valve 2 will close. Water will then be diverted to the percolation ponds through the Carousel Pump Station. As discussed below, for the first 5 minutes of this mode, there shall be a hold timer placed on alarms and logic to allow time for the chlorine level to settle.
3) Chlorination Mode:
    a) For 15 minutes out of every hour, the 4-way valve is positioned so that the chlorine residual analyzer samples from the chlorine contact basins.
    b) When this mode begins, start a 20-minute hold timer so that no alarms are displayed and there will be no PCS logic during the hold time. As noted above, this hold timer will be present for the entire 15 minutes of the chlorination mode, as well as the first 5 minutes of dechlorination mode.
4) If the measured chlorine is outside the operator adjustable range, the DCL Structure Valve 2 shall be closed and DCL Structure Valve 1 shall be opened to divert the water to the Carousel pump station.
5) If the measured chlorine exceeds the range by an operator adjustable percentage (default:10 percent), an alarm shall be sent to the PCS to alert the operators of the need to manually divert the water to the Carousel pump station.

6. Indicators and alarms:
    a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.
7. Failure modes:
    a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.

B. Chlorination/dechlorination Chlorine Sample Pumps and Valve:
1. References:
    a. 60N01.
2. Abstract:
    a. A rotary pump draws a chlorinated sample from chlorine contact tank 1 and 2 and a submersible pump draws effluent from the dechlorination wet well for the sample.
    b. The position of a four-position valve allows the chlorine residual analyzer to monitor chlorine contact basin residual 15 minutes out of every hour and to monitor dechlorination structure residual 45 minutes out of every hour.
3. Hardwired control:
    a. None.
4. Hardwired interlocks/overload programmed interlocks:
    a. None.

5. PCS control:
    a. PCS HAND mode:
        1) Retain existing control of chlorinated or dechlorinated sample pumps, if available.
        2) Retain existing control of the four-position valve, if available.
    b. PCS AUTO mode:
        1) For 15 minutes out of every hour, command the four-position valve to allow flow from chlorine contact basin to the analyzer.
        2) For 45 minutes out of every hour, command the four-position valve to allow flow from the dechlorination structure to the analyzer.
6. Indicators and alarms:
    a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.
7. Failure modes:
    a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.

C. Clarifier/Filters:
1. References:
    a. 85N01.
    b. 85N02.
    c. 85N03.
    d. 85N04.
2. Abstract:
    a. Four existing clarifier/filters will be rehabilitated with new media, new valves with new electric motor actuators (replacing existing pneumatic actuators), new air scour piping and valving, and new support instrumentation.
    b. A new vendor control panel (VCP-3) shall be supplied to control the new valves.
3. Hardwired control:
    a. Hardwired control is achieved through VCP-3.
4. Hardwired interlocks/overload programmed interlocks:
    a. All hardwired interlocking is achieved through VCP-3.
5. PCS control:
    a. PCS HAND mode:
        1) None.
    b. PCS AUTO mode:
        1) The Operator may select the desired discharge flow from each filter in MGD.
        2) VCP-3 performs all control functions, including backwashing, for the clarifier/filters to discharge the Operator designated flow.
        3) At the PCS HMI screen, the Operator shall be able to modify all VCP setpoints.
6. Indicators and alarms:
    a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.
7. Failure modes:
    a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.

D. Air Wash Blowers:
    1. References:
        a. 85N05.
    2. Abstract:
        a. There are two existing blowers that will be replaced with new blowers and starters. A third blower will be added with a new starter. All blowers will be controlled by the new VCP-3.
    3. Hardwired control:
        a. At the LCP, a LOCAL-OFF-REMOTE selector switch with START-STOP pushbuttons operates as follows:
            1) With the LOR switch in the LOCAL position, the operator starts and stops the blower with the START or STOP pushbuttons.
            2) With the LOR switch in the OFF position, the pump will stop.
            3) With the LOR switch in the REMOTE position, the PCS shall control the pump.
    4. Hardwired interlocks/overload programmed interlocks:
        a. The blowers are stopped under the following conditions:
            1) High motor temperature.
            2) High inlet filter differential pressure.
            3) High discharge motor pressure.
        b. Permissive signal shall be sent to the turn on the Air wash blower fans in local mode as indicated in the contract drawings.
    5. PCS control:
        a. PCS HAND mode:
            1) None.
        b. PCS AUTO mode:
            1) VCP-3 performs all control functions, including backwashing, for the clarifier/filters to discharge the Operator designated flow.
            2) At the PCS HMI screen, the Operator shall be able to modify all VCP setpoints.
    6. Indicators and alarms:
        a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.
    7. Failure modes:
        a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.

E. Coagulant Feed Pumps:
    1. References:
        a. 85N06.
    2. Abstract:
        a. Two existing feed pumps and one new will provide coagulant to the clarifier/filters.
        b. Automatic control of pump starts/stops and speed will be from VCP-3 via PLC-4.
    3. Hardwired control:
        a. At the VCP, a HAND-OFF-AUTO selector switch and speed potentiometer operates as follows:
            1) With the HOA switch in the HAND position, the pump will start and the operator can adjust the speed using the potentiometer.

2) With the LOR switch in the OFF position, the pump will stop.
3) With the LOR switch in the AUTO position, the PCS shall control the pump.

4. Hardwired interlocks/overload programmed interlocks:
   a. The dilution water solenoid is hardwired to the pump VCP so that when the pump is running the dilution water solenoid valve is opened.
5. PCS control:
   a. PCS HAND mode:
      1) The pump is controlled manually by the Operator with the following commands:
         a) Start.
         b) Stop.
         c) Speed.
   b. PCS AUTO mode:
      1) The PCS shall receive all pump commands for speed from VCP-3. The PCS shall control the speed of each pump to meet the speed setpoint command from VCP-3. The PCS shall report all status points for running and E-STOP to VCP-3.
6. Indicators and alarms:
   a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.
7. Failure modes:
   a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.

F. Rapid Mix Pump:
1. References:
   a. 85N07.
2. Abstract:
   a. The rapid mix pump will ensure coagulant is being dispersed after injection. It will run when any coagulant pump is running and stop when all pumps are stopped.
3. Hardwired control:
   a. At the LCP, a LOCAL-OFF-REMOTE selector switch with START-STOP pushbuttons operates as follows:
      1) With the LOR switch in the LOCAL position, the operator starts and stops the pump with the START or STOP pushbuttons.
      2) With the LOR switch in the OFF position, the pump will stop.
      3) With the LOR switch in the REMOTE position, the PCS shall control the pump.
4. Hardwired interlocks/overload programmed interlocks:
   a. The pump is stopped and prohibited from running when high motor temperature is detected by the temperature switch.
5. PCS control:
   a. PCS HAND mode:
      1) The pump is controlled manually by the Operator with the following commands:
         a) Start.
         b) Stop.

b. PCS AUTO mode:
1) The PCS shall run the rapid mix pump whenever a coagulant pump is running and stop the rapid mix pump when all coagulant pumps are stopped.

6. Indicators and alarms:
a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.

7. Failure modes:
a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.

G. Backwash Pump Station Chlorine Sample Pumps:
1. References:
a. 87N01.

2. Abstract:
a. The backwash pump station chlorine sample pump will supply samples to a new chlorine analyzer.

3. Hardwired control:
a. At the LCP, a LOCAL-OFF-REMOTE selector switch with START-STOP pushbuttons operates as follows:
1) With the LOR switch in the LOCAL position, the operator starts and stops the pump with the START or STOP pushbuttons.
2) With the LOR switch in the OFF position, the pump will stop.
3) With the LOR switch in the REMOTE position, the PCS shall control the pump.

4. Hardwired interlocks/overload programmed interlocks:
a. None.

5. PCS control:
a. PCS HAND mode:
1) The pump is controlled manually by the Operator with the following commands:
a) Start.
b) Stop.

b. PCS AUTO mode:
1) None.

6. Indicators and alarms:
a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.

7. Failure modes:
a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.

H. Carousel Pump Station:
1. References:
a. 89N01.

2. Abstract:
a. Two existing pumps transfer water from the Middle Pond and South Pond to the North Pond.

b. One new pump will convey excess water at the Carousel Pump Station to the PAU.
c. Pumps will operate to meet a level setpoint in the Carousel Pump Station's wet well.

3. Hardwired control:
   a. At the LCP, a LOCAL-OFF-REMOTE selector switch with START-STOP pushbuttons and a speed potentiometer operates as follows:
      1) With the LOR switch in the LOCAL position, the operator starts and stops the pump with the START or STOP pushbuttons and can adjust speed using the potentiometer.
      2) With the LOR switch in the OFF position, the pump will stop.
      3) With the LOR switch in the REMOTE position, the PCS shall control the pump.
4. Hardwired interlocks/overload programmed interlocks:
   a. The pumps are stopped under the following conditions:
      1) Pump discharge low flow switch is activated after timer expires.
      2) Motor high temperature is detected.
   b. Alarm signals shall be sent to the Plant PLC for each hardwired interlock.
5. PCS control:
   a. PCS HAND mode:
      1) The pump is controlled manually by the Operator with the following commands:
         a) Start.
         b) Stop.
         c) Speed.
   b. PCS AUTO mode:
      1) Carousel pumps 1 and 2 will only be operated in PCS HAND mode and will not have PCS AUTO 1 or AUTO 2 control under this project. However, provide a 4-position HMI switch for each pump with: HAND, OFF, AUTO 1, and AUTO 2. Mark AUTO 1 and AUTO 2 as "FOR FUTURE USE".
      2) Carousel pump 3 shall start when an Operator adjustable level setpoint is reached in the carousel pump station wet well and stop when an Operator adjustable low level setpoint is reached.
      3) A low-low level switch shall serve as a backup to stop all pumps when detected.
      4) High-high level detected in the PAU pump station wet well shall shut down pump 3 in the carousel pump station.
      5) The PCS shall operate the carousel pump 3 to meet an Operator adjustable level setpoint in the carousel pump station wet well.
6. Indicators and alarms:
   a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.
7. Failure modes:
   a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.

I. Production Augmentation Unit (PAU) Pump:
1. References:
   a. 80N01.
   b. 91N01.

2. Abstract:
    a. One PAU pump conveys water from the PAU to the wet well in Structure 80 that then feeds the AWT pump station.
    b. The pump will start and stop according to level setpoints in the Structure 80 wet well.
3. Hardwired control:
    a. At the LCP, a LOCAL-OFF-REMOTE selector switch with START-STOP pushbuttons and a speed potentiometer operates as follows:
        1) With the LOR switch in the LOCAL position, the operator starts and stops the pump with the START or STOP pushbuttons and can adjust speed using the potentiometer.
        2) With the LOR switch in the OFF position, the pump will stop.
        3) With the LOR switch in the REMOTE position, the PCS shall control the pump.
4. Hardwired interlocks/overload programmed interlocks:
    a. The pumps are stopped under the following conditions:
        1) Pump discharge low flow switch is activated.
        2) Motor high temperature is detected.
        3) Wet well low level is detected.
5. PCS control:
    a. PCS HAND mode:
        1) The pump is controlled manually by the Operator with the following commands:
            a) Start.
            b) Stop.
            c) Speed.
    b. PCS AUTO mode:
        1) The PCS shall operate the pump to meet an Operator adjustable level setpoint in Structure 80.
        2) The pumps shall start when an Operator adjustable low level setpoint is reached in Structure 80 and stop when an Operator adjustable high level setpoint is reached in Structure 80.
6. Indicators and alarms:
    a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.
7. Failure modes:
    a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.

J. Distribution Tank Fill Valve:
1. References:
    a. 99N01.
2. Abstract:
    a. Influent water from the distribution system goes to the distribution tank through the tank fill valve.
    b. The tank fill valve is designed to hydraulically close when the tank level produces a determined amount of static head pressure.
    c. The valve does have solenoids to allow for manual opening and closing of the valve.
3. Hardwired control:
    a. None.

4. Hardwired interlocks:
    a. None.
5. PCS control:
    a. PCS HAND mode:
        1) The valve is controlled manually by the Operator with the following commands:
            a) Open.
            b) Close.
    b. PCS AUTO mode:
        1) None.
6. Indicators and alarms:
    a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.
7. Failure modes:
    a. As indicated on the Drawings and specified in Section 17100 - Control Strategies.

K. Distribution Tank Level:
1. References:
    a. 99N01.
2. Abstract:
    a. The level in the reservoir is calculated from the static head pressure.
    b. Range for tank level instruments are 0-27 feet.
3. Hardwired control:
    a. None.
4. Hardwired interlocks:
    a. None.
5. PCS control:
    a. None.
        1) LoLo alarm = 1 foot.
        2) Lo indication = 2 feet.
        3) Hi indication = 24 feet 9 inches.
        4) HiHi alarm = 25 feet.
6. Indicators and alarms:
    a. No additional indicators and alarms specific to the loop that are not covered in the common control strategies.
7. Failure modes:
    a. No additional failure modes specific to the loop that are not covered in the common control strategies.

L. Recycled Water Pumps:
1. References:
    a. 99N01.
    b. 99N02.
    c. 99N03.
2. Abstract:
    a. The booster pump station has 4 pumps that operate in a lead, lag1, lag2, standby configuration with a design capacity of 2,700 gpm at a set discharge pressure of 100 psi.
    b. The booster pump station draws water from the water storage tank and will discharge directly into the recycled water system.

c. The booster pump station can be manually controlled at the VFD panel located in the electrical room, or remotely controlled via the PCS.
d. The booster pump motors are all equipped with VFDs.

3. Hardwired control:
   a. At the LCP, a LOCAL-OFF-REMOTE selector switch with START-STOP pushbuttons and a speed potentiometer operates as follows:
      1) With the LOR switch in the LOCAL position, the operator starts and stops the pump with the START or STOP pushbuttons and can adjust speed using the potentiometer.
      2) With the LOR switch in the OFF position, the pump will stop.
      3) With the LOR switch in the REMOTE position, the PCS shall control the pump.
4. Hardwired interlocks:
   a. The booster pumps are stopped under the following conditions:
      1) High motor temperature.
      2) High discharge pressure.
      3) Low discharge flow.
5. PCS control:
   b. PCS HAND mode:
      1) The booster pump is controlled manually by the Operator with the following commands:
         a) Start.
         b) Stop.
         c) Speed.
   c. PCS AUTO mode:
      1) The booster pump will not start when the tank fill valve is closed, or the tank level is less than an Operator adjustable low-low level setpoint (default: 1 ft).
      2) The pumps shall operate in a LEAD, LAG1, LAG2, STANDBY configuration.
      3) The LEAD recycled water pump shall be called to run at an Operator adjustable low-low pressure setpoint.
      4) The LEAD and LAG pumps will change speeds and turn on and off in accordance with the strategy in Section 17100 to maintain an Operator adjustable discharge pressure setpoint.
      5) The STANDBY pump will only come online when a LEAD or LAG pump has failed.
6. Indicators and alarms:
   d. As indicated on the Drawings and specified herein.
7. Failure modes:
   e. As indicated on the Drawings and specified herein.

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL (NOT USED)

3.08 ADJUSTING (NOT USED)

3.09 CLEANING (NOT USED)

3.10 DEMONSTRATION AND TRAINING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17201

LEVEL MEASUREMENT: SWITCHES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Ball float level switch.

B. Provide all instruments identified in the Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Provide complete documentation covering the traceability of all calibration instruments.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:
   1. Process conditions: Fluids, pressures, temperatures, flows, materials etc.
   2. Physical conditions:
      a. Installation and mounting requirements.
      b. Location within the process.
      c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the Engineer if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

D. Manufacture instrument facilities certified to the quality standards of ISO Standard 9001 – Quality Systems – Model for Quality Assurance in Design/Development, Production, Installation and Servicing.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.07 PROJECT OR SITE CONDITIONS

A. Project environmental conditions as specified in Section 01850 - Design Criteria:
   1. Provide instruments suitable for the installed site conditions including, but not limited to, material compatibility, site altitude, site seismic conditions, humidity, and process and ambient temperatures.

1.08 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.09 MAINTENANCE

A. Furnish all parts, materials, fluids, etc. necessary for operation, maintenance, and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Ball float level switch:
      a. E+H, Liquifloat T FTS20.
      b. Evoqua Water Technologies, 9G-EF.
      c. ITT Flygt, Model ENM-10.
      d. Anchor Scientific Inc., Ecofloat/Solofloat.

2.02 MANUFACTURED UNITS

A. As specified in this Section including Attachment A - ISA Data Sheet - Level Measurement: Switches.

B. Ball float level switch:
   1. General:
      a. Encapsulated body with a switch to determine position of float.
   2. Outputs:
      a. Power supply.
      b. Relay outputs.

c. 1 Form C contact.
d. Rated at 6 amperes at 120 VAC.
e. Programmable for adjustable hysteresis.

3. Element:
   a. Mechanical switch encapsulated in waterproof floating ball of nominal diameter, supported by flexible PVC cable and jacket or heavy neoprene.
   b. The length of the PVC cable shall be, at a minimum, equal to sump depth plus 5 feet.
   c. Float: Provide Type 316 stainless steel or polypropylene, maximum 5.5 inches in diameter.
   d. An operating temperature rating: -4 degrees Fahrenheit to +185 degrees Fahrenheit.
   e. Mercury switches are not acceptable.
   f. Suspend ball float and adjust for level setpoint as required.
   g. Lead wires: Mounted in flexible waterproof PVC cable from switch to junction box terminals without splices.
   h. Provide the number of floats per level system as indicated on the Drawings.
4. Switch:
   a. Power supply:
      1) None.
   b. Outputs:
      1) Single pole double throw contacts rated 10 amps resistive at 120 VAC.
   c. Enclosure:
      1) Non-hazardous area:
         a) NEMA Type 4X.
      2) Class I Division 1 area:
         a) Explosion-proof/Class I Division 1 rated.
         b) NEMA 4X with intrinsic safe circuits.
      3) Class I Division 2 area:
         a) Explosion-proof/Class I Division 1 rated.
         b) Class I Division 2 rated.
         c) NEMA 4X with intrinsic safe circuits.
         d) Hermetically sealed contacts.
      4) For more information, see Attachment A - ISA Data Sheet - Level Measurement: Switches.
5. Components:
   a. Floats shall include Type 316 stainless steel clamp and brackets and 1/4-inch cable to allow testing of the float without entering the basin or wet well.
   b. Provide strain relief at both ends of the float cable.
   c. Float anchors:
      1) Furnish PVC coated anchor kit with Type 316 stainless steel chain with sufficient length as needed.
      2) Provide stainless steel shackles and float clamps.
      3) Manufacturers: The following or equal:
         a) Conery Mfg. Inc.

2.03 ACCESSORIES

A. Provide sunshades for outdoor installation.

2.04 SOURCE QUALITY CONTROL

A. FM approval certification or equal when installed in classified areas.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the installation location for the instrument and verify that the instrument will work properly when installed:
   1. Notify the Engineer promptly if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.04 FIELD QUALITY CONTROL (NOT USED)

3.05 ADJUSTING

A. As specified in Section 17950 - Commissioning for Instrumentation and Controls.

3.06 CLEANING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.07 DEMONSTRATION AND TRAINING (NOT USED)

3.08 PROTECTION (NOT USED)

3.09 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:
   1. Instruments may be as indicated on the Drawings, as specified in the Specifications or both.

END OF SECTION

ATTACHMENT A - ISA DATA SHEET - LEVEL MEASUREMENT: SWITCHES.

Level Switch

SPECIFICATION: 17201

PROJECT INFORMATION

PLANT
PROJECT 8660F10
CUSTOMER UKIAH
LOCATION

ELEMENT/SWITCH

GENERAL NOTE: FIELDS SHOWN WITH THE [*] SYMBOL ARE NOT SHOWN ON THE DATASHEET BUT MAY BE REQUIRED BY THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL SUBMIT COMPLETE ISA DATASHEETS FOR EACH INSTRUMENT PER ALL SPECIFIED REQUIREMENTS.

Tag:	P&ID						
LSHH-89100	89N001	**SERVICE:**	HIGH HIGH AND LOW LOW LEVEL SWITCHES				
LE-89100		**FLUID:**	WATER	**HAZARDOUS APP:**	N/A	**POWER:**	[*]
		MEASURING PRINCIPLE:	FLOAT	**ELEM. ENC. CLASS:**	NEMA 4X	**POWER LOCATION:**	LOOP
		SET POINT:	17.5 FT	**ELEM. MATERIAL:**	MFR. STD.	**OUTPUT:**	RELAY
		MOUNTING:	INTEGRAL	**SWITCH ENCL. CLASS:**	NEMA 4X	**RELAY FORM:**	SPDT
		TYPICAL DETAILS:	NL100	**ENCL. MATERIAL:**	BY VENDOR	**PLC:**	PLC-70299
		SURGE PROTECTION:	NO				

Tag:	P&ID						
LSLL-89100	89N001	**SERVICE:**	HIGH HIGH AND LOW LOW LEVEL SWITCHES				
LE-89100		**FLUID:**	WATER	**HAZARDOUS APP:**	N/A	**POWER:**	[*]
		MEASURING PRINCIPLE:	FLOAT	**ELEM. ENC. CLASS:**	NEMA 4X	**POWER LOCATION:**	LOOP
		SET POINT:	2 FT	**ELEM. MATERIAL:**	MFR. STD.	**OUTPUT:**	RELAY
		MOUNTING:	INTEGRAL	**SWITCH ENCL. CLASS:**	NEMA 4X	**RELAY FORM:**	SPDT
		TYPICAL DETAILS:	NL100	**ENCL. MATERIAL:**	BY VENDOR	**PLC:**	PLC-70299
		SURGE PROTECTION:	NO				

Tag:	P&ID						
LSHH-91101	91N001	**SERVICE:**	HIGH HIGH AND LOW LEVEL SWITCHES				
LE-91101		**FLUID:**	WATER	**HAZARDOUS APP:**	N/A	**POWER:**	[*]
		MEASURING PRINCIPLE:	FLOAT	**ELEM. ENC. CLASS:**	NEMA 4X	**POWER LOCATION:**	LOOP
		SET POINT:	7 FT	**ELEM. MATERIAL:**	MFR. STD.	**OUTPUT:**	RELAY
		MOUNTING:	INTEGRAL	**SWITCH ENCL. CLASS:**	NEMA 4X	**RELAY FORM:**	SPDT
		TYPICAL DETAILS:	NL100	**ENCL. MATERIAL:**	BY VENDOR	**PLC:**	[NOT FOUND ON P&ID]
		SURGE PROTECTION:	NO				

Tag:	P&ID						
LSL-91101	91N001	**SERVICE:**	HIGH HIGH AND LOW LEVEL SWITCHES				
LE-91101		**FLUID:**	WATER	**HAZARDOUS APP:**	N/A	**POWER:**	[*]
		MEASURING PRINCIPLE:	FLOAT	**ELEM. ENC. CLASS:**	NEMA 4X	**POWER LOCATION:**	LOOP
		SET POINT:	2 FT	**ELEM. MATERIAL:**	MFR. STD.	**OUTPUT:**	RELAY
		MOUNTING:	INTEGRAL	**SWITCH ENCL. CLASS:**	NEMA 4X	**RELAY FORM:**	SPDT
		TYPICAL DETAILS:	NL100	**ENCL. MATERIAL:**	BY VENDOR	**PLC:**	[NOT FOUND ON P&ID]
		SURGE PROTECTION:	NO				

Level Switch

SPECIFICATION: 17201

PROJECT INFORMATION

PLANT

PROJECT 8660F10

CUSTOMER UKIAH

LOCATION

ELEMENT/SWITCH

GENERAL NOTE: FIELDS SHOWN WITH THE [*] SYMBOL ARE NOT SHOWN ON THE DATASHEET BUT MAY BE REQUIRED BY THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL SUBMIT COMPLETE ISA DATASHEETS FOR EACH INSTRUMENT PER ALL SPECIFIED REQUIREMENTS.

Tag:	P&ID						
LSHH-99403	99N001	**SERVICE:**	LEVEL FLOAT SWITCHES				
LE-99403		**FLUID:**	WATER	**HAZARDOUS APP:**	N/A	**POWER:**	[*]
		MEASURING PRINCIPLE:	FLOAT	**ELEM. ENC. CLASS:**	NEMA 4X	**POWER LOCATION:**	LOOP
		SET POINT:	25 FT	**ELEM. MATERIAL:**	MFR. STD.	**OUTPUT:**	RELAY
		MOUNTING:	INTEGRAL	**SWITCH ENCL. CLASS:**	NEMA 4X	**RELAY FORM:**	SPDT
		TYPICAL DETAILS:	NL108	**ENCL. MATERIAL:**	MFR. STD.	**PLC:**	PLC-99400
		SURGE PROTECTION:	NO				

Tag:	P&ID						
LSLL-99403	99N001	**SERVICE:**	LEVEL FLOAT SWITCHES				
LE-99403		**FLUID:**	WATER	**HAZARDOUS APP:**	N/A	**POWER:**	[*]
		MEASURING PRINCIPLE:	FLOAT	**ELEM. ENC. CLASS:**	NEMA 4X	**POWER LOCATION:**	LOOP
		SET POINT:	1 FT	**ELEM. MATERIAL:**	MFR. STD.	**OUTPUT:**	RELAY
		MOUNTING:	INTEGRAL	**SWITCH ENCL. CLASS:**	NEMA 4X	**RELAY FORM:**	SPDT
		TYPICAL DETAILS:	NL108	**ENCL. MATERIAL:**	MFR. STD.	**PLC:**	PLC-99400
		SURGE PROTECTION:	NO				

SECTION 17206

LEVEL MEASUREMENT: ULTRASONIC

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Ultrasonic level instruments.

B. Provide all instruments identified in the Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Specific definitions:
   1. FDT: Field Device Tool.
   2. DTM: Device Type Manager.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Provide complete documentation covering the traceability of all calibration instruments.

C. For each instrument with Digital Bus communication protocol:
   1. Provide FDT certificate for the instrument's DTM.
   2. FDT certificate to be approved and listed by the FDT Group.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:
   1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.
   2. Physical conditions:
      a. Installation and mounting requirements.

b. Location within the process.
c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the Engineer if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

D. Manufacture instruments facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.07 PROJECT OR SITE CONDITIONS

A. Project environmental conditions as specified in Section 01850 - Design Criteria:
1. Provide instruments suitable for the installed site conditions including, but not limited to, material compatibility, site altitude, site seismic conditions, humidity, and process and ambient temperatures.

1.08 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.09 MAINTENANCE

A. Furnish all parts, materials, fluids, etc. necessary for operation, maintenance, and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
1. Ultrasonic level sensor with 2-wire integral transmitter:
a. Siemens, SITRANS Probe.
b. Endress+Hauser, Prosonic M FMU Series.
c. Pulsar, dBi HART Intelligent Transducers.

2.02 MANUFACTURED UNITS

A. As specified in this Section including Attachment A - ISA Data Sheet - Level Measurement: Ultrasonic.

B. Ultrasonic level measurement with 2-wire integral transmitter:
   1. General:
      a. Continuous non-contact level measurement device with integral transmitter using ultrasonic echo sensing.
      b. The transducer generates an ultrasonic pulse in the range of 10 to 70 kHz and measures the time required for the pulse to travel to the process surface and return. The level is measured based on constant velocity of sound in air with temperature compensation to adjust for velocity changes relative to temperature.
      c. Each 2- or 3-wire level transmitter system includes, but is not limited to:
         1) Ultrasonic transducer with integral transmitter.
   2. Performance requirements:
      a. Accuracy:
         1) 0.25 percent of range.
      b. Repeatability:
         1) 0.2 percent of range.
   3. Transducer (Integral):
      a. Encapsulated in chemical- and corrosion-resistant material as indicated in Attachment A - ISA Data Sheet - Level Measurement: Ultrasonic or Instrument Index.
      b. Operating temperature range: -5 to 122 degrees Fahrenheit (-20 to 50 degrees Celsius).
      c. Operating relative humidity range: 5 to 95 percent.
   4. Transmitter:
      a. Functions:
         1) Single-level measurement.
         2) Programmable for:
            a) Level.
            b) Tank volume.
      b. Power supply:
         1) 24 VDC, 2-wire loop powered.
         2) Power consumption: 6 VA maximum.
      c. Outputs:
         1) Isolated 4 to 20 milliamperes DC with HART communication protocol.
         2) DTM certified by FDT Group:
            a) Instrument shall be listed in the FDT Group’s certified DTM’s catalog.
      d. Indicator: Liquid crystal display with approximately 0.50-inch display scaled to read in engineering units.
      e. Sensitivity: Able to ignore momentary level spikes or momentary loss of echo and indicate loss of echo condition on indicating transmitter unit.

f. Enclosure:
    1) Non-hazardous area:
        a) NEMA Type 4X.
    2) Class I Division 1 area:
        a) Explosion-proof/Class I Division 1 rated.
        b) NEMA 4X with intrinsic safe circuits.
    3) Class I Division 2 area:
        a) Explosion-proof/Class I Division 1 rated.
        b) Class I Division 2 rated.
        c) NEMA 4X with intrinsic safe circuits.
    4) For more information, see Attachment A - ISA Data Sheet - Level Measurement: Ultrasonic.
g. Mounting: As indicated in the Contract Documents.

2.03 ACCESSORIES

A. Mounting brackets: As indicated on the Drawings.

B. Provide sunshades for outdoor installations.

2.04 SOURCE QUALITY CONTROL

A. Factory calibrate each instrument with a minimum 3-point calibration or according to manufacturer's standard at a facility that is traceable to NIST:
    1. Submit calibration data sheets to the Engineer at least 30 days before shipment of the instruments to the project site.

B. FM approval certification or equal when installed in classified areas.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the installation location for the instrument and verify that the instrument will work properly when installed:
    1. Notify the Engineer promptly if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of instruments.

3.04 FIELD QUALITY CONTROL (NOT USED)

3.05 ADJUSTING

A. As specified in Section 17950 - Commissioning for Instrumentation and Controls.

B. Turn on turbulent surface software feature for all installations measuring surfaces lacking a placid surface. This would include but not be limited to level measurements in mixed media filters and potentially wet wells.

3.06 CLEANING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.07 DEMONSTRATION AND TRAINING (NOT USED)

3.08 PROTECTION (NOT USED)

3.09 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:
   1. Instruments may be as indicated on the Drawings, specified in the Specifications, or both.

END OF SECTION

ATTACHMENT A - ISA DATA SHEET - LEVEL MEASUREMENT: ULTRASONIC

Level Transmitter

PROJECT INFORMATION

PLANT		**CUSTOMER**	UKIAH
PROJECT	8660F10	**LOCATION**	

GENERAL NOTE: FIELDS SHOWN WITH THE [*] SYMBOL ARE NOT SHOWN ON THE DATASHEET BUT MAY BE REQUIRED BY THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL SUBMIT COMPLETE ISA DATASHEETS FOR EACH INSTRUMENT PER ALL SPECIFIED REQUIREMENTS.

GENERAL

SPECIFICATION NUMBER	17206	**MEASURING PRINCIPLE**	ULTRASONIC
DRAWING NUMBER	80N001	**PLC**	PLC-70299
SERVICE	STRUCT 80 LEVEL	**TYPICAL DETAILS**	NL175

CONNECTION

PROCESS CONNECTION	FLANGE MOUNT

FLUID

LEVEL RANGE	0-18 FT	**TEMPERATURE**	N/A

ELEMENT

ELEMENT TAG NO.	LE-80100	**ENCLOSURE CLASS**	NEMA 4X
ELEMENT HAZ. MATERIALS	N/A	**ELEMENT MATERIAL**	BY VENDOR
SUBMERGENCE DETECTION	NO	**TEMPERATURE COMP.**	NO
HEATED ELEMENT	NO		

TRANSMITTER

TRANSMITTER TAG NO.	LIT-80100	**HAZARDOUS APPROVALS**	N/A
MOUNTING	INTEGRAL	**ENCLOSURE CLASS**	NEMA 4X
POWER	[*]	**OUTPUT**	4-20 MA
AMBIENT TEMPERATURE	10-100 DEG F	**MEASUREMENT APPL**	LEVEL
SURGE PROTECTION	YES		

NOTES

2-WIRED, 24 VDC LOOP POWERED TYPE OF TRANSMITTER IS REQUIRED.

SECTION 17208

LEVEL MEASUREMENT: RADAR PULSE TIME OF FLIGHT (PTOF)

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Non-contact radar (PTOF) level instruments.

B. Provide all instruments identified in the Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Specific definitions:
   1. PTOF: Pulse Time of Flight.
   2. FDT: Field Device Tool.
   3. DTM: Device Type Manager.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. For each instrument with digital bus communication protocol:
   1. Provide FDT certificate for the instrument’s DTM.
   2. FDT certificate to be approved and listed by the FDT Group.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Provide instruments manufactured at facilities certified to the quality standards of ISO 9001.

C. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:
   1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.
   2. Physical conditions:
      a. Installation and mounting requirements.

b. Location within the process.
c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

D. Notify the Engineer if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.08 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.09 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
1. Emerson, Rosemount 5408.
2. Endress+Hauser, Micropilot M.
3. Siemens/Milltronics, LR250.
4. Ohmart Vega, VegaPuls.
5. Ametek Drexelbrook, DR7000 Series.

2.02 MANUFACTURED UNITS

A. As specified in this Section including Attachment A - ISA Data Sheet - Level Measurement: Radar Pulse Time of Flight (PTOF).

B. Pulse Time of Flight:
1. General:
a. Instrument emits radar pulses via a transmitter, with a frequency range of 6.3 GHz to 26 GHz.
b. The pulses reflect from the surface being measured and are received back at the instrument via a sensor.
c. The instrument measures the pulse travel time between the transmitter, surface, and receiver to calculate the level.
d. Safety:
1) Shall not generate frequency waves with power levels hazardous to humans.

2. Performance requirements:
    a. Accuracy: Level:
        1) 0.25-inch.
3. Element:
    a. Level element must conform to the process material compatibility as indicated in Attachment A - ISA Data Sheet - Level Measurement: Radar Pulse Time of Flight (PTOF) or the Instrument Index.
    b. Connections:
        1) Process: The antenna design shall be suitable for mounting in a nozzle as indicated in Attachment A - ISA Data Sheet - Level Measurement: Radar Pulse Time of Flight (PTOF) or the Instrument Index.
        2) The design shall be such that product condensation on the antenna shall not affect the performance of the gauge. It shall be possible to choose between either parabolic-, cone-, rod-shaped antennas.
4. Transmitter:
    a. Microprocessor-based signal converter/transmitter.
    b. Power supply:
        1) 24 VDC - 2-wire loop powered.
        2) Power consumption: 15 VA maximum.
    c. Outputs:
        1) Isolated 4-20 mA DC with HART communication protocol.
        2) DTM certified by FDT group.
            a) Instrument shall be listed in the FDT group’s certified DTMs catalog.
    d. Backlit digital display for level or volume.
    e. Self-diagnostics and automatic data checking.
    f. Signal integrity:
        1) Immune to radio frequency and electromagnetic interference with field strength of 15 volts/meter or less over a frequency range of 50 Hz to 460 MHz.
        2) Able to ignore momentary level spikes or momentary loss of echo and indicate loss of echo condition on indicating transmitter unit.
    g. Protected terminals and fuses in a separate compartment, which isolates field connection from electronics.
        1) Indication: Local - 5-digit display.
    h. Enclosure:
        1) Non-hazardous area:
            a) NEMA Type 4X.
        2) For more information, see Attachment A - ISA Data Sheet - Level Measurement: Radar Pulse Time of Flight (PTOF).
    i. Electrical connection: 1/2-inch male NPT.

2.03 ACCESSORIES

A. Software: Provide Windows based PC software for configuration and echo mapping.

B. Provide sun shield for outdoor installations.

2.04 SOURCE QUALITY CONTROL

A. Factory calibrate each level transmitter at a facility that is traceable to NIST.

B. Provide complete documentation covering the traceability of all calibration instruments.

C. FM approval certification or equal when installed in classified areas.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of instruments.

3.04 FIELD QUALITY CONTROL (NOT USED)

3.05 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:
   1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.06 CLEANING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.07 DEMONSTRATION AND TRAINING (NOT USED)

3.08 PROTECTION (NOT USED)

3.09 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:
   1. Instruments may be indicated on the Drawings, specified in the Specifications or both.

END OF SECTION

ATTACHMENT A - ISA DATA SHEET - LEVEL MEASUREMENT: RADAR PULSE TIME OF FLIGHT (PTOF)

Level Transmitter

PROJECT INFORMATION

PLANT		**CUSTOMER**	UKIAH
PROJECT	8660F10	**LOCATION**	

GENERAL NOTE: FIELDS SHOWN WITH THE [*] SYMBOL ARE NOT SHOWN ON THE DATASHEET BUT MAY BE REQUIRED BY THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL SUBMIT COMPLETE ISA DATASHEETS FOR EACH INSTRUMENT PER ALL SPECIFIED REQUIREMENTS.

GENERAL

SPECIFICATION NUMBER	17208	**MEASURING PRINCIPLE**	RADAR PTOF
DRAWING NUMBER	89N001	**PLC**	PLC-70299
SERVICE	CAROUSEL LEVEL TRANSMITTER	**TYPICAL DETAILS**	NL153

CONNECTION

PROCESS CONNECTION	FLANGE MOUNT

FLUID

LEVEL RANGE	0 - 19.5 FT	**TEMPERATURE**	N/A

ELEMENT

ELEMENT TAG NO.	LE-89103	**ENCLOSURE CLASS**	NEMA 4X
ELEMENT HAZ. MATERIALS	N/A	**ELEMENT MATERIAL**	MFR. STD.
SUBMERGENCE DETECTION	NO	**TEMPERATURE COMP.**	NO
HEATED ELEMENT	NO		

TRANSMITTER

TRANSMITTER TAG NO.	LIT-89103	**HAZARDOUS APPROVALS**	N/A
MOUNTING	INTEGRAL	**ENCLOSURE CLASS**	NEMA 4X
POWER	[*]	**OUTPUT**	4-20 MA
AMBIENT TEMPERATURE	10-100 DEG F	**MEASUREMENT APPL**	LEVEL
SURGE PROTECTION	YES		

NOTES

[*]

SECTION 17301

FLOW MEASUREMENT: SWITCHES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Thermal dispersion flow switches.

B. Provide all instruments identified in the Contract Drawings.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Provide complete documentation covering the traceability of all calibration instruments.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:
   1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.
   2. Physical conditions:
      a. Installation and mounting requirements.
      b. Location within the process.
      c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the Engineer if any installation condition does not meet the instrument manufacturer’s recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria:
   1. Provide instruments suitable for the installed site conditions including, but not limited to, material compatibility, site altitude, site seismic conditions, humidity, and process and ambient temperatures.

1.08 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.09 MAINTENANCE

A. Furnish all parts, materials, fluids, etc. necessary for operation, maintenance, and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Thermal dispersion type:
      a. Fluid Components International LLC, FLT93.
      b. Kayden.

2.02 MANUFACTURED UNITS

A. As specified in this Section including Attachment A - ISA Data Sheet - Flow Measurement: Switches.

B. Thermal dispersion type:
   1. General:
      a. Instrument uses a heated probe and a reference probe:
         1) Deviation in the amount of heat measured by the reference probe deviates beyond the setpoint an adjustable relay closes.
         2) Switch:
            a) Micro-processor based with continuous self-diagnostics, “Smart Heater” to prevent sensor failure, no mechanical jumpers or trim pots, and a 3-year warranty.
   2. Performance requirements:
      a. Accuracy: Within 2 degrees Fahrenheit.
      b. Repeatability: Within 1 percent of setpoint range.
      c. Response time: 0.5 to 2.5 seconds.

d. Adjustable Bypass Delay Timer.
e. Adjustable range.

3. Switch characteristics:
   a. Exposed parts: Powder coated aluminum housing.
   b. Wetted parts:
      1) Materials as recommended by the manufacturer and approved by the Engineer.
   c. Power supply:
      1) 115 VAC.
      2) Power consumption: 13 VA maximum.
   d. Operating temperature range: -40 degrees Fahrenheit to 140 degrees Fahrenheit.
   e. Enclosure:
      1) Non-hazardous area:
         a) NEMA Type 4X.
      2) For more information, see Attachment A - ISA Data Sheet - Flow Measurement: Switches.

2.03 ACCESSORIES

A. Provide sunshades for outdoor installations.

2.04 SOURCE QUALITY CONTROL

A. Factory calibrate each instrument with a minimum 3-point calibration or according to Manufacturer's standard at a facility that is traceable to the NIST.
   1. Submit calibration data sheets to the Engineer at least 30 days before shipment of the instruments to the project site.

B. FM approval certification or equal when installed in classified areas.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the installation location for the instrument and verify that the instrument will work properly when installed.
   1. Notify the Engineer promptly if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems

3.04 FIELD QUALITY CONTROL (NOT USED)

3.05 ADJUSTING

A. As specified in Section 17950 - Commissioning for Instrumentation and Controls.

3.06 CLEANING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.07 DEMONSTRATION AND TRAINING (NOT USED)

3.08 PROTECTION (NOT USED)

3.09 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:
   1. Instruments may be indicated on the Drawings, specified in the Specifications or both.

END OF SECTION

ATTACHMENT A - ISA DATA SHEET - FLOW MEASUREMENT: SWITCHES

Flow Switch

SPECIFICATION: 17301

PROJECT INFORMATION

PLANT
PROJECT 8660F10
CUSTOMER UKIAH
LOCATION

ELEMENT/SWITCH

GENERAL NOTE: FIELDS SHOWN WITH THE [*] SYMBOL ARE NOT SHOWN ON THE DATASHEET BUT MAY BE REQUIRED BY THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL SUBMIT COMPLETE ISA DATASHEETS FOR EACH INSTRUMENT PER ALL SPECIFIED REQUIREMENTS.

Tag:	P&ID				
FSL-89100	89N001	**SERVICE:** LOW FLOW SWITCH			
FE-89100		**FLUID:** WATER	**HAZARDOUS APP:** N/A	**POWER:** 120VAC-1P	
		MEASURING PRINCIPLE: THERMAL	**ELEM. ENC. CLASS:** NEMA 4X	**POWER LOCATION:** VFD-89100	
		SET POINT: 400 GPM	**SWITCH ENCL. CLASS:** NEMA 4X	**OUTPUT:** RELAY	
		PROCESS CONNECTION: M-NPT	**PRESSURE:** N/A	**RELAY FORM:** SPDT	
		CONNECTION MATERIAL: MANUFACTURER RECO	**TEMPERATURE:** N/A	**PLC:** [NOT FOUND ON P&ID]	
		INSERTION LENGTH: MANUFACTURER RECO	**VISCOSITY:** N/A	**SURGE PROTECTION:** YES	
		TYPICAL DETAILS: NF111			

Tag:	P&ID				
FSL-89101	89N001	**SERVICE:** LOW FLOW SWITCH			
FE-89101		**FLUID:** WATER	**HAZARDOUS APP:** N/A	**POWER:** 120VAC-1P	
		MEASURING PRINCIPLE: THERMAL	**ELEM. ENC. CLASS:** NEMA 4X	**POWER LOCATION:** VFD-89101	
		SET POINT: 400 GPM	**SWITCH ENCL. CLASS:** NEMA 4X	**OUTPUT:** RELAY	
		PROCESS CONNECTION: M-NPT	**PRESSURE:** N/A	**RELAY FORM:** SPDT	
		CONNECTION MATERIAL: MANUFACTURER RECO	**TEMPERATURE:** N/A	**PLC:** [NOT FOUND ON P&ID]	
		INSERTION LENGTH: MANUFACTURER RECO	**VISCOSITY:** N/A	**SURGE PROTECTION:** YES	
		TYPICAL DETAILS: NF111			

Tag:	P&ID				
FSL-89102	89N001	**SERVICE:** LOW FLOW SWITCH			
FE-89102		**FLUID:** WATER	**HAZARDOUS APP:** N/A	**POWER:** 120VAC-1P	
		MEASURING PRINCIPLE: THERMAL	**ELEM. ENC. CLASS:** NEMA 4X	**POWER LOCATION:** VFD-89102	
		SET POINT: 2000 GPM	**SWITCH ENCL. CLASS:** NEMA 4X	**OUTPUT:** RELAY	
		PROCESS CONNECTION: M-NPT	**PRESSURE:** N/A	**RELAY FORM:** SPDT	
		CONNECTION MATERIAL: MANUFACTURER RECO	**TEMPERATURE:** N/A	**PLC:** [NOT FOUND ON P&ID]	
		INSERTION LENGTH: MANUFACTURER RECO	**VISCOSITY:** N/A	**SURGE PROTECTION:** YES	
		TYPICAL DETAILS: NF111			

Flow Switch

SPECIFICATION: 17301

PROJECT INFORMATION

PLANT
PROJECT 8660F10
CUSTOMER UKIAH
LOCATION

ELEMENT/SWITCH

GENERAL NOTE: FIELDS SHOWN WITH THE [*] SYMBOL ARE NOT SHOWN ON THE DATASHEET BUT MAY BE REQUIRED BY THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL SUBMIT COMPLETE ISA DATASHEETS FOR EACH INSTRUMENT PER ALL SPECIFIED REQUIREMENTS.

Tag:	P&ID						
FSL-91100	91N001	**SERVICE:**	LOW FLOW SWITCH				
FE-91100		**FLUID:**	WATER	**HAZARDOUS APP:**	N/A	**POWER:**	120VAC-1P
		MEASURING PRINCIPLE:	THERMAL	**ELEM. ENC. CLASS:**	NEMA 4X	**POWER LOCATION:**	VFD-91100
		SET POINT:	875 GPM	**SWITCH ENCL. CLASS:**	NEMA 4X	**OUTPUT:**	RELAY
		PROCESS CONNECTION:	M-NPT	**PRESSURE:**	N/A	**RELAY FORM:**	SPDT
		CONNECTION MATERIAL:	MANUFACTURER RECO	**TEMPERATURE:**	N/A	**PLC:**	[NOT FOUND ON P&ID]
		INSERTION LENGTH:	MANUFACTURER RECO	**VISCOSITY:**	N/A	**SURGE PROTECTION:**	YES
		TYPICAL DETAILS:	NF111				

Tag:	P&ID						
FSL-99411	99N001	**SERVICE:**	THERMAL LOW FLOW SWITCH				
FE-99411		**FLUID:**	WATER	**HAZARDOUS APP:**	N/A	**POWER:**	120VAC-1P
		MEASURING PRINCIPLE:	THERMAL	**ELEM. ENC. CLASS:**	NEMA 4X	**POWER LOCATION:**	VFD-99411
		SET POINT:	450 GPM	**SWITCH ENCL. CLASS:**	NEMA 4X	**OUTPUT:**	RELAY
		PROCESS CONNECTION:	IN-LINE	**PRESSURE:**	200 PSIG	**RELAY FORM:**	SPDT
		CONNECTION MATERIAL:	STAINLESS STEEL	**TEMPERATURE:**	10-100 DEG F	**PLC:**	[NOT FOUND ON P&ID]
		INSERTION LENGTH:	MANUFACTURER RECO	**VISCOSITY:**	N/A	**SURGE PROTECTION:**	YES
		TYPICAL DETAILS:	NF111				

Tag:	P&ID						
FSL-99412	99N002	**SERVICE:**	THERMAL FLOW SWITCH				
FE-99412		**FLUID:**	WATER	**HAZARDOUS APP:**	N/A	**POWER:**	120VAC-1P
		MEASURING PRINCIPLE:	THERMAL	**ELEM. ENC. CLASS:**	NEMA 4X	**POWER LOCATION:**	VFD-99412
		SET POINT:	450 GPM	**SWITCH ENCL. CLASS:**	NEMA 4X	**OUTPUT:**	RELAY
		PROCESS CONNECTION:	IN-LINE	**PRESSURE:**	200 PSIG	**RELAY FORM:**	SPDT
		CONNECTION MATERIAL:	STAINLESS STEEL	**TEMPERATURE:**	10-100 DEG F	**PLC:**	[NOT FOUND ON P&ID]
		INSERTION LENGTH:	MANUFACTURER RECO	**VISCOSITY:**	N/A	**SURGE PROTECTION:**	YES
		TYPICAL DETAILS:	NF111				

Flow Switch

SPECIFICATION: 17301

PROJECT INFORMATION

PLANT
PROJECT 8660F10
CUSTOMER UKIAH
LOCATION

ELEMENT/SWITCH

GENERAL NOTE: FIELDS SHOWN WITH THE [*] SYMBOL ARE NOT SHOWN ON THE DATASHEET BUT MAY BE REQUIRED BY THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL SUBMIT COMPLETE ISA DATASHEETS FOR EACH INSTRUMENT PER ALL SPECIFIED REQUIREMENTS.

Tag:	P&ID						
FSL-99414	99N002	**SERVICE:**	THERMAL FLOW SWITCH				
FE-99414		**FLUID:**	WATER	**HAZARDOUS APP:**	N/A	**POWER:**	120VAC-1P
		MEASURING PRINCIPLE:	THERMAL	**ELEM. ENC. CLASS:**	NEMA 4X	**POWER LOCATION:**	VFD-99414
		SET POINT:	450 GPM	**SWITCH ENCL. CLASS:**	NEMA 4X	**OUTPUT:**	RELAY
		PROCESS CONNECTION:	IN-LINE	**PRESSURE:**	200 PSIG	**RELAY FORM:**	SPDT
		CONNECTION MATERIAL:	STAINLESS STEEL	**TEMPERATURE:**	10-100 DEG F	**PLC:**	[NOT FOUND ON P&ID]
		INSERTION LENGTH:	MANUFACTURER RECO	**VISCOSITY:**	N/A	**SURGE PROTECTION:**	YES
		TYPICAL DETAILS:	NF111				

Tag:	P&ID						
FSL-99413	99N002	**SERVICE:**	THERMAL FLOW SWITCH				
FE1-99413		**FLUID:**	WATER	**HAZARDOUS APP:**	N/A	**POWER:**	120VAC-1P
		MEASURING PRINCIPLE:	THERMAL	**ELEM. ENC. CLASS:**	NEMA 4X	**POWER LOCATION:**	VFD-99413
		SET POINT:	450 GPM	**SWITCH ENCL. CLASS:**	NEMA 4X	**OUTPUT:**	RELAY
		PROCESS CONNECTION:	IN-LINE	**PRESSURE:**	200 PSIG	**RELAY FORM:**	SPDT
		CONNECTION MATERIAL:	STAINLESS STEEL	**TEMPERATURE:**	10-100 DEG F	**PLC:**	[NOT FOUND ON P&ID]
		INSERTION LENGTH:	MANUFACTURER RECO	**VISCOSITY:**	N/A	**SURGE PROTECTION:**	YES
		TYPICAL DETAILS:	NF111				

SECTION 17302

FLOW MEASUREMENT: MAGNETIC FLOWMETERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Full-body magnetic flowmeters.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Standards:
   1. International Organization for Standardization (ISO):
      a. 9000 - Quality management systems - Fundamentals and vocabulary.
      b. 17025 - General requirements for the competence of testing and calibration laboratories.
   2. National Institute of Standards and Technology (NIST).
   3. NSF International (NSF).

1.03 SUBMITTALS

A. Furnish Submittals as specified in Section 01330 - Submittal Procedures and Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Include sizing information from the manufacturer that includes:
   1. Chart of the measurement error from zero to maximum measured volumetric flow range indicated in datasheets.
   2. Indication of input parameters and their values used in the calculations.

C. Furnish commissioning Submittals listed below and specified in this Section as specified in Section 01756 - Commissioning:
   1. Manufacturer’s representative qualifications.
   2. Owner training.

1.04 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:
   1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.
   2. Physical conditions:
      a. Installation and mounting requirements.

b. Location within the process.
c. Accessories: Verify that required accessories are provided and are compatible with the process conditions and physical installation.

C. Manufacture instrument facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation and Servicing.

1.05 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems

1.06 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.07 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Notify the Engineer if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.08 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide instruments identified in the Contract Drawings.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Provide instruments suitable for the installed site conditions including, but not limited to, material compatibility, site altitude, site seismic conditions, humidity, and process and ambient temperatures.

2.03 MANUFACTURERS

A. One of the following or equal:
1. Endress+Hauser:
a. Promag W flowtube with 300/500 series transmitter.
b. Promag H flowtube with 300/500 series transmitter.
2. Emerson, Rosemount 8750W.
3. Krohne, IFC.
4. ABB, Watermaster.

2.04 MANUFACTURED UNITS

A. As specified in this Section including Attachment A - ISA Datasheet - Flow Measurement: Magnetic Flowmeters.

B. Magnetic flowmeter:
   1. General:
      a. Magnetic flowmeters obtain the flow velocity by measuring the changes of induced voltage of the conductive fluid passing across a controlled magnetic field.
      b. Complete zero stability shall be an inherent characteristic of the flowmeter system.
      c. Include for each magnetic flow metering system:
         1) A metering tube with electrodes (sensor).
         2) Fully welded flanges that are rated for the full pressure class of the piping.
         3) Signal cable if remote mounted.
         4) Transmitter integral or remote as indicated on the Drawings.
         5) Flowmeter grounding rings.
   2. Performance requirements:
      a. Accuracy:
         1) 0.25 percent of flow rate from 10 to 100 percent of full-scale for velocities ranging between 1.9 to 10 feet per second.
      b. Repeatability:
         1) 0.25 percent of rate.
   3. Element:
      a. Metering tube:
         1) Constructed of Type 304 or 316 stainless steel (unless specifically noted otherwise in the instrument datasheet) with flanged connections to match with piping material.
            a) Carbon steel cannot be used when coils are on the outside of the metering tube, it will not pass the magnetic field.
            b) Coils which are embedded in the liner are not permitted.
         2) Liner material in conformance with:
            a) Manufacturer’s recommendations for the intended service.
            b) NSF certified for drinking water applications.
         3) Electrodes type and material in conformance with:
            a) Manufacturer’s recommendations for the intended service.
            b) Utilize a minimum of 2**,** self-cleaning electrodes.
         4) As indicated in the datasheets.
         5) Meter terminal housing NEMA Type 4X, unless installed in locations such as vaults that will experience submergence. In those applications NEMA 6P is required.
         6) Meter coating consisting of epoxy painted finish.
         7) Components:
            a) 2 grounding rings:
               (1) Which are in conformance with the manufacturer’s bore and material recommendation for the meter’s intended service.

4. Transmitter:
    a. Power supply:
        1) As indicated in the datasheets.
    b. Outputs:
        1) As indicated in the instrument datasheet.
        2) For instruments with 4 to 20 mA HART or digital bus protocol, provide a Device Type Manager (DTM) certification by FDT group.
    c. Microprocessor-based signal converter/transmitter.
    d. Utilize DC pulse technique to drive flux-producing coils.
    e. Contain a 6-digit display for flow rate, percent of span, and totalizer.
    f. Operator keypad interface.
    g. Integral zero return to provide consistent zero output signals in response to an external dry contact closure.
    h. Integral low flow cut-off zero return.
    i. Programmable parameters including:
        1) Meter size.
        2) Full-scale flow rate.
        3) Magnetic field frequency.
        4) Time constant.
    j. Data retention for a minimum of 5 years without auxiliary main or battery power.
    k. Self-diagnostics and automatic data checking.
    l. Protected terminals and fuses in a separate compartment which isolates field connection from electronics.
    m. Ambient operating temperature limits of -5 to 140 degrees Fahrenheit (-20 to 60 degrees Celsius).
    n. Enclosure:
        1) As indicated in the instrument datasheet.
        2) Non-hazardous area:
            a) NEMA Type 4X.
        3) For more information, see Attachment A - ISA Datasheet - Flow Measurement: Magnetic Flowmeters.
    o. The transmitter should retain all setup parameters and accumulated measurements internally in non-volatile memory in the event of power failure.

2.05 ACCESSORIES

A. Provide stainless steel tags for each instrument. Tags shall be labeled as specified in the Contract Documents.

B. Provide sunshades for transmitters located outdoors.

C. Provide galvanic isolation gaskets, nylon/Teflon™ flange bolt insulation bushings and nylon washers on meters installed on pipes with cathodic protection.

2.06 FINISHES (NOT USED)

2.07 SOURCE QUALITY CONTROL

A. Factory calibrate each flow metering system at a facility that is traceable to the NIST.
   1. ISO-17025 accredited test facility with certified accuracy traceable to NIST.
   2. Suggestion, the calibration facility be traceable to international standards and ILAC, International Laboratory Accreditation Committee MRA, Mutual Recognition Agreement.
   3. This ensures worldwide accreditation of calibration laboratories.

B. Evidence of accreditation shall originate from a national verification agency such as A2LA ILAC.

C. FM approval certification or equal when installed in classified areas.

D. A real-time computer-generated printout of the actual calibration date indication actual velocities and as read values of the flow tube.
   1. Flow calibration report of the manufacturers flow lab calibration procedure shall be shipped with the meter system.
   2. Minimum calibration shall be a 3 point calibration including 1, 3, and 10 feet per second velocities for every meter and transmitter system. 2 points at 15 to 20 percent and 80 to 100 percent are statistically proven to be sufficient calibration points.
   3. Manufacturer shall archive calibration reports for future reference.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. For instruments located outdoors or where instrument elements and transmitters are separated by conduit located outside the building envelope, provide surge protection devices at the transmitters.

3.03 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

B. Owner Training:
   1. Perform Owner training as specified in Section 01756 - Commissioning.

3.04 FIELD QUALITY CONTROL

A. Field Verification:
   1. Verify factory calibration of instruments in accordance with the manufacturer’s instructions.

2. The transmitter and sensor to include a method to verify flow meter performance to the original manufacturer specifications.
3. Verification should be traceable to factory calibration using a third party, attested onboard system pursuant to ISO standards.
4. The verification report should be compliant to common quality systems such as ISO 9000 to prove reliability of the meter specified accuracy.
5. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.05 SCHEDULES

A. Instrument datasheets included in this Section.

B. The provided information does not necessarily include all required instruments.

C. Provide all instruments identified in the Contract Documents:
   1. Instruments may be indicated on the Drawings, specified in the Specifications, or both.

END OF SECTION

ATTACHMENT A - ISA DATASHEET - FLOW MEASUREMENT: MAGNETIC FLOWMETERS

Magnetic Flow Transmitter

PROJECT INFORMATION

PLANT		**CUSTOMER**	UKIAH
PROJECT	8660F10	**LOCATION**	

GENERAL NOTE: FIELDS SHOWN WITH THE [*] SYMBOL ARE NOT SHOWN ON THE DATASHEET BUT MAY BE REQUIRED BY THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL SUBMIT COMPLETE ISA DATASHEETS FOR EACH INSTRUMENT PER ALL SPECIFIED REQUIREMENTS.

GENERAL

SPECIFICATION NUMBER	17302	**MEASURING PRINCIPLE**	MAGNETIC
DRAWING NUMBER	99N001	**PLC**	PLC-99400
SERVICE	FLOW METER	**POWER LOCATION**	PCM-99400
		TYPICAL DETAIL(S)	NF130, NF136

CONNECTION

LINE SIZE	12	**PROCESS CONNECTION**	ANSI 150
LINE MATERIAL	PVC	**PROCESS CONN. MATERIAL**	NON-METALLIC

FLUID

FLUID	WATER	**PRESSURE**	125 PSI
NOMINAL FLOW	2000	**TEMPERATURE**	N/A
FLOW RANGE	500-4000 GPM	**VISCOSITY**	N/A
		CONDUCTIVITY	N/A

ELEMENT

ELEMENT TAG NO.	FE-99406	**PROCESS CONNECTION**	ANSI 150
ENCLOSURE CLASS	NEMA 4X	**LINER MATERIAL**	HARD RUBBER
HAZARDOUS APPROVALS	N/A	**VACUUM POSSIBILITY**	NO
TUBE SIZE	12"	**ELECTRODE TYPE**	MFR. STD.
TUBE MATERIAL	MFR. STD.	**ELECTRODE MATERIAL**	316 SST

TRANSMITTER

TRANSMITTER TAG NO.	FIT-99406	**HAZARDOUS APPROVALS**	N/A
MOUNTING	INTEGRAL	**EMPTY PIPE DETECTION**	YES
ENCLOSURE CLASS	NEMA 4X	**BI DIRECTIONAL FLOW**	NO
POWER	120VAC-1P	**PULSE OUTPUT**	NO
AMBIENT TEMPERATURE	10-100 DEG F	**RELAY OPTIONS**	YES
OUTPUT	4-20 MA	**POTTED ELECTRONICS**	NO
SURGE PROTECTION	YES	**CATHODIC PROT. LINE**	NO

NOTES

[*]

Magnetic Flow Transmitter

PROJECT INFORMATION

PLANT		**CUSTOMER**	UKIAH
PROJECT	8660F10	**LOCATION**	

GENERAL NOTE: FIELDS SHOWN WITH THE [*] SYMBOL ARE NOT SHOWN ON THE DATASHEET BUT MAY BE REQUIRED BY THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL SUBMIT COMPLETE ISA DATASHEETS FOR EACH INSTRUMENT PER ALL SPECIFIED REQUIREMENTS.

GENERAL

SPECIFICATION NUMBER	17302	**MEASURING PRINCIPLE**	MAGNETIC
DRAWING NUMBER	99N003	**PLC**	PLC-99400
SERVICE	FLOW METER	**POWER LOCATION**	PCM-99400
		TYPICAL DETAIL(S)	NF130, NF136

CONNECTION

LINE SIZE	16"	**PROCESS CONNECTION**	ANSI 150
LINE MATERIAL	PVC	**PROCESS CONN. MATERIAL**	NON-METALLIC

FLUID

FLUID	WATER	**PRESSURE**	125 PSI
NOMINAL FLOW	2700	**TEMPERATURE**	N/A
FLOW RANGE	400-4000 GPM	**VISCOSITY**	N/A
		CONDUCTIVITY	N/A

ELEMENT

ELEMENT TAG NO.	FE2-99431	**PROCESS CONNECTION**	ANSI 150
ENCLOSURE CLASS	NEMA 4X	**LINER MATERIAL**	HARD RUBBER
HAZARDOUS APPROVALS	N/A	**VACUUM POSSIBILITY**	NO
TUBE SIZE	16"	**ELECTRODE TYPE**	MFR. STD.
TUBE MATERIAL	MFR. STD.	**ELECTRODE MATERIAL**	316 SST

TRANSMITTER

TRANSMITTER TAG NO.	FIT-99431	**HAZARDOUS APPROVALS**	N/A
MOUNTING	INTEGRAL	**EMPTY PIPE DETECTION**	YES
ENCLOSURE CLASS	NEMA 4X	**BI DIRECTIONAL FLOW**	NO
POWER	120VAC-1P	**PULSE OUTPUT**	NO
AMBIENT TEMPERATURE	10-100 DEG F	**RELAY OPTIONS**	YES
OUTPUT	4-20 MA	**POTTED ELECTRONICS**	NO
SURGE PROTECTION	YES	**CATHODIC PROT. LINE**	NO

NOTES

[*]

SECTION 17316

FLOW MEASUREMENT: ROTAMETERS (VARIABLE AREA FLOWMETERS)

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Rotameters (variable area flowmeters).

B. Provide all instruments identified in the Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.04 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:
   1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.
   2. Physical conditions:
      a. Installation and mounting requirements.
      b. Location within the process.
      c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

1. Notify the Engineer if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.08 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.09 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. ABB.
   2. Brooks.
   3. King Instrument Co.

2.02 MANUFACTURED UNITS

A. As specified in this Section including Attachment A - ISA Data Sheet - Flow Measurement: Rotameters (Variable Area Flowmeters).

B. Rotameters:
   1. General:
      a. Variable area type flowmeters with local flow indication.
      b. Glass tube type.
   2. Performance requirements:
      a. Flow range:
         1) As specified in instrument data sheets or instrument index.
      b. Accuracy:
         1) Glass tube: Within 2.0 percent of range.
         2) Metal tube: Within 5.0 percent of range.
         3) Repeatability: 0.50 percent of range.
   3. Element:
      a. Flow tube:
         1) Glass tube: Borosilicate glass, or as required to be compatible with the process conditions.
      b. Turndown: 10 to 1.
      c. Process temperature:
         1) Glass tube: 32 to 200 degrees Fahrenheit.
         2) Metal tube: -20 to 320 degrees Fahrenheit.
      d. Maximum process pressure:
         1) Glass tube: 100 pounds per square inch gauge.
         2) Metal tube: 450 pounds per square inch gauge.
         3) Size tube for the largest of the following:
            a) 2.0 times the normal flow rate.
            b) 1.2 times the maximum flow rate.
            c) 4.0 times the minimum flow rate.

e. Float:
1) Design to provide the widest possible immunity band change for lowest pressure loss.
2) Metal tube rotameters: Float with encapsulated magnet.

4. Components:
a. Seals: O-rings or packing glands fully compatible with process fluid.
b. Integral needle valve for flow control.

5. Scale:
a. Metal tube: Dial indicator with rotatable magnet coupled to magnet encapsulated in rotameter float.

6. Other:
a. Process connection:
1) As indicated on the Mechanical Drawings.
b. Mounting:
1) As indicated on the Drawings.
2) Provide all necessary hardware for rotameter mounting.

2.03 ACCESSORIES (NOT USED)

2.04 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of instruments.

3.04 FIELD QUALITY CONTROL (NOT USED)

3.05 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:
1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.06 CLEANING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.07 DEMONSTRATION AND TRAINING (NOT USED)

3.08 PROTECTION (NOT USED)

3.09 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:
   1. Instruments may be indicated on the Drawings, specified in the Specifications, or both.

END OF SECTION

ATTACHMENT A - ISA DATA SHEET - FLOW MEASUREMENT: ROTAMETERS (VARIABLE AREA FLOWMETERS)

Rotameter

SPECIFICATION: 17316

PROJECT INFORMATION

PLANT

PROJECT 8660F10

CUSTOMER UKIAH

LOCATION

ELEMENT/SWITCH

GENERAL NOTE: FIELDS SHOWN WITH THE [*] SYMBOL ARE NOT SHOWN ON THE DATASHEET BUT MAY BE REQUIRED BY THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL SUBMIT COMPLETE ISA DATASHEETS FOR EACH INSTRUMENT PER ALL SPECIFIED REQUIREMENTS.

Tag:	P&ID						
FI-60101	60N001	**SERVICE:**	CHLORINE SAMPLE FLOW INDICATOR				
		FLUID:	WATER	**TYPICAL DETAILS:**	[*]	**FLOW RANGE:**	0-500 ML/MIN
		MEASURING PRINCIPLE:	VARIABLE AREA FLOW	**PRESSURE:**	125 PSI	**VISCOSITY:**	N/A
		LINE SIZE:	MATCH EXISTING	**TEMPERATURE:**	N/A	**SEAL MATERIAL:**	VITON
		LINE MATERIAL:	MATCH EXISTING	**PROCESS CONN.:**	F-NPT	**TUBE MATERIAL:**	BOROSILICATE GLASS
		PROCESS CONN. MAT'L:	STAINLESS STEEL				

Tag:	P&ID						
FI-87130	87N001	**SERVICE:**	CHLORINE SAMPLE FLOW INDICATOR				
		FLUID:	WATER	**TYPICAL DETAILS:**	[*]	**FLOW RANGE:**	0-500 ML/MIN
		MEASURING PRINCIPLE:	VARIABLE AREA FLOW	**PRESSURE:**	125 PSI	**VISCOSITY:**	N/A
		LINE SIZE:	MATCH EXISTING	**TEMPERATURE:**	N/A	**SEAL MATERIAL:**	VITON
		LINE MATERIAL:	MATCH EXISTING	**PROCESS CONN.:**	F-NPT	**TUBE MATERIAL:**	BOROSILICATE GLASS
		PROCESS CONN. MAT'L:	STAINLESS STEEL				

SECTION 17317

FLOW MEASUREMENT: OPEN CHANNEL

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Open channel flow measurement instruments.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Standards:
   1. Underwriters Laboratories, Inc. (UL):
      a. 913 - Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, III, Division 1, Hazardous (Classified) Locations.

1.03 SUBMITTALS

A. Furnish Submittals as specified in Section 01330 - Submittal Procedures and Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Provide complete documentation covering the traceability of calibration instruments.

C. Furnish commissioning Submittals listed below and specified in this Section as specified in Section 01756 - Commissioning:
   1. Manufacturer's representative qualifications.
   2. Owner training.

1.04 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:
   1. Process conditions: Fluids, pressures, temperatures, flows, materials etc.
   2. Physical conditions:
      a. Installation and mounting requirements.
      b. Location within the process.
      c. Accessories: Verify that required accessories are provided and are compatible with the process conditions and physical installation.

1.05 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.06 PROJECT OR SITE CONDITIONS

A. Project environmental conditions as specified in Section 01850 - Design Criteria.

1.07 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Notify the Engineer if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.08 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.09 MAINTENANCE

A. Furnish parts, materials, fluids, etc., necessary for operation, maintenance, and calibration purposes throughout the warranty period. Deliver these supplies before project substantial completion.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide instruments identified in the Contract Documents.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Provide instruments suitable for the installed site conditions including, but not limited to, material compatibility, site altitude, site seismic conditions, humidity, and process and ambient temperatures.

2.03 MANUFACTURERS

A. One of the following or equal:
   1. HACH, FL1500 Transmitter with US9001 sensor.
   2. Siemens, SITRANS LUT400 with EchoMax XRS-5.

2.04 MANUFACTURED UNITS

A. Open channel flow measure instrument:
   1. General:
      a. The flow measurement device shall calculate a flow rate that meets or exceeds the performance guidelines as specified in this Section.

2. Performance requirements:
    a. Accuracy:
        1) The complete system flow accuracy shall not exceed within 5 percent of rate with within 0.5 percent of rate repeatability.
3. Element:
    a. Weir:
        1) Rectangular.
    b. Ultrasonic level transducer:
        1) Operating temperature range: 0 to 140 degrees Fahrenheit (-18 to 60 degrees Celsius).
        2) Operating relative humidity range: 0 to 95 percent, non-condensing.
        3) Functions:
            a) Temperature compensation.
        4) Mounting: As indicated in the Contract Documents.
        5) Sensors shall be rated for NEMA 6P submergence.
            a) Sensors shall have mechanical decoupling between sensor membrane and outer housing.
            b) Sensors shall be provided with automatic build up compensation to provide self-cleaning when condensation may occur.
            c) Sensors shall be provided with internal heating elements and separate power supplies for these elements when freezing condensation may occur.
4. Transmitter:
    a. Field-selectable units of measure:
        1) Level: Inches, feet, centimeters, and meters.
        2) Velocity: Feet/second, centimeters/second, and meters/second.
        3) Flow rate: Gallons per minute, million gallons per day, cubic feet per second, cubic centimeter per second, and cubic meter per second.
    b. Flow indicating transmitter:
        1) Indicator: Liquid crystal display with approximately 0.50-inch display scaled to read in engineering units.
        2) Sensitivity: Able to ignore momentary level spikes or momentary loss of echo and indicate loss of echo condition on indicating transmitter unit.
        3) Ability to allow for signal profiles and echo mapping:
            a) Provide manufacturer’s software for re-mapping the signal.
    c. Memory storage:
        1) Store programmed parameters in non-volatile memory to prevent loss in case of power interruption.
    d. Power supply:
        1) As indicated in the datasheets.
        2) 120 VAC.
    e. Outputs:
        1) As indicated in the datasheets.
        2) Relay outputs:
            a) 1 Form C contact.
            b) Rated 5 amps at 120 VAC.
            c) Programmable.

2.05 ACCESSORIES

A. Provide sunshades for outdoor installations.

2.06 FINISHES (NOT USED)

2.07 SOURCE QUALITY CONTROL

A. Factory calibrate each instrument with a minimum 3-point calibration or according to Manufacturer's standard at a facility that is traceable to the NIST.
   1. Submit calibration datasheets to the Engineer at least 30 days before shipment of the instruments to the project site.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the installation location for the instrument and verify that the instrument will work properly when installed.

3.02 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Coordinate the installation with trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc., for proper installation of instruments.

3.03 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

B. Owner Training:
   1. Perform Owner training as specified in Section 01756 - Commissioning.
   2. Number of sessions:
      a. Operations: 1.
      b. Maintenance: 1.

3.04 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:
   1. Instruments may be indicated on the Drawings, specified in the Specifications, or both.

END OF SECTION

ATTACHMENT A - ISA DATASHEET - FLOW MEASUREMENT: OPEN CHANNEL

Level Transmitter

PROJECT INFORMATION

PLANT		**CUSTOMER**	UKIAH
PROJECT	8660F10	**LOCATION**	

GENERAL NOTE: FIELDS SHOWN WITH THE [*] SYMBOL ARE NOT SHOWN ON THE DATASHEET BUT MAY BE REQUIRED BY THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL SUBMIT COMPLETE ISA DATASHEETS FOR EACH INSTRUMENT PER ALL SPECIFIED REQUIREMENTS.

GENERAL

SPECIFICATION NUMBER	17206	**MEASURING PRINCIPLE**	ULTRASONIC
DRAWING NUMBER	88N001	**PLC**	PLC-4
SERVICE	CHLORINE CONTACT BASIN OPEN CHANNEL FLOW METER 1	**TYPICAL DETAILS**	NA901

CONNECTION

PROCESS CONNECTION	N/A

FLUID

FLOW RANGE	600-1500 GPM	**TEMPERATURE**	0-140 DEG F

ELEMENT

ELEMENT TAG NO.	LE-88101	**ENCLOSURE CLASS**	NEMA 6P
ELEMENT HAZ. MATERIALS	N/A	**ELEMENT MATERIAL**	MFR. STD.
SUBMERGENCE DETECTION	NO	**TEMPERATURE COMP.**	YES
HEATED ELEMENT	YES		

TRANSMITTER

TRANSMITTER TAG NO.	FIT-88101	**HAZARDOUS APPROVALS**	N/A
MOUNTING	REMOTE	**ENCLOSURE CLASS**	NEMA 4X
POWER	120VAC-1P	**OUTPUT**	4-20 MA
AMBIENT TEMPERATURE	10-100 DEG F	**MEASUREMENT APPL**	FLOW
SURGE PROTECTION	YES		

NOTES

CALCULATED HEIGHT OVER WEIR IS 0.220’ TO 0.40’ CORRESPONDING TO THE FLOW RANGE.

Level Transmitter

PROJECT INFORMATION

PLANT		**CUSTOMER**	UKIAH
PROJECT	8660F10	**LOCATION**	

GENERAL NOTE: FIELDS SHOWN WITH THE [*] SYMBOL ARE NOT SHOWN ON THE DATASHEET BUT MAY BE REQUIRED BY THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL SUBMIT COMPLETE ISA DATASHEETS FOR EACH INSTRUMENT PER ALL SPECIFIED REQUIREMENTS.

GENERAL

SPECIFICATION NUMBER	17206	**MEASURING PRINCIPLE**	ULTRASONIC
DRAWING NUMBER	88N001	**PLC**	PLC-4
SERVICE	CHLORINE CONTACT BASIN OPEN CHANNEL FLOW METER 2	**TYPICAL DETAILS**	NA901

CONNECTION

PROCESS CONNECTION	N/A

FLUID

FLOW RANGE	600-1500 GPM	**TEMPERATURE**	0-140 DEG F

ELEMENT

ELEMENT TAG NO.	LE-88102	**ENCLOSURE CLASS**	NEMA 6P
ELEMENT HAZ. MATERIALS	N/A	**ELEMENT MATERIAL**	MFR. STD.
SUBMERGENCE DETECTION	NO	**TEMPERATURE COMP.**	YES
HEATED ELEMENT	YES		

TRANSMITTER

TRANSMITTER TAG NO.	FIT-88102	**HAZARDOUS APPROVALS**	N/A
MOUNTING	REMOTE	**ENCLOSURE CLASS**	NEMA 4X
POWER	120VAC-1P	**OUTPUT**	4-20 MA
AMBIENT TEMPERATURE	10-100 DEG F	**MEASUREMENT APPL**	FLOW
SURGE PROTECTION	YES		

NOTES

CALCULATED HEIGHT OVER WEIR IS 0.220’ TO 0.40’ CORRESPONDING TO THE FLOW RANGE.

SECTION 17402

PRESSURE/VACUUM MEASUREMENT: INSTRUMENT VALVES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Valve manifolds and instrument valves.

B. Provide all valves identified in the Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Additional requirements:
   1. Product data:
      a. Valve type.
      b. Body material.
      c. Size.
      d. Options.
   2. Shop drawings:
      a. Mounting details for all manifold valves.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Examine the complete set of Contract Documents and verify that the valves are compatible with the installed conditions including:
   1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.
   2. Physical conditions:
      a. Installation and mounting requirements.
      b. Location within the process.
      c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the Engineer if any installation condition does not meet the valve manufacturer's recommendations or specifications.

D. Provide valves manufactured at facilities certified to the quality standards of ISO 9001.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Protect valve manifolds and protective coatings from damage during handling and installation. Repair coating where damaged.

1.07 PROJECT OR SITE CONDITIONS

A. Project environmental conditions as specified in Section 01850 - Design Criteria.
   1. Provide valves suitable for the installed site conditions including, but not limited to, material compatibility, process, and ambient temperatures.

1.08 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.09 MAINTENANCE

A. Furnish all parts, materials, fluids, etc. necessary for operation, maintenance, and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Valve manifold:
   1. One of the following or equal:
      a. Anderson Greenwood.
      b. Hex Valve.
      c. Noshok.
      d. Emerson, Rosemount.

B. Block and bleed valve:
   1. One of the following or equal:
      a. Anderson Greenwood.
      b. Hex Valve.

C. Gauge valve:
   1. One of the following or equal:
      a. Anderson Greenwood.
      b. Hex Valve.

D. Level sensor isolation valve:
    1. One of the following or equal:
        a. Indu-Tech, Level Sensor Isolation Valve.
        b. DeZURIK, Level Sensor Isolation Valve.
        c. Tyco, Rovalve Isolation Knife Gate Valve.

2.02 MANUFACTURED UNITS

A. Valve manifolds:
    1. General:
        a. Provide 2-valve, 3-valve, blowdown type 5-valve, or metering type 5-valve manifolds as indicated on the Drawings.
        b. Valve manifolds shall have one piece bonnet with a metal-to-metal seal to the valve body below the bonnet threads.
    2. Requirements:
        a. Bonnet lock pin to prevent accidental loosening.
        b. Gas leak tested metal-to-metal hard seat design for hard seat valves.
        c. Gas leak tested soft seat design with replaceable seat for soft seat valves.
        d. Manifold valves shall have straight through portion for bi-directional flow and easy roddable cleaning.
        e. Manifold valves shall allow for direct or remote instrument mounting.
        f. Shall be able to withstand pressures up to 6,000 psi for soft seat valves and 10,000 psi for hard seat valves at maximum 200 degrees Fahrenheit.
        g. Materials of construction:
            1) Body material: Type 316 stainless steel.
            2) O-Ring: Teflon™.
        h. 2-Valve manifolds:
            1) 1 isolation valve and 1 drain/vent and calibration valve.
        i. 3-Valve manifolds:
            1) 2 isolation valves and 1 equalizing valve for differential pressure applications.
            2) Plugged vent connections used for vent/drain or calibration.
        j. Blowdown 5-valve manifold:
            1) 2 isolation valves, 1 equalizing valve, 2 blowdown valves for differential pressure applications.
        k. Metering 5-valve manifold:
            1) 2 isolation valves, 2 equalizing valves, 1 vent/drain and calibration valve for differential pressure applications.

B. Block and bleed valves:
    1. General:
        a. Valve shall provide process isolation and venting/draining capabilities.
        b. Gas leak tested metal-to-metal hard seat design for hard seat valves.
        c. Gas leak tested soft seat design with replaceable seat for soft seat valves.
        d. Valve shall not be used with fluids with high solids content, such as raw wastewater or sludge.
    2. Requirements:
        a. Materials of construction:
            1) Body material: Type 316 stainless steel.
            2) O-Ring: Teflon™.

C. Gauge valves:
   1. General:
      a. Valve shall provide process isolation from pressure instrument.
      b. Gas leak tested, metal-to-metal hard seat design for hard seat valves.
      c. Gas leak tested soft seat design with replaceable seat for soft seat valves.
   2. Requirements:
      a. Materials of construction:
         1) Body material: Type 316 stainless steel.
         2) O-Ring: Teflon™.

D. Level sensor isolation valves:
   1. General:
      a. Valve shall provide process isolation from level diaphragm.
      b. Gas leak tested, metal-to-metal hard seat design for hard seat valves.
      c. Gas leak tested soft seat design with replaceable seat for soft seat valves.
   2. Requirements:
      a. Materials of construction:
         1) Body material: Type 316 stainless steel.
         2) Flange diameter size: 3 inches.

2.03 ACCESSORIES

A. Provide tube fitting, female NPT, or pipe butt weld connections if necessary.

B. Provide stainless steel concentric or eccentric pipe nipples when necessary.

2.04 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the installation location and verify it will work properly when installed.
   1. Notify the Engineer promptly if any installation condition does not meet the manufacturer's recommendations or specifications.

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of all valves.

3.04 FIELD QUALITY CONTROL (NOT USED)

3.05 ADJUSTING

A. As specified in Section 17950 - Commissioning for Instrumentation and Controls.

3.06 CLEANING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.07 DEMONSTRATION AND TRAINING (NOT USED)

3.08 PROTECTION (NOT USED)

3.09 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17404

PRESSURE/VACUUM MEASUREMENT: GAUGES

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Pressure/vacuum gauges.

B. Provide all instruments specified in the Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. American Society of Mechanical Engineers (ASME):
   1. B40.100 - Pressure Gauges and Gauge Attachments.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Additional requirements:
   1. Product data:
      a. Accessories such as diaphragm seals, valve manifold, snubbers, and pulsation dampeners.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:
   1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.

2. Physical conditions:
    a. Installation and mounting requirements.
    b. Location within the process.
    c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the Engineer if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.08 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.09 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
    1. Ashcroft:
        a. Maximum pressure less than 10 pounds per square inch: Model 1188.
            1) If a stainless steel dial casing is required:
                a) Model 1009.
        b. Maximum pressure greater than or equal to 10 pounds per square inch: Model 1279.
            1) If a stainless steel dial casing is required:
                a) Model 1009.
        c. Removable Gauges:
            1) Model 1082.
    2. Wika.
        a. Model XSEL type 232.34.
    3. Ametek U.S. Gauge.

2.02 MANUFACTURED UNITS

A. As specified in this Section including Attachment A - ISA Data Sheet - Pressure/Vacuum Measurement: Gauges.

B. General:
   1. Pressure gauge assembly shall include pressure sensing element, gauge case, and dial mechanism.

C. Performance requirements:
   1. Pressure range:
      a. As specified in the Contract Documents.
   2. Accuracy:
      a. Grade 2A, as defined by ASME B40.100.
      b. Within 1.0 percent of span after friction errors are eliminated by tapping or vibration.
      c. Maximum allowable friction inaccuracy: Within 1.0 percent of span.
   3. Element:
      a. Where the maximum pressure is less than 10 pounds per square inch, provide socket and bellows; for all other pressure ranges, employ a Bourdon® tube.
      b. Socket tips for bellows and Bourdon® tube:
         1) Materials: Type 316 stainless steel.
      c. Overpressure: Minimum 130 percent of maximum range pressure without damage to gauge or sensing element.
      d. Wetted materials: Type 316 stainless steel.
   4. Dial gauge:
      a. Dial size: 4-1/2 inches.
      b. Dial case material:
         1) Maximum pressure less than 10 pounds per square inch:
            a) Phenolic.
         2) Maximum pressure greater than or equal to 10 pounds per square inch:
            a) Phenolic.
      c. Provide safety gauge with safety blow out through the back or top of the unit.
      d. Dial face: Gasketed shatterproof glass or polycarbonate.
      e. Provide gauge locks on all pressure gauges directly connected to diaphragm seals.
      f. Provide gauge locks where possible.
      g. Hermetically sealed.
      h. Connection and mounting:
         1) Direct mounted and suitable for outdoor installation.
         2) 1/2-inch NPT.
         3) Connection material: Stainless steel.
      i. Pointer: Externally adjustable.

2.03 ACCESSORIES

A. Pulsation dampeners and snubbers:
   1. Provide pulsation dampener or snubber with each pressure gauge installed on discharge of positive displacement type pump.
   2. Provide piston-type snubber if pressure spikes will exceed 130 percent of gauge maximum range.
   3. Materials: Type 316 stainless steel.

4. Mount pulsation dampener or snubber integrally to the pressure gauge.
5. Connection: 1/2-inch NPT.

B. Provide means for gauge isolation as specified in Section 17402 - Pressure/Vacuum Measurement: Instrument Valves:
   1. Mount valve manifold integrally to the gauge.
   2. Valve manifold and pressure gauge shall be assembled by manufacturer and shipped as an assembly.

C. Provide stainless steel tags for each instrument. Tags shall be labeled as specified in the Contract Documents.

2.04 SOURCE QUALITY CONTROL

A. Factory calibrate each pressure gauge at a facility that is traceable to the NIST.

B. Provide complete documentation covering the traceability of all calibration instruments.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc. for proper installation of instruments.

3.04 FIELD QUALITY CONTROL (NOT USED)

3.05 ADJUSTING

A. Verify factory calibration of all instruments in accordance with the manufacturer's instructions:
   1. Return factory calibrated devices to the factory if they do not meet the field verification requirements for calibration.

3.06 CLEANING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.07 DEMONSTRATION AND TRAINING (NOT USED)

3.08 PROTECTION (NOT USED)

3.09 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:
   1. Instruments may be indicated on the Drawings, specified in the Specifications or both.

END OF SECTION

ATTACHMENT A - ISA DATA SHEET - PRESSURE/VACUUM MEASUREMENT: GAUGES

Pressure Gauge

SPECIFICATION: 17404

PROJECT INFORMATION

PLANT

PROJECT 8660F10

CUSTOMER UKIAH

LOCATION

ELEMENT/SWITCH

GENERAL NOTE: FIELDS SHOWN WITH THE [*] SYMBOL ARE NOT SHOWN ON THE DATASHEET BUT MAY BE REQUIRED BY THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL SUBMIT COMPLETE ISA DATASHEETS FOR EACH INSTRUMENT PER ALL SPECIFIED REQUIREMENTS.

Tag:	P&ID				
PI-60101	60N001	**SERVICE:** PRESSURE INDICATOR			
		FLUID: WATER	**CONNECTION TYPE:** 1/2 IN NPT	**BOTT. HOUSING MAT.:** BY VENDOR	
		TEMPERATURE: 70 DEG F	**ISOLATION SEALS:** N/A	**INSTRUMENT VALVES:** ISOLATION VALVE	
		MEASURING PRINCIPLE: DIRECT	**CASE MATERIAL:** PHENOLIC	**DIAPHRAGM MAT.:** BY VENDOR	
		TYPICAL DETAILS: [*]	**DIAL SIZE:** 4-1/2"	**AMBIENT TEMP:** 10-100 DEG F	
		GAUGE RANGE: 0-30 PSI	**OPTIONS:** [*]		
Tag:	**P&ID**				
PI-87130	87N001	**SERVICE:** PRESSURE INDICATOR			
		FLUID: WATER	**CONNECTION TYPE:** 1/2 IN NPT	**BOTT. HOUSING MAT.:** BY VENDOR	
		TEMPERATURE: 70 DEG F	**ISOLATION SEALS:** N/A	**INSTRUMENT VALVES:** ISOLATION VALVE	
		MEASURING PRINCIPLE: DIRECT	**CASE MATERIAL:** PHENOLIC	**DIAPHRAGM MAT.:** BY VENDOR	
		TYPICAL DETAILS: [*]	**DIAL SIZE:** 4-1/2"	**AMBIENT TEMP:** 10-100 DEG F	
		GAUGE RANGE: 0-30 PSI	**OPTIONS:** [*]		
Tag:	**P&ID**				
PI-99411	99N001	**SERVICE:** PRESSURE INDICATOR			
		FLUID: WATER	**CONNECTION TYPE:** 1/4 IN NPT	**BOTT. HOUSING MAT.:** MFR. STD.	
		TEMPERATURE: 10-100 DEG F	**ISOLATION SEALS:** N/A	**INSTRUMENT VALVES:** BLOCK AND BLEED VALVE	
		MEASURING PRINCIPLE: DIRECT	**CASE MATERIAL:** PHENOLIC	**DIAPHRAGM MAT.:** MFR. STD.	
		TYPICAL DETAILS: NP502	**DIAL SIZE:** 4-1/2"	**AMBIENT TEMP:** 10-100 DEG F	
		GAUGE RANGE: 0-150 PSIG	**OPTIONS:** [*]		
Tag:	**P&ID**				
PI-99412	99N002	**SERVICE:** PRESSURE INDICATOR			
		FLUID: WATER	**CONNECTION TYPE:** 1/4 IN NPT	**BOTT. HOUSING MAT.:** MFR. STD.	
		TEMPERATURE: 10-100 DEG F	**ISOLATION SEALS:** N/A	**INSTRUMENT VALVES:** BLOCK AND BLEED VALVE	
		MEASURING PRINCIPLE: DIRECT	**CASE MATERIAL:** PHENOLIC	**DIAPHRAGM MAT.:** MFR. STD.	
		TYPICAL DETAILS: NP502	**DIAL SIZE:** 4-1/2"	**AMBIENT TEMP:** 10-100 DEG F	
		GAUGE RANGE: 0-150 PSI	**OPTIONS:** [*]		

Pressure Gauge

SPECIFICATION: 17404

PROJECT INFORMATION

PLANT

PROJECT 8660F10

CUSTOMER UKIAH

LOCATION

ELEMENT/SWITCH

GENERAL NOTE: FIELDS SHOWN WITH THE [*] SYMBOL ARE NOT SHOWN ON THE DATASHEET BUT MAY BE REQUIRED BY THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL SUBMIT COMPLETE ISA DATASHEETS FOR EACH INSTRUMENT PER ALL SPECIFIED REQUIREMENTS.

Tag:	P&ID						
PI-99413	99N002	**SERVICE:**	PRESSURE INDICATOR				
		FLUID:	WATER	**CONNECTION TYPE:**	1/4 IN NPT	**BOTT. HOUSING MAT.:**	MFR. STD.
		TEMPERATURE:	10-100 DEG F	**ISOLATION SEALS:**	N/A	**INSTRUMENT VALVES:**	BLOCK AND BLEED VALVE
		MEASURING PRINCIPLE:	DIRECT	**CASE MATERIAL:**	PHENOLIC	**DIAPHRAGM MAT.:**	MFR. STD.
		TYPICAL DETAILS:	NP502	**DIAL SIZE:**	4-1/2"	**AMBIENT TEMP:**	10-100 DEG F
		GAUGE RANGE:	0-150 PSI	**OPTIONS:**	[*]		
Tag:	**P&ID**	**SERVICE:**	PRESSURE INDICATOR				
PI-99414	99N002	**FLUID:**	WATER	**CONNECTION TYPE:**	1/4 IN NPT	**BOTT. HOUSING MAT.:**	MFR. STD.
		TEMPERATURE:	10-100 DEG F	**ISOLATION SEALS:**	N/A	**INSTRUMENT VALVES:**	BLOCK AND BLEED VALVE
		MEASURING PRINCIPLE:	DIRECT	**CASE MATERIAL:**	PHENOLIC	**DIAPHRAGM MAT.:**	MFR. STD.
		TYPICAL DETAILS:	NP502	**DIAL SIZE:**	4-1/2"	**AMBIENT TEMP:**	10-100 DEG F
		GAUGE RANGE:	0-150 PSI	**OPTIONS:**	[*]		
Tag:	**P&ID**	**SERVICE:**	PRESSURE INDICATOR				
PI-99432	99N003	**FLUID:**	WATER	**CONNECTION TYPE:**	1/4 IN NPT	**BOTT. HOUSING MAT.:**	MFR. STD.
		TEMPERATURE:	10-100 DEG F	**ISOLATION SEALS:**	N/A	**INSTRUMENT VALVES:**	BLOCK AND BLEED VALVE
		MEASURING PRINCIPLE:	DIRECT	**CASE MATERIAL:**	PHENOLIC	**DIAPHRAGM MAT.:**	MFR. STD.
		TYPICAL DETAILS:	[*]	**DIAL SIZE:**	4-1/2"	**AMBIENT TEMP:**	10-100 DEG F
		GAUGE RANGE:	0-300 PSI	**OPTIONS:**	[*]		

SECTION 17405

PRESSURE/VACUUM MEASUREMENT: DIRECT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Pressure transmitters and indicators.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 TERMINOLOGY

A. The words and terms listed below are not defined terms that require initial capital letters, but, when used in this Section, have the indicated meaning.
   1. Calibrated range: The range that the pressure transmitter is configured to measure.
      a. The low end of the calibrated range must be greater than the lower range value (LRV) of the transmitter.
      b. The high end of the calibrated range must be less than or equal to the upper range value (URV).
      c. The calibrated range corresponds to the flow signal sent from the transmitter.
   2. Lower range value (LRV): Lowest pressure that the pressure transmitter is capable of measuring.
   3. Upper range value (URV): Highest pressure that the pressure transmitter is capable of measuring.

1.04 SUBMITTALS

A. Furnish Submittals as specified in Section 01330 - Submittal Procedures and Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Provide complete documentation covering the traceability of calibration instruments.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:
   1. Process conditions: Fluids, pressures, temperatures, flows, materials etc.

2. Physical conditions:
    a. Installation and mounting requirements.
    b. Location within the process.
    c. Accessories: Verify that required accessories are provided and are compatible with the process conditions and physical installation.

C. Provide instruments manufactured at facilities certified to the quality standards of ISO 9001.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.08 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
    1. Notify the Engineer if any installation condition does not meet the instrument manufacturer’s recommendations or specifications.

1.09 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.10 MAINTENANCE

A. Furnish parts, materials, fluids, etc., necessary for operation, maintenance, and calibration purposes throughout the warranty period. Deliver these supplies before project substantial completion.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide instruments identified in the Contract Documents.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Provide instruments suitable for the installed site conditions including, but not limited to, material compatibility, site altitude, site seismic conditions, humidity, and process and ambient temperatures.

2.03 MANUFACTURERS

A. One of the following or equal:
    1. Emerson, Rosemount 3051 Series.
    2. Emerson, Rosemount 2051 Series with High performance option.

3. Yokogawa, EJA Series.
4. ABB, 266 Series.
5. Endress & Hauser, Cerabar S Series.

2.04 MANUFACTURED UNITS

A. Pressure transmitters - direct:
   1. General:
      a. Pressure transmitter assembly shall include a diaphragm type pressure transducer and microprocessor-based transmitter for measurement of gauge, vacuum, or absolute pressure.
   2. Performance requirements:
      a. Maximum ratio of total instrument range to calibrated span: 10 to 1.
      b. Accuracy:
         1) Reference accuracy: Plus or minus 0.075 percent of calibrated span, including effects of hysteresis, nonlinearity, and repeatability.
         2) Total performance accuracy: Plus or minus 0.30 percent of calibrated span, including reference accuracy effects, static pressure and ambient temperature effects.
         3) Stability: Plus or minus 0.15 percent of upper range limit over 5 years.
   3. Element:
      a. Diaphragm type transducer integral to pressure transmitter.
      b. Diaphragm material: Stainless steel or ceramic.
      c. Process material compatibility:
         1) Verify material compatibilities with the instrument manufacturer.
      d. Process connection: As specified in Attachment A - ISA Datasheet - Pressure/Vacuum Measurement: Direct.
   4. Transmitter:
      a. Power supply:
         1) As indicated in the datasheets.
         2) 24 VDC - 2 wire loop powered.
      b. Outputs:
         1) As indicated in the datasheets.
         2) Isolated 4-20 mA DC with HART communication protocol.
      c. Provided with electronic microprocessor.
      d. Adjustments: Adjustable electronic zero and span, with elevated or suppressed zero as required by application. Adjustment shall be possible without mechanical fulcrum points or handheld configurator.
      e. Local display:
         1) 5-digit LCD.
         2) Scaled in engineering units.
      f. Enclosure:
         1) As indicated in the datasheets.
         2) Non-hazardous area:
            a) NEMA Type 4X.
      g. Over range protection: To maximum process line pressure.
      h. Conduit: 1/2-inch male NPT.

5. Components:
    a. Transmitter mounting:
        1) As indicated in the datasheets.
        2) Provide necessary hardware for transmitter mounting.

2.05 ACCESSORIES

A. Provide valve manifolds as specified in Section 17402 - Pressure/Vacuum Measurement: Instrument Valves:
    1. Mount valve manifold integrally to the transmitter.
    2. Valve manifold and transmitter shall be assembled by Manufacturer and shipped as an assembly.
    3. Provide remote or integral diaphragm seals as indicated on the Drawings or as indicated in the datasheets.

B. Provide sunshades for outdoor installations.

C. Provide stainless steel tags for each instrument. Tags shall be labeled as specified in the Contract Documents.

2.06 FINISHES (NOT USED)

2.07 SOURCE QUALITY CONTROL

A. Factory calibrate each instrument with a minimum 3-point calibration or according to Manufacturer's standard at a facility that is traceable to the NIST.
    1. Submit calibration datasheets to the Engineer at least 30 days before shipment of the instruments to the project site.

B. FM approval certification or equal when installed in classified areas.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the installation location for the instrument and verify that the instrument will work properly when installed.

3.02 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Coordinate the installation with trades to ensure that the mechanical system has necessary appurtenances including weld-o-lets, valves, etc., for proper installation of instruments.

3.03 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.04 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:
   1. Instruments may be indicated on the Drawings, specified in the Specifications, or both.

END OF SECTION

ATTACHMENT A - ISA DATASHEET - PRESSURE/VACUUM MEASUREMENT: DIRECT

Pressure Transmitter

PROJECT INFORMATION

PLANT		**CUSTOMER**	UKIAH
PROJECT	8660F10	**LOCATION**	

GENERAL NOTE: FIELDS SHOWN WITH THE [*] SYMBOL ARE NOT SHOWN ON THE DATASHEET BUT MAY BE REQUIRED BY THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL SUBMIT COMPLETE ISA DATASHEETS FOR EACH INSTRUMENT PER ALL SPECIFIED REQUIREMENTS.

GENERAL

SPECIFICATION NUMBER	17405	**MEASURING PRINCIPLE**	DIRECT
DRAWING NUMBER	99N003	**PLC**	PLC-99400
SERVICE	PRESSURE TRANSMITTER	**TYPICAL DETAILS**	NP501

CONNECTION

CONNECTION TYPE	M-NPT	**INSTRUMENT VALVES**	BLOCK AND BLEED VALVE

FLUID

FLUID	WATER	**PRESSURE RANGE**	0-300PSIG
TEMPERATURE	10-100 DEG F		

ELEMENT

ELEMENT TAG NO.	PE-99432	**SEAL TYPE**	N/A
ENCLOSURE CLASS	NEMA 4X	**DIAPHRAGM MATERIAL**	MFR. STD.
HAZARDOUS APPROVALS	N/A	**BOTTOM HOUSING MAT.**	MFR. STD.

TRANSMITTER

TRANSMITTER TAG NO.	PIT-99432	**AMBIENT TEMPERATURE**	10-100 DEG F
MOUNTING	INTEGRAL	**OUTPUT**	4-20 MA
ENCLOSURE CLASS	NEMA 4X	**SURGE PROTECTION**	YES

NOTES

[*]

SECTION 17407

PRESSURE MEASUREMENT: SUBMERSIBLE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Submersible pressure transmitters.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 SUBMITTALS

A. Furnish Submittals as specified in Section 01330 - Submittal Procedures, and Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Provide complete documentation covering the traceability of all calibration instruments.

1.04 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:
   1. Process conditions: Fluids, pressures, temperatures, flows, materials etc.
   2. Physical conditions:
      a. Installation and mounting requirements.
      b. Location within the process.
      c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Provide instruments manufactured at facilities certified to the quality standards of ISO 9001.

1.05 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.06 PROJECT OR SITE CONDITIONS

A. Project environmental conditions as specified in Section 01850 - Design Criteria.

1.07 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Notify the Engineer if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

1.08 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.09 MAINTENANCE

A. Furnish all parts, materials, fluids, etc., necessary for operation, maintenance, and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide all instruments identified in the Contract Documents.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. Provide instruments suitable for the installed site conditions including, but not limited to, material compatibility, site altitude, site seismic conditions, humidity, and process and ambient temperatures.

2.03 MANUFACTURERS

A. Submersible level measurement with 2-wire integral transmitter:
   1. One of the following or equal:
      a. Endress+Hauser, Waterpilot FMX21 .
      b. Druck, PTX-1830.
      c. Siemens, SITRANS LH100.
      d. Measurement Specialties, KPSI 700 Series.

2.04 MANUFACTURED UNITS

A. As specified in this Section including Attachment A - ISA Datasheet - Pressure Measurement: Submersible.

B. Submersible level measurement with 2-wire integral transmitter:
   1. General:
      a. Pressure is measured through a diaphragm-type measuring cell and converted to linear pressure measurement.
      b. Each submersible pressure transmitter system shall include:
         1) Signal cable, including pressure compensation tube.
         2) Transducer probe with integral transmitter.
         3) Transmitter cable termination box.

2. Performance requirements:
    a. Accuracy:
        1) 0.3 percent of range.
    b. Repeatability:
        1) 0.25 percent of full scale.
    c. Rangeability:
        1) 3:1.
    d. Range:
        1) As indicated on the Drawings or in the datasheet.
3. Element:
    a. Sensor housing shall be Type 316L stainless steel or titanium with ceramic, Teflon™-coated, or titanium diaphragm.
    b. Protective cap shall be manufacturer's recommended material, chemically resistant to process fluid.
    c. Pressure reference/compensation:
        1) Slip resistant extension cable with pressure compensation tube with Teflon™ filter.
    d. Enclosure for probe and transmitter assembly shall be NEMA Type 6P.
4. Transmitter:
    a. Power supply:
        1) As indicated in the datasheets.
        2) 24 VDC: 2 wire loop powered.
    b. Outputs:
        1) As indicated in the datasheets.
        2) Isolated 4 to 20 mA DC with HART communication protocol.
    c. Ambient operating temperature limits of -10 to 70 degrees Celsius (14 to 158 degrees Fahrenheit).
5. Transmitter cable termination box:
    a. As indicated in the datasheets.
    b. NEMA Type 4X.
    c. Equipped with filter or desiccant chamber to eliminate moisture from the pressure compensation tube.
    d. Termination for signal wires and/or pressure compensation tube**.**

2.05 ACCESSORIES

A. Type 316L stainless steel mounting clamp with Type 304 stainless steel mounting screws.

B. Provide additional anchor to prevent movement.

C. Provide cable clamp and strain relief.

D. Provide computer cable adapter with Windows® software.

E. Provide sunshade for outdoor installations.

2.06 FINISHES (NOT USED)

2.07 SOURCE QUALITY CONTROL

A. Factory calibrate each instrument with a minimum 3-point calibration or according to Manufacturer's standard at a facility that is traceable to the NIST.
   1. Submit calibration datasheet to the Engineer at least 30 days before shipment of the instruments to the project site.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the installation location for the instrument and verify that the instrument will work properly when installed.

3.02 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Coordinate the installation with all trades to ensure that the mechanical system has all necessary appurtenances including weld-o-lets, valves, etc., for proper installation of instruments.

3.03 COMMISSIONING

A. As specified in Section 01756 - Commissioning.

3.04 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:
   1. Instruments may be indicated on the Drawings, specified in the Specifications, or both.

END OF SECTION

ATTACHMENT A - ISA DATASHEET - PRESSURE/VACUUM MEASUREMENT: SUBMERSIBLE

Submersible Pressure Transmitter

PROJECT INFORMATION

PLANT		**CUSTOMER**	UKIAH
PROJECT	8660F10	**LOCATION**	

GENERAL NOTE: FIELDS SHOWN WITH THE [*] SYMBOL ARE NOT SHOWN ON THE DATASHEET BUT MAY BE REQUIRED BY THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL SUBMIT COMPLETE ISA DATASHEETS FOR EACH INSTRUMENT PER ALL SPECIFIED REQUIREMENTS.

GENERAL

SPECIFICATION NUMBER	17407	**MEASURING PRINCIPLE**	DIRECT
DRAWING NUMBER	99N001	**PLC**	PLC-99400
SERVICE	LEVEL TRANSMITTER	**TYPICAL DETAILS**	NL132, NL133

CONNECTION

CONNECTION TYPE	FLANGED	**INSTRUMENT VALVES**	[*]
ISOLATION SEALS	N/A		

FLUID

FLUID	WATER	**INSTRUMENT RANGE**	0-25 FT
TEMPERATURE	10-100 DEG F		

ELEMENT

ELEMENT TAG NO.	LE-99405	**HOUSING MATERIAL**	MFR. STD.
ENCLOSURE CLASS	NEMA 4X	**MEMBRANE MATERIAL**	MFR. STD.
HAZARDOUS APPROVALS	N/A	**DIAPHRAGM MATERIAL**	MFR. STD.

TRANSMITTER

TRANSMITTER TAG NO.	LIT-99405	**SIGNAL OUTPUT**	AI
ENCLOSURE CLASS	NEMA 4X	**OUTPUT**	4-20 MA
TRANS. MOUNTING	INTEGRAL	**AMBIENT TEMPERATURE**	10-100 DEG F
SURGE PROTECTION	YES		

NOTES

[*]

SECTION 17505

ANALYZERS: RESIDUAL CHLORINE

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Residual chlorine analyzers.

B. Provide all instruments identified in the Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Provide complete documentation covering the traceability of all calibration instruments.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Examine the complete set of Contract Documents and verify that the instruments are compatible with the installed conditions including:
   1. Process conditions: Fluids, pressures, temperatures, flows, materials, etc.
   2. Physical conditions:
      a. Installation and mounting requirements.
      b. Location within the process.
      c. Accessories: Verify that all required accessories are provided and are compatible with the process conditions and physical installation.

C. Notify the Engineer if any installation condition does not meet the instrument manufacturer’s recommendations or specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.07 PROJECT OR SITE CONDITIONS

A. Project environmental conditions as specified in Section 01850 - Design Criteria.
   1. Provide instruments suitable for the installed site conditions including, but not limited to, material compatibility, site altitude, site seismic conditions, humidity, and process and ambient temperatures.

1.08 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.09 MAINTENANCE

A. Furnish all parts, materials, fluids, etc. necessary for operation, maintenance, and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Colorimetric residual analyzers:
   1. The following or equal:
      a. HACH, CL17sc.
         1) Transmitter Model sc4500.

2.02 MANUFACTURED UNITS

A. As specified in this Section including Attachment A - ISA Data Sheet - Analyzers: Residual Chlorine.

B. Colorimetric residual analyzers:
   1. General:
      a. Residual chlorine analyzer utilizing the DPD colorimetric method to provide accurate measurements independent of swings in pH or alkalinity levels in the sample source.
      b. Convert from free to total chlorine by changing reagents:
         1) Measure a sample blank before each sample measurement to provide zero reference compensation for sample color and turbidity, changes in light intensity due to voltage fluctuations, or light intensity.
   2. Performance requirements:
      a. Complete analysis every 2.5 minutes for free or total chlorine residual.
      b. Designed for 30 days of unattended operation, with less than 500 milliliters of reagent used per month.

c. Accuracy:
    1) Within 5 percent of reading or within 0.035 milligrams per liters.
d. Range:
    1) 0 to 5 milligrams per liters free or total residual.
e. Repeatability:
    1) Within 5 percent or 0.05 milligrams per liters.

3. Transmitter:
    a. Microprocessor-based signal converter/transmitter:
        1) Self-diagnostic functions available via the alphanumeric, menu-driven keyboard.
    b. Power supply:
        1) 120 VAC.
        2) Power consumption: 95 VA maximum.
    c. Outputs:
        1) Isolated 4 to 20 milliamperes DC.
        2) As indicated on the instrument data sheets.
        3) Relay outputs:
            a) SPST relay contacts: 2.
            b) Selectable to activate on the following conditions:
                (1) High or low sample concentration.
                (2) Analyzer system warning.
                (3) Analyzer system shutdown.
    d. Enclosure:
        1) Rating: NEMA 12 (IP62).
        2) ABS plastic with 2 clear polycarbonate windows.
        3) Wall mounted.
    e. Display:
        1) LCD, 3-digit readout, and 6-character alphanumeric scrolling text line.
    f. Light source:
        1) Class I LED (light emitting diode), with peak wavelength of 520 nanometer; 50,000 hours estimated minimum life.

2.03 ACCESSORIES

A. Provide sunshades for outdoor installations.

B. Provide surge suppression for outdoor installations.

2.04 SOURCE QUALITY CONTROL

A. Factory calibrate each instrument with a minimum 3-point calibration or according to Manufacturer’s standard at a facility that is traceable to the NIST.
    1. Submit calibration data sheets to the Engineer at least 30 days before shipment of the instruments to the project site.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the installation location for the instrument and verify that the instrument will work properly when installed.
   1. Notify the Engineer promptly if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.04 FIELD QUALITY CONTROL (NOT USED)

3.05 ADJUSTING

A. As specified in Section 17950 - Commissioning for Instrumentation and Controls.

3.06 CLEANING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.07 DEMONSTRATION AND TRAINING (NOT USED)

3.08 PROTECTION (NOT USED)

3.09 SCHEDULES

A. The provided information does not necessarily include all required instruments. Provide all instruments identified in the Contract Documents:
   1. Instruments may be indicated on the Drawings, specified in the Specifications, or both.

END OF SECTION

ATTACHMENT A - ISA DATA SHEET - ANALYZERS: RESIDUAL CHLORINE

Analyzer Transmitter

PROJECT INFORMATION

PLANT		**CUSTOMER**	UKIAH
PROJECT	8660F10	**LOCATION**	

GENERAL NOTE: FIELDS SHOWN WITH THE [*] SYMBOL ARE NOT SHOWN ON THE DATASHEET BUT MAY BE REQUIRED BY THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL SUBMIT COMPLETE ISA DATASHEETS FOR EACH INSTRUMENT PER ALL SPECIFIED REQUIREMENTS.

GENERAL

SPECIFICATION NUMBER	17505	**MEASURING PRINCIPLE**	COLORIMETRIC
DRAWING NUMBER	60N001	**PLC**	PLC-70299
SERVICE	CHLORINE ANALYZER 4	**TYPICAL DETAILS**	NA090
POWER LOCATION	PCM-70299		

FLUID

FLUID	WATER	**PRESSURE**	1.5 - 5 PSIG
MEASUREMENT RANGE	0-10 MG/L	**TEMPERATURE**	70 DEG F
SAMPLE FLOW	60- 200 ML/MIN	**SAMPLE TEMPERATURE**	40 - 80 DEG F
SAMPLE pH	6-9		

ELEMENT

ELEMENT TAG NO.	AE-60101	**PROCESS CONNECTION**	SAMPLE LINE
ENCLOSURE CLASS	NEMA 4X	**HAZARDOUS APPROVALS**	N/A
CLEANING APPARATUS	NO	**ELEMENT MOUNTING KIT**	FLOW ASSEMBLY

TRANSMITTER

TRANSMITTER TAG NO.	AIT-60101	**SIGNAL OUTPUT**	AI
ENCLOSURE CLASS	NEMA 4X	**OUTPUT**	4-20 MA
TRANS. MOUNTING	REMOTE	**TRANS. HAZ APPROVALS**	N/A
POWER	120VAC-1P	**RELAY OPTIONS**	YES
SURGE PROTECTION	YES	**AMBIENT TEMPERATURE**	10-100 DEG F
AIR CLEANING SYSTEM	NO		

NOTES

[*]

Analyzer Transmitter

PROJECT INFORMATION

PLANT		**CUSTOMER**	UKIAH
PROJECT	8660F10	**LOCATION**	

GENERAL NOTE: FIELDS SHOWN WITH THE [*] SYMBOL ARE NOT SHOWN ON THE DATASHEET BUT MAY BE REQUIRED BY THE CONTRACT DOCUMENTS. THE CONTRACTOR SHALL SUBMIT COMPLETE ISA DATASHEETS FOR EACH INSTRUMENT PER ALL SPECIFIED REQUIREMENTS.

GENERAL

SPECIFICATION NUMBER	17505	**MEASURING PRINCIPLE**	COLORIMETRIC
DRAWING NUMBER	87N001	**PLC**	PLC-4
SERVICE	CHLORINE ANALYZER 3	**TYPICAL DETAILS**	NA090
POWER LOCATION	PCM-4		

FLUID

FLUID	WATER	**PRESSURE**	1.5 - 5 PSIG
MEASUREMENT RANGE	0-10 MG/L	**TEMPERATURE**	70 DEG F
SAMPLE FLOW	60- 200 ML/MIN	**SAMPLE TEMPERATURE**	40 - 80 DEG F
SAMPLE pH	6-9		

ELEMENT

ELEMENT TAG NO.	AE-87130	**PROCESS CONNECTION**	SAMPLE LINE
ENCLOSURE CLASS	NEMA 4X	**HAZARDOUS APPROVALS**	N/A
CLEANING APPARATUS	NO	**ELEMENT MOUNTING KIT**	FLOW ASSEMBLY

TRANSMITTER

TRANSMITTER TAG NO.	AIT-87130	**SIGNAL OUTPUT**	AI
ENCLOSURE CLASS	NEMA 4X	**OUTPUT**	4-20 MA
TRANS. MOUNTING	REMOTE	**TRANS. HAZ APPROVALS**	N/A
POWER	120VAC-1P	**RELAY OPTIONS**	YES
SURGE PROTECTION	YES	**AMBIENT TEMPERATURE**	10-100 DEG F
AIR CLEANING SYSTEM	NO		

NOTES

[*]

SECTION 17710

CONTROL SYSTEMS: PANELS, ENCLOSURES, AND PANEL COMPONENTS

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PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Design, fabrication and assembly of all instrumentation enclosures, control panels and components provided under this contract, including but not limited to:
      a. Custom built instrumentation and control panels, including all enclosures for hand stations controllers, low voltage power distribution and marshalling panels.
      b. Control panels furnished as part of equipment systems specified in other Divisions, such as vendor control panels (VCPs) and chemical feed panels.
      c. Control components.
      d. Control panel installation.

B. Provide all control panels identified in Contract Documents.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Institute of Electrical and Electronics Engineers (IEEE):
   1. C62.41.1 - Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
   2. 802.3af - Standard for Information Technology Telecommunications and Information Exchange Between Systems - Local and Metropolitan Area Networks - Specific Requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications.
   3. 802.3at - Standard for Information Technology - Local and Metropolitan area networks - Specific requirements - Part 3: CSMA/CD Access Method and Physical Layer Specifications Amendment 3: Data Terminal Equipment (DTE) Power via the Media Dependent Interface (MDI) Enhancements.

C. International Electrotechnical Commission (IEC):
   1. 61643-11 - Low-Voltage Surge Protective Devices - Part 11: Surge Protective Devices Connected to Low-Voltage Power Systems - Requirements and test methods.
   2. 61643-21 - Low-Voltage Surge Protective Devices - Part 21: Surge Protective Devices Connected to Telecommunications and Signaling Networks - Performance Requirements and Testing Methods.

D. Underwriters Laboratories Inc. (UL):
   1. 248-14 - Low-Voltage Fuses - Part 14: Supplemental Fuses.
   2. 497B - Standard for Protectors for Data Communications and Fire-Alarm Circuits.
   3. 508 - Standard for Industrial Control Equipment.
   4. 508A - Standard for Industrial Control Panel.

5. 698A - Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.
6. 913 - Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, III, Division 1, Hazardous (Classified) Locations.
7. 1077 - Standard for Supplementary Protectors for Use in Electrical Equipment.
8. 1283 - Standard for Electromagnetic Interference Filters.
9. 1449 - Standard for Surge Protective Devices.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Specific definitions:
   1. The term "panel" in this Section is interchangeable with the term "enclosure."

1.04 SUBMITTALS

A. Provide submittals as specified in Section 01330 - Submittal Procedures and Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Provide a control panel hardware submittal for each control panel/enclosure being provided on this project, including but not limited to:
   1. Product data:
      a. Enclosure construction details and NEMA type.
      b. Manufacturer's literature and specification data sheets for each type of equipment to be installed within or on the panel or enclosure.
   2. Shop drawings:
      a. Scaled, detailed exterior panel (front and side views) and interior panel layout showing equipment arrangement and dimensional information:
         1) Provide draft for review and approval by Engineer. The Engineer has the authority to substantially alter initial panel layouts.
      b. Complete nameplate engraving schedule.
      c. Structural details of fabricated panels.
   3. Calculations:
      a. Provide installation details based on calculated shear and tension forces:
         1) Calculations shall be signed and sealed by a Professional Engineer licensed in the state where the cabinets and panels will be installed.
      b. For assembled enclosures and other equipment with a weight of 200 pounds or more, provide calculations for:
         1) Weight including panel internal components.
         2) Seismic forces and overturning moments.
         3) Shear and tension forces in connections.
      c. Cooling calculations, including but not limited to:
         1) Highest expected ambient temperature for the enclosure's location.
         2) Internal heat load.
         3) Exposure to direct sunlight.
         4) Dimensions of the enclosure in inches.
         5) Maximum allowable temperature inside the enclosure, based on the lowest operating temperature limit of the installed components.

C. Seismic design:
    1. Seismic panel construction:
        a. Seismic anchorage: Provide seismic design calculations and installation details for anchorage of all panels, enclosures, consoles, etc. to meet seismic requirements in Section 01850 - Design Criteria:
            1) Stamped by a Professional Engineer registered in the state where the project is being constructed.
        b. For floor-mounted freestanding panels weighing 200 pounds or more (assembled, including contents), submit calculations, data sheets, and other information to substantiate that panel, base, and framing meet minimum design strength requirements and seismic requirements as specified in Section 01850 - Design Criteria. Calculations shall be signed and sealed by a Professional Engineer licensed in the state where the cabinets and panels will be installed.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Assemble panels, enclosures, and rack systems along with all internal and external devices, wiring, equipment, and materials in a facility that is recognized by UL to assemble and certify UL-labeled control panels:
    1. Provide all components and equipment with UL 508 listing.
    2. All control panels shall be UL 508A labeled, unless the equipment in the panel and the design in the contract documents cannot be reasonably modified to meet the requirements for UL 508A labeling:
        a. Non-listed, complex, and unique equipment may be evaluated and approved by a third-party testing agency, with prior approval by the Owner. Provide report documenting the testing standard, specification, method of testing, and that the equipment and materials meet appropriate designated standards or have been tested and found suitable for use in a specified manner.
    3. Provide fuses for all equipment that is not UL or UR listed.
    4. Install all intrinsically safe circuits and equipment in accordance with UL698A.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Project environmental conditions as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.
    1. Provide instruments suitable for the installed site conditions including, but not limited to, material compatibility, site altitude, site seismic conditions, humidity, and process and ambient temperatures.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.08 SEQUENCING (NOT USED)

1.09 SCHEDULING (NOT USED)

1.10 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.11 SYSTEM START-UP (NOT USED)

1.12 OWNER'S INSTRUCTIONS (NOT USED)

1.13 COMMISSIONING (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. As listed below in the individual component paragraphs.

B. Provide instruments and other components performing similar functions of the same type, model, or class, and from 1 manufacturer.

2.02 SYSTEM DESCRIPTION

A. Panel dimensions:
   1. Minimum dimensions are scalable from or as indicated on the Drawings and are based upon manufacturer's non-certified information. It is the responsibility of the Contractor or manufacturer to design and size all panels:
      a. Size panels to provide space for all equipment, wiring, terminations, and other items in the panel, including space for future build out.
      b. Panel sizes that substantially deviate (within 3 inches in any dimension) from the sizes indicated on the Drawings must be approved by the Engineer.
      c. Maximum panel depth: 32 inches, unless otherwise indicated.

B. Structural design:
   1. Completed and installed panel work shall safely withstand seismic requirements at the project site as specified in Section 16050 - Common Work Results for Electrical. Enclosures and internal equipment shall be braced to prevent damage from specified forces.

2.03 EXISTING PRODUCTS

A. Provide labor and materials for complete modifications to existing panels as required.

B. Field cut and refinish existing panel faces to original condition to accommodate installation of new instruments, removal of existing instruments, and fitting of blanks to suit new layouts. New instrument supports shall be provided as required for complete installation.

2.04 MATERIALS

A. Construct and finish enclosures using materials capable of withstanding the mechanical, electrical, and thermal stresses, as well as the effects of humidity and corrosion that are likely to be encountered in normal service:
   1. Enclosures shall have the following properties:
      a. NEMA Type 1: Steel.
      b. NEMA Type 4: Steel with gasketed door, raintight.
      c. NEMA Type 4X: Type 316 stainless steel (unless Type 304 is indicated on the Drawings).
      d. NEMA Type 4X: Polycarbonate or fiberglass reinforced polyester (FRP) in corrosive areas where stainless steel is incompatible.
      e. NEMA Type 12: Steel with gasketed door, dusttight.
      f. NEMA Type 7: Cast aluminum.

B. Bolting material:
   1. Commercial quality 1/2-inch diameter, stainless steel hex-head Grade 5 bolts, nuts, and washers, with unified coarse (UNC) threads.
   2. Carriage bolts for attaching end plates.
   3. All other bolted joints shall have S.A.E. standard lock washers.

2.05 MANUFACTURED UNITS

A. Panels/enclosures:
   1. Manufacturers: One of the following or equal:
      a. nVent/Hoffman.
      b. Saginaw Control & Engineering.
      c. Rittal.
   2. Panel assembly:
      a. General guidelines for panel fabrication include:
         1) Continuous welds ground smooth.
         2) Exposed surfaces free of burrs and sharp edges.
         3) Base formed of heavy channel iron, either galvanized or powder coated, minimum 1/2-inch holes at 12-inch spacing to accommodate anchoring of freestanding enclosures to floor.

b. Construct enclosure and mounting panel using stretcher-level quality sheet metal having minimum thickness not less than the following sizes (U.S. Standard Gauge):

Enclosure Height (inches)	Minimum Enclosure Steel Thickness (gauge)	Minimum Back Mounting Panel Thickness (gauge)
Wall-mounted up to 48	14	14
Up to 57	12	12
57 - 69	12	10
69 - 82	12, except 10 on back	10
82 or more	10	10

1) Use heavier sheet metal to meet seismic requirements at the project site or when required due to equipment requirements.

c. For Rittal or engineer approved equal free-standing modular enclosure, construct enclosure and mounting panel using stretcher-level quality sheet metal having minimum thickness not less than the following sizes (U.S. Standard Gauge):

Enclosure Height (inches)	Minimum Enclosure Steel Thickness (gauge)	Minimum Back Mounting Panel Thickness (gauge)
Wall-mounted up to 48	16	14
Up to 57	14	13
57 or more	16	11

d. Construct supporting frame structure with angled, channeled, or folded rigid section of sheet metal, rigidly attached to and having essentially the same outer dimensions as the enclosure surface and having sufficient torsional rigidity to resist the bending moments applied via the enclosure surface when it is deflected.

e. Provide stiffeners for back mounting or C folded back panels in enclosures larger than 4 feet. In addition, secure the panels in place by collar studs welded to the enclosure.

f. Door construction:
   1) Turned-back edges suitably braced and supported to maintain alignment and rigidity without sagging.
   2) Sufficient width to permit door opening without interference with rear projection of flush-mounted instruments.
   3) Heavy-gauge stainless steel hinges.
   4) For NEMA Type 12, Type 4, and Type 4X, provide oil-resistant neoprene sealing gasket and adhesive to seal cover to enclosure.
   5) Gasket installed to seal against roll lip on the enclosure opening.

g. Latches:
   1) For panels, provide each door with an oil tight 3-point latching mechanism and locking handle with rollers on the ends of the latch rods. Latch rods shall be connected to a common door handle, hold

doors securely, and form a compressed seal between door and gasket, at the top, side, and bottom.
a) Provide padlock for each enclosure with padlock provisions.
b) Provide 2 keys per panel.
c) All locks keyed alike.
2) For Rittal or engineer approved equal free-standing modular enclosure, provide each door with a 4-point latching mechanism, if available, or a 2-point latching mechanism if a 4-point is not available.
3) For cabinets not available with 3-point latching hardware, provide multiple clips and padlock hasps.

h. Panel cut-outs:
1) Cut, punch, or drill cutouts for instruments, devices, and windows. Smoothly finish with rounded edges.
2) Allow a minimum of 3-inch envelope around all displays, controllers, and monitors.
3) Reinforce around cut-outs with steel angles or flat bars for the following:
a) Large panel cutouts; for example, openings for local operator interfaces.
b) Pilot device groupings, where the removed metal exceeds 50 percent of the available metal.

3. In addition to the requirements specified above, the following requirements for NEMA Type 4X powder coated stainless steel enclosures apply:
a. Minimum 16-gauge, Type 304 stainless steel.
b. Captive stainless steel cover screws threaded into sealed wells.
c. Inside finish: White polyester powder coating.
d. Specifically designed for use with flange-mounted disconnect handles where required or as indicated on the Drawings.
e. NEMA Type 4X powder-coated stainless steel enclosures are not an acceptable substitute for stainless steel unless indicated on the Drawings.

4. Outdoor panels. Supplementary requirements for panels located outdoors are as follows:
a. All enclosures located outdoors shall be explicitly designed and rated for outdoor service by the manufacturer.
b. Door hardware: Stainless steel.
c. Provide factory installed rain canopy and sun shield for all enclosures with operator interface panels.
d. Bases: Heavy channel, gasketed stainless steel bases, flanges up, for anchoring to pad.

B. Arrangement of components:
1. Arrange panel internal components for external conduit and piping to enter into panel either from above or below.
2. Arrange panel instruments and control devices in a logical configuration, associating pushbutton and selector switches with related readout devices, or as indicated on the Drawings.
3. Mount internal control components on an internal back panel. Devices may be mounted on the side panel only by special permission from the Engineer.
4. All control panel mounted operator interface devices shall be mounted between 3 feet and 5 feet above finished floor.

C. Overcurrent protection:
    1. Main overcurrent device:
        a. Where the electrical power supply voltage to the control panel is more than 120 VAC, provide the panel with a flange-mounted disconnect handle operating a molded-case circuit breaker and provide a control power transformer for 120-VAC circuits:
            1) Door-mounted disconnect handles are not acceptable.
            2) Mechanically interlock the disconnect switch with the control enclosure doors so that no door can be opened unless the power is disconnected, and the disconnect switch cannot be closed until all doors are closed.
            3) Provide means to defeat the interlock.
            4) Lockable in the off position.
        b. Control panels supplied with 120 VAC:
            1) Provide an internal breaker with the line side terminals covered by a barrier.
            2) Provide a nameplate prominently positioned on the control panel identifying the location of the power source and a warning statement requiring the source to be disconnected before opening the door to the enclosure.
            3) Provide a nameplate prominently positioned on the control panel stating "CAUTION Risk of Electric Shock – UPS equipment outputs remain energized with main disconnect in off position" for any panel containing a UPS.
    2. Provide circuit breakers as specified in Section 16412 - Low Voltage Molded Case Circuit Breakers.
    3. Selection and ratings of protective devices:
        a. Interrupting ratings: Not less than the system maximum available fault current at the point of application.
        b. Voltage rating: Not less than the voltage of the application.
        c. Select current rating and trip characteristics to be suitable for:
            1) Maximum normal operating current.
            2) Inrush characteristics.
            3) Coordination of the protective devices to each other and to the source breaker feeding the panel.
        d. Circuit breakers, fuses, and motor overcurrent protection devices used for branch circuit protection must be UL 508A compliant.
            1) Circuit breakers listed under UL 1077 Standard for Supplementary Protectors that do not comply with UL 508A requirements are not acceptable.
            2) Miscellaneous, miniature, and micro fuses listed under UL 248 Part 14 that do not comply with UL 508A requirements are not acceptable.
            3) Manual motor controllers provided with an instantaneous-trip overcurrent mechanism listed under UL 508 that do not comply with UL 508A requirements are not acceptable.
    4. Provide a separate protective device for each powered electrical device:
        a. An individual circuit breaker for each 120-VAC instrument installed within its respective control panel and clearly identified for function.

b. An individual fuse for each:
    1) Discrete input:
        a) 0.5-ampere fuse.
    2) Discrete output:
        a) Size external fuse to open before any I/O-card-mounted fuses.
    3) Analog loop powered from the control panel:
        a) 0.25-ampere fuse.
c. Install protective devices on the back mounting panel and identify by a service nameplate in accordance with the wiring diagrams.

5. Fuses for analog and discrete control loops:
    a. Provide durable, readily visible label for each fuse, clearly indicating the correct type, size, and ratings of replacement fuse:
        1) Label shall not cover or interfere with equipment manufacturer's instructions.
    b. Provide fuses rated for the voltage and available short-circuit current at which they are applied.
    c. Manufacturers: One of the following or equal:
        1) Ferraz Shawmut.
        2) Littelfuse.
        3) Bussmann.
6. Fuse holders:
    a. Modular type:
        1) DIN rail mounting on 35-millimeter rail.
        2) Touch-safe design: All connection terminals to be protected against accidental touch.
        3) Incorporates blown-fuse indicator.
        4) Plug-in style fuse terminals and fuse plugs are not acceptable.
    b. Provide nameplate identifying each fuse:
        1) As specified in Section 16075 - Identification for Electrical Systems.
    c. Manufacturers: One of the following or equal:
        1) Phoenix Contact, UT4-HESI Series.
        2) Allen-Bradley, 1492-FB Series B.
7. Control circuit breakers:
    a. DIN rail mounting on 35-millimeter rail.
    b. Manual OPEN-CLOSE toggle switch.
    c. Rated for 250 VAC.
    d. Interrupting rating: 10 kiloampere (kA) or available fault current at the line terminal, whichever is higher.
    e. Current ratings: As required for the application.
    f. Provide nameplate identifying each circuit breaker:
        1) As specified in Section 16075 - Identification for Electrical Systems.
    g. Manufacturers: One of the following or equal:
        1) Phoenix Contact, TMC Series.
        2) ABB.
        3) Allen-Bradley.
        4) Square D.
8. Electronic circuit protectors:
    a. Used where a NEC Class 2 power circuit is required.
    b. Confirms to NEC Class 2 according to UL 1310.
    c. DIN rail mounting on 35-millimeter rail.

d. Power source:
    1) Operating voltage: 24 VDC.
    2) Output current ratings: As required for the application.
    3) Maximum output current: 4 A.
    4) Maximum nameplate rating: 100VA.
e. LED for status indication.
f. Remote status contact.
g. When using multi-channel electronic circuit protectors, distribute devices such that a failure is limited to a single network or segment.
h. Provide nameplate identifying each circuit electronic circuit protector module:
    1) As specified in Section 16075 - Identification for Electrical Systems.
i. Manufacturers: One of the following or equal:
    1) Single-channel:
        a) Phoenix Contact, PTCB E1 series.
        b) Allen-Bradley, 1694 series.
    2) Multi-channel:
        a) Phoenix Contact, CBMC series.
        b) Puls PISA11 series.

D. Conductors and cables:
1. Power and control wiring:
    a. Materials: Stranded, soft annealed copper.
    b. Insulation: 600 VAC type MTW.
    c. Minimum sizes:
        1) Primary power distribution: 12 AWG.
        2) Secondary power distribution: 14 AWG.
        3) Control: 16 AWG.
    d. Color:
        1) AC power (line and load): Black.
        2) AC power (neutral): White.
        3) AC control: Red.
        4) AC control: Orange for foreign voltages.
        5) DC power and control (ungrounded): Blue.
        6) DC power and control (grounded): White with Blue stripe.
        7) Ground: Green.
2. Signal cables:
    a. Materials: Stranded, soft annealed copper.
    b. Insulation: 600 VAC, PVC outer jacket.
    c. Minimum size: 18 AWG paired triad.
    d. Overall aluminum shield (tape).
    e. Copper drain wire.
    f. Color:
        1) 2-Conductor:
            a) Positive (+): Black.
            b) Negative (-): White and red.

2) 3-Conductor:
a) Positive (+): Black.
b) Negative (-): Red.
c) Signal: White.

g. Insulate the foil shielding and exposed drain wire for each signal cable with heat-shrink tubing.

E. Conductor identification:
1. Identify each conductor and cable with unique wire numbers as specified in Section 16075 - Identification for Electrical Systems.
2. Readily identified without twisting the conductor.

F. General wiring requirements:
1. Wiring methods: Wiring methods and materials for panels shall be in accordance with the NEC requirements for General Purpose (no open wiring) unless otherwise specified.
2. Install all components in accordance with the manufacturer's instructions included in the listing and labeling.
3. Provide a nameplate on the cover of the control panel identifying all sources of power supply and foreign voltages within the control panel.
4. Provide transformers, protective devices, and power supplies required to convert the supply voltage to the needed utilization voltage.
5. Provide power surge protection for all control panels.
6. Provide signal surge protection within control panels for each analog I/O, discrete I/O, and data line (Copper Ethernet, Coax, Fieldbus signals) that originates from outdoor devices.
7. Provide non-metallic ducts for routing and organization of conductors and cables:
a. Provide wiring separation plan.
b. Size ducts for ultimate build-out of the panel, or for 20-percent spare, whichever is greater.
c. Provide separate ducts for signal and low-voltage wiring from power and 120 VAC control wiring:
1) 120 VAC: Grey colored ducts.
2) 24 VDC: White colored ducts.
8. Cables shall be fastened with cable-mounting clamps or with cable ties supported by any of the following methods:
a. Screw-on cable tie mounts.
b. Hammer-on cable-tie mounting clips.
c. Fingers of the nonmetallic duct.
9. Wire ties:
a. No wire ties inside wire duct.
b. Use Panduit Cable tie installation tool, with tension control/cutoff.
c. Verify cut ends are cut flush filed smooth after installed.
10. Provide supports at the ends of cables to prevent mechanical stresses at the termination of conductors.
11. Support panel conductors where necessary to keep them in place.
12. Wiring to rear terminals on panel-mount instruments shall be run in nonmetallic duct secured to horizontal brackets run adjacent to the instruments.

13. Conductors and cables shall be run from terminal to terminal without splice or joints. Exceptions:
    a. Factory-applied connectors molded onto cables shall be permitted. Such connectors shall not be considered as splices or joints.
14. The control panel shall be the source of power for all 120 VAC devices interconnected with the control panel including, but not limited to:
    a. Solenoid valves.
    b. Instruments both mounted in the control panel and remotely connected to the control panel.

G. Provide power circuits for all Contractor and Vendor-furnished PLC cabinets in accordance with the PLC and Instrument Power wiring diagrams Indicated on the Drawings or as specified.

2.06 EQUIPMENT (NOT USED)

2.07 COMPONENTS

A. Thermal management:
1. Provide heating, cooling, and dehumidifying devices in order to maintain all instrumentation and control devices to within a range as specified in Section 17050 - Common Work Results for Process Control and Instrumentation.
2. Air conditioner:
    a. Provide solid-state cabinet coolers or air conditioning units on all outdoor panels containing electronic components such as local operator interfaces, panel instruments, programmable logic controllers, or remote I/O.
    b. Provide filters on intake and exhaust openings.
    c. Increase panel sizes as needed to accommodate cooling units.
    d. Enclosure rating: NEMA Type 4X.
    e. Closed-loop design.
    f. Power supply: 120 VAC.
    g. Manufacturers: The following or equal:
        1) Kooltronic, Guardian X DP Series.
        2) ICEqube, Blade series or IECEx/ATEX for Zones 1 and 2.
3. Heating:
    a. Provide all panels located in areas that are not climate controlled with thermostatically controlled strip heaters, except where all of the following conditions apply:
        1) The panel is not supplied with 120 VAC power.
        2) There are no electronics or moisture-sensitive devices in the enclosure.
        3) The panel is smaller than 38 inches high.
4. Enclosure temperature switch:
    a. Provide wall-mounted bimetallic switch transmitter (to measure internal cabinet temperature in all enclosures) containing electrical components such as PLCs, RTUs, RIO, and VFDs.
    b. Sensor and electronic enclosure.
    c. Accuracy: Within 2 degrees Fahrenheit.

d. Single contact:
1) Manufacturers: One of the following or equal:
a) nVent/Hoffman ATEMNC.
b) Pfannenberg FLZ.
c) Rittal.
e. Dual contact:
1) Manufacturers: The following or equal:
a) nVent/Hoffman ADLTEMP.
b) Rittal.
5. Status relays and discrete inputs for switches, power supplies, and fieldbus devices (if applicable):
a. Provide as indicated on the Drawings or as specified.
6. Fan ventilation:
a. Provide nVent/Hoffman or Rittal fan speed control:
1) Provide 2 door/cabinet-mounted vent fans for every 72 inches of cabinet width.
2) Provide finger-guard kit.
3) Filter kit with 2 spare filters for each intake fan.
4) Provide bezel and gasket kit.
5) Provide fan shroud.
6) Automatically adjust fan speed depending on remote temperature sensor input.
7) 120 VAC, 60 hertz.
8) NEMA Type 5-15R cord connections.

B. Pilot devices:
1. General:
a. Provide operator pushbuttons, switches, and pilot lights, from a single manufacturer.
b. Size:
1) 30.5 millimeters.
c. Heavy duty.
d. Pushbuttons:
1) Contacts rated:
a) NEMA Type A600.
2) Furnish 1 spare normally open contact and normally closed contact with each switch.
e. Selector switches:
1) Contacts rated:
a) NEMA Type A600.
b) Knob type.
2) Furnish 1 spare normally open contact and normally closed contact with each switch.
3) Provisions for locking in the OFF position where lockout provisions are indicated on the Drawings.
f. Pilot lights:
1) Type:
a) LED for interior installations.
2) Push to test.
3) Lamp color:
a) On/Running/Start: Green.

b) Off/Stop: Red.
c) Power: White.
d) Alarm: Yellow.
e) Status or normal condition: White.
f) Opened: Green.
g) Closed: Red.
h) Failure: Yellow.

2. Indoor and outdoor areas:
   a. NEMA Type 4/13.
   b. Manufacturers: One of the following or equal:
      1) Allen-Bradley, Type 800T.
      2) Schneider Electric, Class 9001, Type K.
      3) General Electric, Type CR104P.
      4) IDEC, TWTD Series.
3. Corrosive areas:
   a. NEMA Type 4X.
   b. Corrosion resistant.
   c. Exterior parts of high-impact strength fiberglass-reinforced polyester or multiple-layer epoxy-coated zinc.
   d. Manufacturers: One of the following or equal:
      1) Cutler Hammer, Type E34.
      2) Schneider Electric, Class 9001, Type SK.
      3) Allen-Bradley Type 800H.
      4) IDEC, TWTD Series.
4. Hazardous (Classified) Areas:
   a. Manufacturers: One of the following or equal:
      1) Cutler Hammer, Type E34.
      2) Allen-Bradley, Type 800H.
   b. Corrosion resistant.
   c. Exterior parts of high-impact strength fiberglass-reinforced polyester or multiple-layer epoxy-coated zinc:
      1) All contacts contained within a hermetically sealed chamber:
         a) Pushbuttons.
         b) Selector switches.
         c) Push-to-test contacts on pilot lights.
      2) UL listed and labeled for Class I Division 2 areas.

C. Potentiometer and slidewire transmitters:
   1. Provide a DC output in proportion to a potentiometer input.
   2. Potentiometer input:
      a. 100 ohms to 100 K ohms.
      b. Impedance Greater or equal to 1 M ohms.
      c. Zero turn-up: 80 percent of full-scale input.
      d. Span turn-down: 80 percent of full-scale input.
   3. Field-configurable output:
      a. Voltage and current: All conventional current loops and voltage control signals.
   4. Accuracy including linearity and hysteresis within 0.1 percent maximum at 77 degrees Fahrenheit.
   5. Operating temperature: 32 degrees to 131 degrees Fahrenheit.
   6. Supply power: 9 to 30 VDC.

7. Manufacturers: The following or equal:
    a. Phoenix Contact, Mini Analog Pro.
    b. Allen Bradley Type 800T-U29.

D. Signal isolators and converters:
1. Furnish signal isolators that provide complete isolation of input, output, and power input:
    a. Minimum isolation level: 1.0 kilovolts AC/50 hertz for at least 1 minute.
    b. Adjustable span and zero.
    c. Accuracy: Within 1.0 percent of span.
    d. Ambient temperature range: -4 degrees to 149 degrees Fahrenheit.
2. Manufacturers: One of the following or equal:
    a. Phoenix Contact, Mini Analog Pro.
    b. Acromag, 1500, 600T, 800T, Flat Pack, or ACR Series.
    c. Action Instruments, Q500 Series or Ultra SlimPakII.
    d. AGM Electronics, Model TA-4000.
    e. Moore Industries, MIT 4-Channel.

E. Relays:
1. General:
    a. For all types of 120-VAC relays, provide surge protection across the coil of each relay.
    b. For all types of 24-VDC relays, provide a free-wheeling diode across the coil of each relay.
    c. For plug in type relays, provide a relay base from the same manufacturer as the relay manufacturer.
2. General purpose:
    a. Magnetic control relays.
    b. NEMA ratings:
        1) 300 volts.
        2) 10 Amps thermal continuous test current.
        3) 60 Amps make.
        4) 6 Amps break.
    c. Plug-in type.
    d. LED indication for energization status.
    e. Coil voltages: As required for the application.
    f. Minimum poles: DPDT.
    g. Touch-safe design: All connection terminals to be protected against accidental touch.
    h. Enclose each relay in a clear plastic heat and shock-resistant dust cover.
    i. Quantity and type of contact shall be as indicated on the Drawings or as needed for system compatibility.
    j. Relays with screw-type socket terminals.
    k. Provide additional (interposing) relays when the following occurs:
        1) The number or type of contacts shown exceeds the contact capacity of the specified relays.
        2) Higher contact rating is required in order to interface with starter circuits or other equipment.
    l. DIN rail mounting on 35-millimeter rail.
    m. Ice-cube-type relays with retainer clips to secure relay in socket.
    n. Integrated label holder for device labeling.

o. Manufacturers: One of the following or equal:
    1) Potter and Brumfield: Type KRP or KUP.
    2) IDEC: R* Series (* = H, J, R, S, U).
    3) Allen-Bradley: Type 700 HC.
    4) Square D: Type K.

3. Terminal block relays:
    a. Magnetic control relays.
    b. For use as an interposing relay for PLC based discrete I/O signals.
    c. NEMA ratings:
        1) 250 volts.
        2) 6 Amps continuous.
        3) 1,500 volt-amperes make.
    d. Plug-in type.
    e. LED indication for energization status.
    f. Coil voltages: As required for the application.
    g. Minimum poles: SPDT.
    h. Touch-safe design: All connection terminals to be protected against accidental touch.
    i. Quantity and type of contact shall be as indicated on the Drawings or as needed for system compatibility.
    j. Relays with screw-type socket terminals.
    k. DIN rail mounting on 35-millimeter rail.
    l. Integrated label holder for device labeling.
    m. Manufacturer: One of the following or equal:
        1) Phoenix Contact PLC Series.
        2) Eaton XR TBR Series.
        3) IDEC RV8H Series.
        4) Allen-Bradley Type 700 HL TBR Series.
4. Latching:
    a. Magnetic-latching control relays.
    b. NEMA ratings:
        1) 300 volts.
        2) 5 Amps continuous.
        3) 360 volt-amperes make.
        4) 320 volt-amperes break.
    c. Plug-in type.
    d. DIN rail mounting on 35-millimeter rail.
    e. Coil voltage: As required for the application.
    f. Minimum poles: 2 PDT; as required for the application. Plus 1 spare pole.
    g. Touch-safe design: All connection terminals to be protected against accidental touch.
    h. Clear cover for visual inspection.
    i. Provide retainer clip to secure relay in socket.
    j. Manufacturers: One of the following or equal:
        1) Square D, 8501, Type K.
        2) IDEC, RR2KP Series.
5. Time delay:
    a. Provide time-delay relays to control contact transition time.
    b. Contact rating:
        1) 240 volts.
        2) 10 Amps continuous.

3) 3,600 volt-amperes make.
4) 360 volt-amperes break.

c. Coil voltage: As required for the application.
d. Provide pneumatic or electronic type with on-delay, off-delay, and on/off-delay:
1) For off-delay, use true power-off time-delay relays. Where the required timing range exceeds capability of the off-delay relay use, signal off-delay where power loss will not cause undesirable operation or pneumatic time-delay relays.
e. Minimum poles: 2 PDT.
f. Units include adjustable dial with graduated scale covering the time range in each case.
g. Minimum timing range: 0.1 seconds to 10 minutes, or as required for the application.
h. Manufacturers: One of the following or equal:
1) IDEC, RTE Series.
2) Tyco Electronics, Agastat 7000 Series (pneumatic).
3) Allen-Bradley, Type 700-HR.

F. Terminal blocks:
1. DIN rail mounting on 35-millimeter rail.
2. Rated for 15 amperes at 600 volts.
3. Screw terminal type.
4. Provide mechanism to prevent wire connection from loosening in environments where vibration is present. This mechanism shall not cause permanent deformation to the metal body.
5. Finger-safe protection for all terminals for conductors.
6. Construction: Polyamide insulation material capable of withstanding temperature extremes from -40 degrees to 221 degrees Fahrenheit.
7. Terminals: Plainly identified to correspond with markings on the diagrams:
a. Permanent machine-printed terminal identification.
8. Disconnect-type field signal conductor terminals with socket/screw for testing.
9. Identify terminals suitable for use with more than 1 conductor.
10. Position:
a. So that the internal and external wiring does not cross.
b. To provide unobstructed access to the terminals and their conductors.
11. Provide minimum 25-percent spare terminals.
12. Manufacturers: One of the following or equal:
a. Phoenix Contact, UT4 Series.
b. Phoenix Contact UT6 Series
c. Allen-Bradley, 1492 Series.

G. DIN rail grounding:
1. Grounding terminal blocks used exclusively for bonding each DIN rail section to panel grounding busbar shall:
a. Mount to DIN rail via grounding foot with mounting screw.
b. Connect to the panel grounding busbar shall be via a green insulated conductor sized in accordance with NEC.
c. Not be used for grounding signal cable shields.
2. Screw terminal type.
3. DIN rail mounting on 35-millimeter rail.

4. Provide mechanism to prevent wire connection from loosening in environments where vibration is present. This mechanism shall not cause permanent deformation to the metal body.
5. Finger-safe protection for all terminals for conductors.
6. Terminals: Plainly identified to correspond with markings on the diagrams:
    a. Permanent machine-printed terminal identification.
7. Manufacturers: One of the following or equal:
    a. Phoenix Contact, USKLG Series.
    b. Allen-Bradley, 1492-JG Series.

H. Wire duct:
1. Provide flame retardant plastic wiring duct, slotted with dust cover.
2. Type:
    a. Wide slot.
    b. Narrow slot.
    c. Round hole.
3. Manufacturers: The following or equal:
    a. Panduit.
    b. Phoenix Contact.
    c. Thomas & Betts.
    d. Iboco.

I. DIN rail:
1. Perforated steel.
2. 35 mm width.
3. 15 mm deep.
4. Provide 2-inch offset using one of the following:
    a. Offset brackets.
    b. Preformed standoff DIN Rail Channel.

J. Surge protection devices (SPD):
1. 120 VAC control panel power SPD:
    a. Provide SPD for panel 120 VAC power entrances:
        1) Non-faulting and non-interrupting design.
        2) Provide line to neutral and neutral to ground surge protection.
    b. Provide surge protection at secondary of main circuit breaker:
        1) Surge protection is not required for 120 VAC circuits that are only used for panel lights and receptacles.
        2) For panels receiving power at 480 VAC, provide surge protection on the 120 VAC control power transformer secondary.
    c. DIN rail mounting.
    d. Attach wiring to the SPD by means of a screw-type cable-clamping terminal block:
        1) Gastight connections.
        2) Visual status indication of MOV status on the input and output circuits.
        3) Dry contact rated for remote status indication.
    e. Approvals:
        1) Tested in accordance with IEC 61643-11.
        2) Tested in accordance with UL 1283.

3) Tested in accordance with UL 1449.
4) Surge protection minimum requirements: Withstand a minimum 10-kA test current of an 8/20 µs waveform in accordance with IEEE C62.41.1 Category C Area.

f. Manufacturers: One of the following or equal:
1) Phoenix Contact, Type SFP Filter.
2) Sola HD, STFE Elite series.
3) Rockwell, 4983-DC series.
4) ASCO, Model 277.

2. 24 VDC control panel power SPD:
a. Provide SPD for 24VDC power circuits.
b. Provide surge protection at DC power supply output.
c. DIN rail mounting.
d. Attach wiring to the SPD by means of a screw-type cable clamping terminal block:
1) Optical status indicator.
2) Dry contact rated for remote status indication.
e. Approvals:
1) Tested in accordance with IEC 61643-11.
f. Manufacturers: One of the following or equal:
1) Field instruments that require auxiliary power:
a) Emerson, Model 265 (SLAC) series.
b) Phoenix Contact, Plugtrab PLT--SEC-T3-24-FM-UT.
2) Loop powered field instruments:
a) Emerson/Edco, Model SS65-036-2.

3. Panel mounted control, signal, and data line SPD:
a. General:
1) This section applies to SPD located in a control panel, field panel, network junction box, or marshalling panel.
2) Approvals:
a) Tested in accordance with IEC 61643-21.
b) Tested in accordance with UL 497B.
3) SPD shall consist of 2 parts:
a) Base module:
(1) DIN rail mounting.
(a) Grounded to DIN rail via mounting rail foot.
b) Plug protection module:
(1) Replacing a plug shall not require the removal of any wires nor interrupt the signal.
4) Provide indirect shield ground style SPD unless otherwise noted.
5) Provide ability to locally identify and indicate SPD health.
6) SPD shall be provided with controller module with dry contact for remote status monitoring of SPD device health.
7) SPD modules shall be compatible with signal, communication bus type, data type, or control power being protected.
8) Provide dedicated SPD for each signal, communication bus type, or data line being protected.
b. Manufacturers: One of the following or equal:
1) Phoenix Contact, Plugtrab PT-IQ Series.
2) Dehn, Blitzductor XTU Series.

4. Copper Ethernet SPD:
    a. Protects network equipment from lightning or other surge events.
    b. Suitable for Gigabit networks.
    c. Shielded RJ-45 ports.
    d. Compliant with PoE standards IEEE 802.3af and 802.3at.
    e. Nominal discharge surge current: 10 kA.
    f. Approvals:
        1) Tested in accordance with IEC 61643-21.
        2) Tested in accordance with UL 497B.
    g. Manufacturers: One of the following or equal:
        1) Phoenix Contact, DT-LAN-CAT6+.
        2) Citel, MJ8-C6A.
        3) Weidmuller, VDATA CAT6.
        4) Eaton/MTL, ZoneBarrier High Energy Ethernet.
5. Field device mounted SPD:
    a. Conduit entry mounting.
        1) Provide parallel or through wiring configurations as required by the application.
            a) Use parallel wiring configuration if there is an available cable gland at the device.
            b) Use through wiring configuration if there is no available cable gland at the device.
        2) Provide Screw connections compatible with field device.
    b. NEMA 4X stainless steel material housing.
    c. Approvals:
        1) Tested in accordance with IEC 61643-21.
    d. 4-wire field device:
        1) Module shall provide simultaneous protection of signal cable, communication bus, or data line, and power supply line.
            a) Maximum continuous voltage:
                (1) DC:
                    (a) Signal: 32 VDC.
                    (b) Power supply: 255 VDC.
                (2) AC:
                    (a) Signal: 22.6 VAC.
                    (b) Power supply: 255 VAC.
        2) Manufacturers: The following, engineer knows of no equal:
            a) Endress+Hauser, HAW569-CB2C.
    e. 2-wire or 3-wire field device:
        1) Module shall provide protection for the signal cable, communication bus or data line.
        2) Manufacturers: One of the following or equal:
            a) Endress+Hauser, HAW569 Series.
            b) Phoenix Contact, Surgetrab S-PT Series.
            c) Eaton/MTL, TP Series.

K. Power supplies:
    1. Design power supply system so that either the primary or backup supply can be removed, repaired or replaced, and returned to service without disrupting the system operation.

2. Convert 120 VAC to 24-volt DC or other DC voltages required or as required for the application.
3. Provide redundant backup 24 VDC power supply units to automatically supply the load upon failure of the primary supply.
4. Provide power supply arrangement that is configured with several modules to supply adequate power in the event of a single module failure in either a 1+1 or N+1 configuration as required:
    a. Provide automatic switchover upon module failure.
    b. Alarm contacts monitored by the PLC.
5. Provide protective isolation between power supply units either by means of Diodes, Diode Modules, MOSFET Modules, or use power supplies with built in redundancy. Power supplies with built in redundancy must actively isolate each power supply and be designed as such.
6. Sized to provide 40-percent excess rated capacity.
7. UL 508C listed to allow full-rated output without de-rating.
8. Provide fuse or short-circuit protection.
9. Provide a minimum of 1 set of dry contacts for each power supply configured to change state on failure for monitoring and signaling purposes.
10. Output regulation: Within 0.05 percent for a 10-percent line change or a 50-percent load change.
11. Operating temperature range: 32 degrees to 140 degrees Fahrenheit.
12. Touch-safe design: All connection terminals to be protected against accidental touch.
13. DIN rail mounting on 35-millimeter rail:
    a. Mount the power supply in the proper orientation as recommended by the manufacturer to ensure adequate thermal dispersion without derating the power supply.
14. Provide self-protecting power supplies with a means of limiting DC current in case of short circuit.
15. Manufacturers: One of the following or equal:
    a. Fully redundant:
        1) Phoenix Contact, Quint Power Supply with SFB technology.
            a) Phoenix Contact, Quint.
        2) IDEC, PS5R Series:
        3) Sola.
        4) PULS.
    b. Redundancy module:
        1) Phoenix contact, O-ring redundancy module.

L. Intrinsic safety barriers:
1. Transformer isolated barrier:
    a. Containing a transformer to provide complete:
        1) Isolation between the safe and hazardous areas for loop-powered devices.
        2) 3-way isolation between the safe area, hazardous area, and power supply powered devices.
    b. Resistor for current limitation.
    c. Fuses for short-circuit protection.
    d. Provide barriers with pluggable connectors that are coded for easy replacement.
    e. Transmission error shall be less than or equal to 0.1 percent of full-scale.

f. DIN rail mounting on 35-millimeter rail.
g. Approvals:
1) FM.
2) UL 913.

2. Types:
a. Switch isolators:
1) Designed and approved for use with discrete inputs.
2) Supply power: 20 to 30 VDC.
3) Output to track input.
4) LED in the cover to indicate the status of the input.
5) Selector switch to change the logic of the input.
6) Input: Dry contact.
7) Output: SPDT relay.
b. Transmitter and converters for use with 4- to 20-milliampere signals without Hart® communications capability:
1) Designed and approved for use with 4- to 20-milliampere analog signals.
2) Designed for powering 2- and/or 3-wire transmitters in hazardous locations and repeating and/or generating the current to the safe area.
3) Supply voltage: 20 to 30 VDC.
c. Transmitter and converters for use with 4- to 20-milliampere signals with Hart® communications capability:
1) Designed and approved for use with 4- to 20-milliampere analog signals.
2) Designed for powering 2- and/or 3-wire transmitters in hazardous locations and repeating and/or generating the current to the safe area.
3) Transfer digital signals from the hazardous area to the safe area.
4) Complete bi-directional communication between a smart transmitter located in the field and the suitable equipment located in the safe area.
5) Supply voltage: 20 to 30 VDC.

3. Manufacturers: One of the following or equal:
a. Phoenix Contact, MACX Series.
b. Pepperl + Fuchs.

M. Starters:
1. Magnetic motor starters:
a. As specified in Section 16422 - Motor Starters.
2. Integral self-protected starters:
a. As specified in Section 16422 - Motor Starters.

N. Variable frequency drives:
1. As specified in Section 16262 - Variable Frequency Drives 0.50 - 50 Horsepower.

O. Limit switches:
1. Nonhazardous locations:
2. AC contact rating 120 volts, 10 A.
3. DC contact rating 125 volts, 0.4 A.

4. Provide robust actuation mechanism not prone to degradation.
5. Provide complete actuator mechanism with all required hardware.
6. Allows for contact opening even during contact weld condition.
7. UL approved.
8. Operating temperature range: 0 degrees to 230 degrees Fahrenheit).
9. Manufacturers: One of the following or equal:
    a. Allen-Bradley, 802 Series.
    b. Honeywell, HDLS Series.
    c. Eaton, E47, E49, E50.
10. Nonhazardous locations:
    a. Rating:
        1) NEMA Type 4X - nonhazardous areas.
        2) Explosion-proof - Class I Div. 1 areas.
        3) Explosion-proof or NEMA 4X with intrinsic safe circuits and contacts - Class I Division 2 areas.
    b. Manufacturers: One of the following or equal:
        1) Allen-Bradley, 802XR Series.
        2) Honeywell, BX, BX2 GSX Series.
        3) Eaton, 10316h Series.

P. Current switches:
1. Operate from 120-VAC supply voltage.
2. 1 normally open and normally closed contacts.
3. Adjustable current setting.
4. Manufacturers: The following or equal:
    a. Zelio®, RM35.
    b. Phoenix Contact, EMD Series.

Q. Current transmitters:
1. Input current range: As indicated on the Drawings.
2. Output: 4-20 mA.
3. Operate from 24 VDC supply voltage.
4. Output overload protected.
5. Accuracy: Within 0.5 percent full-scale.
6. Ripple and Noise: 1 percent Max., peak to peak.
7. Frequency: 50/60 hertz.
8. Manufacturer:
    a. Phoenix Contact: Mini Analog Pro Series.
    b. CR Magnetics: CR4320 series.
    c. American Aerospace: 1070 Series.

2.08 ACCESSORIES

A. Provide panels with an inside protective pocket to hold the panel drawings. Ship panels with 1 copy of accepted Shop Drawings including, but not limited to, schematic diagram, connection diagram, and layout drawing of control wiring and components in a sealed plastic bag stored in the panel drawing pocket.

B. Provide floor stands or legs with a minimum height of 12 inches where needed or as indicated on the Drawings.

C. Provide a folding shelf for enclosures that contain programmable controllers. The shelf shall be mounted on the inside surface of the door, capable of supporting a laptop computer.

D. Provide nameplate to each panel as indicated on the Drawings:
   1. Provide as specified in Section 16075 - Identification for Electrical Systems on all internal and external instruments and devices.
   2. Provide a nameplate with the following markings that is plainly visible after installation:
      a. Manufacturer’s name, trademark, or other descriptive marking by which the organization responsible for the panel can be identified.
      b. Supply voltage, phase, frequency, and full-load current.
      c. Power source or circuit ID.
      d. Short-circuit current rating of the panel based on one of the following:
         1) Short-circuit current rating of a listed and labeled assembly.
         2) Short-circuit current rating established utilizing an approved method.

E. Lighting:
   1. Provide 1 luminaire for each section, on the interior of the panel, spaced evenly along the top-front of the enclosure door opening(s):
      a. Covered or guarded.
      b. Provide On-Off door-activated switches where indicated on the Drawings.
      c. 120-volt, single-phase, 15-amp style plug.
      d. Provide 4,000 K, 900 Lumens LED fixture.
         1) Provide additional fixtures for every 36 inches of width.

F. Receptacles:
   1. Provide 1 duplex receptacle located every 6 feet of enclosure width, spaced evenly along the back mounting panels.
   2. GFCI, 120-volt, single-phase, 15-amp style plug.
   3. Provide circuit breaker or fuse to limit receptacle draw to 5 amperes.

G. Grounding:
   1. Provide the following:
      a. Grounding strap between enclosure doors and the enclosure.
      b. Equipment grounding conductor terminals.
      c. Provide equipment grounding busbar with lugs for connection of all equipment grounding wires.
      d. Bond multi-section panels together with an equipment grounding conductor or an equivalent grounding busbar.
   2. Identify equipment grounding conductor terminals with the word "GROUND," the letters "GND", the letter "G", or the color green.
   3. Signal cable shields shall only be grounded at a single point in the loop. Unless otherwise noted, ground signal cable shields at control panel.
   4. Ensure the continuity of the equipment grounding system by effective connections through conductors or structural members.
   5. Design so that removing a device does not interrupt the continuity of the equipment-grounding circuit.
   6. Provide an equipment-grounding terminal for each incoming power circuit, near the phase conductor terminal.

7. Size ground wires in accordance with NEC and UL Standards, unless noted otherwise.
8. Unless otherwise noted, connect all exposed, noncurrent-carrying conductive parts, devices, and equipment to the equipment-grounding circuit.
9. Connect the door stud on the enclosures to an equipment-grounding terminal within the enclosure using an equipment-bonding jumper.

H. Provide sunshades and insulation for all outdoor installations.

2.09 MIXES (NOT USED)

2.10 FABRICATION (NOT USED)

2.11 FINISHES

A. Finishes:
   1. Metallic (non-stainless):
      a. Metal surfaces of panels shall be prepared by chemical cleaning and mechanical abrasion in accordance with the finish manufacturer's recommendations to achieve a smooth, well-finished surface.
      b. Scratches or blemishes shall be filled before finishing. One coat of zinc phosphate shall be applied per the manufacturer's recommended dry-film thickness and allowed to dry before applying the finish coat.
      c. Finish coat shall be a baked polyester-urethane powder, aliphatic air-dry polyurethane, or epoxy enamel to meet NEMA rating specified application.
      d. Exterior of enclosures located outdoors shall be UV-resistant polyester powder coating. Total dry film thickness shall be 3 mils, minimum.
   2. Stainless steel:
      a. Stainless enclosures shall be provided with a Number 4 brushed finish - not painted.

B. Colors:
   1. Exterior color of panels mounted indoors shall be manufacturer's standard light gray.
   2. Exterior of panels mounted outdoors shall be manufacturer's standard white.
   3. Panel interiors shall be manufacturer's standard white.

2.12 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine the installation location for the instrument and verify that the instrument will work properly when installed.
   1. Notify the Engineer promptly if any installation condition does not meet the instrument manufacturer's recommendations or specifications.

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. Install enclosures so that their surfaces are plumb and level within 1/8-inch over the entire surface of the panel; anchor securely to wall and structural supports at each corner, minimum. Direct attachment to drywall is not permitted.

B. Install the enclosure per guidelines and submitted installation instructions to meet the seismic requirements at the project site.

C. Provide floor stand kits for wall-mounted enclosures larger than 48 inches high.

D. Provide concrete housekeeping pads for freestanding enclosures.
   1. Refer to the structural typical details.

E. Install gasket and sealing material under panels with floor slab cutouts for conduit:
   1. Undercoat floor-mounted panels.

F. Provide a full-size equipment-grounding conductor in accordance with NEC included with the power feeder. Terminate to the incoming power circuit-grounding terminal.

G. All holes for field conduits, etc. shall be cut in the field. There shall be no additional holes, factory cut holes, or hole closers allowed. Incorrect holes, additional holes, or miscut holes shall require that the entire enclosure be replaced.

H. Protect all wiring from sharp edges and corners.

I. Control panels that are adjacent to motor control centers shall be fully wired to the motor control centers using wireways integral to the motor control center or additional conduits as needed. These interconnections are not shown or reflected on the Conduit Schedule but shall be shown on the Loop Drawings prepared by the Contractor.

J. Provide individually fused analog input module points with blown-fuse indicator lights, mounted external of the module on the output terminal strip.

K. Side panels:
   1. Side panels shall be kept free off all control equipment and devices. Any deviation must be sent to the engineer in writing asking for a deviation.

3.04 ERECTION, INSTALLATION, APPLICATION, AND CONSTRUCTION (NOT USED)

3.05 REPAIRS/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL (NOT USED)

3.08 ADJUSTING (NOT USED)

3.09 CLEANING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.10 DEMONSTRATION AND TRAINING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17720

CONTROL SYSTEMS: PROGRAMMABLE LOGIC CONTROLLERS

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Programmable logic controller (PLC) based control systems hardware.
   2. Development software to be used with the specified PLC hardware.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Institute of Electrical and Electronics Engineers (IEEE).

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Specific definitions:
   1. CPU: Central processing unit.
   2. I/O: Input/Output.

C. Specific definitions:
   1. Development operating software: The software provided by the PLC manufacturer for use in programming the PLC.
   2. Application software: The software that is programmed specifically for the Project.

1.04 SYSTEM DESCRIPTION

A. Provide all PLC hardware as indicated on the Drawings and as specified in this Section.

1.05 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Product data:
   1. CPU:
      a. Processor type.
      b. Processor speed.
      c. Memory.
      d. Internal processor battery backup time.

2. I/O modules:
    a. Type.
    b. Standard wiring diagram.

C. Calculations:
1. Submit calculations or documented estimate to verify that memory requirements of this Section are met, including spare requirements. If possible, use PLC manufacturer's calculation or estimating worksheet.
2. Submit calculations to verify that spare I/O requirements of this Section are met.
3. Submit calculations to verify that PLC power supply requirements of this Section are met.

D. Product data:
1. Programming languages.
2. Operating system requirements.

E. Control logic:
1. Fully annotated copy of programmed PLC logic.
2. Cross-referenced index of all PLC registers or points.

F. Provide application software for the specific Project process requirements.
1. Fully annotated copy of programmed PLC logic in its native format.
2. Cross-referenced index of all PLC registers or points.

1.06 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Provide PLC hardware manufactured at facilities certified to the quality standards of ISO 9001.

C. Additional requirements:
1. Provide PLC system components by a single manufacturer:
    a. Third-party communication modules may be used only for communication or network media functions not provided by the PLC manufacturer.
2. Use PLC manufacturer approved hardware, such as cable, mounting hardware, connectors, enclosures, racks, communication cable, splitters, terminators, and taps.
3. All PLC hardware, CPUs, I/O devices, and communication devices shall be new, free from defects, and produced by manufacturers regularly engaged in the manufacture of these products.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.08 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE

A. CPU: 1 spare for each type of CPU in the system.

B. I/O cards: 3 spares for each type of I/O card in the system.

C. Power supplies: 2 spares for every power supply in the system.

D. Network/communications cards: 1 spare for every network or communications card in the system.

E. Remote adapter: 1 spare for every remote adaptor in the system.

F. Chassis: 1 spare for each chassis size in the system.

G. Communication cable: 1 spare for each type of cable used in the system.

H. Installed spare requirements:
   1. I/O points:
      a. Provide total of 25 percent spare I/O capacity for each type of I/O at every PLC/RIO rack using the following calculation:

$$\left(1 - \frac{\text{UTILIZED IO POINT COUNT}}{\text{TOTAL IO POINT COUNT}}\right) * 100 = \%\text{SPARE}$$

      b. Wire all spare I/O points to field terminal blocks in the same enclosure the PLC/RIO resides in.
   2. PLC backplane capacity:
      a. Provide 25-percent or 3 spare backplane slots, whichever is greater, in all racks containing I/O.
   3. PLC memory:
      a. Provide 50-percent spare program volatile memory.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Rockwell Automation:
      a. For Plant PLC (PLC-4, PLC-99400): ControlLogix 5580, 1756-L8 Series.
      b. For Vendor PLC (VCP-3): CompactLogix 5380, 5069-L3 Series.

B. The PLC programming software system shall be manufactured by PLC hardware manufacturer:
   1. Rockwell Software:
      a. Studio 5000.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. Programmable logic controller:
   1. Construction:
      a. Furnish plug-in modular system.
      b. Provide PLCs capable of operating in a hostile industrial environment without fans, air conditioning, or electrical filtering:
         1) Temperature: 0 to 55 degrees Celsius.
         2) RFI: 80 to 1,000 MHz.
         3) Vibration: 10 to 500 hertz.
         4) Humidity: 0 to 95 percent.
      c. Provide internal power supplies designed to protect against overvoltage and frequency distortion characteristics frequently encountered with the local power utility.
      d. Design the PLC system to function as a standalone unit that performs all of the control functions described in this Section completely independent from the functions of the HMI system PC-based operator interfaces:
         1) Failure of the HMI system shall not impact data acquisition, control, scaling, alarm checking, or communication functions of the PLC.
   2. CPU:
      a. Configure each CPU so that it contains all the software relays, timers, counters, number storage registers, shift registers, sequencers, arithmetic capability, and comparators necessary to perform the specified control functions.
      b. Capable of interfacing with all discrete inputs, analog inputs, discrete outputs, analog outputs, and communication cards to meet the specified requirements.
      c. Capable of supporting and implementing closed-loop floating-point math and PID control that is directly integrated into the CPU control program.
   3. Memory:
      a. Non-volatile memory: On-board complementary metal-oxide-semiconductor (CMOS), electrically erasable programmable read-only memory (EEPROM), PCMCIA, compact flash card, or SD card.

b. Supply with sufficient memory to implement the specified control functions plus a reserve capacity as specified with the requirements of this Section:
    1) Reserve capacity:
        a) Totally free from any system use.
    2) Programmed in a multi-mode configuration with multiple series or parallel contacts, function blocks, counters, timers, and arithmetic functions.

4. Programming:
    a. Provide a system where processors are programmed by:
        1) Portable laptop computer both locally and via the PLC control network.
5. PLC power supply:
    a. Input: 120 VAC.
    b. Mounted in the PLC housing or as indicated on the Drawings.
    c. Sized to power all modules mounted in that housing including an average module load for any empty housing slots plus 50 percent above that total.
6. PLC input/output, I/O modules: 16-channel General:
    a. Compatible with all of the PLCs being furnished under the contract and by the same manufacturer as the PLCs.
    b. Provide I/O modules that:
        1) Isolate in accordance with IEEE Surge Withstand Standards and NEMA Noise Immunity Standards.
        2) Provide A/D and D/A converters with optically or galvanically isolated inputs and outputs.
        3) Accept dual-ended inputs.
    c. The use of common grounds between I/O points is not acceptable.
    d. Provide modules that are removable without having to disconnect wiring terminals:
        1) Utilize a swing-arm or plug-in wiring connector.
    e. Provide at each PLC the I/O modules for the following:
        1) Designated future I/O points contained in the I/O Lists and/or shown on the P&IDs, control schematics, or described in the control strategies.
        2) Installed spare capacity in accordance with the requirements of this Section.
        3) Wire all spares provided to the field terminal strip.
    f. Condition, filter, and check input signals for instrument limit conditions.
    g. Filter, scale, and linearize the raw signal into an engineering-units-based measurement.
    h. Alarm measurements for high, low, rate-of-change limits, and alarm trends.
    i. Provide external fuses mounted on the field connection terminal block for all discrete input, discrete output, and analog input I/O points.
    j. When multiple cards of the same I/O type are provided and parallel equipment, instrumentation, or redundant processes exist, distribute I/O among cards to ensure that a single card failure will not render an entire process unavailable.
    k. Discrete input modules:
        1) Defined as contact closure inputs from devices external to the input module.

2) Provide inputs that are optically isolated from low-energy common-mode transients to 1,500 volts peak from users wiring or other I/O modules.
3) Individually isolated inputs.
4) With LEDs to indicate status of each discrete input.
5) Input voltage: 120VAC.
6) Provide input module points that are individually fused with blown-fuse indicator lights, mounted external of the module on the output terminal strip:
a) Coordinate external fuse size with the protection located on the module, so that the external fuse opens first under a fault condition.

l. Discrete output modules:
1) Defined as contact closure outputs for ON/OFF operation of devices external to the output module:
a) Triac outputs may be used, with the permission of the Engineer. Care must be used in applying this type of module to ensure that the leakage current through the output device does not falsely signal or indicate an output condition.
2) Optically isolated from inductively generated, normal mode and low-energy common-mode transients to 1,500 volts peak.
3) LEDs to indicate status of each output point.
4) Output voltage: 120VAC.
5) Individually isolated outputs.

m. Analog input modules: individually isolated:
1) Signal type: Provide 4-20 mA for most applications; other levels are acceptable to interface to vendor control panels.
2) Analog-to-digital conversion: Minimum 12-bit precision with the digital result entered into the processor.
3) The analog-to-digital conversion updated with each scan of the processor.
4) Individually isolated each input.
5) Coordinate the size of the external fuse with the protection located on the module, so that the external fuse opens first under a fault condition.

n. Analog output modules:
1) Signal type: Provide 4-20 mA for most applications; other levels are acceptable to interface to vendor control panels.
2) Individual isolated output points each rated for loads of up to 1,000 ohms.

o. Specialty I/O modules:
1) HART analog input module:
a) Channels per module: 4 minimum.
b) Signal type: Each channel individually configurable for current (0 to 20 mA DC or 4 to 20 mA DC) or voltage (0 to 5 VDC, 0 to 10 VDC, or -10 to 10 VDC).
c) Each channel can individually have HART enabled or disabled.
d) Flash-upgradeable firmware.
e) Mounts in slot in PLC backplane.
f) Modules shall be configured using the specified PLC programming software.

2) HART analog output module:
a) Channels per module: 4 minimum.
b) Signal type: Each channel individually configurable for current (0 to 20 mA DC or 4 to 20 mA DC) or voltage (0 to 5 VDC, 0 to 10 VDC, or -10 to 10 VDC).
c) Each channel can individually have HART enabled or disabled.
d) Flash-upgradeable firmware.
e) Mounts in slot in PLC backplane.
f) Modules shall be configured using the specified PLC programming software.

7. Communications modules:
a. Remote I/O adapter module:
1) For any PLC location requiring more than 1 housing to mount all of the I/O modules or that is identified as a RIO, provide the appropriate remote I/O adapter module for communication with the secondary housing(s).
2) Install the RIO adapter module in the PLC backplane and the RIO backplane.
3) Provide adapter modules that support all available types of I/O modules required.
4) Provide all network taps, connectors, termination resistors, drop cables, and trunk cables necessary for remote I/O communications.
5) Complete diagnostic LEDs.
b. Network communications modules:
1) General:
a) Install communications modules in the PLC backplane.
2) Ethernet:
a) Ports: 1 RJ-45 as indicated on the Drawings.
b) Communication rate: 100 Mbit/s.
c) Allen-Bradley ControlLogix - 1756-EN2T.
3) Provide all network taps, connectors, termination resistors, drop cables, and trunk cables necessary for remote I/O communications.

8. PLC backplane housing:
a. Mount the PLC power supply, CPU, communications module, and I/O modules in a suitable standard PLC backplane or housing.
b. Provide spare slots in each PLC and RIO location in accordance with the requirements of this Section.
c. Provide a blank slot filler module for each spare slot.

B. HMI system interface:
1. As specified in Section 17733 - Control Systems: Network Materials and Equipment.

C. PLC programming software:
1. Furnish operating software capable of monitoring and/or controlling the PLCs via the PLC data network:
a. Contain diagnostics to collect troubleshooting and performance data and display it in easy to understand graphs and tables.

b. Monitor devices at each drop on the PLC data network for proper communications.
c. Provide the ability to program all PLCs on the PLC data network from the Engineer's console.

2. PLC programming laptop/desktop operating system:
   a. Microsoft Windows 10.
3. The PLC programming software shall be suitable for the PLCs specified above.
4. PLC programming software for all programming, monitoring, searching, and editing:
   a. Usable both on-line, while connected to the PLC, and off-line.
   b. The operating software shall display multiple series and parallel contacts, coils, timers, counters, and mathematical function blocks.
   c. Capable of disabling/forcing all inputs, outputs, and coils to simulate the elements of the ladder logic; forced elements shall be identifiable by means of color change.
   d. Include a search capability to locate any address or element and its program location.
   e. Display at the EC, PLC status information, such as faults and communication errors and amount of memory remaining.
5. The PLC programming software shall support the following programming languages:
   a. Ladder Diagram.
   b. Function Block Diagram.
6. Generate a PLC program printout, which is fully documented, through the PLC programming software:
   a. Fully documented program listings include, as a minimum, appropriate rungs, address, and coils shown with comments to clarify to a reader what that segment of the program accomplishes on an individual line-by-line basis.
   b. Include a sufficient embedded comment for every rung of the program explaining the control function accomplished in said rung.
   c. Use a mnemonic associated with each contact, coil, etc. that describes its function.
   d. Utilize the tag and loop identification as contained in the P&IDs:
      1) If additional internal coils, timers, etc. are used for a loop, they shall contain the loop number.
   e. Provide a cross-reference report of program addresses.
7. Software functions automatically without operator intervention, except as required to establish file names and similar information:
   a. Furnish the operating system software that is the standard uncorrupted product of the PLC manufacturer with the following minimum functions:
      1) Respond to demands from a program request.
      2) Dynamic allocation of the resources available in the PLC. These resources include main memory usage, computation time, peripheral usage, and I/O channel usage.
      3) Allotment of system resources based on task priority levels such that a logical allocation of resources and suitable response times are ensured.
      4) Queuing of requests in order of priority if one or more requested resources are unavailable.

5) Resolution of contending requests for the same resource in accordance with priority.
6) Service requests for execution of one program by another.
7) Transfer data between programs as requested.
8) Management of all information transfers to and from peripheral devices.
9) Control and recovery from all program fault conditions.
10) Diagnose and report real-time hardware device errors.

8. Program execution:
   a. Application software - program execution scheduled on a priority basis:
      1) A multilevel priority interrupt structure is required.
      2) Enter into a list of pending programs a program interrupted by a higher priority program:
         a) Resume its execution once it becomes the currently highest priority program.
      3) Schedule periodic programs.
      4) Base the allocation of resources to a time-scheduled program on its relative priority and the availability of resources.
9. Start-up and restart:
   a. Provide software that initializes and brings a PLC or any microprocessor-based hardware unit from an inactive condition to a state of operational readiness.
   b. Initialization:
      1) Determination of system status before start-up of initializing operating system software and initializing application software.
      2) Loading of all memory-resident software, initializing timers, counters, and queues, and initialization of all dynamic database values.
10. Shutdown:
   a. Where possible, provide orderly shutdown capability for shutdowns resulting from equipment failure, including other PLC processor failures, primary power failure, or a manually entered shutdown command.
   b. Upon loss of primary power, a high-priority hardware interrupt initiates software for an immediate, orderly shutdown.
   c. Hardware is quickly and automatically commanded to a secure state in response to shutdown command or malfunction.
   d. Alarm PLC failure at the operator interface level.
11. Diagnostics:
   a. Furnish diagnostic programs with the PLC software package to detect and isolate hardware problems and assist maintenance personnel in discovering the causes for system failures.
   b. Use the manufacturer's standard diagnostic routines as much as possible.
   c. Furnish diagnostic software and test programs for each significant component in the control system.
   d. As a minimum, provide diagnostic routines to test for power supply, central processing unit, memory, communications, and I/O bus failures.
12. Calendar/time program:
   a. The calendar/time program to update the second, minute, hour, day, month, and year and transfer accurate time and date information to all system-level and application software.

b. Variations in the number of days in each month and in leap years must be handled automatically by the program.
c. The operator must be able to set or correct the time and date from any operator interface, only at the highest security level.

13. Algorithms:
    a. Implementation of algorithms for the determinations of control actions and special calculations involving analog and discrete data.
    b. Algorithms must be capable of outputting positional or incremental control outputs or providing the product of calculations.
    c. Algorithms must include alarm checks where appropriate.
    d. Provide, as a minimum, the following types of algorithms:
        1) Performs functions such as summing several variables, raising to a power, roots, dividing, multiplying, and subtracting.
        2) A switch algorithm, which reads the current and value from its input address and stores it as the value of its output address. 2 types of switches shall be accommodated: 2 outputs with 1 input and 1 output with 2 inputs.
        3) A 3-mode proportional-integral-derivative, PID, controller algorithm, with each of the 3 modes independently adjustable, supports both direct and reverse-acting modes.
        4) Lead, lag, dead time, and ratio compensators.
        5) Integration and totalization of analog process variables.
14. Furnish a comprehensive database for the analog inputs, calculated values, control modules, and outputs:
    a. In addition, provide spare database points for future expansion.
15. One integrated database can be utilized for all types of analog points or separate databases for each type; in either case, the database for each point must include all specified aspects.
16. All portions of the database must be available for use by the display, report, and other specified software modules.
17. All of the data fields and functions specified below must be part of the point definition database at the operator interface. Provide the capability to define new database points through the point display specified below as well as modifying defined points through these displays. This point definition and modification must include all of the features and functions defined below. The analog database software must support the following functions and attributes:
    a. Analog input signal types:
        1) Provide software at the remote terminal units (RTUs) and PLCs to read variable voltage/current signals and pulse duration/frequency type analog input signals.
    b. Input accuracy:
        1) Inputs must be read with an accuracy of within 0.05-percent full-scale or better.
        2) Data conversion errors must be less than 0.05-percent full-scale.
        3) Pulse accumulation error less than or equal to 1 count of actual input count at a scan rate of once per minute.
        4) Maintain for a minimum of 1 year the system accuracy stated above without adjustments.

c. Blocking:
    1) Provide mechanisms to inhibit or block the scanning and/or processing of any analog input through the operator interface.
    2) For any input so blocked, the operator may manually enter a value to be used as the input value.
d. Filtering:
    1) For each analog input, provide a first order lag digital filter with an adjustable filter factor.
e. Linearizing:
    1) Where analog inputs require square root extraction or other linearization, provide a mechanism to condition the filtered data before the process of scaling and zero suppression takes place.
f. Calculated values:
    1) Provide means to allow for pseudo-inputs calculated by algebraic and/or Boolean expressions utilizing real inputs, other calculated values, constants, etc.
    2) These values must be handled the same as real inputs in terms of record-keeping, alarming, etc.
g. Scaling and zero suppression:
    1) Provide a conversion program to convert input values into engineering units in a floating-point format.
h. Alarms:
    1) Provide an alarm program to check all analog variables against high-high, high, low, and low-low alarm limits.
    2) When an analog value exceeds a set limit, it must be reported as an alarm based on individually set priority level for each alarm point.
    3) Provide an adjustable hysteresis band in order to prevent excessive alarms when a variable is hovering around an alarm limit.
    4) Must be possible to inhibit alarms based on external events, e.g., lock-out low pump flow alarm when the pump is off.
i. Averages:
    1) Provide a program to calculate and store hourly, daily, and monthly averages of analog variables.
    2) Continuously compute averages, e.g., the average for the current period to the present point in time must be stored in memory and available for use in displays, etc.
    3) Update hourly averages each minute or at the polling interval for the selected variable.
    4) Update daily averages at least once each hour and calculate using the results of the hourly averages.
    5) Update monthly averages at least once each day and calculate using the results of the daily averages.
    6) At the end of each averaging period, store the average values for the period on the hard disk for historical record-keeping and reset the present period average register to the present value of the variable.
    7) The active database must include the present period average and previous period average for each variable and averaging period.
j. Totals:
    1) Provide a program to calculate and store hourly, daily, and monthly totalization of analog variables.

2) Assign a scaling factor to each variable to convert to the appropriate units based on a 1-minute totalizing interval.
3) Assign a separate factor for each totalizing interval.
4) Variables for which totalization is inappropriate must have scaling factors of zero.
5) At the end of each totalizing period, store the totalized values for the period on the hard disk for historical record-keeping and reset the present period totalization register to zero.
6) The active database must include the present period total and previous period total for each variable and totalizing period.

k. Engineering units:
1) Provide software to allow the system and the operator to convert all the measured analog variables to any desired engineering units.
2) The operator must be able to view displays and generate reports of any measured variable in one or more engineering units such as flow in gpm, mgd, cfs, and acre-feet per day.
3) Pre-program the conversion of the engineering units, and, if not pre-programmed, the operator must be able to program new engineering unit conversions by using simple methods, e.g., multiplication of the database attributes by a constant.
4) The programming method must be at a level and compatible with the specified training of the operator and the Owner's personnel.
5) New conversions must not require the services of a special programmer and/or special, high-level, programming training.

l. Control modules:
1) For each control function configured, whether processed at the RTU, PLC, or operator interface, maintain a file of necessary data including input values, setpoints, constants, intermediate calculated values, output value and limit clamps, etc.
2) Input and output assignments, setpoints, and constants must be adjustable by the operator through the operator interface.
3) Provide control algorithms for manual control with output values adjustable by the operator.

m. Analog outputs:
1) Analog outputs must be maintained as part of the database.
2) These outputs must be adjustable manually by the operator through the operator interface or through automatic control algorithms.

18. Some of the above functions may be better accomplished in the data acquisition and graphic display software package; it is the responsibility of the ICSC to optimize the location of the various functions between all software packages.

D. General control functions:
1. Analog control functions:
a. PID, lead/lag, signal select, alarm, limit, delay, and time base.
b. Furnish the control system complete with a library of mathematical/calculation software to support averaging, weighted average, addition, subtraction, multiplication, division, square root extraction, exponential, AND, OR, NAND, NOR, XOR, and NXOR functions.

c. All math utilities must be linkable to process data points or manual inputs via control block configuration.
d. By linking control blocks to data points, the math library must support system unit conversion and calculation requirements.

2. Discrete control functions:
   a. AND, OR, NOT, EXCLUSIVE OR, comparators, delays, and time base.
3. Software support:
   a. Retain in firmware all control and logic functions at each RTU and PLC and in RAM at the operator interface.
   b. Call each function as required by the configured controls to perform the intended function.
4. Control and status discrepancies:
   a. Generate a discrepancy/fail alarm for any pump, valve, or final control element if a discrepancy exists between a system or operator command and the device status.
      1) For example, the system commands to start (call), and the pump fails to start (run status report back), within predetermined operator-programmable time delay (time disagree), then a discrepancy (fail) alarm shall be generated.
   b. Involuntary change in the device's status must also generate an alarm:
      1) For example, a pump starts when not commanded to do so, or a pump shuts down while running even though it still has a command to run.
   c. Each command, status, and alarm must cause the color of the symbol to change.
   d. Because many discrete final control elements have a cycle time in excess of the scan interval, provide each control output with an associated delay period selected to be longer than the operating period of the control element:
      1) Delay periods for each final control element must be adjustable at the operator interface.
      2) List all time delays in the final documentation.
5. Some of the above functions may be better accomplished in the data acquisition and graphic display software package; it is the responsibility of the ICSC to optimize the location of the various functions between all software packages.

E. Control configuration:
1. Provide software to allow control strategies to be developed, and their operation initiated through the operator interface.
2. Provide standardized control point displays for defining the control functions including the function type, input/output addresses, setpoints, tuning constants, etc.
3. Provide a mechanism to link separate control functions together into an integrated control strategy.
4. Provide a mechanism to download operational/control setpoints developed at any operator interface to any PLC or RTU for operational implementation.

5. Provide a mechanism to define and implement operational/control setpoints locally at the PLC or RTU, and to upload them to the operator interface for operational record-keeping.
6. Perform control configurations on-line at the operator interface; the PLC or RTU may be taken off-line when being configured or downloaded.

F. Remote inputs and outputs (RIOs):
1. Compatible with all of the PLCs being furnished under this Contract, shall be by the same manufacturer as the PLCs, and, as a minimum, include:
   a. Power supply.
   b. Rack.
   c. Backplane.
   d. Communications module.
   e. I/O modules.
   f. Enclosure.
2. Provide all cables and software needed for a complete and operational RIO system as specified in the Contract Documents.
3. Provide a group of pre-assigned diagnostic registers to report RIO system faults to the driver PLC.
4. The control system must continue operation should a fault occur on a single RIO drop:
   a. Upon clearing the fault, restart communications to that drop automatically.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Utilize personnel to accomplish or supervise the physical installation of all elements, components, accessories, or assemblies:
   1. Employ installers who are skilled and experienced in the installation and connection of all elements, components, accessories, and assemblies.

C. All components of the control system including all data network cables are the installation responsibility of the ICSC unless specifically noted otherwise.

D. General:
   1. The control system logic program shall reside at the PLC level.

E. Use the tag and loop identifications found on the P&IDs for all tags used and/or assigned as part of the application software work provided by the ICSC.

F. Program the PLC logic using the following language(s):
   1. Ladder Diagram.
   2. Function Block Diagram.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION

A. Provide a minimum of 4 CD/DVD copies of the following:
   1. Application software:
      a. Finalized fully annotated copy of programmed PLC logic in its native format.
      b. Cross-referenced index of all PLC registers or points.

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL (NOT USED)

3.08 ADJUSTING (NOT USED)

3.09 CLEANING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.10 DEMONSTRATION AND TRAINING

A. Tailor training specifically for this Project that reflects the entire control system installation and configuration.

B. Perform training by pre-approved and qualified representatives of the ICSC and/or manufacturer of the PLC hardware and programming software:
   1. A representative of the ICSC may perform the PLC hardware training only if the representative has completed the manufacturer's training course for the PLC hardware.
   2. A representative of the ICSC may perform the PLC programming software training only if the representative has completed the manufacturer's training course for the PLC programming software.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17721

CONTROL SYSTEMS: LOCAL OPERATOR INTERFACE (LOI)

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Local Operator Interface (LOI) control systems hardware and software.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.04 SYSTEM DESCRIPTION

A. Provide all LOI hardware identified in the Contract Documents.

B. Provide a licensed copy of the Manufacturer's Programming software for the selected LOIs.

1.05 SUBMITTALS

A. Furnish submittals in accordance with Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Product data:
   1. Complete manufacturer's brochures for each item of equipment.
   2. Complete manufacturer's brochures that identify LOI software and options. Mark up to clearly show options and components to be provided, and cross out any options or components that will not be provided.
   3. Manufacturer's operation and installation instructions.
   4. Additional requirements:
      a. Display type and size.
      b. Operator input.
      c. Processor type and speed.
      d. Memory size.
      e. Programming protocols.
      f. Communication protocols.
      g. Power requirements.
      h. Operating temperature and humidity ranges.
      i. NEMA ratings.

C. Shop drawings:
   1. Furnish the following:
      a. System block diagram showing relationship and connections between devices. Include manufacturer and model information, and address settings.
      b. Mounting drawings with dimensions and elevations for each equipment location, including identification of all components, preparation and finish data, and nameplates.
      c. Electrical connection diagrams.
      d. Complete grounding requirements.
   2. Graphic screens:
      a. Color printouts of each graphic screen and all control pop-ups.
   3. Furnish data sheets for each component together with a technical product brochure or bulletin:
      a. Manufacturer's model number.
      b. Project equipment tag.
   4. Complete and detailed bills of materials identified by each cabinet. Include with each bill of material item the following:
      a. Quantity.
      b. Description.
      c. Manufacturer.
      d. Part numbers.

D. Operation and maintenance manuals:
   1. Complete installation, operations, calibration, and testing manuals as described in Section 01756 - Commissioning.

E. Record documents:
   1. Electrical connection diagrams revised to reflect any changes made in the field and submitted as record Drawings.

1.06 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Examine the complete set of Contract Documents and verify that the LOI equipment is compatible with the installed conditions.

C. Notify the Engineer if any installation condition does not meet the manufacturer's recommendations or specifications.

D. Provide LOI hardware manufactured at facilities certified to the quality standards of ISO Standard 9001 - Quality Systems - Model for Quality Assurance in Design/Development, Production, Installation, and Servicing.

E. System compatibility:
   1. The software must be the standard operating software system designed specifically for use with the LOI hardware.
   2. The software must be furnished and developed by the manufacturer of the LOI hardware.

1.07 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.08 PROJECT OR SITE CONDITIONS

A. Project environmental conditions as specified in Section 01850 - Design Criteria.
   1. Provide LOI equipment suitable for the installed site conditions including, but not limited to, site altitude, site seismic conditions, humidity, and ambient temperatures.

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 COMMISSIONING (NOT USED)

1.15 MAINTENANCE

A. Provide system upgrades and maintenance fixes for a period of 2 years from substantial completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. One of the following or equal:
   1. Allen-Bradley, PanelView 5000.
   2. Red Lion, G3 Panel.
   3. Maple Systems, OMI 5000 Series.

B. Provide the LOI graphic software system manufactured by the LOI hardware manufacturer.

C. One of the following or equal:
   1. Rockwell, Studio 5000.
   2. Red Lion Crimson.
   3. Indusoft WebStudio.

2.02 EXISTING PRODUCTS (NOT USED)

2.03 MATERIALS (NOT USED)

2.04 MANUFACTURED UNITS

A. Local Operator Interface:
   1. General:
      a. Provide Local Operator Interface located on the face of the PCM as indicated on the Drawings.
      b. NEMA rating to match the control panel rating on which it's mounted.
      c. Local Operator Interface consists of graphical display screen with operator input capabilities.
      d. Capable of stand-alone operation in conjunction with 1 PLC.
      e. Equipped with data network communication capabilities.
   2. Display:
      a. Type:
         1) Color TFT LCD screen.
      b. Resolution:
         1) 800 by 600 pixels.
         2) 1024 by 768 pixels.
         3) 1200 by 800 pixels.
      c. Size: As indicated on the Drawings.
      d. Easy display viewing at any angle in various ambient light conditions.
      e. Operator input:
         1) Configurable touch screen.
      f. Screen update speed: The screen update speed and screen change speed less than 1 second.
      g. Provide following features for outdoor use:
         1) Anti-glare screen overlay.
         2) Luminescence: Minimum 1,000 Nits.
   3. Graphic configuration:
      a. Easily configured graphics by:
         1) Portable laptop computer both locally and via the PLC data network.
         2) SCADA Engineer's console via the PLC data network.
      b. As specified in this Section.
   4. Memory:
      a. Minimum application memory:
         1) 128 MB Flash EPROM.
   5. CPU: Minimum 100 MHz.
   6. Communications:
      a. EtherNet/IP.
   7. Environment:
      a. Temperature: 0 to 50 degrees Celsius.
      b. Relative humidity: 10 to 90 percent.
   8. Electrical:
      a. Power supply:
         1) 24 VDC.
         2) 120 VAC.

B. Local Operator Interface software:
   1. Provide a complete software package to be used for programming the necessary screens and operator interaction with the LOIs.
   2. Operating system:
      a. Microsoft Windows 10.
   3. Furnish software with preconfigured symbols, objects, graphics, and imported bitmaps for the generation of the displays.
   4. Software must allow bitmaps to be imported or exported to or from other applications.
   5. Capable of generating custom reports, complete with screen prints.
   6. Capable of working with multiple screens concurrently.
   7. Provide dialog boxes for defining object attributes.
   8. Configure objects using fill in dialog boxes.
   9. Furnish graphic and text editor that allows custom formatting in order to customize and change the appearance of objects and text:
      a. Allow selection of different fill patterns to define object status.
   10. As a minimum, provide the following object capabilities:
      a. Operator inputs:
         1) Momentary pushbutton.
         2) Maintained pushbutton.
         3) Latched pushbutton.
         4) Multistate pushbutton.
         5) Keypad enable button.
         6) Cursor point.
      b. Control list selectors:
         1) Standard control list.
         2) Piloted control list.
      c. Global objects.
      d. Display objects:
         1) Bar graph.
         2) Scale.
         3) Message display.
         4) Multistate indicator.
         5) List indicator.
         6) Numeric data display.
      e. Screen selector objects:
         1) Go to.
         2) Return.
         3) Screen list selector.
      f. Embedded variables:
         1) Time.
         2) Date.
         3) Numeric variable.
      g. Graphics:
         1) Lines.
         2) Shapes.
         3) Freeform drawings.
         4) Imported graphics.

5) Background text.
6) Selection table for standard ISA symbols.
7) PID controller faceplate.

h. Alarm screens.

11. Documentation:
    a. Provide complete user documentation, including examples of how to operate the various modules within the system.
    b. Provide the documentation in electronic format, HTML based with the ability to search for topics by keyword or search or specific text.
12. On-line help:
    a. Provide an on-line "help" facility, based upon Windows standard Hypertext:
        1) Useful, context-sensitive information on the operation of the package:
            a) That can be invoked on-line through a point-and-click operation.
            b) The "help" facility must also support the ability to perform full text word search, add custom comments, bookmark topics, copy and pasting into another application, printing, and use of system fonts and colors.

2.05 EQUIPMENT (NOT USED)

2.06 COMPONENTS (NOT USED)

2.07 ACCESSORIES (NOT USED)

2.08 MIXES (NOT USED)

2.09 FABRICATION (NOT USED)

2.10 FINISHES (NOT USED)

2.11 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. All components of the control system including all data network cables are the installation responsibility of the ICSC unless specifically noted otherwise.

C. Provide panel support bracing if more than 25 percent of the area has been removed to allow for the mounting of the LOI.

D. All tags used and/or assigned as part of the application programming work are to use the tag and loop identifications found on the P&IDs.

E. Station graphics:
   1. Configure the graphic display for each device both in the treatment plant, and/or process area, including but not limited to:
      a. Symbols for:
         1) Pumps.
         2) Valves.
         3) Major instruments.
         4) Flowmeters.
         5) Pressure transmitter.
         6) Major equipment.
      b. Alarm symbols including intrusion alarm.
      c. Relevant test and operational data.
      d. Status for each controller or controlled device:
         1) Hand-Off-Auto Status.
         2) Local-Off-Remote Status.
         3) Run.
         4) Call.
         5) Fail.
         6) Open.
         7) Close.
         8) Hold.
         9) Modulate.
         10) Running.
      e. Depict a change of state of pumps and valves by a change in color.
   2. Production and usage bar graph:
      a. Depict the production for each site and/or piece of equipment, as determined during the requisite graphics meeting, within the treatment plant, summarized to type, and total usage, with a bar graph and numeric value for each analog value.
   3. System level summary:
      a. Show the level for the plant influent and effluent production, etc., via a display using bar graphs and numbers, as determined during the requisite graphics meeting.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL (NOT USED)

3.08 ADJUSTING (NOT USED)

3.09 CLEANING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.10 DEMONSTRATION AND TRAINING

A. Perform the training using pre-approved and qualified representatives of the ICSC and or manufacturer of the LOI software:
   1. A representative of the ICSC may perform the training only if the representative has completed the manufacturer's training course for the LOI software.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17733

CONTROL SYSTEMS: NETWORK MATERIALS AND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Materials and equipment used in process control and LAN networks including:
      a. Network switches.
      b. Media converters.
      c. Routers.
      d. Patch panels and other data network hardware.
      e. Related accessories.
      f. Firewall

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Electronic Industries Alliance/Electronic Components, Assemblies & Materials Association (EIA/ECA):
   1. 310-E - Cabinets, Racks, Panels, and Associated Equipment.

C. Institute of Electrical and Electronics Engineers (IEEE):
   1. 802.1X - Standard for Local and Metropolitan Area Networks–Port-Based Network Access Control.
   2. 802.3 - Standard for Ethernet.
   3. 802.11b - Standard for Information Technology - Telecommunications and information exchange between systems - Local and Metropolitan networks - Specific requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications: Higher Speed Physical Layer (PHY) Extension in the 2.4 GHz band.

D. National Electrical Manufacturers Association (NEMA):
   1. 250 - Enclosures for Electrical Equipment (1000 V Maximum).

E. Telecommunications Industry Association (TIA):
   1. 569 - Telecommunications Pathways and Spaces.
   2. 607 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

F. Underwriters Laboratories, Inc. (UL).

1.03 DEFINITIONS

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Product data:
   1. Include information on all network equipment.
   2. Manufacturer’s operation and installation instructions.

C. Shop drawings:
   1. Complete set of drawings including but not limited to:
      a. System block diagram showing relationship and connections between devices provided under this Contract, including connections to any existing equipment.
      b. Include manufacturer and model information, and address settings.
      c. Network riser diagram.
      d. Network port diagram, which physically locates all ports within the facility, and identifies their patch panel and switch port.
      e. Construction drawings for all equipment cabinets, including dimensions, identification of all components, preparation and finish data, and nameplates.
      f. Electrical connection diagrams.
      g. Complete grounding requirements.
   2. Furnish data sheets for each component together with a technical product brochure or bulletin:
      a. Manufacturer's model number.
      b. Project equipment tag.
   3. Complete and detailed bills of materials broken up by each cabinet. Each bill of material item will include the following:
      a. Quantity.
      b. Description.
      c. Manufacturer.
      d. Part numbers.

D. Calculations:
   1. Cooling calculations, including but not limited to:
      a. Highest expected ambient temperature for the enclosure's location.
      b. Internal heat load.
      c. Exposure to direct sunlight.
      d. Dimensions of the enclosure in inches.
      e. Maximum allowable temperature inside the enclosure, based on the lowest operating temperature limit of the installed components.

E. Seismic design:
   1. Seismic panel construction:
      a. Seismic anchorage: Provide seismic design calculations and installation details for anchorage of all cabinets, racks, panels, enclosures, consoles, etc. to meet seismic requirements as specified in Section 01850 - Design Criteria:
         1) Stamped by a Professional Engineer registered in the state where the project is being constructed.
      b. For freestanding panels weighing 200 pounds or more (assembled, including contents), submit calculations, data sheets, and other information to substantiate that cabinet, base, and framing meet minimum design strength requirements and seismic requirements as specified in Section 01850 - Design Criteria. Calculations shall be signed and sealed by a Professional Engineer licensed in the state where the cabinets and panels will be installed.

F. Test reports:
   1. As specified in Section16125 - Fiber Optic Cable and Appurtenances and Section 17950 - Commissioning for Instrumentation and Controls.
   2. Signed test results as described in this Section.
   3. Test results shall include:
      a. Narrative describing the test procedures followed.
      b. Block diagram of test set up.
      c. Manufacturer’s information on test equipment used.
      d. Detailed test results.
      e. A narrative summarizing the results of the testing and identifying any further action required.

G. Operating manuals:
   1. Complete installation, operation, calibration, and testing manuals as specified in Section 01756 - Commissioning.

H. Record drawings:
   1. As specified in Section 17950 - Commissioning for Instrumentation and Controls.
   2. Electrical connection diagrams shall be revised to reflect any changes made in the field and submitted as record drawings.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.08 SEQUENCING (NOT USED)

1.09 SCHEDULING (NOT USED)

1.10 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

1.11 SYSTEM START-UP (NOT USED)

1.12 OWNER'S INSTRUCTIONS (NOT USED)

1.13 COMMISSIONING (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS

2.01 MANUFACTURERS (NOT USED)

2.02 SYSTEM DESCRIPTION

A. Provide all network equipment identified in the Contract Documents.

2.03 EXISTING PRODUCTS (NOT USED)

2.04 MATERIALS (NOT USED)

2.05 MANUFACTURED UNITS

A. Ethernet switches:
    1. Managed Process Floor Ethernet switches:
        a. Manufacturers: One of the following, no equal:
            1) Rockwell, Stratix 5700.
            2) Hirschmann, BRS-40.
            3) Cisco, IE2000.
            4) Red Lion, N-Tron, 7000.
        b. Properties:
            1) Hardware:
                a) Power supply:
                    (1) Accepts redundant power feeds.
                        (a) Provide NEC Class 2 power circuit.
                        (b) 24 VDC, 100VA maximum rating.
                b) No fans or moving parts.
            2) Performance:
                a) Enclosure:
                    (1) All metal housing.
                b) Capable of performing basic switching without special programming or configurations. Additional features available through software setup includes but not limited to:
                    (1) SNMP.

(2) VLAN.
(3) QoS.
(4) Port Mirroring.
(5) DHCP Server
c) IGMP Snooping with EtherNet/IP plug & play compatibility.
d) 802.1d, 802.1w, 802.1D RSTP.
3) Environment:
a) Operating temperature range: 32 to 140 Degrees Fahrenheit.
b) Humidity:10 to 95 percent, non-condensing.
4) Connections:
a) Copper: RJ-45.
(1) Auto-negotiating.
(2) Quantity: As required to provide network connections indicated on the Drawings plus 20 percent spare.
b) Fiber: Gigabit SFP port.
(1) Quantity: As required to provide network connections indicated on the Drawings, minimum 2.
5) Mounting:
a) DIN Rail mounting.
b) As indicated on the Drawings.

B. SFP Transceivers:
1. Provide Gigabit transceivers unless otherwise indicated, or as required to interface with other equipment:
a. Multimode: 1000BASE-SX.
b. Multi-source agreement compliant.
2. Manufacturers: The following or equal:
a. Cisco, unless transceivers are provided by Ethernet switch vendor.

C. Media converters:
1. Copper to fiber transceiver:
a. Manufacturers: One of the following or equal:
1) N-Tron.
a) Transition Networks.
b) Phoenix Contact.
c) Black Box.
2) Transceiver shall be used to convert Ethernet communication between copper and fiber optic cables.
3) Match protocol, speed, and media of attached equipment.
a) Meets requirements of IEEE 802.3 Ethernet standard.
b) Connector type:
c) Fiber: SFP.
(1) Copper: RJ-45.
d) Power supply:
(1) 110 VAC.
e) Mounting:
(1) As indicated on the Drawings.

D. Secure Firewall:
1. Manufacturers: The following, no equal:
a. Cisco, ISA3000.

2. Properties:
    a. 2 copper Gigabit Ports.
    b. 2 fiber Gigabit Ports.
    c. Mini-USB Port.
    d. Compact Flash Port.
    e. Hardware:
        1) Rack or DIN rail mountable.
        2) Power supply:
            a) Provide redundant power supplies:
                (1) 24 VDC at 24W.
    f. Environment:
        1) Operating temperature range: -40 to 158 degrees Fahrenheit.
        2) Humidity: 5 to 95 percent, non-condensing.
    g. Capable of performing basic filtering and networking with web based graphical user interface:
        1) VPN Support.
    h. Connector type:
        1) Fiber: SFP.
        2) Copper: RJ-45.
    i. Mounting:
        1) Provide hardware for DIN rail mounting.

E. Patch panels:
    1. Fiber optic patch panels:
        a. General:
            1) All optical fiber cables shall be provided with strain relief and terminated at a fiber patch panel. Final connections between the patch panel and the fiber optic network equipment shall be made via factory tested fiber optic patch cords.
            2) All fiber cable strands shall be terminated at the patch panels, no loose fiber strands are allowed.
            3) Provide space for excess fiber and provide strain relief for the fiber cable.
            4) Fiber cables shall be installed such that the outer sheath of the cable is carried into the interconnect enclosure or patch panels before breaking out buffer tubes.
            5) Fiber connectors: LC.
        b. DIN Rail mounted:
            1) Manufacturers: One of the following or equal:
                a) DINSpace, SNAP XL.
                b) Corning.
                c) Hirschmann, MIPP.
            2) Properties:
                a) Use for the termination of a single cable inside of cabinets, in small enclosures or as indicated on the plans.
                b) DIN rail mounted fiber patch panels shall be provided as complete unit including the housing, connector panels, splice trays, and fiber connectors.

F. Copper patch panels:
   1. General:
      a. All equipment and premises cables shall be terminated at a patch panel, except for field equipment connections.
      b. Final connections between the patch panel and network equipment shall be by patch cords.
      c. Provide factory tested copper patch cords as required to support all network devices.
         1) Provide 25 percent spare copper patch cords.
      d. Cables shall be installed such that the outer sheath of the cable is carried into the patch panel before breaking out conductors.
      e. Maintain twist of broken out conductors in accordance with TIA standards.
      f. UL listed.
      g. Properties:
         1) Modular, all metal construction with built-in strain relief.
         2) Compatible with both shielded and unshielded jack modules.
         3) Patch panel and jack modules shall be by same manufacturer.
         4) Utilizes jack modules for copper Ethernet cable termination.
         5) Provided shielded jack modules with a 360-degree conductive path to ground as required by the installation. Install per manufacturer's recommendation.
         6) Patch panel and jack modules shall meet or exceed category cable standard.
         7) Jack module shall be capable of at least 20 termination cycles.
         8) Provide 25 percent spare jack modules of each type.
      h. Accessories:
         1) Removable rear cable management bracket.
         2) Rear individual port labels.
         3) Front color-coded individual port labels.
         4) Termination tool.
   2. Manufacturers: One of the following or equal:
      a. 19-inch rack mounted:
         1) Panduit, Mini-Com series.
         2) OCC, DCC series.
         3) CommScope, SL series.
      b. DIN Rail mounted:
         1) DINSpace, SNAP XL.
         2) OCC, DTC.

2.06 EQUIPMENT (NOT USED)

2.07 COMPONENTS (NOT USED)

2.08 ACCESSORIES

A. Provide duplex patch cords to connect the interface cards provided with the associated patch panels.

B. Provide dust covers or plugs for all unused ports.

2.09 MIXES (NOT USED)

2.10 FABRICATION (NOT USED)

2.11 FINISHES (NOT USED)

2.12 SOURCE QUALITY CONTROL (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Provide installation and configuration for the new and existing managed Ethernet switches. Provide configuration of the Ethernet switch network for a complete, functioning plant control system as indicated on the Drawings and as specified in this Section:
   1. Refer to SCADA block diagrams for all new network connections.
   2. Provide configuration for all managed Ethernet switches and other components including but not limited to VLAN (virtual local area network), additional Plant PLC communication cards, and separate managed Ethernet switches as required, such that there is isolation of the following networks:
      a. Remote I/O network: This includes the connections between the Plant PLC and:
         1) Plant PLC expansion racks.
         2) Plant PLC remote I/O (RIO) racks.
      b. Field network: This includes the connections between the PLC and:
         1) Field devices.
         2) LOI (Local Operator Interface).
         3) Vendor furnished Ethernet network components.
         4) Valve actuator network: This includes the connections between the PLC and the valve master stations.
      c. PLC network: This includes the connections between the Plant PLCs and the I/O server(s).
      d. Process control network: This includes the connections between the I/O server(s) and other equipment including but not limited to servers, workstations, and printers.
   3. The process floor managed Ethernet switches for the process control network shall be configured and programmed for rapid fail over protection.

C. All racks shall be level and plumb.

D. All work shall be performed in a neat and workmanlike manner.

E. Cable management:
   1. All cables and equipment shall be installed in strict conformance with the manufacturer's recommendations:
   2. Install cable using lubricant designed for cable pulling.
   3. Install hook-and-loop wrap on all cable bundles within the network rack/enclosure. Plastic tie-wraps are not acceptable.
   4. Install network cables without splices.
   5. Installed bend radius shall be a minimum of 10 times the cable diameter.
   6. Terminate all pairs at the jack and patch panel.
   7. Route all cables through cable management or other form of containment. No loose, unsupported cables are permitted to span across network equipment.
   8. Use corner strips to protect cables from edges inside ducts and to maintain bend radius requirements.

F. Internal rack wiring:
   1. Cables shall be installed avoiding sharp bends.
   2. Provide enough working space inside rack or cabinets such that closing enclosure doors does not crush or compress cabling.
   3. Bundle cables together in groups of no more than 12.
   4. Route cables from both sides of the rack to patch panels. Do not bring all bundles from a single side.
   5. No cabling shall obstruct equipment ventilation.
   6. Individual pairs will be untwisted less than 1/2-inch at termination points.
   7. Ground enclosure and equipment in accordance with TIA-607:
      a. Individually bond all network equipment chassis to rack's grounding busbar. Do not daisy-chain bonding conductors.
      b. Size the bonding conductor per network equipment manufacturer's recommendation, or No. 10 AWG, whichever is larger.

G. External rack wiring:
   1. Do not install fiber cables in non-continuous cable supports such as cable ladders or wire baskets without radius cable supports or solid bottoms.
   2. Maintain cable separation in accordance with TIA-569:
      a. Install cables a minimum of 40 inches away from electrical motors and transformers.
      b. Install cables a minimum of 12 inches away from fluorescent lighting.

H. All cables and terminations shall be labeled with cable designations as specified in Section 16075 - Identification for Electrical Systems.

I. Each data port shall be individually labeled with its patch panel/switch port ID:
   1. Labeling must be printed - no handwritten labels will be allowed.

J. At the completion of the wiring installation, provide the following documentation:
   1. A plan-view of the premise(s) showing the jack numbering scheme.
   2. A printed certification report for the entire wiring installation showing compliance with all TIA specifications for data cable.
   3. Reports such as those generated by Fluke DSP cable certification equipment meet this requirement.

K. Managed Ethernet switches:
   1. Configure switches to prevent broadcast storms.
   2. All installations shall employ IGMP snooping to limit multicast messaging.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 RE-INSTALLATION (NOT USED)

3.07 FIELD QUALITY CONTROL (NOT USED)

3.08 ADJUSTING

A. Perform all firmware installations, configuration and other set up, as required, to place the network into proper operation.

3.09 CLEANING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.10 DEMONSTRATION AND TRAINING

A. After completion of the cable system tests and before placing the system in operation, power up all devices installed on the LAN and verify communication between the devices.

B. Verify that all equipment is operable on the network simultaneously. Confirm that all network device communications settings are properly configured.

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES (NOT USED)

END OF SECTION

SECTION 17750

CONTROL SYSTEMS: WIRELESS COMMUNICATIONS - RADIO

PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. General and design requirements applicable to industrial wireless radio communication system Work and submittals.
   2. General requirements for supply, installation, and commissioning of an industrial wireless radio communication system, including but not limited to the following:
      a. Materials, hardware, software, equipment fabrication, installation, configuration, programming, hardware and software testing, start-up, commissioning, training, and documentation.

B. The ICSC shall procure the service of a radio sub-contractor as specified in Section 01110 - Summary of Work, to perform all the Work described in this Section and all contractor documents related to the industrial wireless radio communication system.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Abbreviations:
   1. AGL: Above ground level.
   2. Antenna CL: Antenna center line mounting height.
   3. ASL: Above sea level.
   4. CPM: Critical path method.
   5. EIRP: Effective isotropic radiated power.
   6. FCC: Federal Communications Commission.
   7. FRN: FCC Registration Number.
   8. ITS: Institute for Telecommunications Science.
   9. LOS: Line of sight.
   10. RF: Radio frequency.
   11. RSSI: Receive signal strength intensity.
   12. SIM: Subscriber identity module.
   13. WLAN: Wireless local area network.

C. Definitions:
   1. BER: Bit error rate, a unitless measure of the number of bit errors that occur in a given number of bit transmissions.
   2. dB: Decibel, a relative expression representing a change in radio frequency power.
   3. dBi: A decibel referenced against an isotropic radiator.

4. dBd: A decibel referenced to a dipole antenna.
5. dBm: A decibel referenced to 1 milliwatt (mW).
6. Direct Sequence Spread Spectrum (DSSS): A spread-spectrum technology used in IEEE 802.11 and IEEE 802.11b/g used to achieve data rates up to 2 Mbps.
7. Fade margin: The difference between the received signal level at the input to the receiver and the sensitivity of the receiver.
8. Fresnel zone: The area around the line-of-sight that radio waves spread out into after being transmitted by the antenna.
9. Radio Path Survey: In-field wireless communication site survey performed by the radio sub-contractor during the preliminary construction phase of the project.
10. Receiver Sensitivity: The minimum signal power level with an acceptable Bit Error Rate (in dBm or mW) that is necessary for the receiver to accurately decode a given signal.

D. Standards:
   1. American Concrete Institute (ACI):
      a. 318 - Building Code Requirements for Structural Concrete.
   2. ASTM International (ASTM):
      a. A475 - Standard Specification for Zinc-Coated Steel Wire Strand.
      b. A586 - Standard Specification for Metallic-Coated Parallel and Helical Steel Wire Structural Strand.
   3. Code of Federal Regulations (CFR):
      a. Title 47 - Telecommunication.
   4. Institute of Electrical and Electronics Engineers (IEEE):
      a. 802.11 - Wireless LAN Standards.
   5. International Electrotechnical Commission (IEC).
   6. National Fire Protection Association (NFPA):
      a. 79 - Electrical Standard for Industrial Machinery.
   7. Telecommunications Industry Association (TIA):
      a. 222 - Structural Standard for Antenna Supporting Structures and Antennas and Small Wind Turbine Support Structures.
      b. 1019 - Installation, Alteration, and Maintenance of Antenna Supporting Structures and Antennas.
   8. State and Local code requirements.

1.03 DELEGATED DESIGN

A. As specified in Section 01357 - Delegated Design Procedures.

B. Anchoring and bracing for equipment installed outdoors.

1.04 SUBMITTALS

A. Furnish submittals as specified in Sections 01330 - Submittal Procedures and Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Submittals for the in-field radio path survey:
    1. Initial submittal:
        a. Submit the following for review and approval, prior to the radio path survey:
            1) Credentials of the firm to perform the radio path survey.
            2) Testing equipment used.
            3) Testing methodology.
            4) Software for path study.
            5) Project CPM schedule.
            6) Submit a description of testing methods.
            7) Example data forms to be used during the site testing.
            8) Survey dates at the sites that would be suitable for performing the analysis.
    2. Radio path survey submittal:
        a. For all the sites, prepare an RF path survey report as described below:
            1) Provide a topographic overview of the paths analyzed as part of the radio path survey:
                a) Include on the overview:
                    (1) Locations of all airports, large water bodies, tall structures, overhead electrical lines, and airstrips located within 2,000 meters of any proposed radio site.
                    (2) Provide topographical plan and profile drawings for each path.
                    (3) Frequency analysis report that includes the usage traffic in the designed frequency band by other commercial and non-commercial business in the area.
            2) Provide RF path survey calculations including the following information:
                a) Field-verified coordinates of each site in longitude and latitude.
                b) Distance between sites (miles), for each communication link.
                c) Elevation of each site (ft. ASL).
                d) Direction of path (degrees from north).
                e) Antenna type used.
                f) Antenna mounting height.
                g) Up tilt/down tilt angles for proposed antenna mountings.
                h) Received signal
            3) Provide recommendations for modifications or adjustments to the design for extending all paths with insufficient fade margin for reliable operation including to but not limited to the following:
                a) Proposed repeater sites.
                b) Antenna gain improvements.
                c) Antenna height mounting adjustments.
                d) Antenna/radio quantity, especially for master stations for communicating to all remote sites successfully.
                e) Path calculations for the improved radio paths.
            4) Provide a summary of findings and recommendations for further work.
        b. Upon completion of the radio path survey, submit a final report to the Owner for review a minimum of 30 days before the second coordination meeting as specified in the Submittals article under “Prepare and Submit

an Agenda for the second Coordination Meetings." Summarize the radio path survey results and include the following:
1) Field data captured.
2) Recommended antenna and repeater/receiver sites.
3) Recommended antenna heights and types.
4) Recommended sites that serve as communication hubs to collect data.
5) Critical communication paths and loops for adding redundant links.
6) Summary of findings and recommendations.

c. If, upon review of the radio path survey report, the Owner determines that the information is insufficient or incomplete in any way, perform all necessary actions to complete the report.

C. Prepare and submit an agenda for 2 mandatory coordination meetings.
1. First meeting:
a. Summarize their understanding of the Project.
b. Discuss any proposed alternatives.
c. Schedule access to Owner sites.
d. Schedule the remaining coordination meetings.
e. Request any additional information required from the Owner.
f. Review the preliminary design, software radio path study report, and plan radio path survey.
g. Select the hardware to be used during the in-field radio path survey, meeting the requirements described in the contract documents.
h. Understand the project construction sequence.
i. Understand municipal ordinance and other construction restrictions associated with the sites.
j. Schedule the in-field radio path survey during high-foliage season after coordination with the Owner for all wireless radio communication links.
2. Second meeting:
a. Schedule a meeting after the radio path survey has been completed:
1) To present the findings of the radio path survey to the Owner and Engineer.
b. Discuss the content of the radio path survey report in a line-by-line manner.
c. Outline the recommended and optimal configuration for the Owner's wireless radio system architecture.
d. Coordinate radio configuration settings with the Owner including, but not limited to, the following:
1) IP addresses.
2) Passwords.
3) Encryption and security settings.
4) Operating Mode.
5) Polling.
e. Discuss any exceptions or deviations from design calculations on antenna heights and site locations.
f. Discuss construction and work progress schedule.
g. Discuss training requirements and schedule.

D. Delegated design submittals:
    1. For outdoor installations:
        a. Project-specific calculations with anchoring and bracing details based on support conditions and requirements to resist loads specified in Section 01850 - Design Criteria.

E. Submit product data for all components of the radio communication system:
    1. Radio.
    2. SIM card(s).
    3. Antenna.
    4. Cables between radio and antenna.
    5. All other related accessories.
    6. Certification for outdoor installation.
    7. Communication port type and quantity.
    8. Installation details for each component indicated above.
    9. For each type of radio/antenna:
        a. Provide operating mode setup, encryption, and polling configuration information.
    10. Block diagram showing the location of each component of the radio communication system.
    11. Radio link map associated with each site.

F. Furnish commissioning submittals listed below and specified in this Section as specified in Section 01756 - Commissioning:
    1. Manufacturer’s representative qualifications.
    Owner training.

1.05 QUALITY ASSURANCE

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Verify communications between sites as follows:
    1. Perform radio path survey to verify the theoretical performance of the software radio path study report.
    2. Verify the radio paths using received signal strength and interference measurements obtained in the field and obtain an approval from the Owner and the Engineer prior to procurement installation, testing, and commissioning.

C. After installation, verify using field-collected data that the installed equipment conforms to reliability benchmark developed as part of the field testing.

1.06 DELIVERY, STORAGE, AND HANDLING

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

1.07 PROJECT OR SITE CONDITIONS

A. As specified in Section 01850 - Design Criteria.

1.08 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate radio configuration and encryption options with the Owner:
      a. Adjust configuration and encryption settings as deemed necessary by the Owner.
      b. Provide radio configuration record files and save the device configuration on a standard SD card if available.
   2. Configure security settings and options as recommended by the radio manufacturer and as deemed necessary by the Owner and Engineer. Provide setup for secure username and password authentication by the Owner.
      a. Alerts shall be sent to defined list of recipients via pre-configured SMS text message.
      b. Alerts shall be sent to defined list of recipients via SMTP (email) message.

B. For licensed radio systems, coordinate and assist the Owner in obtaining and updating all required radio licenses with the FCC.

1.09 WARRANTY

A. As specified in Section 01783 - Warranties and Bonds.

B. Provide a minimum of 1 year of warranty from substantial completion date for all wireless communication equipment.

1.10 MAINTENANCE

A. Furnish all parts, materials and additional components necessary for maintenance and calibration purposes for 1 year:
   1. Deliver all supplies before Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL

A. Furnish and install an industrial wireless communication system that will serve the following sites:

1. Coordinates are approximate.

Site Name	Site Coordinates (Latitude N; Longitude W)	Antenna Tag	Wireless Technology/ Operational Mode	Antenna Mounting Height	Notes
Master Site	39 06 50.73; 123 11 29.74	ANT1-99400	900MHz licensed	35 feet above ground level	Omni-directional
Water Tank (Recycled Water Pump Station)	39 09 33.89; 123 11 41.76	ANT2-99400	900MHz licensed	35 feet above ground level	Yagi

B. The wireless radio communication system shall be provided as indicated on the Drawings, software radio communication path study reports attached in Attachment A, and as described in this Section.

C. The Contract Documents for the components of the wireless communication system are based on software radio path studies.

D. Verify site conditions, perform a detailed radio path survey, and provide a completely functional wireless radio communication system.

2.02 DESIGN AND PERFORMANCE CRITERIA

A. System must be in accordance with the following:
1. Code of Federal Regulations:
    a. CFR Title 47:
        1) Part 15 - Unlicensed Spread Spectrum.
        2) Part 90 - UHF Radio Systems - Subpart C and J.
        3) Part 101 - Fixed Microwave Services.
            a) Subpart H - Private Operational Fixed Point-to-Point Microwave Service.
            b) Subpart O - Multiple Address Systems.
2. NFPA 79, Annex “D” Standards.
3. NEC.
4. NEMA.
5. ISA.
6. IEC.
7. State and Local code requirements.
8. TIA 1019.

B. Performance requirements for wireless radio communication:
    1. The following are the radio path requirements for the radio communication system:
        a. Minimum fade margin: 20dB.
        b. Less than 25 percent obstruction within the first 60 percent of the Fresnel zone.
    2. Minimum antenna mounting heights are described on the following:
        a. At a minimum, as specified in software radio path study design report in Attachment A.

2.03 MANUFACTURERS

A. Radio:
    1. Licensed radio:
        a. One of the following or equal:
            1) General Electric, Orbit LN Series.

B. Transmission cables:
    1. Manufacturers: One of the following or equal:
        a. CommScope:
            1) HELIAX Cable Products.
        b. Times Microwave Systems.

C. Surge protectors:
    1. Manufacturers: One of the following or equal:
        a. CommScope:
            1) T Series Surge Arrestors.
            2) Gas Tube Surge Arrestors.
        b. Phoenix Contact, Trabtech Series.
    2. As specified in Section 17710 - Control Systems: Panels, Enclosures, and Panel Components.

D. Antennas:
    1. Radio antennas:
        a. Manufacturers: One of the following or equal:
            1) Kathrein Scala.
            2) CommScope.

E. Antenna support structure:
    1. One of the following or equal:
        a. Rohn Products, LLC.
        b. Trylon, Inc.

2.04 MANUFACTURED UNITS

A. Licensed radio system:
    1. General:
        a. The radio system comprises the following:
            1) Wireless radio(s).
            2) Antennas.
            3) Surge protectors.

4) Transmission cables.
5) Software and other accessories as specified in the Components article.
6) Protocol conversion modules as indicated on the Drawings.

2. Performance requirements:
   a. Frequency: 902-928 MHz.
   b. Ambient temperature range: -20 to 60 degrees Celsius.
   c. Enclosure protection class:
      1) IEC IP20.
   d. Bi-directional (2-way) system:
      1) Transceiver:
         a) Carrier power: 0.1 to 5 W, programmable.
         b) Transmission mode: Packet.
         c) Interface:
            (1) Ethernet 10/100 MB RJ-45 port.
         d) Duty cycle: Continuous.
         e) Power supply: 10-30 VDC.

B. Transmission cables characteristics:
   1. 1/2-inch, nominal diameter.
   2. Continuous section without splices or connectors other than at the radio and antenna.
   3. Rated for outdoor installation.
   4. Cable length: As indicated on the Drawings or as indicated in the path study report.
   5. Cable characteristics:
      a. Attenuation: Less than 5 dB at 960 MHz per 100 feet.
      b. Characteristic impedance: 50 ohms.
      c. Coaxial shield.
      d. Dielectric: Foam.

C. Antennas:
   1. Radio antenna characteristics:
      a. Yagi antenna:
         1) Frequency range: 902-928 MHz.
         2) Nominal impedance: 50 ohm.
         3) Connector: N-Type.
         4) Gain: 7 dB or greater.
         5) Construction material: All welded aluminum.
         6) Operating temperature:
            a) Stationary: -40 to 85 degrees Celsius.
            b) Cyclic: -40 to 55 degrees Celsius.
      b. Omni-directional antenna characteristics:
         1) Frequency range: 902-928 MHz.
         2) Nominal impedance: 50 ohm.
         3) Connection: N-type.
         4) Gain: 10 dB or greater.
         5) Construction material: All welded aluminum.
         6) Operating temperature: -40 to 75 degrees Celsius.

3. Antenna support structures:
    a. Antenna mast:
        1) Mast shall be 2 inch schedule 80 steel pole. Furnish mast as one continuous length for full height without splices.
        2) Each mast shall be grounded with dedicated ground rod and grounding conductors.
        3) Provide required accessories for complete installation of antenna.
        4) See Electrical drawings for details.

2.05 MATERIALS (NOT USED)

2.06 ACCESSORIES

A. Antenna accessories:
    1. Provide all required mounting accessories required for installation, such as clamps, brackets adapters, and related hardware for a complete installation.
        a. Mounting guidelines shall be provided in the installation details indicated on the Drawings and as recommended by the manufacturer.
    2. Provide mounting hardware to meet the wind and seismic requirements at the Project Site as specified in Section 01850 - Design Criteria.

B. Provide lightning surge arrestors and data line surge protection for radios or antennas located outdoors.

C. Provide antenna cables, connectors, and related hardware for a complete installation.

D. Provide din-rail mounting adapters required for installation of radios in control panels/communication cabinets, as needed for each application.

E. Software:
    1. Provide software package for radio diagnostic testing.
    2. Provide radio configuration via a secured wireless or wired ethernet network.

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION

A. Anchoring and bracing to structures:
    1. Prepare equipment anchor setting template(s) and use to position anchors during construction of supporting structure(s).
    2. Install anchors of type and material indicated on approved anchoring designs.
    3. Install anchors with embedment indicated on approved anchoring designs.

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Tag and label terminal blocks, radio system components and associated wiring as indicated in the Drawings and as specified in Section 16075 - Identification for Electrical Systems.

3.04 COMMISSIONING

A. As specified in Section 01756 - Commissioning and Section 17950 - Commissioning for Instrumentation and Controls for communications testing requirements.

B. Functional Testing:
   1. Hardware and communication testing:
      a. Perform tests to show that the integrated system hardware and software is fully operational and in compliance with the requirements specified in the Contract Documents.
      b. Engineer approval of the FAT Communication Testing activities is required before proceeding to FAT Platform Testing.
   2. Failure testing: Demonstrate how the system responds to and recovers from abnormal conditions including, but not limited to:
      a. Equipment failure.
      b. Operator error.
      c. Communications subsystem error.
      d. Communications failure.
      e. Simulated/forced software lockups.
      f. Power failure (both utility power and power to HMI and/or SCADA hardware).
      g. High system loading conditions.

C. Owner Training:
   1. Perform Owner training as specified in Section 01756 - Commissioning.
   2. Radio communication initial training: Provide 1 - hour training session for up to 2 individuals from the Owner on the following:
      a. Radio communication system hardware, setup, basic working principle of the installed system and basic troubleshooting and diagnostics.
   3. Radio communication follow-up training: Provide 1 - hour training session for up to 2 individuals from the Owner on the following:
      a. Radio communication system configuration, encryption, advanced troubleshooting, and diagnostics.

3.05 FIELD QUALITY CONTROL

A. Verify using field-collected data that the installed equipment conforms to reliability benchmarks developed as part of the field testing.

B. Submit a report to document field-verified transmit and receive signal strength and any RF interference after installation of final communication elements.
   1. Troubleshoot issues and assist Owner with FCC coordination if interference is detected during startup and commissioning.

C. The installation shall follow the wireless network manufacturer's recommended installation practices and comply with all applicable codes.

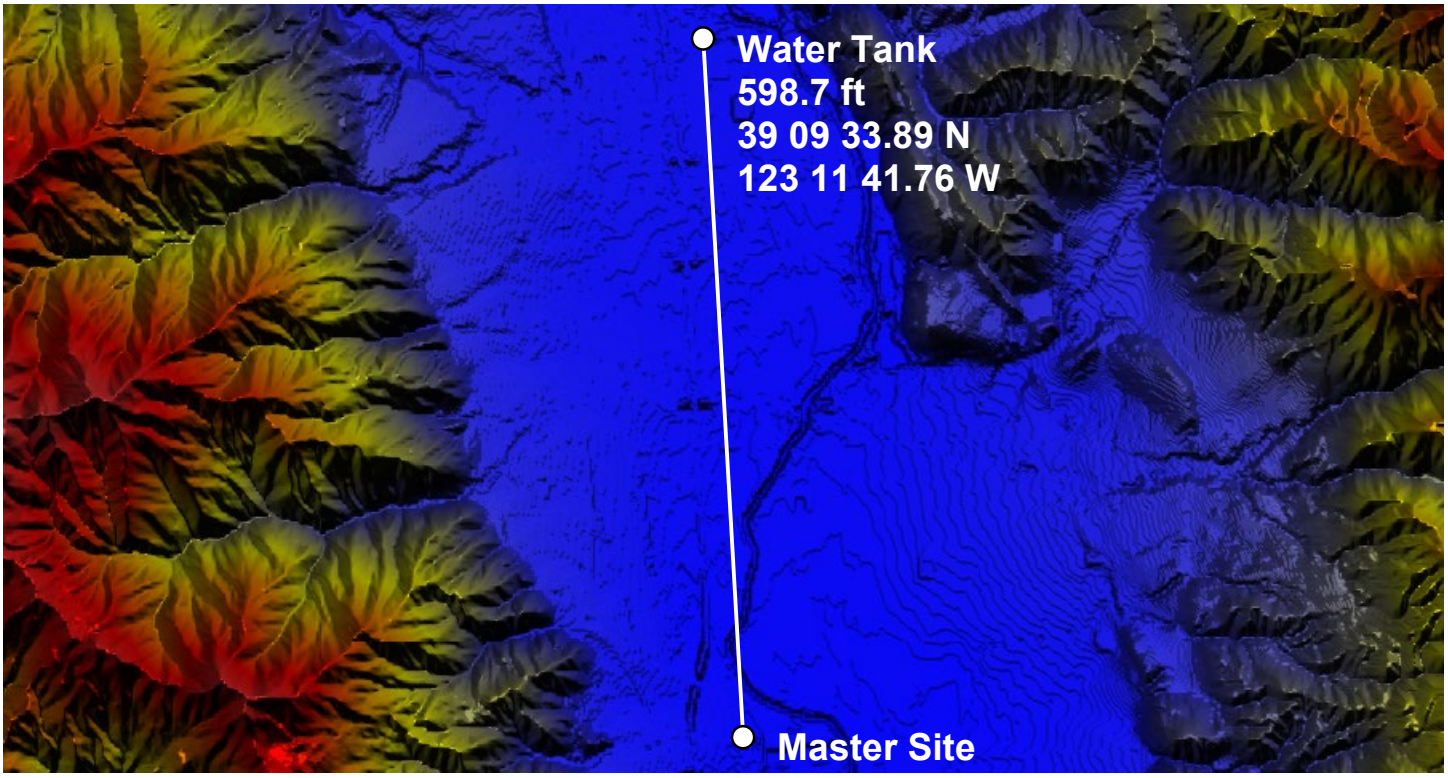
D. Upon completion of installation, provide the services of a factory-certified local service technician to perform start-up testing. Record test results and compare to factory testing to confirm proper operation of equipment. Submit test results with operation and maintenance manuals.

3.06 ADJUSTING

A. Orient directional antennas as required for maximum receive strength signal intensity during startup.

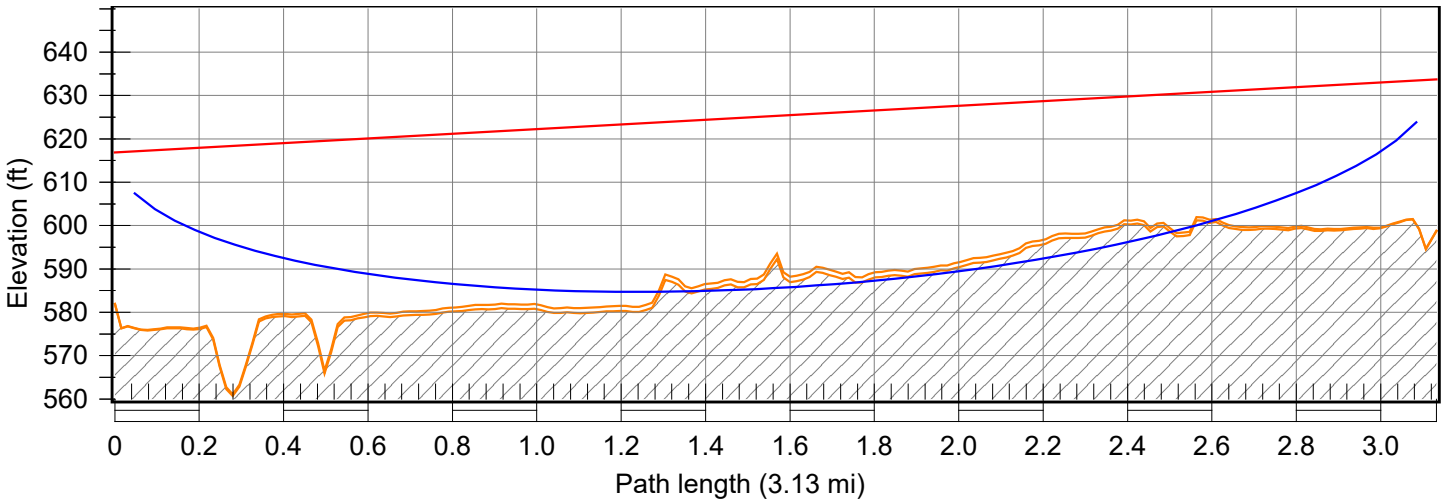
END OF SECTION

ATTACHMENT A - PATH STUDY REPORT



City of Ukiah
Recycled Water Project - Phase 4
Radio Communications Path Study

Attachment A to Specification 17750, Control Systems: Wireless Communications - Radio



Master Site	
Latitude	39 06 50.73 N
Longitude	123 11 29.74 W
Azimuth	356.72°
Elevation	582 ft ASL
Antenna CL	35.0 ft AGL

Frequency (MHz) = 928.0
K = 1.33
%F1 = 60.00

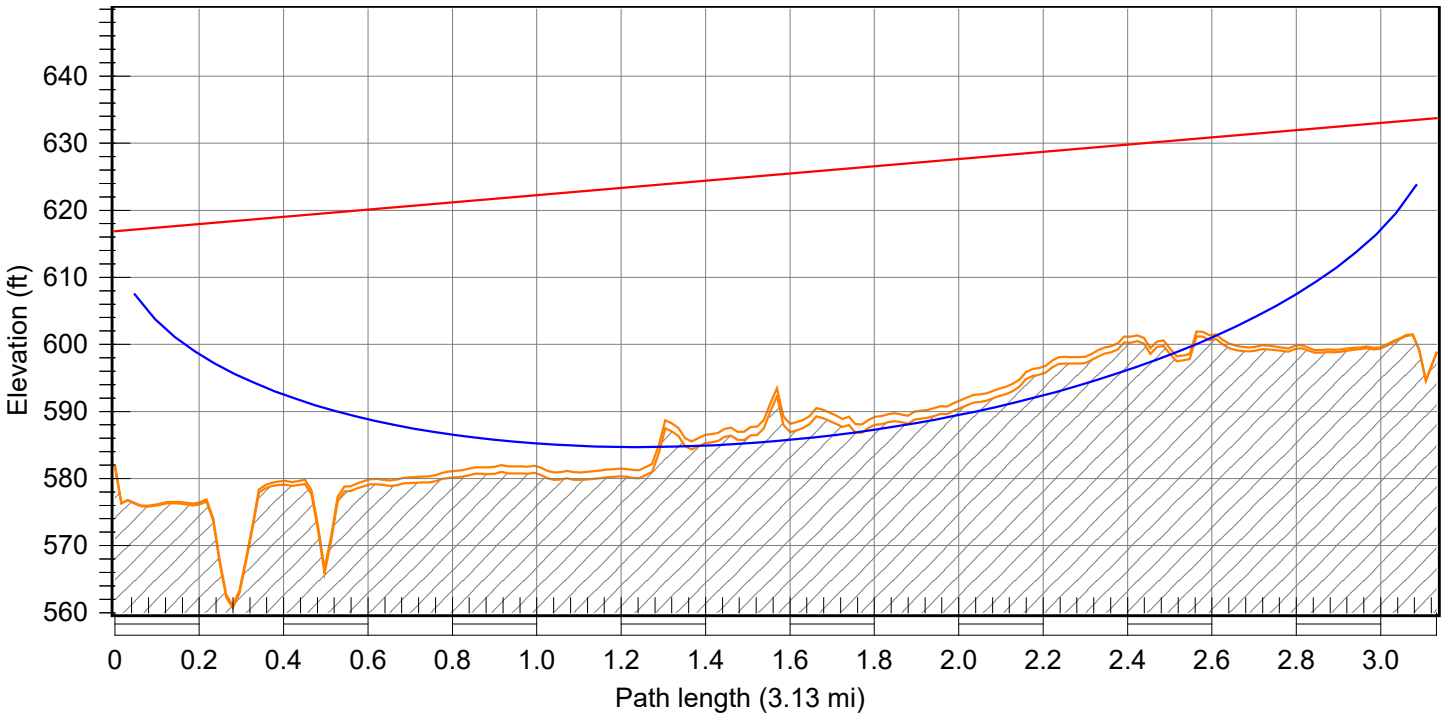
Water Tank	
Latitude	39 09 33.89 N
Longitude	123 11 41.76 W
Azimuth	176.72°
Elevation	599 ft ASL
Antenna CL	35.0 ft AGL

Transmission details (Master Site-Water Tank.pl5)

	Master Site	Water Tank
Latitude	39 06 50.73 N	39 09 33.89 N
Longitude	123 11 29.74 W	123 11 41.76 W
True azimuth (°)	356.72	176.72
Vertical angle (°)	0.04	-0.08
Elevation (ft)	581.89	598.73
Antenna model	OMNI (TR)	YAGI (TR)
Antenna gain (dBd)	6.85	7.85
Antenna height (ft)	35.00	35.00
TX line model	EFX2-50	EFX2-50
TX line unit loss (dB/100 ft)	2.40	2.40
TX line length (ft)	67.80	67.97
TX line loss (dB)	1.63	1.63
Connector loss (dB)	0.10	0.10
Frequency (MHz)	928.00	
Polarization	Vertical	
Path length (mi)	3.13	
Free space loss (dB)	105.87	
Atmospheric absorption loss (dB)	0.02	
Field margin (dB)	5.00	
Diffraction loss	3.63	
Net path loss (dB)	98.98	98.98
Radio model	LN9-25KHz	LN9-25KHz
Radio file name	ln9_25khz	ln9_25khz
TX power (dBm)	28.75	27.40
EIRP (dBm)	36.02	35.67
RX threshold criteria	10-6 BER	10-6 BER
RX threshold level (dBm)	-114.00	-114.00
RX threshold level (µv)	0.45	0.45
Receive signal (dBm)	-71.58	-70.23
Receive signal (µv)	58.98	68.88
Receive field strength (µv/m)	802.77	687.46
Thermal fade margin (dB)	42.42	43.77

	Master Site	Water Tank
Annual location availability (%)	100.00000	100.00000
Annual location unavailability (min)	0.00	0.00
Annual multipath availability (%)	99.99428	99.99580
Annual multipath unavailability (min)	30.07	22.05

Transmission summary (Master Site-Water Tank.pl5)



F = 928.00 MHz K = 1.33 %F1 = 60.0, 60.0

	Master Site	Water Tank
Latitude	39 06 50.73 N	39 09 33.89 N
Longitude	123 11 29.74 W	123 11 41.76 W
True azimuth (°)	356.72	176.72
Vertical angle (°)	0.04	-0.08
Elevation (ft)	581.89	598.73
Antenna model	OMNI (TR)	YAGI (TR)
Antenna gain (dBd)	6.85	7.85
Antenna height (ft)	35.00	35.00
TX line model	EFX2-50	EFX2-50
TX line length (ft)	67.80	67.97
TX loss (dB)	1.73	1.73
RX loss (dB)	1.73	1.73
Diffraction loss	3.63	
Radio model	LN9-25KHz	LN9-25KHz
TX power (dBm)	28.75	27.40
EIRP (dBm)	36.02	35.67

	Master Site	Water Tank
Receive signal (dBm)	-71.58	-70.23
Receive signal (µv)	58.98	68.88
Thermal fade margin (dB)	42.42	43.77
Annual location availability (%)	100.00000	100.00000
Annual multipath availability (%)	99.99428	99.99580

Diffraction report (Master Site-Water Tank.pl5)

Diffraction algorithm	Pathloss
Multiple knife edge method	Deygout
Maximum number of obstacles	2
Obstacle radius method	Major obstacle only
Foreground loss method	Scaled height-gain

	Master Site	Water Tank
Elevation (ft)	581.89	598.73
Antenna height (ft)	35.00	35.00
Effective antenna height (ft)	35.00	46.43
Distance (mi)	3.13	
Frequency (MHz)	928.00	
Earth radius factor K	1.33	
Polarization	Vertical	
Tree type	Dry bare trees	
Ground type	Average	

1 - Near single knife edge	
Location (mi)	1.30
Left side (mi)	0.00
Right side (mi)	3.13
Clearance (ft)	0.00
Clearance /F1 (%)	53.96
V	-0.76
Radius (mi)	0.41
Loss (dB)	0.52
2 - Near single knife edge	
Location (mi)	1.46
Left side (mi)	0.00
Right side (mi)	3.13
Clearance (ft)	0.00
Clearance /F1 (%)	56.20
V	-0.79
Radius (mi)	1.09
Loss (dB)	0.47
3 - Near single knife edge	
Location (mi)	1.57
Left side (mi)	0.00
Right side (mi)	3.13
Clearance (ft)	0.00
Clearance /F1 (%)	48.09
V	-0.68
Radius (mi)	4.78
Loss (dB)	0.85
4 - Near single knife edge	
Location (mi)	2.39
Left side (mi)	0.00
Right side (mi)	3.13
Clearance (ft)	0.00
Clearance /F1 (%)	50.84

V	-0.72
Radius (mi)	36.03
Loss (dB)	1.79
Diffraction loss	3.63
Tree - building loss (dB)	0.00
Free space loss (dB)	105.87
Atmospheric absorption loss (dB)	0.02
Total loss (dB)	109.52

SECTION 17901

SCHEDULES: FIELD INSTRUMENTS

PART 1 GENERAL

1.01 SUMMARY

A. The Schedules Field Instrument is not a take-off list. Refer to Drawings and Specifications for additional information. Where any discrepancies between this list and the P&ID drawings arise, the P&ID shall govern.

B. Abbreviations used in the Instrument Index are defined on the Drawings.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 SCHEDULES FIELD INSTRUMENTS

A. Schedules Field Instruments attached.

END OF SECTION

ATTACHMENT A - SCHEDULES: FIELD INSTRUMENTS

Field Instruments

Specification: 17201

Tag	Type	Range or Setpoint	Description	Drawing
LSHH-89100		17.5 FT	HIGH HIGH AND LOW LOW LEVEL SWITCHES	89N01
LSLL-89100		2 FT	HIGH HIGH AND LOW LOW LEVEL SWITCHES	89N01
LSL-91101		2 FT	HIGH HIGH AND LOW LEVEL SWITCHES	91N01
LSHH-91101		7 FT	HIGH HIGH AND LOW LEVEL SWITCHES	91N01
LSLL-99403		1 FT	LEVEL FLOAT SWITCHES	99N01
LSHH-99403		25 FT	LEVEL FLOAT SWITCHES	99N01

Specification: 17206

Tag	Type	Range or Setpoint	Description	Drawing
LIT-80100	ULTRASONIC	0-18 FT	STRUCT 80 LEVEL	80N01
FIT-88101	ULTRASONIC	600-1500 GPM	CHLORINE CONTACT BASIN OPEN CHANNEL FLOW METER 1	88N01
FIT-88102	ULTRASONIC	600-1500 GPM	CHLORINE CONTACT BASIN OPEN CHANNEL FLOW METER 2	88N01

Specification: 17208

Tag	Type	Range or Setpoint	Description	Drawing
LIT-89103	RADAR PTOF	0-19.5 FT	CAROUSEL LEVEL TRANSMITTER	89N01

Specification: 17301

Tag	Type	Range or Setpoint	Description	Drawing
FSL-89100	THERMAL	400 GPM	LOW FLOW SWITCH	89N01
FSL-89101	THERMAL	400 GPM	LOW FLOW SWITCH	89N01
FSL-89102	THERMAL	2000 GPM	LOW FLOW SWITCH	89N01
FSL-91100	THERMAL	875 GPM	LOW FLOW SWITCH	91N01
FSL-99411	THERMAL	450 GPM	THERMAL LOW FLOW SWITCH	99N01
FSL-99412	THERMAL	450 GPM	THERMAL FLOW SWITCH	99N02
FSL-99413	THERMAL	450 GPM	THERMAL FLOW SWITCH	99N02
FSL-99414	THERMAL	450 GPM	THERMAL FLOW SWITCH	99N02

Specification: 17302

Tag	Type	Range or Setpoint	Description	Drawing
FIT-99406	MAGNETIC	500-4000 GPM	FLOW METER	99N01
FIT-99431	MAGNETIC	400-4000 GPM	FLOW METER	99N03

Field Instruments

Specification: 17316

Tag	Type	Range or Setpoint	Description	Drawing
FI-60101	CHLORINE	0-500 ML/MIN	CHLORINE SAMPLE FLOW INDICATOR	60N01
FI-87130	CHLORINE	0-500 ML/MIN	CHLORINE SAMPLE FLOW INDICATOR	87N01

Specification: 17404

Tag	Type	Range or Setpoint	Description	Drawing
PI-60101	PRESSURE	0-30 PSI	PRESSURE INDICATOR	60N01
PI-87130	PRESSURE	0-30 PSI	PRESSURE INDICATOR	87N01
PI-99411	PRESSURE	0-150 PSIG	PRESSURE INDICATOR	99N01
PI-99412	PRESSURE	0-150 PSI	PRESSURE INDICATOR	99N02
PI-99413	PRESSURE	0-150 PSI	PRESSURE INDICATOR	99N02
PI-99414	PRESSURE	0-150 PSI	PRESSURE INDICATOR	99N02
PI-99432	PRESSURE	0-300 PSI	PRESSURE INDICATOR	99N03

Specification: 17405

Tag	Type	Range or Setpoint	Description	Drawing
PIT-99432	PRESSURE	0-300 PSIG	PRESSURE TRANSMITTER	99N03

Specification: 17407

Tag	Type	Range or Setpoint	Description	Drawing
LIT-99405	P-SUB	0-25 FT	LEVEL TRANSMITTER	99N01

Specification: 17505

Tag	Type	Range or Setpoint	Description	Drawing
AIT-60101	CHLORINE	0-10 MG/L	CHLORINE ANALYZER 4	60N01
AIT-87130	CL	0-10 MG/L	CHLORINE ANALYZER 3	87N01

SECTION 17903

SCHEDULES: I/O LIST

PART 1 GENERAL

1.01 SUMMARY

A. The I/O list is not a take-off list. Additional information is as indicated on the Drawings and specified in the Contract Documents. Where any discrepancies between this list and the P&ID drawings arise, the P&ID shall govern.

B. Abbreviations used in the I/O list are indicated on the Drawings.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 I/O LIST

A. As specified in Attachment A - I/O list.

END OF SECTION

ATTACHMENT A – I/O LIST

PLC I/O Listing for PLC-4

Drawing	Tag	I/O	Location	Description	Service	(E/F)
85N05	F-85105	AI	PLC-4		AIR WASH VENTURI FLOWMETER	E
85N06	L-85180	AI	PLC-4		TNK 2 LEVEL	E
87N01	A-87130	AI	PLC-4	CL	CHLORINE ANALYZER 3	
88N01	F-88101	AI	PLC-4		CHLORINE CONTACT BASIN OPEN CHANNEL FLOW METER 1	
88N01	F-88102	AI	PLC-4		CHLORINE CONTACT BASIN OPEN CHANNEL FLOW METER 2	
PLC-4	**Total AI Points = 5**					
85N06	SS-85181	AO	PLC-4	SPEED OUT	COAGULANT FEED PUMP NO. 1	E
85N06	SS-85182	AO	PLC-4	SPEED OUT	COAGULANT FEED PUMP NO. 2	E
85N06	SS-85183	AO	PLC-4	SPEED OUT	COAGULANT FEED PUMP NO. 3	E
PLC-4	**Total AO Points = 3**					

PLC I/O Listing for PLC-4

Drawing	Tag	I/O	Location	Description	Service	(E/F)
85N06	AUX1-85181	DI	PLC-4	RUNNING	COAGULANT FEED PUMP NO. 1	E
85N06	AUX1-85182	DI	PLC-4	RUNNING	COAGULANT FEED PUMP NO. 2	E
85N06	AUX1-85183	DI	PLC-4	RUNNING	COAGULANT FEED PUMP NO. 3	E
85N06	AUX2-85181	DI	PLC-4	E-STOP	COAGULANT FEED PUMP NO. 1	E
85N06	AUX2-85182	DI	PLC-4	E-STOP	COAGULANT FEED PUMP NO. 2	E
85N06	AUX2-85183	DI	PLC-4	E-STOP	COAGULANT FEED PUMP NO. 3	E
85N07	AUX1-85104	DI	PLC-4	RUNNING	RAPID MIX PUMP	
85N07	HSAR-85104	DI	PLC-4	REMOTE	RAPID MIX PUMP	
85N07	TSH-85104	DI	PLC-4	HIGH TEMP	RAPID MIX PUMP	
87N01	AUX1-87132	DI	PLC-4	READY	BACKWASH PUMP NO. 1	E
87N01	AUX1-87133	DI	PLC-4	READY	BACKWASH PUMP 2	E
87N01	AUX1-87134	DI	PLC-4	RUNNING	BACKWASH CHLORINE SAMPLE PUMP	
87N01	AUX2-87132	DI	PLC-4	FAILED	BACKWASH PUMP NO. 1	E
87N01	AUX2-87133	DI	PLC-4	FAILED	BACKWASH PUMP 2	E
87N01	HSAR-87134	DI	PLC-4	REMOTE	BACKWASH CHLORINE SAMPLE PUMP	
87N01	LSH-87130	DI	PLC-4		HIGH LEVEL SWITCH	E
87N01	LSL-87130	DI	PLC-4		LOW LEVEL SWITCH	E
87N01	TSH-87134	DI	PLC-4	HIGH TEMP	BACKWASH CHLORINE SAMPLE PUMP	
PLC-4	**Total DI Points = 18**					
85N07	MS-85104	DO	PLC-4	RUN	RAPID MIX PUMP	
87N01	MS-87132	DO	PLC-4	RUN	BACKWASH PUMP NO. 1	E
87N01	MS-87133	DO	PLC-4	RUN	BACKWASH PUMP 2	E
87N01	MS-87134	DO	PLC-4	RUN	BACKWASH CHLORINE SAMPLE PUMP	
PLC-4	**Total DO Points = 4**					

PLC I/O Listing for PLC-70299

Drawing	Tag	I/O	Location	Description	Service	(E/F)
60N01	A-60101	AI	PLC-70299	CL	CHLORINE ANALYZER 4	E
80N01	L-80100	AI	PLC-70299		STRUCT 80 LEVEL	
89N01	L-89103	AI	PLC-70299		CAROUSEL LEVEL TRANSMITTER	
PLC-70299 Total AI Points = 3						
60N01	HSAR-60009	DI	PLC-70299	REMOTE	DCL STRUCT CHLORINE VALVE	E
60N01	ZSC-60009	DI	PLC-70299	CLOSED	DCL STRUCT CHLORINE VALVE	E
60N01	ZSO-60009	DI	PLC-70299	OPENED	DCL STRUCT CHLORINE VALVE	E
89N01	LSHH-89100	DI	PLC-70299		HIGH HIGH AND LOW LOW LEVEL SWITCHES	
89N01	LSLL-89100	DI	PLC-70299		HIGH HIGH AND LOW LOW LEVEL SWITCHES	
PLC-70299 Total DI Points = 5						
60N01	ZCC-60009	DO	PLC-70299	CLOSE	DCL STRUCT CHLORINE VALVE	E
60N01	ZCO-60009	DO	PLC-70299	OPEN	DCL STRUCT CHLORINE VALVE	E
PLC-70299 Total DO Points = 2						

PLC I/O Listing for PLC-99400

Drawing	Tag	I/O	Location	Description	Service	(E/F)
99N01	F-99406	AI	PLC-99400		FLOW METER	
99N01	L-99405	AI	PLC-99400		LEVEL TRANSMITTER	
99N03	F-99431	AI	PLC-99400		FLOW METER	
99N03	P-99432	AI	PLC-99400		PRESSURE TRANSMITTER	
PLC-99400 Total AI Points = 4						
99N01	LSHH-99403	DI	PLC-99400		LEVEL FLOAT SWITCHES	
99N01	LSLL-99403	DI	PLC-99400		LEVEL FLOAT SWITCHES	
99N01	ZSC-99402	DI	PLC-99400	CLOSED	TANK FILL VALVE	
99N01	ZSO-99402	DI	PLC-99400	OPENED	TANK FILL VALVE	
99N04	JS1-99400	DI	PLC-99400	PWR SUP OK	PCM CABINET	
99N04	JS2-99400	DI	PLC-99400	PWR SUP OK	PCM CABINET	
99N04	JS3-99400	DI	PLC-99400	REDUNDANCY OK	PCM CABINET	
99N04	JS4-99400	DI	PLC-99400	ACB OK	PCM CABINET	
99N04	TSH-99400	DI	PLC-99400	PLC TEMP	PCM CABINET	
99N04	XA4-99400	DI	PLC-99400	SPD2 FAIL	PCM SURGE PROTECTOR	
99N04	XA5-99400	DI	PLC-99400	ES-P FAIL		
99N04	XA6-99400	DI	PLC-99400	SPD FAIL	PCM SURGE PROTECTOR	
99N04	XA7-99400	DI	PLC-99400	ECP-P FAIL		
99N04	ZS1-99400	DI	PLC-99400	INTRUSION	PCM CABINET	
PLC-99400 Total DI Points = 14						
99N01	ZCC1-99402	DO	PLC-99400	CLOSE	TANK FILL VALVE	
99N01	ZCC2-99402	DO	PLC-99400	CLOSE	TANK FILL VALVE	
99N01	ZCO1-99402	DO	PLC-99400	OPEN	TANK FILL VALVE	
99N01	ZCO2-99402	DO	PLC-99400	OPEN	TANK FILL VALVE	
PLC-99400 Total DO Points = 4						

SECTION 17950

COMMISSIONING FOR INSTRUMENTATION AND CONTROLS

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PART 1 GENERAL

1.01 SUMMARY

A. Section includes:
   1. Testing requirements that apply to process control and instrumentation systems for the entire Project.

1.02 REFERENCES

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Electronics Industries Alliance (EIA).

C. Telecommunications Industry Association (TIA).

1.03 DEFINITIONS

A. As specified in Sections 01756 - Commissioning and 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Specific definitions:
   1. Complete End-to-End Testing (CEET) - Signals are tested from the field device through the PLC program, the network, and all the way to the operator's HMI graphic screens.
   2. Loop Validation Tests - Signals are tested from the field device to the PLC.
   3. Platform Testing: Testing of the PLC and SCADA/HMI at the manufacturer's shop to demonstrate the program's functionality based upon specified and designed control requirements.
   4. PTO: Profibus Trade Organization.
   5. Permanent Link: The fixed portion of cabling installed between an equipment outlet and its immediate distributor or between 2 distributors.

1.04 SYSTEM DESCRIPTION (NOT USED)

1.05 SUBMITTALS

A. Furnish submittals as specified in Section 01330 - Submittal Procedures.

B. General:
   1. Reference additional detailed test submittal scheduling and prerequisite requirements as specified in the Sequencing article of Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

C. Overall test plan:
   1. Develop the PCIS system test submittals in consultation and cooperation with all applicable subcontractors.
   2. Develop and submit an overall testing plan for the PCIS. The overall test plan to be reviewed and approved by the Engineer before detailed test plans, procedures, and forms will be reviewed.

3. Describe the test phases as they apply specifically to this Project and each process system.
4. Provide a preliminary testing schedule to show the sequence of tests and commissioning as they apply to each process system and each PLC.
5. Provide a description of factory tests. Describe what equipment will be included, what testing equipment will be used, and the simulator that will be used.
6. Provide examples of proposed forms and checklists.

D. Test procedures:
1. Develop and submit detailed test procedures to show that the integrated SCADA system hardware and software is fully operational and in compliance with the requirements specified in the Contract Documents.
2. Provide a statement of test objectives for each test.
3. Prepare specific procedures for each process system.
4. Describe sequentially the steps to be followed in verifying the correct operation of each process system, including all features described in the loop descriptions, control strategies, and shown in the P&IDs. Implied or generic test procedures are not acceptable.
5. Specify who will perform the tests, specifically what testing equipment will be used (including serial numbers and NIST-traceable calibration), and how the testing equipment will be used.
6. Describe the expected role of the Engineer, as well as any requirements for assistance from Owner's staff.
7. Provide the forms and checklists to be used.

E. Test forms:
1. Submit completed calibration forms, test forms, and checklists.
    a. Test forms shall include the detailed test procedures or shall include clear references to separate pages containing the complete test procedure applicable to each form. If references to procedures are used, the complete procedure shall be included with each test binder.
    b. Every page of each test form shall include project name, date, time, name of person conducting the test, signature of person conducting the test, and for witnessed tests, place for signature of person (Engineer and Owner) witnessing the test.
    c. Sample test forms at the end of this Section show the minimum required content.
        1) The sample test forms have not been customized for this Project.
        2) Contractor shall develop and submit test forms customized for the Project and meeting the specified test and submittal requirements.

F. FAT procedure additional minimal requirements:
1. Prepare and submit a FAT procedure which includes:
    a. Control system testing block diagram.
    b. Estimated test duration.

G. Details on the simulator construction, components, and operation. Testing binders:
1. Sub-system to be tested, provide and submit a test binder containing all test procedures and individual test forms for the test. References to other documents for test procedures and requirements are not acceptable.

2. Fill out in advance headings and all other information known before the test.
3. Include applicable test plan information, as well as a list of all test prerequisites, test personnel, and equipment.
4. Include or list reference material and provide separately at the time of the test.
5. Record test results and verify that all test requirements and conditions have been met.

H. Test reports:
1. At the conclusion of each test, submit a complete test report, including all test results and certifications.
2. Include all completed test binders, forms, and checklists.
3. Submission, review, and acceptance of each test report is required before the start of the sub-system.

1.06 QUALITY ASSURANCE

A. Test personnel:
1. Furnish qualified technical personnel to perform all calibration, testing, and verification. The test personnel are required to be familiar with this Project and the equipment, software, and systems before being assigned to the test program.

1.07 DELIVERY, STORAGE, AND HANDLING (NOT USED)

1.08 PROJECT OR SITE CONDITIONS (NOT USED)

1.09 SEQUENCING (NOT USED)

1.10 SCHEDULING (NOT USED)

1.11 WARRANTY (NOT USED)

1.12 SYSTEM START-UP (NOT USED)

1.13 OWNER'S INSTRUCTIONS (NOT USED)

1.14 MAINTENANCE (NOT USED)

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXAMINATION (NOT USED)

3.02 PREPARATION (NOT USED)

3.03 INSTALLATION

A. As specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

B. Installation supervision:
   1. Provide as specified in Section 17050 - Common Work Results for Process Control and Instrumentation Systems.

3.04 ERECTION, INSTALLATION, APPLICATION, CONSTRUCTION (NOT USED)

3.05 REPAIR/RESTORATION (NOT USED)

3.06 COMMISSIONING

A. Commissioning as specified in Section 01756 - Commissioning.

B. Testing and training phase:
   1. Source testing:
      a. Manufacturer services: Provide as specified in the table below.

Section Number	Section Title	Source Testing (Witnessed or Non-Witnessed)
17100 - Control Strategies	Control Strategies	Witnessed
17101 - Specific Control Strategies	Specific Control Strategies	Witnessed
17710 - Control Systems - Panels, Enclosures, and Panel Components.	Control Systems - Panels, Enclosures, and Panel Components	Witnessed
17950 - Commissioning for Instrumentation and Controls	Commissioning for Instrumentation and Controls	Witnessed

      b. Prerequisite requirements:
         1) Engineer approval of the hardware and equipment source testing submittal, Manufacturer Certificate of Source Testing, is required before proceeding to Preliminary FAT.
      c. Preliminary FAT (Pre-FAT):
         1) The purpose of the Pre-FAT is to provide assurance that the HMI/SCADA system is ready for the full, witnessed FAT, in terms of both stability and functionality.
            a) Debugging of software and troubleshooting of hardware shall occur during and before the pre-FAT, not during the FAT.
            b) Contractor shall fully test the HMI/SCADA system and fix all deficiencies found before the FAT.

2) Conduct utilizing test procedures approved by Engineer.
3) Owner shall have the right to witness any or all of the Pre-FAT testing and shall be notified in writing 20 days before the start of the pre-FAT.
4) Submit a letter, signed by the Contractor's project manager or company officer, certifying that integrated system hardware and software has been tested and confirmed to be fully operational and in compliance with the requirements specified in the Contract Documents and is fully ready for the full, witnessed FAT.
    a) Attach the completed pre-FAT test forms, signed by the Contractor's staff.
5) Engineer approval of the pre-FAT submittal is required before proceeding to FAT.

d. FAT hardware and communications testing:
1) Perform tests to show that the integrated system hardware and software is fully operational and in compliance with the requirements specified in the Contract Documents.
2) The complete PCIS system including operator stations, servers, network equipment, printers, PCMs, PLCs, RTUs, LCPs, CCS, peripherals, communications equipment, and other HMI/SCADA equipment, shall be assembled, connected, and software loaded for a fully functional FAT of the integrated system.
3) For any fault tolerant networks such as ring topology networks, disconnect each segment of the network individually to demonstrate proper failover and alarming at the HMI.
4) Testing simulation:
    a) Inputs and outputs shall be simulated and proper control and system operation shall be validated.
    b) Whenever supplied equipment is available, such as devices internal to the control panel, test input and output signals using the equipment. Simulation is not acceptable.
    c) FAT shall make use of simulators that contain switches, pilot lights, variable analog signal generators, and analog signal level displays, which shall be connected to the I/O points within the HMI/SCADA system.
        (1) The use of jumper wires, terminal block mounted pilot lights, and loose meters to act as or supply the functionality of a simulator shall not be allowed.
        (2) The simulator may consist of a PLC, operating under a HMI/SCADA software package, or other approved software that has its I/O points wired to PLC's I/O points.
        (3) Software operating on a PC may then act as the switches, pilot lights, variable analog signal generators, and analog signal level displays.
5) Additional source tests are specified in other sections of the Instrumentation and Control Specifications.
6) Owner shall have the right to witness any or all of the FAT testing and shall be notified in writing 20 days before the start of the FAT.

7) Verify communications between the hardware and the programmer's software comply with specified requirements.
    a) For systems that contain RTUs or remote communications with other devices, the complete communications system must be factory tested, including actual interfacing with telephone company equipment and/or the actual radios used for radio based telemetry systems.
8) Panel inspections:
    a) Engineer will inspect each control panel for completeness, workmanship, fit and finish, and compliance with the Contract Documents and the accepted shop drawings.
        (1) Inspection to include, as a minimum: Layout, mounting, wire and data cable routing, wire tags, power supply, components and wiring, I/O components layout (including terminals, wiring and relays), device layout on doors and front panels, and proper ventilation operation.
    b) Inspection forms:
        (1) Provide panel inspection forms as part of the FAT procedures submittal.
        (2) A sample FAT control panel form has been provided at the end of this Section.
9) I/O test:
    a) Engineer will verify that I/O is properly wired to field terminals and is properly mapped into the PLC and the rest of the SCADA system, including all operator interface devices.
    b) Test methodology:
        (1) Discrete inputs:
            (a) Apply appropriate input from simulator at panel terminal, observe input card indicator, observe data value at each indicated data address, and observe data received at field wiring terminals or operator interface screen.
        (2) Discrete outputs:
            (a) Issue commands from operator interface screen or PLC, verify output card indicator light, and measure response at field wiring terminals or multimeter.
        (3) Analog inputs:
            (a) Apply appropriate analog input signal at panel terminals on simulator, observe data value at each indicated data address, and observe data properly received at field wiring terminals or operator interface screen.
            (b) Check each point at 0 percent, 50 percent, and 100 percent of scale.
        (4) Analog outputs:
            (a) Enter scaled values in the output buffer file, observe the output data file value, and measure appropriate response at field wiring terminals or multimeter.
            (b) Check each point at 0 percent, 50 percent, and 100 percent of scale.

c) Test forms to include, but not be limited to the following data:
(1) PLC and panel number.
(2) I/O type.
(3) I/O tag name.
(4) Rack/slot/number of I/O point.
(5) Check-off for correct response for each I/O point.
(6) Comments field.
(7) Initials of individual performing test.
(8) Date test was performed.
(9) Witness signature lines.

10) System configuration test:
a) Demonstrate and test the setup and configuration of operator stations, servers, development stations, and peripherals.
b) Demonstrate utility software and functions, such as virus protection, backup, optical drive burning, network monitoring, etc.
c) Demonstrate the proper operation of peripheral hardware.
d) Demonstrate general HMI/SCADA functions.
e) Demonstrate proper operation of log-on and other security access functions.
f) Demonstrate the proper operation of all historical data storage, trend, display, backup, and report functions.
g) Test automatic fail over of redundant equipment.
h) Demonstrate the proper operation of the alarm display and acknowledgement functions.
i) For any fault tolerant networks, such as ring topology networks, disconnect each segment of the network individually to demonstrate proper failover and alarming.
j) Test forms:
(1) For each test, list the specification page and paragraph of the function demonstrated, and provide a description of the function.
(2) List the specific tests and steps to be conducted.
(3) For each function, list all of the different sub-functions or ways the function can be used, and provide a test check-off for each:
(a) Include signature and date lines.

11) Engineer approval of the FAT Communication Testing activities is required before proceeding to FAT Platform Testing.

e. FAT Platform Testing - Control logic test:
1) Verify the PLC, HMI and SCADA, provides monitoring and control functionality based upon specified and designed control requirements.
2) Testing requirements:
a) Demonstrate each function described in the Control Strategies.
b) Demonstrate in detail how each function operates under a variety of operating scenarios.
(1) Test to verify the application of each general control strategy function to each specific control strategy or loop description.

c) Demonstrate the proper operation of the programming and configuration for each control strategy or loop description.
(1) Test each strategy or loop description on a sentence by sentence and function by function basis.
(2) Loops with similar or identical logic must each be tested individually.
(3) Test the boundaries of each numeric operator input by entering values outside of the allowable range.

d) Demonstrate the proper operation of all digital communication links and networks.
(1) Verify each digital communication I/O point.

e) Failure testing: Demonstrate how the system responds to and recovers from abnormal conditions including, but not limited to: equipment failure, operator error, communications subsystem error, communications failures, simulated/forced software lockups, power failure (both utility power and power to HMI and/or SCADA hardware), process equipment failure, and high system loading conditions.

3) Test forms:
a) Submit completed test forms for each loop including but not limited to the fully revised and approved control strategy.
b) Identify the cause and effect as each I/O point is toggled through the simulator.
(1) Identify and track proper and/or improper operation of the loop.
c) Note any deficiencies or operational changes on the forms for correction and documentation:
(1) Include signature and date lines.

4) Engineer approval of the FAT submittal is required prior to shipment of system components.

2. Owner training:
a. Demonstration requirements are specified in this Section.

Table 1

Course Title	Minimum Course Length (hours per session)	Personnel (Estimated Number of Students)	Minimum Number of Sessions
System Overview	4	5	1
Operator Training - Basic	12	5	2
Operator Training - Advanced	8	5	2
PLC Hardware	8	5	1
PLC Software	16	5	1
LOI Hardware and Software	6	5	1
Network Equipment	6	5	1

Table 1			
Course Title	**Minimum Course Length (hours per session)**	**Personnel (Estimated Number of Students)**	**Minimum Number of Sessions**
Follow-Up Training	8	5	2
Instrument Training	12	3	1
Analytical Instrument Training	4	3	2

3. Training course requirements:
   a. System overview training:
      1) Furnish training courses that give the Owner's supervisory level personnel and overview of all elements of the PCIS system that focus on the overall functional aspect of elements of the control system and provide an understanding of the interaction of the various components.
      2) Furnish a training course that gives the Owner's supervisory level personnel and overview of the new Contractor-provided elements of the PCIS system. Focus on the overall functional aspects of each new elements of the control system, particularly the mechanical system vendor-provided control packages.
   b. Operator training:
      1) Furnish training courses that instruct system operators in the efficient operation of all aspects of the PCIS that include not only the general operation of the control system but also the operation of specific system features.
      2) Furnish training courses that instruct system operators in the efficient operation of Contractor-provided aspects of the PCIS that include not only the general operation of each control system but also the operation of specific system features.
      3) Operator's training shall include the following for each vendor package and programmable device:
         a) Control system overview: Architecture, equipment functions, software components, etc.
         b) Display navigation, overview, and types of displays.
         c) Process and equipment monitoring and control: Basic principles and operation.
         d) Logging ON and OFF the system and description of the security and access system.
         e) Alarm subsystem.
         f) Trending: Provide a thorough session on how to use all trending functions.
         g) Reports: How to access, print, and review content.
         h) Control strategies: Present an average 15-minute review of each control strategy, including a hands-on demonstration of screens and operator functions for each.
         i) Instruction on the use of all operational functionality alarm logging, trending, displays, database, reports, and control

software developed for the Project and incorporated in the installed PCIS system.

c. PLC hardware training:
   1) Furnish training on PLC hardware and on related components, including battery backup equipment, UPSs, LOI hardware, control circuits, and analog circuits.
   2) Furnish training on PLC hardware principles, product features, proper installation, operation, troubleshooting, and maintenance.
   3) PLC training may be provided by manufacturer's certified trainers.
d. PLC software training:
   1) Furnish training on PLC software.
   2) 2 types of training are required, basic and project-specific:
      a) Basic PLC software training covers the principles of PLC programming and the specific features and function of the PLC products used on this Project, provided by one of the PLC manufacturer's certified trainers.
      b) Project-specific PLC software training covers the programming conventions, new standardized software modules, specific control strategy programs, and documentation created for the Work performed under this Contract. This training includes the specific knowledge needed to modify, expand, duplicate, troubleshoot, and repair the PLC programs provided under this Contract, provided by a qualified member of the ICSC who is thoroughly familiar with the delivered system, and is one of the senior programmers who programmed the PLCs for this Project.
e. LOI hardware and software training:
   1) Provide the following:
      a) Overview of hardware and firmware, including starting, stopping, and PLC interface.
      b) Configuration of tag database.
      c) Creating, editing, and saving display screens.
      d) Troubleshooting.
f. Network equipment training:
   1) Furnish basic training on all network hardware, switch and router configuration and software, and network monitoring software.
   2) Include a detailed description and explanation of the installed network architecture, media, and functions.
   3) Furnish an overview of the function and operation of each piece of network equipment.
   4) Furnish training on network maintenance troubleshooting and repair.
   5) Furnish training on how to install spare or off-line backup equipment.
   6) Basic network overview:
      a) Discuss a basic network overview for each site.
      b) Discuss the architecture (loop, star, etc.), media redundancy, and items that are not readily apparent to staff.
      c) Discuss how to monitor the network health through the HMI network screen.
      d) Discuss both enterprise level networks, the PCS communications network, and the field network.

7) Ethernet switches:
    a) Discuss the various types of switches (Layer 2, Layer 3, etc.).
    b) Discuss switch health monitoring through the HMI.
    c) Discuss the VLAN configuration (what ports should be used for what network, etc.).
    d) Discuss testing procedures.
8) Field networks:
    a) General:
        (1) Discuss general principles behind likely device failures and actions to take to resolve such failures for each type of field network.
    b) DLR networks:
        (1) Discuss how to add non-DLR equipped devices to a DLR network.
        (2) Discuss how to monitor and test DLR network health through an ETAP module or DLR capable switch.

g. Follow-up training:
1) Provide a series of on-site follow-up training classes beginning after process start-up of the SCADA/PCIS system. The intent for these classes is to provide the Owner's personnel the opportunity for a review and "refresher" of the training topics and material after they have had some experience using the system.
2) Mutually schedule and develop the content of these classes with the Owner no later than 1 month before the beginning of the first session:
    a) Schedule at the Owner's discretion on non-consecutive days spaced out over the process start-up and warranty period.

h. Instrumentation training:
1) Furnish training covering all instruments and control panels.
2) Furnish the specified quantity of training, allocated to cover new instruments and hardwired controls as specified in this Section and specifically determined in the accepted training plan.
3) Train maintenance staff in the use, cleaning, calibration, maintenance, and troubleshooting of all the instruments furnished within this Project.
4) Furnish training on the operation of new hardwired controls.

i. Analytical instrument training:
1) Furnish training covering all analytical instruments.
2) Furnish the specified quantity of training, allocated to cover new analytical instruments as specified in this Section and specifically determined in the accepted training plan.
3) Train maintenance staff in the use, cleaning, calibration, maintenance, and troubleshooting of all the analytical instruments furnished within this Project.
4) Provide training by manufacturer.

4. Recording training sessions:
a. Record all training.
b. Produce audio-visual presentations by recording the actual training sessions of the Owner's personnel.
c. Furnish digital video disk (DVD) format.

d. These disks become the property of the Owner and cover, in detail, the training for the specific hardware and software of all the systems provided for the Project.
e. Provide all the necessary cameras and recording equipment.

5. Installation testing:
   a. Calibration:
      1) Performed by Contractor and ICSC.
      2) Calibrate and adjust all instruments, devices, valves, and systems, in conformance with the component manufacturer's instructions and as specified in these Contract Documents.
      3) Replace either individually or within a system, defective elements that cannot achieve proper calibration or accuracy.
         a) Calibration for discrete devices:
            (1) Calibrate and adjust devices for reliable operation and to avoid nuisance tripping.
         b) Calibration for ultrasonic and radar level devices:
            (1) Provide Echo Transmission and signal quality on level transmitters including guided and unguided units.
               (a) Submit printout of the actual transmission and parameters.
            (2) Adjust mounting, as required, to obtain accurate readings.
            (3) Post mounting: Provide any additional calibration required by manufacturer.
         c) Calibrating analog transmitters:
            (1) Components having adjustable features are to be set accurately for the specific conditions and applications of this installation.
            (2) Test and verify that components and/or systems are within the specified limits of accuracy.
            (3) Calibration points:
               (a) Calibrate each analog instrument at 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent of span, using test instruments with accuracies traceable to NIST.
            (4) Field verify calibration of instruments including units that have been factory-calibrated to determine whether any of the calibrations are in need of adjustment.
         d) Analyzer calibration:
            (1) Calibrate and test each analyzer system as a workable system after installation. Follow the testing procedures directed by the manufacturers' technical representatives.
            (2) Submit completed instrument calibration sheets for every field instrument and analyzer.
            (3) Calibration tags:
               (a) Attach a calibration and testing tag to each instrument, piece of equipment, or system.
               (b) Sign the tag when calibration is complete.
         e) Calibration for industrial networking test equipment:
         f) Submit calibration documentation.

b. Loop check:
    1) Performed by the Contractor.
    2) Cabling installed, terminated, and labeled.
    3) Perform continuity check of wiring to each field device through intermediate devices to field terminals in the cabinet.
    4) Complete loop check form for each device.
    5) Submit loop check test results before proceeding to the next step.
c. Loop validation tests:
    1) Performed by the Contractor, ICSC, and manufacturer's representative, working together, and witnessed by the Owner or Owner's representative.
    2) Perform tests on the signal from each field device through intermediate devices to the I/O module on the PLC.
        a) The PLC may or may not be connected to the network.
    3) Engineer approval of the loop validation test submittal is required before proceeding to CEET.
d. Copper Ethernet cable acceptance testing:
    1) All testing procedures and field-test instruments shall comply with applicable requirements of:
        a) TIA-1152 - Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling.
        b) TIA-568.0-E - Generic Telecommunications Cabling for Customer Premises.
        c) TIA-568.1-E - Commercial Building Telecommunications Infrastructure Standard.
        d) TIA-568.2-D - Balanced Twisted-Pair Telecommunications Cabling and Components Standard.
        e) Copper Ethernet cable installation testing as specified in Section 16950 - Field Electrical Acceptance Tests.
    2) Testing shall be performed by trained technicians who have successfully completed an appropriate training program and have obtained a certificate as proof thereof shall execute the tests. These certificates may have been issued by any of the following organizations or an equivalent organization:
        a) Manufacturer of the connectors or cable.
        b) Manufacturer of the test equipment used for the field certification.
        c) Training organizations (e.g., BICSI).
    3) Submit the following information before testing begins:
        a) Manufacturer’s catalog sheets, specifications, and the most recent calibration report for the test equipment.
        b) Certificate of testing technician’s training.
        c) A schedule of all balanced twisted-pair copper links to be tested, including:
            (1) Cable identification as it appears on the cable records.
            (2) Cable identification as it appears on the individual test reports.
            (3) Cable identification as specified in Section 16075 - Identification for Electrical Systems.
        d) Sample test reports.

e) All installed cabling Permanent Links shall be field-tested and pass the test requirements and analysis as described below.
   (1) Any Permanent Link that fails these requirements shall be diagnosed and corrected.
   (2) Any corrective action that must take place shall be documented and followed with a new test to prove that the corrected Permanent Link meets performance requirements.
   (3) The final and passing result of the tests for all Permanent Links shall be provided in the test results documentation in accordance with the testing requirements.

f) Acceptance of the test results shall be given in writing after the project is fully completed and tested in accordance with Contract Documents and to the satisfaction of the Engineer.

4) Cable field-test instruments:

a) The field-test instrument shall be within the calibration period recommended by the manufacturer, typically 12 months.

b) Certification tester requirements:
   (1) Level III in accordance with TIA-1152.
   (2) Independent verification of accuracy.
   (3) Must be capable of storing more than 10,000 results for all required measurements.
   (4) Manufacturer: The following or equal:
      (a) Fluke CableAnalyzer Industrial Ethernet Kit, DSX2-5-IE-K1.

c) Permanent Link adapters:
   (1) Use manufacturer's adapter for connecting to tested equipment.
      (a) Patch cables shall not be used for testing.
   (2) RJ45 plug must meet the requirements for NEXT, FEXT and Return Loss in accordance with TIA-568.2-D Annex C.

d) Measurement capabilities:
   (1) Wire Map.
   (2) Length.
   (3) Propagation Delay.
   (4) Delay Skew.
   (5) DC Loop Resistance.
   (6) DC Resistance Unbalance.
   (7) Insertion Loss.
   (8) NEXT (Near-End Crosstalk).
   (9) PS NEXT (Power Sum Near-End Crosstalk).
   (10) ACR-N (Attenuation to Crosstalk Ratio Near-End).
   (11) PS ACR-N (Power Sum Attenuation to Crosstalk Ratio Near-End).
   (12) ACR-F (Attenuation to Crosstalk Ratio Far-End).
   (13) PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far-End).
   (14) Return Loss.
   (15) TCL (Transverse Conversion Loss).

(16) ELTCTL (Equal Level Transverse Conversion Transfer Loss).
(17) Time Domain Reflectometer.
(18) Time Domain Xtalk Analyzer.

5) Testing requirements:
   a) Field-test instruments shall have the latest software and firmware installed.
   b) Permanent Link test results including the individual frequency measurements from the tester shall be recorded in the test instrument upon completion of each test for subsequent uploading to a PC in which the administrative documentation (reports) may be generated.
   c) Testing shall be performed on each cabling segment from connector to connector.
      (1) Sampling is not acceptable.
   d) The installer shall build a reference link:
      (1) All components shall be anchored so it is not possible to disturb them.
      (2) The technician is to conduct a Permanent Link test each day, for each type of category cable used, to ensure no degradation of the tester or its Permanent Link adapters.
   e) Unless noted otherwise tests shall use the following frequency resolution:
      (1) 1 - 31.25 MHz: 150 kHz.
      (2) 31.25 - 100 MHz: 250 kHz.
      (3) 100 - 250 MHz: 500 kHz.
   f) Wire Map measurement:
      (1) Wire map test is intended to verify pin-to-pin termination at each end and check for installation connectivity errors. For each of the 8 conductors in the cabling, the wire map indicates:
         (a) Continuity to the remote end.
         (b) Shorts between any two or more conductors.
         (c) Reversed pairs.
         (d) Split pairs.
         (e) Transposed pairs.
         (f) Distance to open on shield.
         (g) Any other miss-wiring.
         (h) The correct connectivity of telecommunications outlets/connectors is defined in TIA-568.2-D:
            - 2 color schemes are permitted.
            - User shall define which scheme is to be used.
            - Field tester shall document which color scheme was used.
   g) Length measurement:
      (1) Record the length of each cable. Use the physical length of the link calculated using the pair with the shortest electrical delay for reporting and to determine pass/fail.
      (2) Pass or fail criteria is based on the maximum length allowed for the Permanent Link as specified in TIA-568.D-2 plus the nominal velocity of propagation (NVP) uncertainty

of 10 percent. For a Permanent Link, the length measurement can be 325 feet before a fail is reported.

h) Propagation Delay measurement:
   (1) Is the time it takes for a signal to reach the end of the link.
   (2) The measurement shall be made at 10 MHz in accordance with TIA-1152.
   (3) The propagation delay of each balanced twisted pair shall be recorded.
   (4) Is not to exceed 498 ns in accordance with TIA-568.2-D Section 6.4.21.

i) Delay Skew measurement:
   (1) Is the difference in propagation delay at 10 MHz between the shortest delay and the delays of the other wire pairs.
   (2) The delay skew of each balanced twisted pair shall be recorded.
   (3) Is not to exceed 44 ns in accordance with TIA-568.2-D Section 6.4.22.

j) DC Resistance:
   (1) Often reported as Resistance, is the loop resistance of both conductors in the pair.
   (2) Is not specified in TIA-1152 but shall be recorded for all 4 pairs.

k) DC Resistance Unbalance:
   (1) Often reported as Resistance Unbalance, is the difference in resistance of the 2 wires within the pair.
   (2) Is not specified in TIA-1152 for a Permanent Link but shall be recorded for all 4 pairs.

l) Insertion Loss:
   (1) Is the loss of signal strength over the cabling (in dB).
   (2) Worst case shall be reported for all 4 pairs in one direction only.
   (3) Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk.
   (4) Is not to exceed the Category 6 Permanent Link limits in accordance with TIA-568.2-D Section 6.4.10.

m) NEXT (Near-End Crosstalk):
   (1) Is the difference in amplitude (in dB) between a transmitted signal and the crosstalk received on other wire pairs at the same end of the cabling.
   (2) Shall be measured in both directions (12 pair to pair possible combinations).
   (3) Both worst case and worst margins shall be reported.
   (4) Is not to exceed the Category 6 Permanent Link limits in accordance with TIA-568.2-D Section 6.4.11.
   (5) Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).
   (6) The Time Domain Xtalk data shall be stored for any marginal or failing NEXT results.

n) PS NEXT (Power Sum Near-End Crosstalk):
   (1) Is the difference (in dB) between the test signal and the crosstalk from the other pairs received at the same end of the cabling.
   (2) Shall be measured in both directions (8 pair possible combinations).
   (3) Both worst case and worst margins shall be reported.
   (4) Is not to exceed the Category 6 Permanent Link limits in accordance with TIA-568.2-D Section 6.4.12.
   (5) Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).
   (6) Time Domain Xtalk data shall be stored for any marginal or failing PS NEXT results.

o) ACR-N (Attenuation Crosstalk Ratio Near-End):
   (1) Is a calculation of NEXT minus Insertion Loss of the disturbed pair in dB.
   (2) Shall be calculated in both directions.
   (3) Is not specified in TIA-1152 but shall be recorded for all 12 possible combinations.

p) PS ACR-N (Power Sum Attenuation Crosstalk Ratio Near-End):
   (1) Is a calculation of PS NEXT minus Insertion Loss of the disturbed pair in dB.
   (2) Shall be calculated in both directions.
   (3) Is not specified in TIA-1152 but shall be recorded for all 8 possible combinations.

q) ACR-F (Attenuation Crosstalk Ratio Far-End):
   (1) Is a calculation of FEXT minus Insertion Loss of the disturbed pair in dB.
   (2) Shall be measured in both directions (24 pair to pair possible combinations).
   (3) Both worst case and worst margins shall be reported.
   (4) Is not to exceed the Category 6 Permanent Link limits in accordance with TIA-568.2-D Section 6.4.14.
   (5) Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).

r) PS ACR-F (Power Sum Attenuation Crosstalk Ratio Far-End):
   (1) Is a calculation of PS FEXT minus Insertion Loss of the disturbed pair in dB.
   (2) Shall be measured in both directions (8 pair possible combinations).
   (3) Both worst case and worst margins shall be reported.
   (4) Is not to exceed the Category 6 Permanent Link limits in accordance with TIA-568.2-D Section 6.4.16.
   (5) Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).

s) Return Loss:
   (1) Is the difference (in dB) between the power of a transmitted signal and the power of the signals reflected back.
   (2) Shall be measured in both directions (8 pair possible combinations).
   (3) Both worst case and worst margins shall be reported.

(4) Shall be ignored at all frequencies where the Insertion Loss is less than 3 dB for that pair.
(5) Is not to exceed the Category 6 Permanent Link limits in accordance with TIA-568.2-D Section 6.4.9.
(6) Reported margins found to be within the accuracy of the field tester shall be marked with an asterisk (*).
(7) Time Domain Reflectometer data shall be stored for any marginal or failing Return Loss results.

t) TCL (Transverse Conversion Loss):
(1) Is the ratio (in dB) between a differential mode signal inject at the near-end and the common-mode signal measured at the near-end on the same wire pair.
(2) Shall be measured in both directions.
(3) Is not specified in TIA-1152 for a Permanent Link but shall be recorded for all 8 possible combinations.

u) ELTCTL (Equal Level Transverse Conversion Transfer Loss):
(1) Is the ratio (in dB) between a differential mode signal inject at the near-end and the common-mode signal measured at the far end on the same wire pair minus the Insertion Loss of that pair.
(2) Shall be measured in both directions.
(3) Is not specified in TIA-1152 for a Permanent Link but shall be recorded for all 8 possible combinations.

6) Test results documentation:
a) The detailed test results documentation data is to be provided in an electronic database for each tested balance twisted-pair and shall contain the following information:
(1) The overall Pass/Fail evaluation of the link-under-test.
(2) The date and time the test results were saved in the memory of the tester.
(3) The identification of the customer site as specified by the end-user.
(4) The name of the test limit selected to execute the stored test results.
(5) The name of the personnel performing the test.
(6) The version of the test software and the version of the test limit database held within the test instrument.
(7) The manufacturer, model and serial number of the field-test instrument.
(8) The adapters used.
(9) The factory calibration date.
(10) Wire Map.
(11) Propagation Delay values, for all 4 pairs.
(12) Delay Skew values, for all 4 pairs
(13) DC Resistance values, for all 4 pairs
(14) DC Resistance Unbalance, values for all 4 pairs
(15) Insertion Loss, worst case values for all 4 pairs
(16) NEXT, worst case margin and worst case values, both directions
(17) PS NEXT, worst case margin and worst case values, both directions.

(18) ACR-F, worst case margin and worst case values, both directions.
(19) PS ACR-F, worst case margin and worst case values, both directions.
(20) Return Loss, worst case margin and worst case values, both directions.
(21) TCL, worst case values both directions.
(22) ELTCTL, worst case values, both directions.
(23) Time Domain Crosstalk data if the link is marginal or fails.
(24) Time Domain Reflectometer data if the link is marginal or fails.

b) Maintain a set of “red-line” throughout during construction:
(1) Drawings shall be available for review at any time as requested by Owner or Engineer.
(2) Provide record copy drawings at the end of the project shall be in CAD format and include notations reflecting the as built conditions of any additions to or variation from the drawings provided such as, but not limited to cable paths and termination point.
(3) The as built drawings shall include, but are not limited to block diagrams, frame and cable labeling, cable termination points, equipment room layouts and frame installation details.
(4) The as builts shall include all field changes made up to construction completion:
(a) Field directed changes to pull schedule.
(b) Horizontal cable routing changes.

7) Associated detail drawings. Engineer approval of the copper Ethernet cable acceptance-testing submittal is required before proceeding to CEET.

e. Complete End-to-End Testing (CEET):
1) Performed by Contractor, ICSC, manufacturer's representative working together, with assistance from the OWNER or the inspection staff, as needed.
a) The participants need to be dedicated full-time to CEET.
b) ICSC will provide staff to verify input signals at, and create output signals from, an HMI or Engineering Workstation.
c) Contractor and ICSC will be responsible for creating field signals and verifying proper operation of final control elements.

2) Prerequisites:
a) CEET cannot begin until the successful completion of the preceding tests:
(1) Calibration.
(2) Loop check.
(3) Loop validation tests.
(4) Copper Ethernet cable acceptance testing.
(5) Industrial network testing.

3) Testing description:
a) This testing is to ensure all I/O signals operate to the intent of the design from the field device to the HMI and all other auxiliary controls and indicators in the PCS.

b) Connect PLC to the network to test signals from the field device through the PLC program, the network, and to the operator's HMI graphic screens. The outputs will be energized for a duration long enough to verify proper operation of the final control element.
c) SCADA screens:
(1) Test and record operator commands and signal readouts to each operator device where there is more than one operator interface point.
(2) For each signal, perform separate tests for SCADA computer screens, local operator interface (LOI) screens, and local control panels.
(3) Retest any loop following any necessary corrections.

4) Check control loops under simulated operating conditions by causing a range of input signals at the primary control elements and observing appropriate responses of the respective control and monitoring elements, final control elements, and the graphic displays associated with the HMI/SCADA system.
a) Use actual process inputs wherever available.
b) Issue commands from the HMI/SCADA system and verify proper responses of field devices.
(1) Test SCADA system inputs from field device to SCADA system operator workstations.
(a) Track responses through trend charts in the HMI/SCADA system.
(2) Test SCADA system outputs from SCADA operator workstations to field devices and equipment.

5) Discrete device testing:
a) Exercise each field device providing a discrete input to the HMI/SCADA system in the field and observe the proper operation shall be observed at the operator workstation:
(1) Test limit switches, set limits mechanically, and observe proper operation at the operator workstation.
(2) Exercise starters, relay contacts, switch contacts, and observe proper operation.
(3) Calibrate and test instruments supplying discrete inputs and observe proper operation.
b) Test each device accepting a discrete output signal from the HMI/SCADA. Perform the appropriate operator action at the SCADA operator stations (including LOIs, if present) and confirm the proper operation of the field device:
(1) Stroke valves through outputs from the HMI/SCADA system, and confirm proper directional operation. Confirm travel limits and any feedback signals to the HMI/SCADA system.
(2) Exercise motors starters from the HMI/SCADA system and verify proper operation through direct field observation.
(3) Exercise solenoids and other field devices from the HMI/SCADA system and verify proper operation through direct field observation.

6) Analog device testing:
   a) Apply continuously variable up and down analog inputs to verify the proper operation and setting of discrete devices (signal trips, etc.).
   b) Apply provisional settings on controllers and alarm setpoints.
7) Analog input:
   a) Exercise each field device monitoring the analog signal, through the HMI/SCADA system.
      (1) Apply simulated sensor inputs corresponding to 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent of span for networks that incorporate analog elements and monitor the resulting outputs to verify compliance to accuracy tolerance requirements.
8) Analog output:
   a) Exercise each field device requiring an analog command signal, through the HMI/SCADA system.
      (1) Vary the output from the PLC HMI/SCADA system and measure the end device position, speed, etc. to confirm the proper operation of the device for the supplied analog signal.
      (2) Manually set the output from the HMI/SCADA screen at 0 percent, 25 percent, 50 percent, 75 percent, and 100 percent and measure the response at the final device and at any intermediate devices.
9) Submit completed test forms:
   a) Discrete instrument input devices:
      (1) Switch setting, contact action, and dead band.
      (2) Valve position switches:
         (a) Response in the PLC as the valve is stroked from the PLC.
         (b) Field observed actual valve position, and valve indicator position as the valve is stroked from the PLC.
      (3) Operator interface switches (control stations and other pilot devices) and associated response.
      (4) Starter and drive auxiliary device contact response.
      (5) Response of all other discrete inputs to the PLC.
      (6) Test equipment used and associated serial numbers.
   b) Discrete output devices:
      (1) Observed response of field device to the discrete output from the PLC.
      (2) Observe the proper operation of Open, Close, Start, Stop, On, Off, etc.
      (3) Test equipment used and associated serial numbers.
   c) Analog input devices:
      (1) Calibration range.
      (2) Calibration data: Input, output, and error at each test value.
      (3) Analog input associated PLC register address.
      (4) Value in PLC register at each test point.
      (5) Value displayed at each operator interface station (local operator interface displays and SCADA workstations).
      (6) Test equipment used and associated serial numbers.

d) Analog output devices:
(1) Calibration range.
(2) Test value at each test point.
(3) Analog output associated PLC register address.
(4) Control variable value at field device at each test point.
(5) Physical device response at each test point:
(a) Response to be actual valve position, or motor speed, etc.
(6) Test equipment used and associated serial numbers.

10) Failure testing:
a) Demonstrate how the system reacts and recovers from abnormal conditions including, but not limited to:
(1) Equipment failure.
(2) Communications sub-system error.
(3) Power failure.
(4) Process equipment failure.
(5) High system loading conditions.

11) Engineer approval of the CEET submittals is required before proceeding to Functional Testing.

6. Functional testing:
a. General:
1) Testing to demonstrate proper operation of systems with process equipment operating over full operating ranges under conditions as closely resembling actual operating conditions as possible.
2) Performed by Contractor, ICSC, manufacturer's representative working together, with assistance from the OWNER or the inspection staff, as needed.
3) Additional tests are specified in other Instrumentation and Control Sections.
4) Follow approved detailed test procedures and check lists for Functional Test activities.

b. Control logic operational validation:
1) The purpose of control logic validation is to field test the operation of the complete control system, including all parts of the HMI/SCADA system, all control panels (including vendor control panels), all control circuits, all control stations, all monitored/controlled equipment, and final control elements.
2) Demonstrate control functionality shown on the P&IDs, control schematics, and other drawings, and specified in the loop descriptions, control strategies, Electrical Specifications, and Mechanical Equipment Specifications.
3) Test in detail on a function-by-function and sentence-by-sentence basis.
4) Thoroughly test hardware and software functions:
5) Including all hardwired and software control circuit interlocks and alarms.

6) Test final control elements, controlled equipment, control panels, and ancillary equipment under startup, shut down, and steady-state operating conditions to verify all logic and control is achieved.
7) Control logic validation tests to include, but not limited to: a repeat of all control logic tests from the FAT, modified and expanded to include all field instruments, control panels, circuits, and equipment.

c. Loop tuning:
1) Optimally tune all electronic control stations and software control logic incorporating proportional, integral, or derivative control. Apply control signal disturbances at various process variable levels and adjusting the gain, reset, or rate settings as required to achieve proper response.
2) Verify the transient stability of final control elements operating over the full range of operating conditions, by applying control signal disturbances, monitoring the amplitude and decay rate of control parameter oscillations and making necessary controller adjustments as required to eliminate excessive oscillatory amplitudes and decay rates. As a minimum, achieve 1/4-wave amplitude decay ratio damping (subsidence ratio of 4) under the full range of operating conditions.
3) If excessive oscillations or system instability occur, as determined by the Engineer, continue tuning and parameter adjustments, or develop and implement any additional control algorithms needed to achieve satisfactory control loop operation.
4) Functional validation sheets:
a) Document each Functional test on an approved test form.
b) Document loop tuning with a report for each loop, including two-pen chart recordings showing the responses to step disturbance at a minimum of 3 setpoints or process rates approved by the Engineer. Show tuning parameters on the charts, along with time, date, and sign-off by Contractor and Engineer.
c) Include on the form, functions which can be demonstrated on a loop-by-loop basis:
(1) Loop number and P&ID number.
(2) Control strategy, or reference to specification tested.
(3) Test procedures: Where applicable, use the FAT function-by-function, sentence-by-sentence loop test checklist forms modified to meet the requirements of the Functional test. Otherwise, create new forms.
d) For functions that cannot be demonstrated on a loop-by-loop basis (such as overall plant power failure), include on the test form a listing of the specific steps and tests to be conducted. Include with each test description the following information:
(1) Specification page and paragraph of function demonstrated.
(2) Description of function and/or text from specification.
(3) Test procedures: use the FAT loop test checklist forms modified to meet the specific testing conditions of the Functional test.

5) Functional certification:
a) Provide Manufacturer's Certificate of Installation and Functionality Compliance as specified in Section 01756 - Commissioning.
(1) Including all test forms with test data entered, submitted to the Engineer with a clear and unequivocal statement that all Functional test requirements have been satisfied.

7. Clean Water Facility Testing:
a. ICSC shall be onsite to support Clean Water Test activities and provide functional changes as required.

C. Process Start-up Phase:
1. Process Start-up:
a. ICSC shall be onsite to support Process Start-up activities and provide functional changes as required.
2. Process Operation Period:
a. ICSC shall be available to support Process Operational Period and provide functional changes as required.
3. PCIS Optimization and Fine-Tuning:
a. General:
1) After the Process Operational Period, test PCIS system for additional 60 days as specified in this Section to identify issues and make corrections, as needed.
2) This is part of the Work that must be completed as a condition of substantial completion and final completion for the entire Project.
3) The complete PLC control and HMI/SCADA system must run continuously for the duration of the PCIS Optimization and Fine-Tuning.
4) Test and use the entire process control system under standard operating conditions.
5) Exercise all system functions.
6) Log failure, any system interruption and accompanying component, subsystem, or program failure including time of occurrence, duration of each failure, failure classification, and cause:
a) Provide a competently trained technician or programmer on call for the Project Site during all normal working days and hours from the start of the PCIS Optimization and Fine-Tuning until final acceptance of the system.
(1) Response time to the Project Site: 24 hours or less, for a major failure.
b. SCADA system testing:
1) Exercise each system function, e.g., status report, alarms, logs, and displays several times at a minimum, and in a manner that approximates "normal" system operation.
2) Failure of the HMI/SCADA system during testing shall be considered as indicating that the programs and operating system do not meet the requirements of the specifications.
a) Corrective action is required before restarting the PCIS Optimization and Fine-Tuning.
3) Only those components, sub-systems, and systems covered in this Section and supplied under this Contract shall be considered for this

acceptance test. Problems and failures of other systems shall not be considered as part of this test, except as they display the capabilities of this system to detect failures.

4) Failures:
   a) Classify failures as either major or minor:
      (1) Minor failure:
         (a) A small and non-critical component failure or software problem that can be corrected by the Owner's operators.
         (b) Log this occurrence but this is not a reason for stopping the test and is not grounds for non-acceptance.
         (c) Should the same or similar component failure occur repeatedly, this may be considered as grounds for non-acceptance.
         (d) Failure of one printer or operator station is considered a minor failure providing all functions can be provided by backup equipment, i.e., alternate printers and operator station, and repairs can be made and equipment returned to service within 3 working days.
      (2) Major failure:
         (a) Considered to have occurred when a component, subsystem, software control, or program fault causes a halt in or improper operation of the system and/or when a technician's work is required to make a repair or to re-initiate operation of the system.
         (b) Cause termination of the PCIS Optimization and Fine-Tuning.
         (c) Start a new acceptance test when the causes of a major failure have been corrected.
         (d) A failure is also considered major when failure of any control system that results in an overflow, underflow, overdose, or underdose condition occurs.

5) Technician report:
   a) Each time a technician is required to respond to a system malfunction, they must complete a report, which includes details concerning the nature of the complaint or malfunction and the resulting repair action required and taken.
   b) If a malfunction occurs which clears itself or which the operator on duty is able to correct, no report is required or logged as specified above.
   c) If a technician has performed work but no report is written, then a major failure is considered to have occurred.
   d) Each report shall be submitted within 24 hours to the Engineer and the Owner, or its representative.

3.07 FIELD QUALITY CONTROL (NOT USED)

3.08 RE-INSTALLATION (NOT USED)

3.09 ADJUSTING (NOT USED)

3.10 CLEANING (NOT USED)

3.11 PROTECTION (NOT USED)

3.12 SCHEDULES

A. Example test forms:
   1. Example test forms are attached at the end of this Section. They may be used as a starting point for the development of Project-specific test forms for this Project.
   2. The example test forms are not intended to be complete or comprehensive. Edit and supplement the forms to meet the requirements for testing and test forms specified in this Section and other Contract Documents.

END OF SECTION

ATTACHMENT A - FACTORY ACCEPTANCE TEST - CONTROL PANELS

	FACTORY ACCEPTANCE TEST - CONTROL PANELS	

1. GENERAL INSPECTION

A. Structural Inspection

- ☐ Verify Lifting Lugs Installed
- ☐ Verity enclosure has lock and lock is functional
- ☐ Confirm that seismic bracing components are provided per manufacturer's installation instructions

B. Exterior Inspection

- ☐ Cabinet exterior is clean, scratch, and dent free
- ☐ Inspect externally for corrosion and damage
- ☐ Verify enclosure door opens and closes easily
- ☐ Verify enclosure has a 3-point latch
- ☐ Verify enclosure has a flange mounted disconnect (where voltages greater than 120 VAC enter the cabinet)
- ☐ Verify enclosure has the appropriate NEMA rating (1, 1G, 12, 3R, 4, 4X, etc.)
- ☐ Verify enclosure is the appropriate size (not grossly larger than design, and will still fit in the plant)

Nameplates

- ☐ Cabinet has identification nameplate
- ☐ All door labels are straight, spelled correctly, and match the tagging defined in the Contract
- ☐ Cabinet has a nameplate that includes the following:
  - ☐ Power source(s)
  - ☐ Integrator's Logo
  - ☐ Circuit ID(s)
  - ☐ Short Circuit KAIC ratings
- ☐ If labels are screwed to door, silicone was utilized to cover screw holes (Labels screwed to the door of a NEMA 4/4X panel technically violates the NEMA rating.)

Door Devices

- ☐ All devices penetrating the outside of panel have gaskets, silicone or both
- ☐ All door devices are installed (HMIs, Pilot Devices, etc.)
- ☐ Door mounted equipment is mounted straight and square
- ☐ All exterior or door mounted equipment present and accounted for, installed and securely fastened
- ☐ NEMA classification has not been violated due to penetrations
- ☐ Door mounted equipment has the same NEMA rating as the panel
- ☐ All door mounted equipment installed at the correct height
- ☐ All door mounted equipment installed in the correct positions and order (layout of door mounted equipment is grouped properly and in a logical manner)
- ☐ Doors with multiple penetrations have adequate bracing (if needed)
- ☐ Visually check condition of indicators , controllers and annunciators
- ☐ Check that pilot lights illuminate correctly
- ☐ Check the Push-To-Test function
- ☐ Ensure correct pilot light color

Peripheral Devices

- ☐ Horn / Beacon is installed (where required)
- ☐ Silence and Reset pushbutton

PROJECT NAME:		TEST DATE:	
FACILITY NAME:		TESTED BY:	
PROCESS AREA:		COMPANY:	
NETWORK ID:		PAGE:	
WITNESSED BY:		SIGNATURE:	

	FACTORY ACCEPTANCE TEST - CONTROL PANELS	

1. GENERAL INSPECTION (continued)

C. Interior Inspection

- ☐ Cabinet is cleaned of marks and dirt.
- ☐ Inspect internally for corrosion and damage.
- ☐ Back panel is clean of marks and dirt.
- ☐ Interior of panel vacuumed and shall be free of all debris.
- ☐ Check that the panel roof is clean and clear of foreign materials.
- ☐ Bottom of panel has been cut out (where bottom entry is required), with angle iron welded around the bottom perimeter. Re-painting has been performed.
- ☐ If internal light door limit switch is provided, ensure the light automatically turns "on" when the doors are open.
- ☐ Check that a document pocket has been provided.
- ☐ Intrusion alarms (where required).

Interior Labeling

- ☐ All panel mounted equipment has identification labeling, by using either a Brothers or Phenolic type tags.
- ☐ Verify that door mounted components are mounted square and symmetrical.
- ☐ Verify that nameplates are straight, legible, and spelled correctly.
- ☐ All terminal blocks are identified/labeled with permanent labels including tight end blocks and caps.
- ☐ All wiring shrink labeled and or phased correctly to the specifications.
- ☐ All wire labels shrunk completely rotated and aligned alike for easy identification.
- ☐ All fuses and circuit breakers are labeled with ID and current rating.
- ☐ System Integrator’s label or labels installed on door.
- ☐ Panel manufacturer model/serial number tag is present.
- ☐ All required safety/warning tags installed and straight.
- ☐ Correct UL (typically UL 508) or cUL tag installed and registered and all other associated tags installed and straight (the UL tag might not be installed in the panel at the factory test. If the panel is modified due to changes during the factory test or a punch list generated from the factory test, the UL labeling would need to be re-applied. Some UL shops do not apply the UL label until the panel is released to be shipped.).

Wireways

- ☐ Plastic wire way covers installed properly.
- ☐ Plastic wireways have no sharp edges.
- ☐ No wire Ties inside the wireways.
- ☐ No sharp edges on wire ties.
- ☐ Separation: White duct is used for DC voltages, Gray duct is used for AC voltages.
- ☐ Ensure wiring duct is not over-full, includes provision for 20% more wiring and the cover may easily be installed. Panduit recommends 50% duct fill, but 40% is a better practice.

PROJECT NAME:		TEST DATE:	
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1. GENERAL INSPECTION (continued)

C. Interior Inspection (continued)

Wiring

- ☐ Visually check terminals and condition of internal wirings
- ☐ Verify that the control panel has been assembled and wired as designed
- ☐ Verify that all components are operational and perform the functions intended
- ☐ Verify that all components are sized appropriately for the application
- ☐ Verify that equipment control circuits function as intended
- ☐ Back of door wiring is labeled and neatly formed
- ☐ Back panel to door wiring has sufficient bending radius with spiral wrap
- ☐ Wire connection has been verified wired to correct points within the panel
- ☐ Individual wires have been given a pull test to verify a good terminal connection
- ☐ Wire and cable minimum bending radius have not been violated
- ☐ All equipment installed straight and square to back panel
- ☐ Wire colors are correct:
  - ☐ Black and White > AC hot and neutral, respectively
  - ☐ Red > AC control signals
  - ☐ Blue > DC power and control (Blue w/White stripe for DC ground)
  - ☐ Yellow > Foreign voltages (those still present when panel power is disconnected)
  - ☐ Green > AC equipment ground
  - ☐ Black > TSP (+)
  - ☐ White> TSP(-)
- ☐ Analog wiring shields are continuous (connected by a dedicated terminal block for such shields)
- ☐ Analog shield wires are grounded within the panel, where not otherwise grounded at the transmitter itself
- ☐ Discrete inputs are separately fused or protected by a circuit breaker on a “per loop” basis
- ☐ Intrinsic Safety Wiring
  - ☐ Ensure wiring associated with intrinsic safety circuits or intrinsic safety barriers is kept away from all other wiring by UL minimum distances or by a physical (grounded metal) barrier preventing non-intrinsically safe wiring from coming in contact with intrinsically safe circuits or wiring
- ☐ Verify all spare terminals are installed according to the percentage listed in the specifications

Grounding

- ☐ Equipped with “Blackburn” or other grounding type lug
- ☐ Lug is securely fastened to the panel structure
- ☐ Verify Grounding bar is installed
- ☐ Verify Isolated ground bar is installed

PROJECT NAME:		TEST DATE:	
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2. POWER TEST

A. AC Power

- ☐ AC Power is routed correctly within the panel, and is isolated from DC and network wiring.
- ☐ All fuses are installed and sized properly.
- ☐ All breakers are installed and sized properly.
- ☐ 24 VDC Power Supplies are functional.
- ☐ 24 VDC Power fail contacts are functional.
- ☐ 24 VDC power supplies are redundant, and have diode modules enabling the hot swap-over between supplies.
  - ☐ 24 VDC supplies are equipped with dry contact failure alarms, wired as PLC inputs to signal failure of any DC power supply. Such alarm inputs to the PLC have been tested as being functional.
- ☐ Dedicated receptacle is wired to receive a dedicated AC supply.
- ☐ Verify continuity for all DC commons, ground and AC neutrals.
- ☐ Verify that the CP temporary input power is connected correctly and is the correct voltage.
- ☐ Close the CP main circuit breaker(s).
- ☐ Verify that voltages at subsequent circuit breakers are correct.
- ☐ Close circuit breakers.
- ☐ Verify that power feeding interruptible and uninterruptible power supplies is correct.
- ☐ Turn on power supplies if they are not already on.
- ☐ Verify that voltages at distribution terminals are correct.
- ☐ Energize any remaining hardware such as the PLC.

B. Uninterruptible Power Supply (UPS)

- ☐ Mounted appropriately within the cabinet, on a dedicated shelf, or rear of a swing-out sub panel.
- ☐ Is equipped with maintenance bypass switch (or at least plug/receptacle means for bypassing the unit).
- ☐ Test all UPS alarms (on inverter, failure, battery failure etc.)
- ☐ Turn off the AC power supply and verify that the UPS will be switched on to supply the designated vital loads in the control panel.

3. CONTROLS & AUXILIARY DEVICES TEST

- ☐ Verify all interposing and auxiliary relays are functioning.
- ☐ Verify panel lights are functioning.

Ventilation and Heating

- ☐ If ventilation fans are fitted, check the fans operate correctly any associated air filters are clean and not blocked.
- ☐ Verify components are installed in the correct orientation for proper air flow.

4. HARDWIRED INTERLOCK AND SAFETY TEST

- ☐ Verify that hardwired interlocks through the control panel as shown on schematic drawings are functioning. For example, outlet high pressure switch interlock to a pump.
- ☐ Verify that all hardwired safety devices through the control panel is functioning. For example, the pull cord emergency stops of conveyors.

PROJECT NAME:		TEST DATE:	
FACILITY NAME:		TESTED BY:	
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5. PLC TEST

A. Components

☐ PLC interior High Temperature alarm is installed, wired to the PLC, and is shown to be functional.

☐ Relays have transient suppression across their coils. This is particularly important for DC coil relays, where diodes in reverse polarity are often used.

☐ TVSS is installed across the main incoming 120 VAC.

PLC and PLC Rack

☐ Verify all cards are securely seated.

☐ Ensure clearance around PLC rack has been met, such that convective heat transfer is not impeded by devices erroneously mounted in the “no encroachment” area. Confirm with manufacturer clearance recommendations.

B. PLC I/O Test

☐ Furnish **I/O test forms** and test all the listed input and output points as follows:

☐ Discrete Inputs: Simulate a field contact closure by “shorting” across the appropriate terminal blocks. Observe the transition between a logical “0” and “1” in the PLC software.

☐ Discrete Outputs: Force the output bit to toggle between logical “0” and logical “1” using the PLC software. Measure contact resistance at the wired terminal blocks using a digital meter selected for the “ohms” setting.

☐ Analog Inputs: Connect a signal generator to the appropriate terminal blocks. Tailor the connection depending on whether a 2-wire or 4-wire simulation is required. Modulate the 4-20mA signal. Observe the associated PLC internal memory register to transition between 0-65535 or if scaled in engineering units, between 0 and the maximum scaled engineering unit. The latter method is preferred.

☐ Analog Outputs: Force the output register to a value between 0-65535 or 0-100%, if the scaling block can be manipulated. Observe the measured 4-20mA value increment and decrement using a digital ammeter.

C. Redundant Controllers (where required) Test

☐ Remove Communication cable from primary PLC to verify switching to backup PLC

☐ Remove Communication cable from backup PLC to verify switching back to primary PLC

☐ Remove Power cable from primary PLC to verify switching to backup PLC

☐ Remove Power cable from backup PLC to verify switching back to primary PLC

D. PLC Control Logic Verification

☐ The PLC control strategy is verified by following the Control Logic Verification Form based on the specifications. Each control strategy will be verified by simulating the process and checking the state or value of PLC outputs. The results of equipment status and alarms and process instrument values and trends shall also be verified on the Plant SCADA graphic screens stored in a temporary SCADA computer. Since all PLC input and output wiring has been verified and some field devices are not available during Factory Acceptance Testing, certain inputs will be simulated either by means of additional hardware and/or software as described below.

☐

☐

☐ DI states are either simulated by hardwired switches or forced inputs using a programming terminal.

☐ For example, when starters and drives are not provided as part of the contract, jumpers may be installed from the output call relays to the running confirmation inputs to simulate the running state of the motors.

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5. PLC TEST (continued)

D. PLC Control Logic Verification (continued)

Typical Fault Logic

- ☐ If the fault input is high and the disable (if applicable) for the fault is not high and the common disable (if applicable) is not high begin timing. If any of these conditions changes, stop timing and reset the timer. If the timer reaches its preset, activate the alarm output. If the fault alarm is a shutdown alarm stop the associated motor and latch the alarm so that it remains present even if the condition clears.
- ☐ The fault condition must return to normal and the alarm must be reset for a latched alarm to clear.

Typical Fail to Start Logic

- ☐ If the motor is called to run (call output high) and no running feedback is received (running input is low) and the fail to start and common alarm disables (if applicable) are not high start timing. If any of these conditions changes, stop timing and reset the timer. If the timer reaches its preset, activate the alarm output, stop calling the motor and latch the alarm.

6. HMI OR OIT TEST

HMI / OIT Functionality

- ☐ Communication with PLC
- ☐ Screen Layouts
- ☐ Screen Navigation
- ☐ Set Point Entry
- ☐ Animation
- ☐ Color Correctness (Green=Run, Red=Off, Amber=Alarm, or the agreed upon convention)
- ☐ Alarms
- ☐ Acknowledge and Reset
- ☐ Security / Access Levels / Passwords

7. NETWORK COMMUNICATION TEST

A. Network Components

- ☐ Fiber optic cabling terminates in a patch panel
- ☐ Media converters are installed and functional
- ☐ Terminating resistors have been installed for trunk/tap topologies or where required
- ☐ Wire and cable bending limitations have not been violated

B. Networking Functions

- ☐ Verify data transfer via the network to different PLCs as shown on the Network Block Diagrams
- ☐ Verify network traffic rate and error margin is acceptable

PROJECT NAME:		TEST DATE:	
FACILITY NAME:		TESTED BY:	
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WITNESSED BY:		SIGNATURE:	

8. FAT DOCUMENTATION AND RECORD

Panel Documentation

- ☐ As-built panel drawings showing actual panel construction and devices arrangement and c/w Bill of Material.
- ☐ Panel schematic and interconnection drawings.
- ☐ P&ID drawings and schematic drawings for the process area controlled by the panel that is to be tested.
- ☐ I/O list test forms of the process area to be tested.
- ☐ FAT procedure of the process area to be tested.
- ☐ Test record forms of the process area to be tested. Forms shall include area for signature of responsible test personnel.
- ☐ Hard copy of the PLC application program of the process area to be tested.
- ☐ Hard copy of the HMI/OIT graphic screens of the process area to be tested.

9. FAT TOOLS AND SOFTWARE

- ☐ Simulation software if required
- ☐ Digital volt meter Fluke 87
- ☐ Process meter Fluke 787
- ☐ Laptop computer with PLC application program
- ☐ Temporary SCADA computer with HMI software and applicable graphic screens
- ☐ Jumper wires

PROJECT NAME:		TEST DATE:	
FACILITY NAME:		TESTED BY:	
PROCESS AREA:		COMPANY:	
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WITNESSED BY:		SIGNATURE:	

ATTACHMENT B - INSTALLATION AND CERTIFICATION CHECKLIST DOCUMENTATION

	INSTALLATION AND CERTIFICATION CHECKLIST DOCUMENTATION	

INSTRUMENT LOOP NO. _____

SERVICE DESCRIPTION _____

A COPY OF LATEST ISSUE OF THE FOLLOWING DOCUMENTS ARE INCLUDED IN THIS INSTRUMENT INSTALLATION CERTIFICATION FILE:

☐ INSTRUMENT SPECIFICATION SHEETS (FOR ALL INSTRUMENTS IN THE LOOP)

☐ INSTRUMENT INSTALLATION DETAILS (FOR ALL INSTRUMENTS IN THE LOOP)

☐ INSTRUMENT LOOP WIRING DIAGRAMS

☐ INSTRUMENT INSTALLATION CERTIFICATION CHECKLIST

☐ SIZING CALCULATIONS

☐ INSTRUMENT INSTALLATION SCHEDULE (APPLICABLE PART)

☐ NAMEPLATE SCHEDULE (APPLICABLE PART)

☐ VENDOR LITERATURE CALIBRATION INFORMATION

	☐ No	☐ Yes
INSTRUMENT LOOP IS PART OF EQUIPMENT START-UP/SHUTDOWN INTERLOCKS?		

REMARKS: _____

CHECKED BY (COMPANY) _____ ACCEPTED BY (COMPANY) _____

SIGNATURE _____ SIGNATURE _____

DATE _____ DATE _____

ATTACHMENT C - SWITCHES INSTALLATION AND CALIBRATION CHECKLIST

	SWITCHES INSTALLATION AND CALIBRATION CHECKLIST	

INSTRUMENT LOOP NO. _____

SERVICE DESCRIPTION _____

CHECK BELOW, WHEN COMPLETED:

☐ BENCH CALIBRATED PER SPECIFICATION SHEET NO. _____

☐ VERIFIED PER P&ID NO. _____

☐ CORRESPONDS TO SPECIFICATION SHEET NO. _____

☐ WIRING CORRECT PER INSTRUMENT LOOP DRAWING NO. _____

☐ INSTALLATION CORRECT PER DETAIL NO. _____

☐ ACCESSORIES ARE PRESENT AND PROPERLY INSTALLED

☐ INSTRUMENT IS ACCESSIBLE FOR MAINTENANCE OR REMOVAL

☐ ENGRAVED LAMINATED NAMEPLATE (NO SPELLING ERRORS) PERMANENTLY INSTALLED

	☐ No	☐ Yes
INSTRUMENT LOOP IS PART OF EQUIPMENT START-UP/SHUTDOWN INTERLOCKS?		

FIELD CALIBRATION CHECK

CONTACT NO.	FUNCTION	FOR SIGNAL	CONTACT IS TO	AT SPECIFIED VALUE FOR	ACTUAL TRIP POINT WAS
1	☐ ALARM	☐ INCR	☐ OPEN	SET PT = _____	SET PT = _____
	☐ S/D PERM	☐ DECR	☐ CLOSE	RESET = _____	RESET = _____
2	☐ ALARM	☐ INCR	☐ OPEN	SET PT = _____	SET PT = _____
	☐ S/D PERM	☐ DECR	☐ CLOSE	RESET = _____	RESET = _____
3	☐ ALARM	☐ INCR	☐ OPEN	SET PT = _____	SET PT = _____
	☐ S/D PERM	☐ DECR	☐ CLOSE	RESET = _____	RESET = _____
4	☐ ALARM	☐ INCR	☐ OPEN	SET PT = _____	SET PT = _____
	☐ S/D PERM	☐ DECR	☐ CLOSE	RESET = _____	RESET = _____

NOTE: PERM IS ABBREVIATION FOR PERMISSIVE

	SWITCHES INSTALLATION AND CALIBRATION CHECKLIST	

REMARKS: _____

CHECKED BY (COMPANY) _____ ACCEPTED BY (COMPANY) _____

SIGNATURE _____ SIGNATURE _____

DATE _____ DATE _____

ATTACHMENT D - TRANSMITTER/CONTROLLER/INDICATOR INSTALLATION AND CALIBRATION CHECKLIST

	TRANSMITTER/CONTROLLER/INDICATOR INSTALLATION AND CALIBRATION CHECKLIST	

☐ ☐

INSTRUMENT LOOP IS PART OF EQUIPMENT START-UP/SHUTDOWN INTERLOCKS? No Yes

INSTRUMENT TYPE ☐ TRANSMITTER ☐ CONTROLLER ☐ INDICATOR

☐ OTHER DESCRIPTION _____

INSTRUMENT TAG NO. _____ SERIAL NO. _____

SERVICE DESCRIPTION _____

BENCH CALIBRATION CHECK

INPUT RANGE = _____

HEAD CORRECTION = _____

CALIBRATED SPAN = _____

OUTPUT RANGE = _____

☐ LINEAR

☐ SQUARE ROOT

% CALIB SPAN	DESIRED VALUE	ACTUAL VALUE	EXPECTED VALUE	ACTUAL VALUE
0				
50				
100				

CHECK BELOW, WHEN COMPLETED:

☐ BENCH CALIBRATED PER SPECIFICATION SHEET NO. _____

☐ VERIFIED PER P&ID NO. _____

☐ CORRESPONDS TO SPECIFICATION SHEET NO. _____

☐ WIRING CORRECT PER INSTRUMENT LOOP DRAWING NO. _____

☐ INSTALLATION CORRECT PER DETAIL NO. _____

☐ ACCESSORIES ARE PRESENT AND PROPERLY INSTALLED

☐ INSTRUMENT IS ACCESSIBLE FOR MAINTENANCE OR REMOVAL

☐ ENGRAVED LAMINATED NAMEPLATE (NO SPELLING ERRORS) PERMANENTLY INSTALLED

FIELD CALIBRATION CHECK

INPUT RANGE = _____

OUTPUT RANGE = _____

% CALIB SPAN	DESIRED VALUE	ACTUAL VALUE	EXPECTED VALUE	ACTUAL VALUE
0				
50				
100				

	TRANSMITTER/CONTROLLER/INDICATOR INSTALLATION AND CALIBRATION CHECKLIST	

☐ DIRECT ☐ REVERSE

☐ ACTION VERIFIED AT 50% SPAN

☐ ACTION VERIFIED AT _____ SPAN

CONTROLLER SETTINGS								
SETTING	**GAIN**	**PB**	**RESET (INTEGRAL)**	**DERIV. (RATE)**	**HIGH LIMIT**	**LOW LIMIT**	**ELEV. ZERO**	**ZERO SUPP**
PRE-TUNE								
POST-TUNE								

PRE-TUNE SETTINGS					
	GAIN	**PB**	**RESET (REPEAT/MIN)**	**RESET (MIN/REPEAT)**	**DERIVATION (MINUTES)**
FLOW	1.0	100	10	0.1	N/A
LEVEL	1.0	100	MIN.	MAX.	N/A
PRESSURE	2.0	50	2.0	0.5	N/A
TEMP.	4.0	25	0.1	10	OFF

REMARKS _____

CHECKED BY (COMPANY) _____ ACCEPTED BY (COMPANY) _____

SIGNATURE _____ SIGNATURE _____

DATE _____ DATE _____

ATTACHMENT E - ANALYZERS INSTALLATION AND CALIBRATION CHECKLIST

	ANALYZERS INSTALLATION AND CALIBRATION CHECKLIST	

☐ No ☐ Yes

INSTRUMENT LOOP IS PART OF EQUIPMENT START-UP/SHUTDOWN INTERLOCKS?

TYPE OF INSTRUMENT _____

INSTRUMENT TAG NO. _____ SERIAL NO. _____

SERVICE DESCRIPTION _____

CHECK BELOW, IF TRUE

☐ BENCH CALIBRATED PER SPECIFICATION SHEET NO. _____

☐ VERIFIED PER P&ID NO. _____

☐ CORRESPONDS TO SPECIFICATION SHEET NO. _____

☐ WIRING CORRECT PER INSTRUMENT LOOP DRAWING NO. _____

☐ INSTALLATION CORRECT PER DETAIL NO. _____

☐ ACCESSORIES ARE PRESENT AND PROPERLY INSTALLED

☐ INSTRUMENT IS ACCESSIBLE FOR MAINTENANCE OR REMOVAL

☐ ENGRAVED LAMINATED NAMEPLATE (NO SPELLING ERRORS) PERMANENTLY INSTALLED

REMARKS _____

CHECKED BY (COMPANY) _____ ACCEPTED BY (COMPANY) _____

SIGNATURE _____ SIGNATURE _____

DATE _____ DATE _____

ATTACHMENT F - CONTROL VALVES
INSTALLATION AND CALIBRATION CHECKLIST

	CONTROL VALVES INSTALLATION AND CALIBRATION CHECKLIST	

☐ No ☐ Yes

INSTRUMENT LOOP IS PART OF EQUIPMENT START-UP/SHUTDOWN INTERLOCKS?

☐ VALVE TAG NO. _____ SERIAL NO. _____

☐ TRANSDUCER TAG NO. _____ SERIAL NO. _____

☐ SOLENOID TAG NO. _____ SERIAL NO. _____

☐ VOLUME BOOSTER TAG NO. _____ SERIAL NO. _____

☐ POSITIONER _____ SERIAL NO. _____

SERVICE DESCRIPTION _____

TRANSDUCER CHECK					
INPUT RANGE =			OUTPUT RANGE =		
CALIBRATED SPAN =			CALIBRATED SPAN =		
BENCH					
SPAN	DESIRED	ACTUAL	SPAN	EXPECTED	ACTUAL
0%			0%		
50%			50%		
100%			100%		
FIELD					
SPAN	DESIRED	ACTUAL	SPAN	EXPECTED	ACTUAL
0%			0%		
50%			50%		
100%			100%		

CHECK BELOW, IF TRUE:

☐ BENCH CALIBRATED PER ABOVE _____

☐ VERIFIED PER P&ID NO. _____

☐ CORRESPONDS TO SPECIFICATION SHEET NO. _____

- ☐ VALVE SPECIFICATION NO. _____
- ☐ TRANSDUCER SPECIFICATION NO. _____
- ☐ SOLENOID SPECIFICATION NO. _____

☐ WIRING CORRECT PER INSTRUMENT LOOP DRAWING NO. _____

☐ INSTALLATION CORRECT PER INSTRUMENT INSTALLATION DETAILS _____

- ☐ VALVE DETAIL NO. _____
- ☐ TRANSDUCER DETAIL NO. _____
- ☐ SOLENOID DETAIL NO. _____

	CONTROL VALVES INSTALLATION AND CALIBRATION CHECKLIST	

☐ ACCESSORIES ARE PRESENT AND PROPERLY INSTALLED

☐ INSTRUMENT IS ACCESSIBLE FOR MAINTENANCE OR REMOVAL

☐ ENGRAVED LAMINATED NAMEPLATE (NO SPELLING ERRORS) PERMANENTLY INSTALLED

VALVE CHECK			
FLOW CHECK	☐ PROCESS FLOW DIRECTION THROUGH THE VALVE IS CORRECT		
SAFETY CHECK	ON LOSS OF AIR VALVE FAILS ☐ OPEN ☐ CLOSE	ON LOSS OF POWER SOLENOID FAILS ☐ TO VENT ☐ TO VALVE	
TRAVEL CHECK	FULL OPEN AT _____ PSI	FULL CLOSED AT _____ PSI	MEASURED TRAVEL _____ INCHES
SEATING CHECK	☐ ON BENCH ☐ IN-LINE	RESULTS	ACTUATOR BENCH SET
POSITIONER CHECK			
VALVE FULL OPEN AT _____ PSI TO POSITIONER			
VALVE FULL CLOSED AT _____ PSI TO POSITIONER			
VOLUME BOOSTER CHECK			
BYPASS VALVE (GAIN) ADJUSTING SCREW BACKED OUT _____ TURNS FROM CLOSED TO ENSURE QUICK BUT STABLE OPERATION (TYPICALLY 1-1/2 TO 2 TURNS)			

REMARKS _____

CHECKED BY (COMPANY) _____ ACCEPTED BY (COMPANY) _____

SIGNATURE _____ SIGNATURE _____

DATE _____ DATE _____

APPENDIX A
MITIGATION MONITORING AND REPORTING PROGRAM

MITIGATION MONITORING AND REPORTING PROGRAM

City of Ukiah
Recycled Water Project
Final Initial Study / Mitigated Negative Declaration

SCH #2013032072

Prepared for:
City of Ukiah
Public Works Administration Office
300 Seminary Avenue
Ukiah, CA 95482

Prepared by:

SMB Environmental, Inc.

May 2013

INTRODUCTION

Pursuant to the California Environmental Quality Act (CEQA; Public Resources Code Section 21000, et seq. and CEQA Guidelines), the City of Ukiah, California (City) prepared a Public Draft Initial Study/Mitigated Negative Declaration (IS/MND) to evaluate potential environmental impacts associated with the City's proposed Recycled Water Project (Proposed Project/Action). The purpose of the Proposed Project/Action is to replace/augment existing water supplies in Ukiah Valley. Recycled water use within the Ukiah Valley would offset existing and future water demands for irrigation and frost protection of agricultural land, and in doing so, would support the local agricultural industry. It would also offset urban irrigation demands, ease storage limitations at the Ukiah Wastewater Treatment Plant (UWWTP) and reduce treated wastewater discharges to the Russian River.

CEQA Guidelines require public agencies to adopt a Mitigation Monitoring and Reporting Program (MMRP) for changes to the project which it has adopted or made a condition of project approval in order to mitigate or avoid significant effects on the environment. A MMRP is required for the proposed project because the IS/MND identifies potentially significant adverse impacts related to project implementation, and mitigation measures have been identified to reduce those impacts.

On March 27, 2013, to initiate public review of the Draft IS/MND, the City filed a Notice of Completion (NOC) for the project with the Governor's Office of Planning and Research (State Clearinghouse or SCH) and the County of Mendocino and released the Draft IS/MND for a 30-day public review. The State Clearinghouse identified the project with SCH #2013032072. The public review period was established between March 27 and April 26, 2013, with copies of the Draft IS/MND available for review at the City's Public Works Administration Office, at 300 Seminary Avenue, Ukiah, CA 95482; and the Main Branch Library, 105 North Main Street, Ukiah, CA 95482. On March 27, 2013, the Ukiah Daily Journal published the Notice of Intent/Notice of Availability (NOI/NOA) to adopt a Mitigated Negative Declaration for the Proposed Project/Action. A Public Draft of the IS/MND was also posted on the City's website at http://www.cityofukiah.com/.

In May 2013, the City prepared a Final IS/MND according to CEQA Guidelines and incorporates all comments received by the State Clearinghouse and the City during the 30-day public review period. As a result, some of the mitigation measures identified in the Public Draft IS/MND have been revised to reflect those comments. Based on the Final IS/MND, the Proposed Project/Action would not result in new significant impacts, substantially increase the severity of previously disclosed impacts, or involve any of the other conditions related to changed circumstances or new information that can require a subsequent or supplemental EIR under Public Resources Code section 21166 and CEQA Guidelines section 15162 beyond those impacts and conditions already identified in the City's Public Draft IS/MND.

PURPOSE OF MITIGATION MONITORING AND REPORTING PROGRAM

This MMRP has been prepared to ensure that all required mitigation measures are implemented and completed in a satisfactory manner before and during project construction and operation. The MMRP may be modified by the City during project implementation, as necessary, in response to changing conditions or other refinements. Table A (included at the end of this document) has been prepared to assist the responsible parties in implementing the mitigation measures. The table identifies individual mitigation measures, monitoring/mitigation timing, responsible person/agency for implementing the measure, monitoring and reporting procedure, and space to confirm implementation of the mitigation measures. The numbering of mitigation measures follows the numbering sequence found in the Public Draft IS/MND.

ROLES AND RESPONSIBILITIES

Unless otherwise specified herein, the City is responsible for taking all actions necessary to implement the mitigation measures under its jurisdiction according to the specifications provided for each measure and for demonstrating that the action has been successfully completed. The City, at its discretion, may delegate implementation responsibility or portions thereof to a licensed contractor or other designated agent. The City would be responsible for overall administration of the MMRP and for verifying that

City staff members and/or the construction contractor has completed the necessary actions for each measure.

The City would designate a project manager to oversee implementation of the MMRP. The City of Ukiah's Public Works Department is primarily responsible for implementing the mitigation measures for the Proposed Project as described in this MMRP. Duties of the project manager include the following:

- Ensure that routine inspections of the construction site are conducted by appropriate City staff; check plans, reports, and other documents required by the MMRP; and conduct report activities.
- Serve as a liaison between the City and the contractor or project applicant regarding mitigation monitoring issues.
- Complete forms and maintain reports and other records and documents generated by the MMRP.
- Coordinate and ensure that corrective actions or enforcement measures are taken, if necessary.

The responsible party for implementation of each item would identify the staff members responsible for coordinating with the City on the MMRP.

REPORTING

The City's project manager shall prepare a monitoring report, upon completion of the project, on the compliance of the activity with the required mitigation measures. Information regarding inspections and other requirements shall be compiled and explained in the report. The report shall be designed to simply and clearly identify whether mitigation measures have been adequately implemented. At a minimum, each report shall identify the mitigation measures or conditions to be monitored for implementation, whether compliance with the mitigation measures or conditions has occurred, the procedures used to assess compliance, and whether further action is required. The report shall be presented to the City Council.

MITIGATION MONITORING AND REPORTING PLAN TABLE

The categories identified in Table A are described below.

- **Mitigation Measure –** This column provides the text of the mitigation measures identified in the IS/MND.
- **Timing –** This column identifies the time frame in which the mitigation will take place.
- **Enforcement –** This column identifies the party responsible for enforcing compliance with the requirements of the mitigation measure.
- **Dated Signature for Verification of Compliance –** This column is to be dated and signed by the person (either project manager or his/her designee) responsible for verifying compliance with the requirements of the mitigation measure.

Table A
Mitigation Monitoring and Reporting Plan for the City of Ukiah's Recycled Water Project IS/MND

Mitigation Measure	Timing	Implementation[1]	Enforcement[1]	Dated Signature for Verification of Compliance
3.3 AIR QUALITY				
Mitigation Measure AIR-1: Dust Control. During all phases of construction, the following dust control procedures shall be implemented: • Water all active construction sites as necessary. • Cover all trucks having soil, sand, or other loose material or maintain at least two feet of freeboard on all trucks. • Apply water as necessary, or apply non-toxic soil stabilizers on all unpaved access roads, parking areas and staging areas at construction sites. • Sweep if visible soil material is carried into adjacent streets. • Water or apply non-toxic soil binders to exposed soil stockpiles. • Limit traffic speeds on unpaved areas to 15 mph.	Prior to construction of The Proposed Project/Action.	City of Ukiah Public Works Department	City of Ukiah Public Works Department Mendocino County Air Quality Management District	
3.4 BIOLOGICAL RESOURCES				
Mitigation Measure BIO-1: Conduct Breeding/Nesting Surveys. For construction activities that occur between February 1 and August 31, preconstruction breeding bird surveys shall be conducted by a qualified biologist prior to and within 10 days of any initial ground-disturbance activities. Surveys shall be conducted within all suitable nesting habitat within 250 feet of the activity. All active, non-status passerine nests identified at that time should be protected by a 50 foot radius minimum exclusion zone. Active raptor or special-status species nests should be protected by a buffer with a minimum radius of 200 feet. CDFW and USFWS recommend that a minimum 500-foot exclusion buffer be established around active white-tailed kite and golden eagle nests. The following considerations apply to this mitigation measure: • Survey results are valid for 14 days from the survey date. Should ground disturbance commence later than 14 days from the survey date, surveys should be repeated. If no breeding birds are encountered, then work may proceed as planned. • Exclusion zone sizes may vary, depending on habitat characteristics and species, and are generally larger for raptors and colonial nesting birds. Each exclusion zone would remain in place until the nest is abandoned or all young have fledged.	Prior to and during construction of the Proposed Project/Action.	City of Ukiah Public Works Department	City of Ukiah Public Works Department California Department of Fish and Wildlife U.S. Fish and Wildlife Service	

[1] The City of Ukiah's Public Works Department is primarily responsible for implementing the mitigation measures for the Proposed Project/Action as described in this MMRP.

Table A Mitigation Monitoring and Reporting Plan for the City of Ukiah's Recycled Water Project IS/MND				
Mitigation Measure	**Timing**	**Implementation[1]**	**Enforcement[1]**	**Dated Signature for Verification of Compliance**
• The non-breeding season is defined as September 1 to January 31. During this period, breeding is not occurring and surveys are not required. However, if nesting birds are encountered during work activities in the non-breeding season, disturbance activities within a minimum of 50 feet of the nest should be postponed until the nest is abandoned or young birds have fledged.				
Mitigation Measure BIO-2: Conduct A Preconstruction Survey for Western Pond Turtles and Relocate, if Necessary. A qualified biologist shall conduct a pre-construction survey for western pond turtles no more than 30 days prior to construction in suitable aquatic habitats within the project corridor, including stream crossings, drainage ditches, and culverts. A combination of visual and trapping surveys may be performed with authorization from CDFW. If the species is found near any proposed construction areas, impacts on individuals and their habitat shall be avoided to the extent feasible. If occupied habitat can be avoided, an exclusion zone shall be established around the habitat and temporary plastic fencing shall be installed around the buffer area with "Sensitive Habitat Area" signs posted and clearly visible on the outside of the fence. If avoidance is not possible and the species is determined to be present in work areas, the biologist with approval from CDFW may capture turtles prior to construction activities and relocate them to nearby, suitable habitat a minimum of 300 feet downstream from the work area. Exclusion fencing should then be installed if feasible to prevent turtles from reentering the work area. For the duration of work in these areas the biologist should conduct monthly follow-up visits to monitor effectiveness.	Prior to and during construction of the Proposed Project/Action.	City of Ukiah Public Works Department	City of Ukiah Public Works Department California Department of Fish and Wildlife	
Mitigation Measure BIO-3: Avoid cutting through the creeks. As described in the Proposed Project/Action description, all of the creek crossings will be crossed by using trenchless construction techniques in the dry season. Specifically, no pipeline construction activities shall occur between December 1 and May 31 (a work window identified by the National Marine Fisheries Service), which is the period when adult and juvenile salmonids are likely to occur in the Russian River. Construction crews shall avoid entering the stream channels during installation.	Prior to and during construction of the Proposed Project/Action.	City of Ukiah Public Works Department	City of Ukiah Public Works Department North Coast Regional Water Quality Control Board National Marine Fisheries Service	
Mitigation Measure BIO-4: Implement Construction Best Management Practices. To reduce potentially significant erosion and siltation, the City and/or its selected contractor(s) shall obtain a Stormwater Pollution Prevention Permit (SWPPP) and implement Best Management Practices and erosion control measures as required by the North Coast RWQCB. Best Management Practices to reduce erosion and siltation shall include, at a minimum, the following	Prior to the construction of the Proposed Project	City of Ukiah Public Works Department	City of Ukiah Public Works Department North Coast Regional Water Quality Control Board	

Table A
Mitigation Monitoring and Reporting Plan for the City of Ukiah's Recycled Water Project IS/MND

Mitigation Measure	Timing	Implementation[1]	Enforcement[1]	Dated Signature for Verification of Compliance
measures: Avoidance of construction activities during inclement weather; limitation of construction access routes and stabilization of access points; stabilization of cleared, excavated areas by providing vegetative buffer strips, providing plastic coverings, and applying ground base on areas to be paved; protection of adjacent properties by installing sediment barriers or filters, or vegetative buffer strips; stabilization and prevention of sediments from surface runoff from discharging into storm drain outlets; use of sediment controls and filtration to remove sediment from water generated by dewatering; and returning all drainages to preconstruction conditions. Construction crews shall avoid entering the stream channels during installation.				
Mitigation Measure BIO-5: Develop and Implement a Frac-Out Contingency Plan for Trenchless Construction Activities. For trenchless construction activities that use drilling lubricants, the City or its contractor shall prepare and implement a frac-out contingency plan that is intended to minimize the potential for a frac-out associated with tunneling activities; provide for the timely detection of frac-outs; and ensure an organized, timely, and "minimum-impact" response in the event of a frac-out and release of drilling lubricant (i.e., bentonite). The contingency plan will require, at a minimum, the following measures. • Trenchless construction activities to be conducted during a work window identified by the National Marine Fisheries Service when adult and juvenile salmonids are not present in the project area (June 1 through November 30). • A full-time monitor will attend all drilling to look for observable frac-out conditions or lowered pressure readings on drilling equipment. If a frac-out is identified, all work will stop, including the recycling of drilling lubricant. In the event of a frac-out into water, the pressure of water above the tunnel will keep excess mud from escaping through the fracture. The location and extent of the frac-out will be determined, and the frac-out will be monitored for 4 hours to determine whether the drilling lubricant congeals (bentonite will usually harden, effectively sealing the frac-out location). • If the drilling lubricant congeals, no other actions will be taken that would potentially suspend sediments in the water column. • Surface releases of bentonite will be allowed to harden and then will be removed.	Prior to and during construction of the Proposed Project/Action.	City of Ukiah Public Works Department	City of Ukiah Public Works Department	

Table A
Mitigation Monitoring and Reporting Plan for the City of Ukiah's Recycled Water Project IS/MND

Mitigation Measure	Timing	Implementation[1]	Enforcement[1]	Dated Signature for Verification of Compliance
• The contingency plan will identify additional measures to be taken to contain or remove the drilling lubricant if it does not congeal.				
Mitigation Measure BIO-6: Obtain all Required Authorizations. Prior to issuance of encroachment permits for the Proposed Project/Action, the City, as necessary, shall conduct a wetlands delineation study in sensitive areas of the Proposed Project/Action and obtain all required authorization from agencies with jurisdiction riparian habitats and jurisdictional wetlands in the area. Such agencies may include, but are not limited to, the United States Army Corps of Engineers, the California Department of Fish and Wildlife, and the North Coast Regional Water Quality Control Board. Impacted habitat shall be offset through onsite restoration, offsite restoration, or purchase of credits at a CDFW and USFWS-approved mitigation bank in the region at no less than a 1:1 ratio.	Prior to and during construction of the Proposed Project/Action.	City of Ukiah Public Works Department	City of Ukiah Public Works Department North Coast Regional Water Quality Control Board California Department of Fish and Wildlife U.S. Fish and Wildlife Service U.S. Army Corps of Engineers	
3.5 CULTURAL RESOURCES				
Mitigation Measure CR-1: Conduct Pre-construction Survey and Avoidance of Identified Cultural Resources. Prior to and/or during the engineering and final design phase, a qualified professional archeologist or cultural resources specialist will provide a final pre-construction survey of the exact proposed pipeline alignment and placement of the project facilities within the proposed construction corridor and ensure that the construction activities of the Proposed Project/Action will not affect the archeological resources P-23-004814, P-23-004815, and P-23-003663 as identified by NWIC above. In the unlikely event that the Proposed Project/Action could affect these resources, the proposed project facilities shall be constructed in a manner that will avoid damaging these resources. Specifically, the pipeline shall either be installed by avoidance of the resource by realignment of the pipeline or facility around the resource(s) and/or as in the case of crossing the Northwestern Railroad, the resource shall be avoided by going beneath through the implementation of horizontal directional drilling (HDD) or another equally effective construction technique(s). In addition, the archeological resource sites shall include the installation of barrier fencing or other physical barriers to prevent construction personnel and vehicles from coming onto the sites during construction. During construction, the area shall be monitored by a professional archaeologist to ensure that (1) barrier fencing is maintained, (2) vehicles and workers do in fact remain off the site, and (3) violations of the exclusion area are reported and infractions are policed in accordance with treatment of other environmental violations. Any construction or post-construction use of the road adjacent to the sites in support of the pipeline shall be confined to the road which shall be used	Prior to and throughout construction	City of Ukiah Public Works Department	City of Ukiah Public Works Department	

Table A
Mitigation Monitoring and Reporting Plan for the City of Ukiah's Recycled Water Project IS/MND

Mitigation Measure	Timing	Implementation[1]	Enforcement[1]	Dated Signature for Verification of Compliance
"as is" and shall not be modified by grading or expanded in width.				
Mitigation Measure CR-2: Halt work if cultural resources are discovered. In the event that any prehistoric or historic subsurface cultural resources are discovered during ground disturbing activities, all work within 100 feet of the resources shall be halted and after notification, the City shall consult with a qualified archaeologist to assess the significance of the find. If any find is determined to be significant (CEQA Guidelines 15064.5[a][3] or as unique archaeological resources per Section 21083.2 of the California Public Resources Code), representatives of the City and a qualified archaeologist shall meet to determine the appropriate course of action. In considering any suggested mitigation proposed by the consulting archaeologist in order to mitigate impacts to historical resources or unique archaeological resources, the lead agency shall determine whether avoidance is necessary and feasible in light of factors such as the nature of the find, project design, costs, and other considerations. If avoidance is infeasible, other appropriate measures (e.g., data recovery) shall be instituted. Work may proceed on other parts of the project site while mitigation for historical resources or unique archaeological resources is carried out.	Upon discovery of cultural resources	City of Ukiah Public Works Department	City of Ukiah Public Works Department	
Mitigation Measure CR-3: Stop work if paleontological remains are discovered. If paleontological resources, such as fossilized bone, teeth, shell, tracks, trails, casts, molds, or impressions are discovered during ground-disturbing activities, work will stop in that area and within 100 feet of the find until a qualified paleontologist can assess the significance of the find and, if necessary, develop appropriate treatment measures in consultation with the City.	Before and during ground-disturbing activities.	City of Ukiah Public Works Department	City of Ukiah Public Works Department	
Mitigation Measure CR-4: Halt work if human remains are found. If human remains are encountered during excavation activities conducted for the Proposed Project/Action, all work in the adjacent area shall stop immediately and the Mendocino County Coroner's office shall be notified. If the Coroner determines that the remains are Native American in origin, the Native American Heritage Commission shall be notified and will identify the Most Likely Descendent, who will be consulted for recommendations for treatment of the discovered human remains and any associated burial goods.	Upon the discovery of suspected human remains.	City of Ukiah Public Works Department	For actions taken to satisfy the requirements of Section 106: the State Historic Preservation Office (SHPO) For all project-related improvements that would be located within the City of Ukiah and County of Mendocino: City of Ukiah Public Works Department and Mendocino County Coroner	
3.6 GEOLOGY AND SOILS				

Table A
Mitigation Monitoring and Reporting Plan for the City of Ukiah's Recycled Water Project IS/MND

Mitigation Measure	Timing	Implementation[1]	Enforcement[1]	Dated Signature for Verification of Compliance
Mitigation Measure GEO-1: Perform Geotechnical Investigation. The City shall require a design-level geotechnical study to be prepared prior to project implementation to determine proper design and construction methods, including any cathodic protection measures needed for installing the pipelines in these soils as well as the design of the storage pond(s). The geotechnical study shall evaluate the potential for impacts to groundwater by determining soil permability and other characteristics that affect water movement, in addition to issues related to erosion and seismic hazards.	Prior to completion of engineering plans for the Proposed Project/Action.	City of Ukiah Public Works Department	City of Ukiah Public Works Department	
3.8 HAZARDS AND HAZARDOUS MATERIALS				
Mitigation Measure HAZ-1: Store, Handle, Use Hazardous Materials in Accordance with Applicable Laws. The City shall ensure that all construction-related hazardous materials and hazardous wastes shall be stored, handled, and used in a manner consistent with relevant and applicable federal, state, and local laws and done in a manner that protects surface waters and groundwater. In addition, construction-related hazardous materials and hazardous wastes shall be staged and stored away from stream channels and steep banks to keep these materials a safe distance from near-by residents and prevent them from entering surface waters in the event of an accidental release. Additionally, the City shall develop a spill contingency plan that addresses measures to address spills and leaks of hazardous materials as well as appropriate use of adequate storage containers for containment.	Prior to construction and operation the Proposed Project/Action	City of Ukiah Public Works Department	City of Ukiah Public Works Department	
Mitigation Measure HAZ-2: Properly Dispose of Contaminated Soil and/or Groundwater. If contaminated soil and/or groundwater is encountered or if suspected contaminated is encountered during project construction, work shall be halted in the area, and the type and extent of the contamination shall be identified. A contingency plan to dispose of any contaminated soil or groundwater will be developed through consultation with appropriate regulatory agencies.	Prior to construction and operation the Proposed Project/Action	City of Ukiah Public Works Department	City of Ukiah Public Works Department	
Mitigation Measure HAZ-3: Properly Dispose of Hydrostatic Test Water. Dewatering and of the pipeline during hydrostatic testing in the construction phase as well as any dewatering needed as a result of operations and maintenance activities shall be discharged to land and not into any creeks, drainages, or waterways and shall require prior approval from the North Coast Regional Water Quality Control Board.	Prior to construction and operation the Proposed Project/Action	City of Ukiah Public Works Department	City of Ukiah Public Works Department	
Mitigation Measure HAZ-4: Consult with FAA, Ukiah Municipal Airport, USFWS, and CDFW. The City shall initiate consultation with the Ukiah Municipal Airport operations manager as well as with the FAA, USFWS, and CDFW to disclose plans for developing the new wastewater storage facility and	Prior to construction and operation the Proposed	City of Ukiah Public Works Department	City of Ukiah Public Works Department Ukiah Municipal Airport	

Table A
Mitigation Monitoring and Reporting Plan for the City of Ukiah's Recycled Water Project IS/MND

Mitigation Measure	Timing	Implementation[1]	Enforcement[1]	Dated Signature for Verification of Compliance
seek their input resulting in the development of a specific plan and/or management activities to avoid or reduce the potential for attracting hazardous wildlife movement into or across the approach or departure airspace.	Project/Action.		Federal Aviation Administration California Department of Fish and Wildlife U.S. Fish and Wildlife Service	
Mitigation Measure HAZ -5: Develop and Maintain Emergency Access Strategies. In conjunction with Mitigation Measure Traffic-1: Develop a Traffic Control Plan identified below in the Traffic and Transportation section, comprehensive strategies for maintaining emergency access shall be developed. Strategies shall include, but not limited to, maintaining steel trench plates at the construction sites to restore access across open trenches and identification of alternate routing around construction zones. Also, police, fire, and other emergency service providers shall be notified of the timing, location, and duration of the construction activities and the location of detours and lane closures.	Prior to construction and operation the Proposed Project/Action.	City of Ukiah Public Works Department	City of Ukiah Public Works Department	
3.9 HYDROLOGY AND WATER QUALITY				
Mitigation Measure HWQ-1: Implement Construction Best Management Practices. To reduce potentially significant erosion and siltation, the City and/or its selected contractor(s) shall obtain a Stormwater Pollution Prevention Permit (SWPPP) and implement Best Management Practices and erosion control measures as required by the North Coast RWQCB. Best Management Practices to reduce erosion and siltation shall include the following measures: Avoidance of construction activities during inclement weather; limitation of construction access routes and stabilization of access points; stabilization of cleared, excavated areas by providing vegetative buffer strips, providing plastic coverings, and applying ground base on areas to be paved; protection of adjacent properties by installing sediment barriers or filters, or vegetative buffer strips; stabilization and prevention of sediments from surface runoff from discharging into storm drain outlets; use of sediment controls and filtration to remove sediment from water generated by dewatering; and returning all drainage patterns to pre-existing conditions.	Develop SWPPP prior to and throughout construction.	City of Ukiah Public Works Department	City of Ukiah Public Works Department North Coast Regional Water Quality Control Board	
Mitigation Measure HWQ-2: Implement Recycled Water Best Management Practices. In order to help reduce the potential effects of increased salt loading potential as a result of using recycled water, the City shall: Ensure that water is applied consistent with Title 22 requirements and in amounts	Incorporation measures into SWPPP prior to construction and implementation	City of Ukiah Public Works Department	City of Ukiah Public Works Department North Coast Regional Water Quality Control Board	

Table A
Mitigation Monitoring and Reporting Plan for the City of Ukiah's Recycled Water Project IS/MND

Mitigation Measure	Timing	Implementation[1]	Enforcement[1]	Dated Signature for Verification of Compliance
(frequency and intensity) which meet the demands of the plant (agronomic rates), but not in excessive amounts such that salts buildup in the soil beyond the root zone and/or otherwise are leached to groundwater; • Ensure that adequate soil drainage is maintained; • Ensure that salt-sensitive plants are not to be spray wet; and • Addressing sodium and alkalinity concerns through addition of water and soil amendments, including addition of gypsum. In addition and prior to operation of the recycled water system, the City shall prepare and submit for approval of the North Coast Regional Water Quality Control Board, a recycled water operations and maintenance plan and recycled water users guide to identify general and site-specific BMPs that will be implemented to ensure that recycled water will be used in a manner that protects ground and surface water. The BMPs shall address measures to protect against recycled water runoff that is not incidental, provide for detection and correction of leaks, and ensure that pollutants such as salts and nutrients are not discharged at concentrations that could adversely impact groundwater. The BMPs shall also address both agronomic irrigation and frost protection uses. Specifically, the recycled water for irrigation BMPs shall include the type of irrigation system, proper design and operation of the irrigation system, application methods (e.g., agronomic application, use of repeat start times and multiple water days to increase irrigation efficiency and reduce runoff potential, no application during precipitation events), setbacks to surface waters, physical systems to capture runoff and prevent it from reaching surface waters. BMPs shall also describe how salts and nutrients will be managed in a manner that protects groundwater quality. Frost protection BMPs shall include limiting frost protection use to relatively flat parcels, use of very low application rates for the shortest period possible, pre-season system inspections and testing, regular in-season system checks, inspection checks during spray events that include checking for ponding and runoff, logging of spray events, and maintenance of a cover crop between vineyard rows to provide capacity for retention and limited treatment.	throughout construction, as appropriate			
Mitigation Measure HWQ-3: Prepare Antidegradation Analysis. Prior to implementation, the City shall prepare and submit to the North Coast Regional Water Board an antidegradation analysis as part of its Report of Waste Discharge that demonstrates that the storage and irrigation of recycled water will not result in degradation of groundwater or surface water. The analysis shall identify the fate and transport of pollutants of concern, and shall address salts, nutrients, and	Development of the Report of Waste Discharge.	City of Ukiah Public Works Department	City of Ukiah Public Works Department North Coast Regional Water Quality Control Board	

Table A
Mitigation Monitoring and Reporting Plan for the City of Ukiah's Recycled Water Project IS/MND

Mitigation Measure	Timing	Implementation[1]	Enforcement[1]	Dated Signature for Verification of Compliance
any other pollutants that could be present in the recycled water at concentrations that could affect groundwater quality. For the pond(s), the analysis shall determine the leakage rate through the pond liner and the impact of pond leakage on groundwater and nearby surface water. The analysis shall determine whether there are any anticipated increases in pollutant concentrations over background groundwater quality. If any potential degradation is identified, the analysis shall demonstrate that any degradation is in the best interest of the people of the state and that it will not result in the exceedance of any groundwater quality objectives. This antidegradation analysis shall be prepared and submitted as part of a Report of Waste Discharge.				
3.12 NOISE				
Mitigation Measure NOI-1: **Limit Construction Hours.** Construction activities will be limited to the least noise-sensitive times and will comply with both the City and Mendocino County noise ordinances. Construction, alteration, repair or land development activities shall be allowed on weekdays between the hours of 7 a.m. and 7 p.m., on Saturdays between the hours of 8 a.m. and 5 p.m. No construction shall be permitted on Sundays.	Prior to and during construction of the Proposed Project/Action.	City of Ukiah Public Works Department	City of Ukiah Public Works Department	
Mitigation Measure NOI-2: Locate Staging Areas away from Sensitive Receptors. The City's construction specification shall require that the contractor select staging areas as far as feasibly possible from sensitive receptors.	Prior to and during construction of the Proposed Project/Action.	City of Ukiah Public Works Department	City of Ukiah Public Works Department	
Mitigation Measure NOI-3: Maintain Mufflers on Equipment. The City's construction specifications shall require the contractor to maintain all construction equipment with manufacturer's specified noise-muffling devices.	Prior to and during construction of the Proposed Project/Action.	City of Ukiah Public Works Department	City of Ukiah Public Works Department	
Mitigation Measure NOI-4: Idling Prohibition and Enforcement. The City shall prohibit and enforce unnecessary idling of internal combustion engines. In practice, this would mean turning off equipment if it will not be used for five or more minutes.	Prior to and during construction of the Proposed Project/Action.	City of Ukiah Public Works Department	City of Ukiah Public Works Department	
Mitigation Measure NOI-5: Equipment Location and Shielding. The City shall require locating all stationary noise-generating construction equipment such as air compressors as far as possible from homes and businesses.	Prior to and during construction of the Proposed Project/Action.	City of Ukiah Public Works Department	City of Ukiah Public Works Department	
3.17 TRAFFIC AND TRANSPORTATION				
Mitigation Measure TRA-1: Prepare and Implement Traffic Control Plan. As is consistent with existing policy, the City shall require the contractor to	Prior to and during construction of the Proposed	City of Ukiah Public Works Department	City of Ukiah Public Works Department	

Table A Mitigation Monitoring and Reporting Plan for the City of Ukiah's Recycled Water Project IS/MND				
Mitigation Measure	**Timing**	**Implementation[1]**	**Enforcement[1]**	**Dated Signature for Verification of Compliance**
prepare and implement effective traffic control plans in the areas of City and County streets to show specific methods for maintaining traffic flows. Examples of traffic control measures to be considered include: 1) use of flaggers to maintain alternating one-way traffic while working on one-half of the street; 2) use of advance construction signs and other public notices to alert drivers of activity in the area; 3) use of "positive guidance" detour signing on alternate access streets to minimize inconvenience to the driving public; 4) provisions for emergency access and passage; and 5) designated areas for construction worker parking.	Project/Action.			
Mitigation Measure TRA-2: Return Roads to Pre-construction Condition. Following construction, the City shall ensure that road surfaces that are damaged during construction are returned to their pre-construction condition or better.	Prior to and during construction of the Proposed Project/Action.	City of Ukiah Public Works Department	City of Ukiah Public Works Department	

APPENDIX B
WWTP GEOTECHNICAL REPORT (REVISION 2)

DRAFT GEOTECHNICAL REPORT (REVISION 2)

City of Ukiah Recycled Water Pipeline – Phase 4 Design Project
Wastewater Treatment Plant Improvements
Ukiah, California

DRAFT

Prepared by:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
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February 2023

Prepared for:

carollo
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File No. 19-503.1
February 3, 2022

Mr. Brian Avon, PE
Carollo Engineers, Inc.
2795 Mitchell Drive
Walnut Creek, CA 94598

Subject: **DRAFT GEOTECHNICAL REPORT (Revision 2)**
City of Ukiah Recycled Water Pipeline – Phase 4 Design Project
Wastewater Treatment Plant (WWTP) Improvements
Ukiah, California

Dear Mr. Avon,

Crawford & Associates, Inc. (Crawford) is pleased to submit this DRAFT Geotechnical Report for the City of Ukiah Recycled Water Pipeline – Phase 4 Design Project in Ukiah, California. Crawford prepared this report in accordance with our agreement dated August 16, 2022 addressing the basin, wet well, and electrical improvements at the WWTP. We will issue a final report based on your comments on this draft.

Thank you for selecting Crawford to be on your design team. Please call if you have questions or require additional information.

Sincerely,

Crawford & Associates, Inc,

Reviewed By,

Amando B. Castro, PE
Project Engineer

Benjamin Crawford, PE, GE
Principal

Johnathan Wright, PE, GE
Project Manager

DRAFT

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APPENDIX I

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APPENDIX II

2022 Crawford Boring Legend and Logs
2017 Crawford Boring Logs
2014 LACO Boring Logs

APPENDIX III

Laboratory Test Results
Hazardous Materials Laboratory Results

APPENDIX IV

Site-Specific Ground Motion Hazard Analysis

DRAFT

1 INTRODUCTION

1.1 PURPOSE

Crawford & Associates, Inc. (Crawford) prepared this Geotechnical Report for the City of Ukiah Wastewater Treatment Plant (WWTP) Improvements as part of the Recycled Water Pipeline – Phase 4 Design Project. This report is intended to provide geotechnical and geologic data and provide conclusions and recommendations addressing the planned basin, wet well, and electrical improvements at the WWTP.

1.2 GEOTECHNICAL SERVICES

To prepare this report, Crawford:

- Discussed the project with Jason Benson, PE, with the City of Ukiah, Alan Hodge with the City of Ukiah WWTP and Brian Avon, PE and Craig Andrews with Carollo Engineers (Carollo);
- Attended a kick-off meeting at the site to meet with the design team and Alan Hodge to discuss project needs and objectives;
- Reviewed historical geotechnical data in the LACO report “Ukiah Recycled Water Pipeline, Geotechnical Report” dated October 17, 2014.
- Reviewed historical geotechnical data in the Crawford Geotechnical Report “City of Ukiah Chlorine Contact Basin Expansion, Geotechnical Report” dated November 4, 2017.
- Reviewed the Carollo 60% design submittal “Storage Pond Grading Plan” dated August 2022;
- Reviewed available geologic and seismic maps;
- Drilled and sample two test borings to a maximum depth of 31.5 feet (ft) below ground surface (bgs);
- Performed laboratory tests on representative soil samples from the exploratory borings;
- Performed a site-specific ground motions hazard analysis;
- Performed geotechnical engineering analysis for design and construction of the proposed concrete lined basin, pump station and electrical component improvements; and
- Developed conclusions and recommendations.

2 PROJECT DESCRIPTION

The City of Ukiah WWTP plans to upgrade their wastewater treatment facility by demolishing two of their existing sludge basins that are currently not in use. Following demolition of the two sludge basins, the WWTP plans to construct a new lined basin covering the area of both existing basins. In addition, the project proposes to install a wet well and electrical equipment supported on a mat foundation.

Based on the Storage Pond Grading Plan (August 2022), we understand that the current planned finished grade for the bottom of the basin is at elevation 570 ft, however we understand this elevation is flexible. The plan sheet shows that one embankment will surround the new basin. The embankment crest elevation is 581 ft and will be 13 ft wide, and the embankment slopes will be 3 horizontal to 1 vertical (3H:1V) for the inner slopes and 3H:1V for the outer

slopes. We understand the new embankment will be constructed by generally adding new fill to the old embankment. The new inner slopes will extend into the existing basin and sludge area. An access road leading inside the basin is planned along the east embankment, as well as around the crown of the basin. Two inlets are planned to be on the north and east inner slopes.

We understand the new wet well will be constructed at the center of the north embankment. The wet well is planned to be 180 sq. ft. with a planned inlet elevation of 570 ft. The wet well is planned to be founded on a mat foundation. Additionally, a shallow mat foundation will likely support the electrical components of the wet well. The electric components are proposed to be located approximately 30 ft northeast of the basin next to an existing electric panel. The details of the electric components were not established at the time of this report.

3 SITE DESCRIPTION

The existing sludge basins are located within the City of Ukiah WWTP at 391 Plant Road in Ukiah, CA. The site coordinates used for the project site are approximate latitude 39.1117° and longitude -123.1900°. We understand that the two sludge basins were originally constructed in the 1950's as one large basin, however a berm was later constructed in the center of the basin which separated the large basin into two basins (see Photo 1 below). The basins combined measure approximately 500 ft wide by 300 ft long.

The existing ground surface within the basins range from elevation 572 ft to 574 ft. The existing berm surrounding the two basins has a surface elevation of approximately 581 ft, and the existing center berm separating the two basins has a surface elevation of approximately 576 ft. The basin neighbors the City of Ukiah WWTP's percolation ponds to the east, recycled water storage ponds to the south, railroads tracks to the west, and the City of Ukiah WWTP to the north.

We provide a Vicinity Map shown on Figure 1 in Appendix I.



Photo 1: Central Berm Showing Both Basins Facing South

4 SITE GEOLOGY

The project site lies within the Coast Ranges Geomorphic Province, characterized by a series of northwest trending mountain ranges sub-parallel to the San Andres Fault. The Coast Ranges is composed of thick Mesozoic and Cenozoic sedimentary strata. The northern Coast Ranges are dominated by the irregular, knobby, landslide-topography of the Franciscan Complex. The project site is located within the Ukiah Valley, an alluvial valley situated within the Coast Ranges.

The Geologic Map of California: Ukiah Sheet[1] shows the site as being underlain by Quaternary (Recent) alluvium. The alluvium consists of predominately unconsolidated gravel, sand, silt, and clay deposited in channels and on floodplains of the Russian River (located adjacent to the facility property). Quaternary (Pleistocene) age non-marine terrace deposits are also mapped on site, which consist of gravelly clay to sandy/silty gravel.[2]

We provide a Geologic Map on Figure 3 in Appendix I.

5 SUBSURFACE CONDITIONS

5.1 FIELD EXPLORATION

5.1.1 SOIL BORINGS

Crawford retained Geo-Ex Subsurface Exploration to drill two exploratory borings on August 30, 2022 within the sludge basin, and Taber Drilling to drill two exploratory borings on September 27, 2017 for the nearby chlorine contact basin project. LACO retained Clear Heart Drillers to drill four borings within the existing basin embankments on September 11, 2014 for the Ukiah Recycled Water Project. Table 1 provides a subsurface exploration summary for the borings considered for this study.

[1] Jennings, C.W. and Strand, R.G., (1960), Geologic Map of California: Ukiah Sheet

[2] California Department of Water Resources (2004), Ukiah Valley Ground Water Basin, California groundwater Bulletin 118

Table 1: Subsurface Exploration Summary

Boring Number	Completion Date	Drill Rig Type/ Drilling Equipment Type	Hammer Type	Hammer Efficiency (%)	Approx. Ground Surface Elevation (ft)	Boring Depth (ft)
Crawford Exploratory Borings (2022)						
A-22-001	9/30/2022	D50(Track Mounted)	Auto	101.9[1]	581	31.5
A-22-002	9/30/2022				576	26.5
DCP-22-001	9/22/2022	N/A	35 lb 18-in drop	N/A	573	10.0
DCP-22-002	9/22/2022				573	9.6
Crawford Exploratory Borings (2017)						
B1	9/27/2017	CME 55 (Truck Mounted)	Auto	82[2]	--[4]	50.0
B2	9/27/2017				--[4]	26.5
LACO Exploratory Borings (2014)						
B-15	9/11/2014	CME 75 (Track Mounted)	Auto	N/A[3]	587	21.5
B-16	9/11/2014				586	21.5
B-17	9/11/2014				576	21.5
B-19	9/11/2014				588	21.5

1. A hammer energy calibration test was not performed specifically for this project/site; however, a previous hammer energy testing result provided by Geo-Ex found the hammer to have an energy efficiency of 101.9%.
2. A hammer energy calibration test was not performed specifically for this project/site; however, a previous hammer energy testing result provided by Taber Drilling found the hammer to have an energy efficiency of 82%.
3. A hammer energy calibration test was not recorded in the boring logs.
4. Elevations were not recorded at the time of the published report.

Soil samples were recovered by means of a 2.0-inch O.D. “Standard Penetration” split-spoon sampler without 1.4-inch stainless steel liners and a 3.0-inch O.D. “Modified California” split-spoon sampler with 2.4-inch stainless steel liners. Relatively undisturbed samples were also recovered by means of a 3-inch OD thin-walled Shelby sampler. The shelby samples were “pushed” in to recover sample and the “resistance” was measured (in psi). Drive samplers were advanced with standard 350 ft-lb striking force using a 140 lb. automatic hammer and a drop height of 30 inches. Sampler penetration resistance was recorded to provide a field measure of relative densities and can be correlated to soils strength and bearing characteristics. Consistency of cohesive soils were obtained in the field by means of pocket penetrometer and field pocket torvanes. The field-recorded (uncorrected) blow counts and down pressure used to insert the Shelby tubes are shown on our 2022 boring logs in Appendix II. 2017 Crawford and 2014 LACO boring logs are attached in Appendix II. Boring locations are shown on the Exploration Map on Figure 2 in Appendix I.

Crawford’s project engineers and geologists logged the exploratory borings consistent with the Unified Soil Classification System (USCS) and the 2010 Caltrans Logging Manual. Crawford retained samples from the borings in sealed constrainers for laboratory testing and reference. Groundwater observations were recorded during drilling operations when encountered. At

completion, the exploratory borings were backfilled following Mendocino County Environmental Health requirements.

5.1.2 DYNAMIC CONE PENETROMETER

The Dynamic Cone Penetrometer (DCP) test provides an approximate quantification of a material's apparent density or stiffness. For this project, DCP testing was completed using manual equipment as described below. The purpose of the test was to aid in understanding the thickness of the soft/loose sludge sediments and soil, and the depth to more competent bearing materials within the existing basins.

Crawford project engineers completed a total of two DCP tests on September 22, 2022. The DCP tests were completed using a hand-operated tool called a "Wildcat DCP," manufactured by Triggs Technology, Inc. The test consists of continuously driving a 1.4-inch O.D. steel cone tip attached to a lead rod until refusal (50 blows per approximately 4-inches) is reached. The rods are advanced using a hand-actuated, 35-lb safety drop hammer falling a distance of 15-inches.

5.2 SUBSURFACE SOIL/ROCK

The subsurface soils encountered in the 2022 borings are generally consistent with the materials encountered in the 2017 Crawford and 2014 LACO borings and published mapping for the site vicinity. We summarize the encountered materials as described below.

Sludge Basin – The explorations completed within the existing sludge basin and center berm indicate that very soft deleterious material (likely sludge) is present to an elevation of about 566.5 ft to 567.5 ft, or about 5.5 ft to 6.5 ft below existing basin grade.

Perimeter Berm – Embankment fill consisting of tan, medium dense, silty sand was encountered from berm grade (approximate elevation 581 ft) to elevation 576 ft. The embankment fill was underlain by soft to hard lean clay and loose to medium dense clayey sand, encountered between elevations 576 ft to 550 ft. Gravelly lean clay was encountered beneath this layer at elevation 550 ft. and based on nearby borings performed for the Chlorine Contact Basin Project, this layer extends to the maximum depth explored, likely between elevations[3] 520 ft and 530 ft.

We present more detailed descriptions of the subsurface soils on the boring logs in Appendix II.

5.3 GROUNDWATER

We encountered groundwater in boring A-22-001 at approximate elevation 560 ft (21 ft bgs) and we did not encounter groundwater in boring A-22-002. Our 2017 borings encountered groundwater at approximate elevations 572.2 ft and 563.6 ft for borings B1 and B2, respectively. LACO encountered groundwater in their boring B-17 at an approximate elevation of 565 ft on September 11, 2014. Based on our conversations with the city, groundwater was not encountered at the time the Chlorine Contact Basin was constructed.

The WWTP staff provided historical groundwater elevations for two monitoring wells (GW-01 and GW-02) in the vicinity of the plant for the 2017 Chlorine Content Basin report. According to

[3] Actual boring elevations were not recorded for the 2017 Crawford borings. Elevations were estimated from current topographic information provided by Carollo.

WWTP staff, GW-1 and GW-2 were relocated from their previous location referenced in the 2017 report. The new locations for Monitoring wells GW-01 and GW-02 are located about 50 to 100 feet south and 1,500 to 1600 feet east of the southern embankment, respectively. To supplement the data from 2017, Table 2 below shows groundwater data previously measured, as well as recent groundwater measurements from the relocated monitoring wells.

Table 2: Summary of Subsurface Exploration

Date	2017 CCB Report		2023 Sludge Basin Report	
	GW-02[1]	GW-01[2]	GW-01	GW-02
	Elevation[3]		Elevation[4]	
Mar-04	554.22	564.23	N/A	N/A
Oct-04	550.56	559.63	N/A	N/A
Mar-05	559.05	564.22	N/A	N/A
Oct-05	550.53	561.8	N/A	N/A
Mar-06	556.1	565.24	N/A	N/A
Oct-06	550.14	559.71	N/A	N/A
Apr-07	553.64	563.58	N/A	N/A
Oct-07	551.932	557.29	N/A	N/A
Mar-08	555.9	563.87	N/A	N/A
Oct-08	551.66	563.12	N/A	N/A
Mar-09	554.8	554.18	N/A	N/A
Oct-09	550.65	564.67	N/A	N/A
Mar-10	555.25	557.57	N/A	N/A
Oct-10	550.33	563.91	N/A	N/A
Apr-11	550.72	557.07	N/A	N/A
Oct-11	550.7	550.68	N/A	N/A
Jul-12	N/A	565.27	N/A	N/A
Aug-12	N/A	563.27	N/A	N/A
May-21	N/A	N/A	561.81	551.36
Feb-21	N/A	N/A	564.11	561.52
Aug-21	N/A	N/A	557.17	550.02
Oct-21	N/A	N/A	561.97	563.96
Feb-22	N/A	N/A	564.58	556.0
Jul-22	N/A	N/A	559.78	550.63
May-22	N/A	N/A	563.42	553.62
Oct-22	N/A	N/A	557.94	551.77

[1]Formally MW-1, [2]Formally MW-2
[3]Well elevations provided by the Rau & Associates, Inc. 2017
[4] Elevations provided by City of Ukiah WWTP

Based on our understanding of the site conditions, flooding occurs throughout the winter months and the buoyancy forces should be estimated based on historical and/or expected high water events at the site. The recent groundwater data, from the WWTP, show the design groundwater elevation fluctuates between elevation 565 ft and 560 ft.

6 LABORATORY TESTS

The following laboratory tests were completed on representative soil samples obtained from the 2022 exploratory borings complete by Crawford:

- Grain Size Analysis (ASTM D6913)
- Moisture Content-Dry Density (ASTM D2216, ASTM D2937)
- No. 200 Wash (ASTM D1140)
- Plasticity Index (ASTM D4318)
- pH and Minimum Resistivity (CTM 643)
- Redox Potential (ASTM G-200m)
- Sulfate Content (CTM 417)
- Sulfides (AWWA C105/A25.5)
- Unconfined Compression (ASTM D2166)

The following laboratory testing was completed on the soil/sludge samples obtained from the 2022 exploratory borings completed by Crawford:

- CAM 17 Heavy Metals (EPA 6010/7470)
- Purgeable Aromatics and Total Petroleum Hydrocarbons (EPA 8015)
- Total Concentrations (TTLC)
- Volatile Organic Content (EPA 8260)

We present the laboratory test results in Appendix III.

7 CORROSION CONSIDERATIONS

A soils corrosivity analysis is important for estimating and mitigating the deterioration of buried ferrous metals and concrete. Soil corrosivity tests were completed on four samples obtained from the field exploration. Results of the soil corrosion tests are summarized in Table 4. Detailed laboratory results are included in Appendix III. Table 4 summarizes the results of soil corrosivity tests on samples from our test borings.

Table 3: Soil Corrosion Test Summary

Boring-Sample Number	Depth (ft)	Minimum Resistivity (Ohm-cm)	Soil pH	Chloride Content (ppm)	Sulfate Content (ppm)	Redox Potential (mv)	Sulfides Presence
A-22-001-3B	5.0	2,950	6.84	4.8	27.5	+ 212	NEGATIVE
A-22-002-4A	6.0	1,470	7.05	15.3	31.6	N/A	N/A

To evaluate the potential for external corrosion potential on ductile iron pipe from soil, the 10-point system in C105/A21.5 (ANSI/AWWA 1999) was used. The 10-point system is a methodology used to determine the corrosive nature of a soil to ferrous metals based on the resistivity, pH, redox potential, sulfides presence, and drainage characteristics. The results of the 10-point system analysis showed a maximum of two points; which indicates a non-corrosive environment (AWWA 2005).

According to the American Concrete Institute (ACI) 318, a sulfate concentration less than 1,000 parts per million (ppm) is considered negligible. A chloride content of less than 600 ppm is generally non-corrosive to reinforced concrete.

Based on the results of tested samples, the soil may be generally characterized as “non-corrosive” to concrete and ferrous metals. The tests results are only an indicator of soil corrosivity and the designer should consult with a corrosion engineer if these values are considered significant.

8 BASIN CONTENTS

Soil samples were collected from the sludge basin on September 30, 2022, between elevations 567 ft to 565 ft (7.5 to 9.5 ft bgs) in boring A-22-002 (collected using a Shelby tube) and submitted to Pace Analytical (ELAP #2961) for preliminary analysis on October 25, 2022. Samples were was analyzed for Volatile Organics (EPA Method 8260B), Purgeable Aromatics and Total Petroleum Hydrocarbons (EPA Method 8015B), and CAM 17 Metals (EPA Methods 6010B and 7471A). We summarize the results below and attach a copy of the Pace report in Appendix III.

Volatile Organics – Tetrachloroethene (0.011 milligrams/kilogram[mg/kg]), toluene (0.0051 mg/kg), and xylenes (0.0016 mg/kg) were reported in the sample; the laboratory noted that the sample was analyzed outside of hold time. These reported concentrations do not exceed applicable hazardous waste limits.

Purgeable Aromatics and Total Petroleum Hydrocarbons – Gasoline Range Organics were reported in this sample at a concentration of 0.78 mg/kg; the laboratory noted that the sample was analyzed outside of hold time. This reported concentration does not exceed applicable hazardous waste limits.

CAM 17 Metals – None of the reported metal concentrations exceeded their respective Total Threshold Limit Concentrations (TTLC), nor did any of the reported metals concentrations exceed ten times their respective Soluble Threshold Limit Concentration (STLC); further analysis of this sample for soluble concentrations is not warranted. Reported metals concentrations do not exceed applicable hazardous waste limits.

Based on the analytical data from the soil sample from boring A-22-002, it does not appear that concentrations of Volatile Organics, Purgeable Aromatics and Total Petroleum Hydrocarbons, or CAM 17 metals exceed applicable hazardous waste limits. The soil samples collected were not preserved and delivered within the specified time limit (‘hold time”). As a result, the above results are meant to be preliminary and proper testing and sampling should be performed during construction prior to excavation or disposal.

9 SEISMIC DESIGN PARAMETERS

Crawford completed a site-specific ground motion hazard analysis in accordance with ASCE 7-16 Section 11.4.8 and a summary of the seismic design parameters are presented in Table 5.

Table 4: Seismic Design Parameters

Design Parameter	Value (g)
Design Spectral Acceleration for Short Period (S_{DS})	1.004
Design Spectral Acceleration for 1 sec Period (S_{D1})	0.959
MCE Spectral Response Acceleration for short Period (S_{MS})	1.506
MCE Spectral Response Acceleration Parameter for 1 sec Period (S_{M1})	1.438

See Appendix IV for the detailed site-specific ground motion hazard analysis.

9.1 SURFACE FAULT RUPTURE

No known active faults are mapped within or through the project area. The California Geologic Survey (CGS) considers a fault to be active if it has shown movement one or more times during the Holocene period, defined as the last 11,700 years. According to the CGS, the closest active fault is the Maacama Fault about 1.8 miles east of the site. Based on this mapping we consider the potential for fault rupture at the site low.

We present a fault activity map as Figure 4.

9.2 LIQUEFACTION POTENTIAL AND SEISMICALLY INDUCED SETTLEMENT

Soil liquefaction can occur when saturated, relatively loose sand and specific soft, fine-grained saturated soils are subject to ground shaking strong enough to create soil particle separation that results from increased pore pressure. This separation and subsequent pore pressure dissipation can lead to decreased soil shear strength and settlement. Liquefaction is known to occur in soils ranging from low plasticity silts to gravels. However, soils most susceptible to liquefaction are clean sands to silty sands and non-plastic silts.

To evaluate the potential for soil liquefaction to occur at the site, Crawford used the simplified procedure outlined by Youd et al. (2001)[4], the 2022 and 2017 Crawford boring data, the 2014 LACO boring data, laboratory test results, design groundwater level of elevation 565 ft, and seismicity data from our site-specific hazards analysis summarized in Section 9 above and attached in Appendix IV.

The 2014 LACO borings were not deep enough to accurately perform liquefaction analysis, however the LACO borings indicate the potential for liquefaction is considered low due to primarily encountering clayey soils. Based on the soil conditions encountered in the 2017 Crawford borings, our analysis indicates a liquefaction potential index of 2.3 categorizing the site as low risk with a liquefaction induced settlement of less than 1 inch, within the silty sand layer located about 25 ft bgs at the chlorine contact basin location. However, this sand layer was not encountered in our 2022 Crawford borings. Therefore, this sand layer is likely discontinuous across the site. Based on the encountered soil conditions, we expect the potential

[4] Youd & Idriss: Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils, April 2001

for liquefaction within the proposed sludge basin and wet well to be low but may still result in up to 1 inch of settlement.
LATERAL SPREADING AND seismic SLOPE inSTABILITY
Site topography is relatively flat, with predominately clayey soils, and the liquefaction potential is low therefore, we consider lateral spreading and seismic slope instability not to be a concern at this site.

10 CONCLUSIONS AND RECOMMENDATIONS

We conclude that the site is suitable from a Geotechnical standpoint for the proposed improvements. Key Geotechnical considerations include groundwater near the base of the basin excavation (which may cause difficult construction conditions), presence of soft deleterious materials (i.e. sludge) within the basin, and the presence of saturated soils.

10.1 GRADING

We understand that the WWTP is seeking design alternatives for both concrete liner and plastic liner systems. The grading recommendations below should provide adequate support for both liner alternatives. Excessively soft sediments should be prepared following the recommendations below, regardless of liner type selection.

10.1.1 ORIGINAL GROUND & SUBGRADE PREPARATION

Prior to site grading, clear the site to remove vegetation, debris, unneeded utilities, and other deleterious materials. Process and compact the exposed subgrade in new structure and/or fill areas as follows:

- Scarify the subgrade to a depth of approximately 10 inches.
- Moisture condition subgrade soil to at least 2% over optimum moisture content and compact to a minimum 90% relative compaction per ASTM D1557.

We encountered saturated (saturation ranging between 90 to 99%) lean clays and clayey sands near the expected bottom of excavation which will likely require drying back. Should difficult construction conditions be encountered, we recommend alternative methods of subgrade preparation. Based on the expected size of exposed subgrade, chemical treatment is likely an economic option. Alternatively, the subgrade could be replaced with fabric wrapped crushed rock and/or aggregate base with and without geosynthetics and/or geogrids could potentially provide a stable working platform.

10.1.2 EXCAVATABILITY

Based on the data collected during this and previous exploration programs, soils should be excavatable with typical grading equipment such as backhoes, excavators, and scrapers.

10.1.3 OVEREXCAVATION

The DCP tests completed within the basin and borings within the embankments indicate very soft sludge sediments to about elevation 567 ft. To reduce settlement and to create a firm, unyielding surface, the soft sediments within the existing basin should be removed within the planned lined basin area. Within the proposed lined basin area, overexcavate the near surface

very soft sludge sediments to elevation[5] 566 ft. Extend overexcavation 5 ft laterally beyond the edge of the basin bottom, this will require some reworking of the existing embankment.

10.1.4 FILL PLACEMENT & COMPACTION

Place fill in maximum 8-inch-thick loose lifts, moisture condition to at least optimum moisture content and compact to a minimum 90% relative compaction per ASTM D1557. Native materials, minus organics, debris and other deleterious materials, are suitable for engineered fill if not exceeding a maximum particle size of 4 inches. Excavated materials unsuitable for use as structural fill can be placed outside the structure limits, or disposed off-site.

10.1.5 IMPORT FILL

Import fill should be free of deleterious debris and meet the following requirements:

- Plasticity Index of less than 15
- Organic content of less than 2%
- Sieve Size Percentage Passing

Sieve Size	Percentage Passing
3-inch	100
No. 4	35 - 100
No. 30	20 - 100
No. 200	10 – 45

If imported soil is required for construction, Crawford must review and approve the soils for use prior to transport to the site.

10.1.6 OVER-OPTIMUM SOIL MOISTURE

Excessively over-optimum (wet) soil conditions can make proper compaction difficult or impossible. Due to the shallow groundwater at the site wet soil will likely be encountered during construction. In general, wet soil can be mitigated by:

- Discing the soil during prolonged periods of dry weather,
- Overexcavating and replacing with drier material,
- Stabilizing using aggregate and/or stabilization fabric or grid.

Crawford should observe the conditions and provide more specific mitigation recommendations during construction.

10.1.7 BENCHING

Bench fill into the existing embankment at a minimum of one foot horizontally for every one foot of fill placed, or as necessary to remove loose material and provide proper compaction along the zone of transition.

10.2 BASIN

[5] This elevation is estimated based on the provided topographic survey and limited subsurface exploration information. Crawford must observe the bottom of the excavation to confirm the presence of firm, unyielding native materials prior to placing fill, rebar or concrete.

Based on our conversations with the City and Carollo, the planned finished grade for the bottom of the basin is elevation 570 ft. Our DCP tests completed within the existing basin area indicate the very soft sludge materials extend to about elevation 566.5 ft to 567.5 ft (about 5.5 to 6.5 ft bgs). To improve support and reduce settlement, the very soft sludge materials within the existing basin should be removed to about elevation 567 ft (See Section 10.1.3), and replaced with engineered fill or the basin bottom be lowered to achieve support within the more competent native soil below an elevation of 567 ft. Following the overexcavation of the very soft sludge sediments, the exposed subgrade at about elevation 567 ft should be scarified, moisture conditioned and compacted per Section 10.1. The designer should consider the potential for buoyancy forces when designing the bottom of the basin elevation.

10.2.1 FOUNDATION DESIGN PARAMETERS

Support for the proposed reconstructed sludge basin can achieve support for the foundation elements in compacted engineered fill or firm processed native soils below an elevation of 567 ft.

Use a modulus of subgrade reaction of 15 k/ft^3 (corresponds to an allowable 1,250 psf for 1 inch of settlement). The proposed sludge basin is expected to settle on the order of 1 inch with a differential settlement of about ½ inch over a distance of about 50 ft. We expect this settlement to occur during construction.

Resistance to lateral loads (including those due to wind or seismic forces) may be determined using a coefficient of friction of 0.40 between the bottom of cast-in-place concrete foundations and the underlying soils. Lateral resistance for foundations is also available from passive soil pressure acting against the vertical face of the footings and the structure. The allowable passive pressures available may be taken as equivalent to pressures exerted by fluids weighing 220 psf per foot of embedment depth, up to a maximum of 2,000 psf. The passive pressure is only applicable if the retained earth is allowed to strain at least 0.02H.

These two modes of resistance can be combined; however, since horizontal movement is required to mobilize passive resistance, decrease the passive pressure by one-half if both friction and passive pressures are used.

Clean foundation excavations of debris and loose soil/rock prior to placing structural concrete. Slope the ground surface away from the structures to direct surface water away from the facility.

10.2.2 BUOYANCY RESISTANCE

If buoyancy uplift will be a design consideration, buoyancy forces can be counter balanced using thickened slabs or pressure relief valves.

10.3 WET WELL

10.3.1 FOUNDATION DESIGN PARAMETERS

We understand that the wet well is planned to be supported on a mat foundation between elevations 567 ft to 568 ft. Based on information from our A-22-001 boring, loose clayey sand was encountered to an elevation of 568 ft. Provided the cast-in-place structure achieves uniform support within the underlying loose clayey sands at about elevation 568 ft, a modulus of subgrade reaction of 18 k/ft^3 (corresponds to an allowable 1,500 psf for 1 inch of settlement) can

be used for design. Total and differential foundation settlement is expected to be less than 1 inch and ½ inch, respectively.

Lateral forces may be resisted by friction developed between the base of the footing and the underlying soil. Use a coefficient of friction of 0.45 for concrete cast against soil to resist sliding. Additional lateral resistance may be provided by assuming a passive pressure based on an equivalent fluid weight of 270 pcf. The passive capacity reduces to an equivalent fluid weight of 150 pcf during a seismic event. In designing the structure to resist lateral loads, the upper 12 inches of soil should be ignored.

Clean foundation excavations of debris and loose soil/rock prior to placing structural concrete. Slope the ground surface away from the structures to direct surface water away from the facility.

10.3.2 BUOYANCY RESISTANCE

We expect buoyancy uplift will not be a design consideration for the wet well. However, buoyancy forces can be counter balanced using thickened slabs or base extensions. If base extensions are used, uplift resistance is provided by the effective unit weight of the soil column directly above the base extension and wedge of soil extending outward and upward at a rate of 1:2 (H:V) from the edge of the base extension. Assuming an effective unit weight of 58 pcf for base extension uplift resistance below groundwater.

10.3.3 LATERAL EARTH PRESSURES

Use the equivalent fluid weights (EFWs) shown in the table below for design of permanent structures. We assume in-place native materials with level backfill conditions.

Table 5: Soil Equivalent Fluid Weights

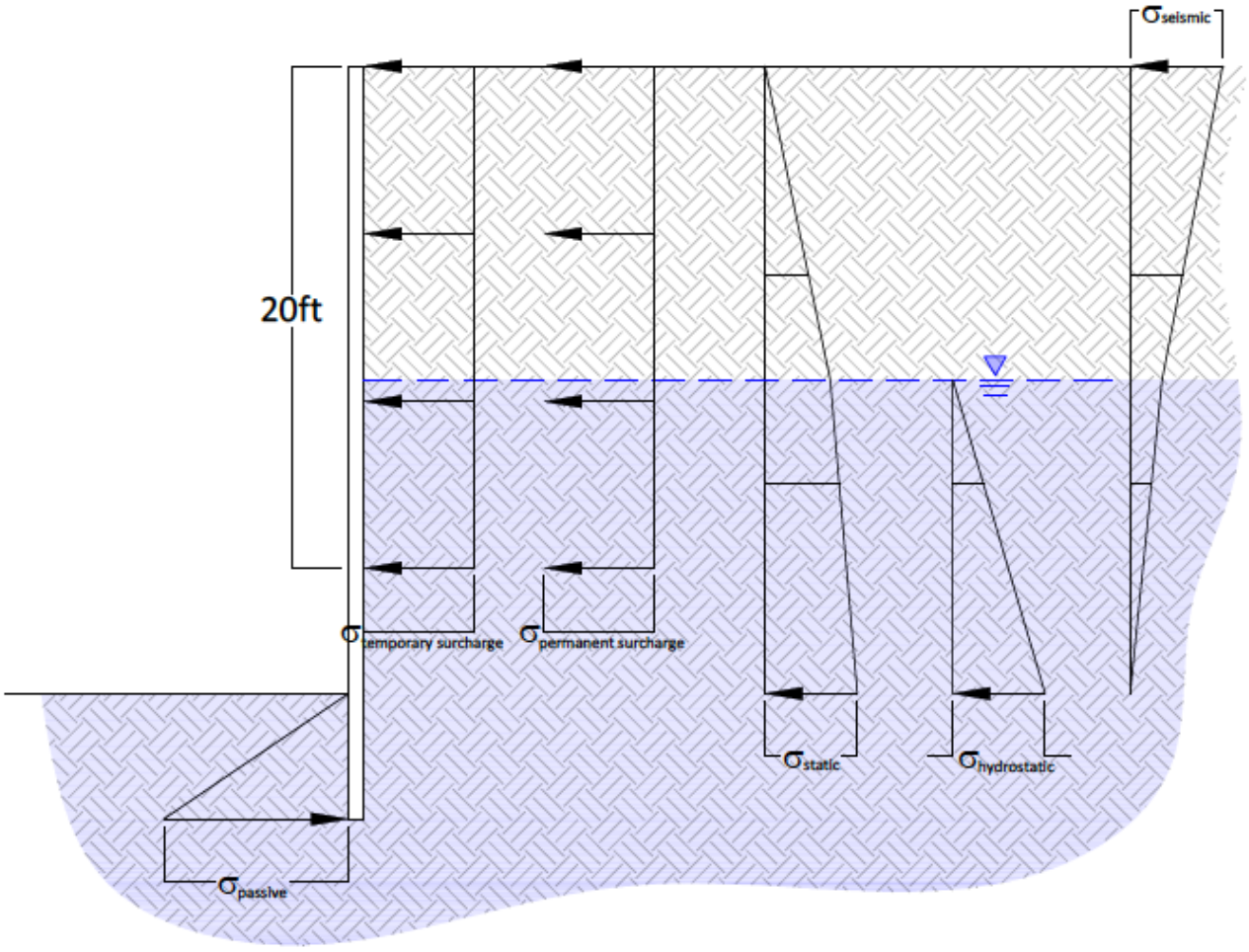
Condition	Groundwater Condition	Static EFW (pcf)	Additional Seismic EFW (pcf)
At-Rest	Above Groundwater	67	30
Active		46	20
At-Rest	Below Groundwater	34	15
Active		23	10

The EFW values above were calculated using an average unit weight of approximately 125 pcf (63 pcf below groundwater) and an angle of internal friction (ϕ) of 28°. Include full hydrostatic pressure (buoyant + hydrostatic) for walls designed to be in services below the water table.

For *static design*, apply the resultant of the static at-rest earth pressure at a depth of 0.33H from the base of the wall where H equals the wall height. The at-rest earth pressure does not include a factor of safety.

We estimate the EFW for seismic loading using the Mononabe-Okabe equation. Apply the additional seismic pressures separately at a depth 0.5H from the base of the wall, where H equals the wall height. For *seismic design*, reduce the allowable passive pressure from 270 pcf to 150 pcf. We provided a general pressure diagram below.

Apply the equivalent fluid weights as shown in the diagram below.



For surcharge loads, apply an additional uniform lateral load behind the wall equivalent to the greater of 0.45-times the design surcharge pressure.

10.4 CONSTRUCTION CONSIDERATIONS

10.4.1 SHORING/TEMPORARY SLOPES

The contractor is responsible for the safety of all temporary excavations and must provide trench sloping and shoring design/construction in accordance with current CalOSHA requirements. In general, we encountered OSHA Type C soils at the site.

If temporary slopes are used in lieu of shoring, they must comply with OSHA standards.

10.4.2 DEWATERING

Based on the observed groundwater levels during our current and previous subsurface explorations and discussions with the WWTP personnel (see Section 5.3), groundwater was observed as high as elevation 565 ft. Therefore, groundwater may adversely affect the project

during construction. The contractor will be responsible for designing and implementing a dewatering system to meet the requirements of the project. Dewatering operations will need to draw the groundwater down to a minimum of 3 ft below the planned excavation during construction.

11 RISK MANAGEMENT

Our experience and that of our profession clearly indicates that the risks of costly design, construction, and maintenance problems can be significantly lowered by retaining the Geotechnical Engineer of Record to provide additional services during design and construction. For this project, Crawford should be retained as the Geotechnical Engineer of Record to:

- Review and provide comments on the civil plans and specifications prior to construction.
- Observe foundation excavations.
- Update this report if design changes occur, 2 years or more lapse between this report and construction, and/or site conditions have changed.

If Crawford is not retained to perform the above applicable services, we are not responsible for any other party's interpretation of our report, and subsequent addendums, letters, and discussions.

12 LIMITATIONS

Crawford performed services in accordance with generally accepted geotechnical engineering principles and practices currently used in this area. Do not use this report for different locations and/or projects without the written consent of Crawford. Where referenced, we used ASTM or Caltrans standards as a general (not strict) *guideline* only.

Crawford based this report on the current site conditions. We assumed the soil and groundwater conditions are representative of the subsurface conditions on the site. Actual conditions between explorations and other data points could be different.

Our scope did not include evaluation of on-site hazardous materials.

Logs of our explorations are presented in Appendix A. The lines designating the interface between soil types are approximate. The transition between soil types may be abrupt or gradual. Our recommendations are based on the final logs, which represent our interpretation of the field logs and general knowledge of the site and geological conditions.

Modern design and construction are complex, with many regulatory sources/restrictions, involved parties, construction alternatives, etc. It is common to experience changes and delays. The owner should set aside a reasonable contingency fund based on complexities and cost estimates to cover changes and delays.

APPENDIX I

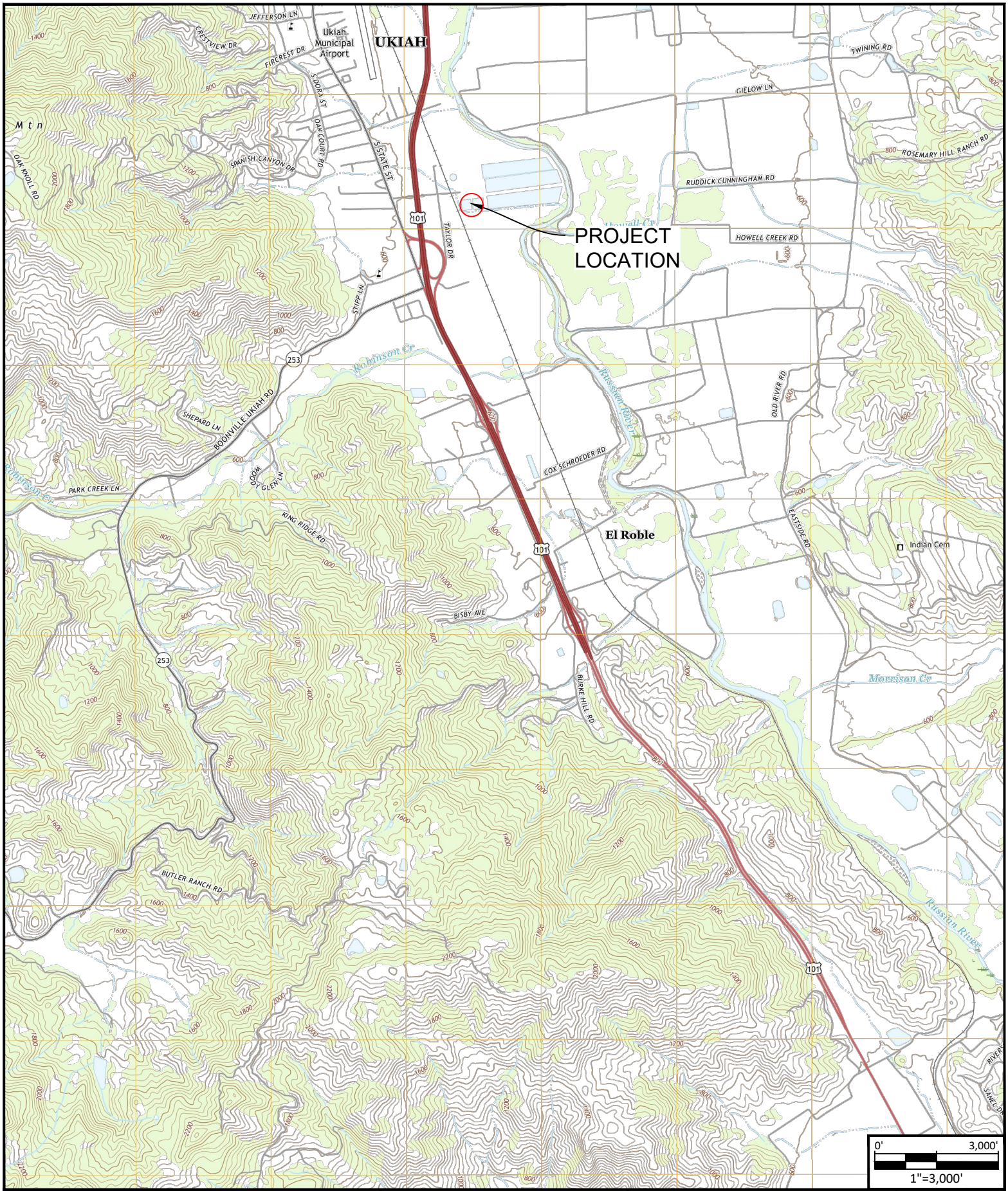
Figure 1 – Vicinity Map

Figure 2 – Exploration Location Map

Figure 3 – Geologic Map

Figure 4 – Fault Map

DRAFT



NORTH

Source:
USGS 7.5' Topographic Maps, Elledge Peak Quadrangle, Mendocino County, California, 2021, 1:24,000.

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City of Ukiah Recycled Water Pipeline - Phase 4 Design Project

Ukiah, CA

Figure 1
Vicinity Map

Prj. No: 19-503.1
Date: 11/09/2022

B2
B1
B-15
A-22-001
B-19
DCP-22-001
DCP-22-002
A-22-002
B-17
B-16

Legend

- CRAWFORD 2022 BORING LOCATION
- CRAWFORD 2022 DCP LOCATION
- CRAWFORD 2017 BORING LOCATION
- LACO 2014 BORING LOCATION

0' 50'
1"=50'

NORTH

Source:
Basemap: AutoCAD Civil3D Geolocation Tool, using Bing Maps

Topographic Data: Topographic Data provided by Carollo via electronic transfer on 10/31/22.

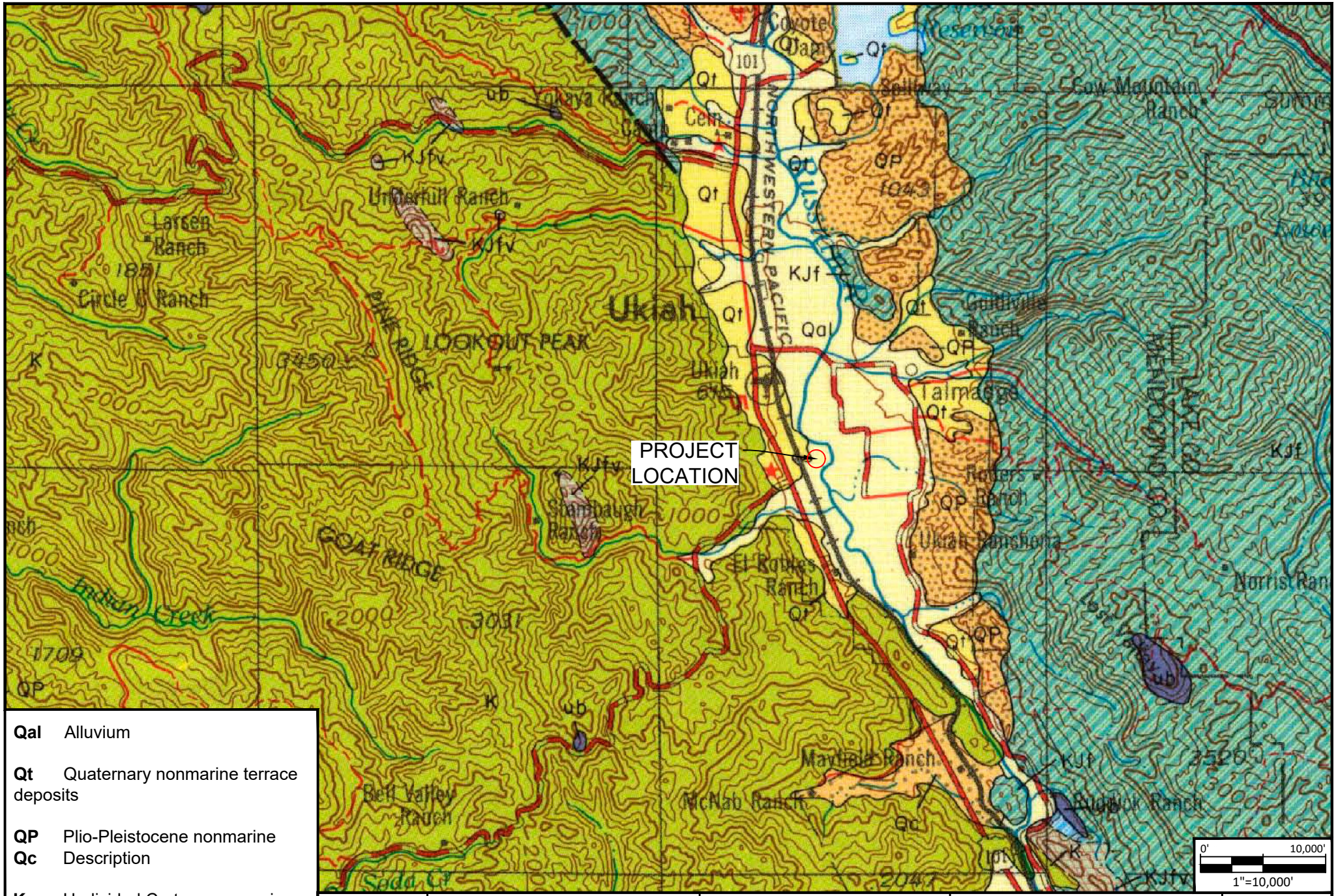
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City of Ukiah Recycled Water Pipeline - Phase 4 Design Project

Ukiah, CA

Figure 2
Exploration Location Map

Prj. No: 19-503.1
Date: 11/09/2022



Source:
Charles W. Jennings, Rudolph G Strand; Geologic Map of California, Ukiah Sheet; Olaf P. Jenkins Edition; 1:250,000; State of California, Department of Natural Resources; 1992.

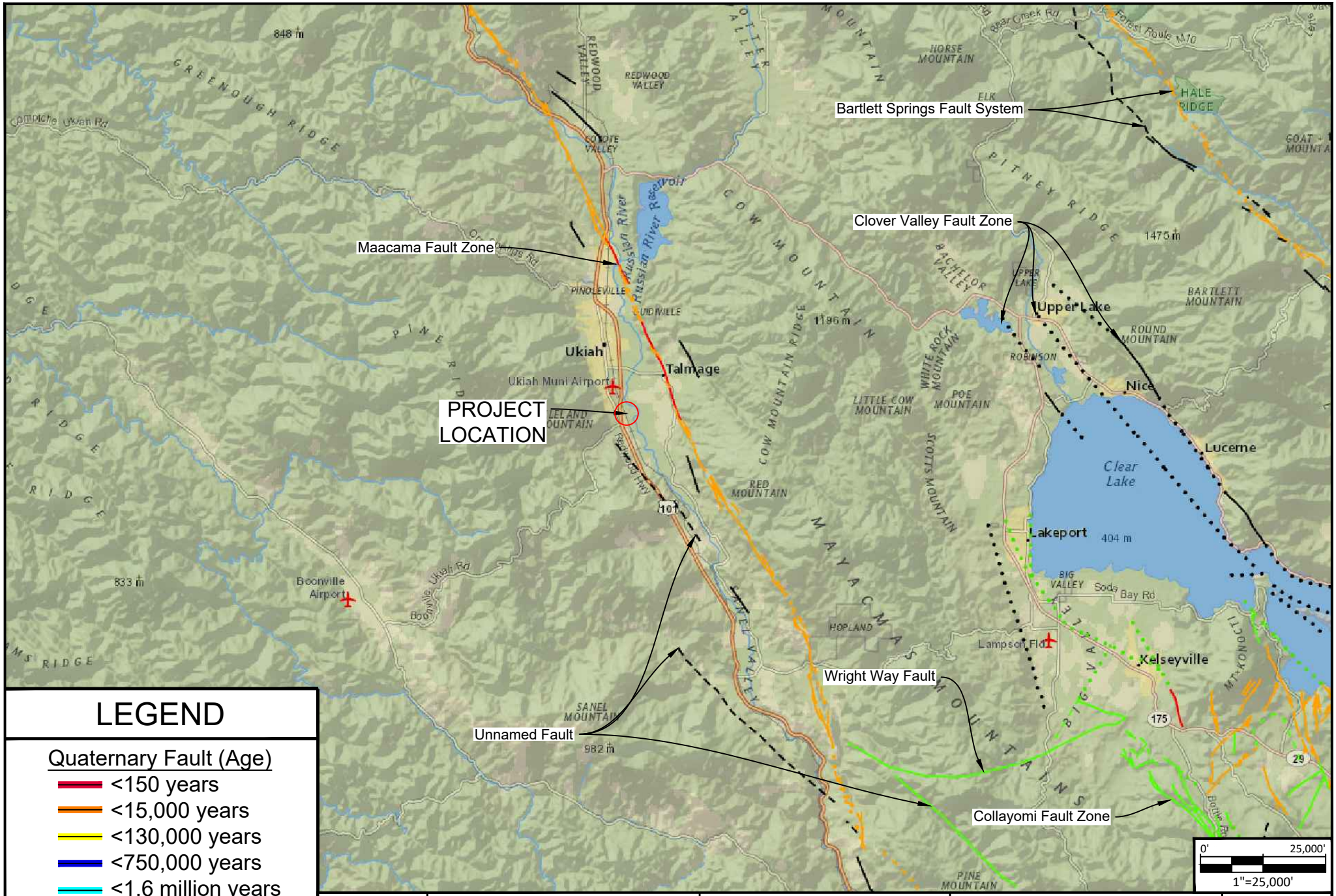
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City of Ukiah Recycled Water Pipeline - Phase 4 Design Project

Ukiah, CA

Figure 3
Geologic Map

Prj. No: 19-503.1
Date: 11/09/2022



LEGEND

Quaternary Fault (Age)

- <150 years
- <15,000 years
- <130,000 years
- <750,000 years
- <1.6 million years

Location

- Well Constrained
- Moderately Constrained
- Inferred

NORTH

Source:
Basemap: National Geographic, Esri, Garmin, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, increment P Corp.

Fault Data: USGS GIS Data

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City of Ukiah Recycled Water Pipeline - Phase 4 Design Project

Ukiah, CA

Figure 4
Fault Map

Prj. No: 19-503.1
Date: 11/09/2022

APPENDIX II

2022 Crawford Boring Legend and Logs
2017 Crawford Boring Logs
2014 LACO Boring Logs

DRAFT

GROUP SYMBOLS AND NAMES

Graphic / Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic / Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY elastic ELASTIC SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTS

C	Consolidation
CL	Collapse Potential
CP	Compaction Curve
CR	Corrosion, Sulfates, Chlorides
CU	Consolidated Undrained Triaxial
DR	Drained Residual Shear Strength
DS	Direct Shear
EI	Expansion Index
M	Moisture Content
OC	Organic Content
P	Permeability
PA	Particle Size Analysis
PI	Liquid Limit, Plastic Limit, Plasticity Index
PL	Point Load Index
PM	Pressure Meter
PP	Pocket Penetrometer
R	R-Value
SE	Sand Equivalent
SG	Specific Gravity
SW	Swell Potential
TV	Pocket Torvane
UC	Unconfined Compression - Soil
	Unconfined Compression - Rock
UU	Unconsolidated Undrained Triaxial
UW	Unit Weight

SAMPLER GRAPHIC SYMBOLS

- Standard Penetration Test (SPT)
- Standard California Sampler (ID 2.0 in.)
- Modified California Sampler (ID 2.5 in.)
- Shelby Tube
- Piston Sampler
- NX Rock Core
- HQ Rock Core
- Bulk Sample
- Other (see remarks)

DRILLING METHOD SYMBOLS

- Auger Drilling
- Rotary Drilling
- Dynamic Cone or Hand Driven
- Diamond Core

WATER LEVEL SYMBOLS

- First Water Level Reading (during drilling)
- Static Water Level Reading (short-term)
- Static Water Level Reading (long-term)

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010) with Errata Sheet (2015).

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Boring Record Legend

Soil Legend | Sheet 1 of 2

CONSISTENCY OF COHESIVE SOILS				
Descriptor	**Unconfined Compressive Strength (tsf)**	**Pocket Penetrometer (tsf)**	**Torvane (tsf)**	**Field Approximation**
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 - 0.50	0.25 - 0.50	0.12 - 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 - 1.0	0.50 - 1.0	0.25 - 0.50	Can be penetrated several inches by thumb with moderate effort
Stiff	1.0 - 2.0	1.0 - 2.0	0.50 - 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2.0 - 4.0	2.0 - 4.0	1.0 - 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

APPARENT DENSITY OF COHESIONLESS SOILS	
Descriptor	**SPT N_{60} (blows / 12 inches)**
Very Loose	0 - 5
Loose	5 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

MOISTURE	
Descriptor	**Criteria**
Dry	No discernable moisture
Moist	Moisture present, but no free water
Wet	Visible free water

PERCENT OR PROPORTION OF SOILS	
Descriptor	**Criteria**
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

SOIL PARTICLE SIZE		
Descriptor		**Size**
Boulder		> 12 inches
Cobble		3 to 12 inches
Gravel	Coarse	3/4 inch to 3 inches
	Fine	No. 4 Sieve to 3/4 inch
Sand	Coarse	No. 10 Sieve to No. 4 Sieve
	Medium	No. 40 Sieve to No. 10 Sieve
	Fine	No. 200 Sieve to No. 40 Sieve
Silt and Clay		Passing No. 200 Sieve

PLASTICITY OF FINE-GRAINED SOILS	
Descriptor	**Criteria**
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll, and not much time is required to reach the plastic limit; it cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

CEMENTATION	
Descriptor	**Criteria**
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).

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Boring Record Legend

Soil Legend

Sheet 2 of 2

LOG OF BORING A-22-001

PROJECT NO: 19-503.1
PROJECT: Ukiah Recycled Water Pipeline
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers, Inc.
LOGGED BY: ABC
DEPTH OF BORING: 31.5 (ft)

BEGIN DATE: 09/30/2022
COMPLETION DATE: 09/30/2022
SURFACE ELEVATION: 581.0 (ft)
SURFACE CONDITION: Soil
WATER DEPTH: 21.0 ft
READING TAKEN: 09/30/22
HAMMER EFFICIENCY: 101.9 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface Exploration
DRILLING METHOD: Solid-Stem Auger
DRILL RIG: D50
HAMMER TYPE: Automatic; 140 (lbs); 30 (in) drop
SAMPLER TYPE & SIZE: MCAL (2.4" ID), SPT (1.4" ID), Bulk
BOREHOLE DIAMETER: 4.0 (in)
BACKFILL METHOD: Neat Cement Grout

FIELD										LABORATORY							
ELEVATION (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 IN.	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	PLASTIC LIMIT	LIQUID LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
580	1		Bulk 1					SILTY SAND (SM); medium dense; tan/gray; dry to moist; mostly fine SAND; little to some low plasticity fines.	100								Embankment material
579	2																
578	3		1	9 12 16	28				100								
577	4																
576	5							Lean CLAY with SAND (CL); hard; brown; moist; mostly low plasticity fines; little fine SAND.									
575	6		2	7 7 6	13	+4.5			100		20	31			79		
574	7																
573	8		3	9 7 2	9	+4.5			78								Corrosivity Analysis Soil pH: 6.84 Min. Resistivity: 2,950 ohm-cm Chloride: 4.8 ppm Sulfate: 27.5 ppm Redox Potential: (+) 212 mv Sulfides Presence: Negative
572	9												17.5	110.4			
571	10							CLAYEY SAND (SC); loose; gray; moist; mostly fine SAND; some low plasticity fines.									
570	11		4	3 3 4	7			moist to wet	78				15.4	116.2	32		
569	12																
568	13																
567	14																
566	15		5	5 8 12	20				67								
565	16							medium dense; brown; moist			23	38	23.2	103.0			
564	17																
563	18							Lean CLAY (CL); very stiff; brown; moist; mostly low plasticity fines; trace coarse to fine SAND.									
562	19																
561	20																
560	21		6	12 16 20	36	4.00			100				18.9	110.6			Tv = 1.34 tsf Unconfined Compressive Strength: 8050 psf
559	22																
558	23																
557	24							CLAYEY SAND with GRAVEL (SC); medium dense; brown; wet; mostly coarse to fine SAND; some low plasticity fines; few fine GRAVEL.									
556	25		7	8 9 12	21				0								
555	26														44		sand catcher
554	27																
553	28																
552	29																
551	30																
550	31		8	5 6 10	16	1.50			83		19	28					Tv = 0.875 tsf
549	32							Lean CLAY (CL); mostly low plasticity fines; few fine SAND.									little fine GRAVEL in shoe
548	33							Bottom of borehole at 31.5 ft bgs									

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(916) 455-4225

PROJECT NO: 19-503.1
PROJECT: Ukiah Recycled Water Pipeline
BORING: A-22-001
ENTRY BY: OMR
CHECKED BY: ABC
SHEET # 1 of 1

LOG OF BORING A-22-002

PROJECT NO: 19-503.1
PROJECT: Ukiah Recycled Water Pipeline
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers, Inc.
LOGGED BY: ABC
DEPTH OF BORING: 26.5 (ft)

BEGIN DATE: 09/30/2022
COMPLETION DATE: 09/30/2022
SURFACE ELEVATION: 577.0 (ft)
SURFACE CONDITION: Soil
WATER DEPTH: Not Encountered
READING TAKEN: N/A
HAMMER EFFICIENCY: 101.9 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface Exploration
DRILLING METHOD: Hollow-Stem Auger
DRILL RIG: D50
HAMMER TYPE: Automatic; 140 (lbs); 30 (in) drop
SAMPLER TYPE & SIZE: MCAL (2.4" ID), SH
BOREHOLE DIAMETER: 6.0 (in)
BACKFILL METHOD: Neat Cement Grout

FIELD									LABORATORY							
ELEVATION (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 IN.	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	PLASTIC LIMIT	LIQUID LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
576	1							SILTY SAND (SM); medium dense; brown; moist; mostly fine SAND; few fines.									
575	2																rig chatter at 2.5'
574	3																
573	4																
572	5																
571	6		1	8 7 6	13	0.25			67								Tv = 0.4 tsf
570	7							Lean CLAY (CL); soft; gray; moist; mostly low plasticity to medium plasticity fines.					21.0	103.7			Corrosivity Analysis Soil pH: 7.05 Min. Resistivity: 1,470 ohm-cm Chloride: 15.3 ppm Sulfate: 31.6 ppm
569	8		2						100								concrete in sampler; moved 5' north
568	9				400 psi	1.00		stiff									Tv = 0.55 tsf
567	10																
566	11		3		250 psi	0.50			100								Tv = 0.5 tsf
565	12							medium stiff									
564	13																
563	14																
562	15																
561	16		4	3 8 12	20	3.50		very stiff	83		25	43	24.0	102.9	96		Tv = 1.5 tsf Unconfined Compressive Strength: 6912 psf
560	17																
559	18																
558	19																
557	20																
556	21		5	4 9 13	22	3.50			83								Tv = 1.5 tsf
555	22																
554	23																
553	24																
552	25																
551	26		6	3 5 8	13	2.00			39						92		Tv = 0.625 tsf
550	27							Bottom of borehole at 26.5 ft bgs									
549	28																

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Sacramento, CA 95831
(916) 455-4225

PROJECT NO: 19-503.1
PROJECT: Ukiah Recycled Water Pipeline
BORING: A-22-002
ENTRY BY: OMR
CHECKED BY: ABC
SHEET # 1 of 1

LOG OF BORING B1

PROJECT NO: 17-414.1
PROJECT: Ukiah WWTP CCB Replacement
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo
LOGGED BY: KKL
DEPTH OF BORING: 50(ft)

BEGIN DATE: 9/27/17
COMPLETION DATE: 9/27/17
SURFACE ELEVATION: (ft)
SURFACE CONDITION: Soil
WATER DEPTH: 5.5 (ft)
READING TAKEN: 9/27/17
HAMMER EFFICIENCY: 82 (%)

DRILLING CONTRACTOR: Taber
DRILLING METHOD: Solid-Stem Auger, Rotary Wash
DRILL RIG: CME 55
HAMMER TYPE: Auto, 140-lb, 30-inch drop
SAMPLER TYPE & SIZE: CAL (2.4"ID)
BOREHOLE DIAMETER: 4 (in)
BACKFILL METHOD: Neat Cement Grout with Tremie

FIELD										LABORATORY							
ELEVATION (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 IN.	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	PLASTIC LIMIT	LIQUID LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
	1							SILTY SAND with GRAVEL (SM); medium dense; brown; dry to moist; about 16% coarse to fine GRAVEL; about 38% coarse to fine SAND; about 46% low plasticity, low toughness fines.										
	2																	
	3		1	4 6 8	14				83				12.5	122.4	46			
	4																	
	5		2	4 3 3	6				72									
	6							SILTY SAND (SM); very loose to loose; brown; wet; trace fine GRAVEL; about 75% coarse to fine SAND; about 25% low plasticity fines.					18	109				Direct Shear: phi=37.5; C=400 psf
	7																	
	8		3	4 1 2	3	0.75			72				12.7	108.5				
	9							Lean CLAY (CL); medium stiff; mottled gray and brown; moist; about 5% fine SAND; about 95% medium plasticity, medium toughness fines.										
	10		4	2 2 3	5				67									
	11					0.5		Trace fine GRAVEL; about 10% fine SAND; about 90% medium plasticity, medium toughness fines.			20	33	26.2	100.1				Unconfined Compressive Strength = 936 psf.
	12																	
	13																	
	14																	
	15		5	7 7 14	21			Very stiff; about 5% fine SAND; about 95% medium plasticity fines; no trace gravel.	83									
	16					3.75					24	48						
	17																	
	18							SANDY lean CLAY (CL); medium stiff; mottled gray and brown; moist; about 3% fine GRAVEL; about 40% coarse to fine SAND; about 57% medium plasticity, medium toughness fines.										
	19																	
	20		6	7 10 10	20				94									
	21					0.75							19.6	111.5	57			
	22																	
	23							SILTY SAND (SM); medium dense; brown; wet; about 70% fine SAND; about 30% nonplastic to low plasticity fines.										
	24																	

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Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831
(916) 455-4225

PROJECT NUMBER: 17-414.1
PROJECT: Ukiah WWTP CCB Replacement
BORING: B1
ENTRY BY: KKL
CHECKED BY:
SHEET 1 of 2

ELEVATION (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 IN.	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LABORATORY: PLASTIC LIMIT	LIQUID LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
	26		7	11 16 14	30			SILTY SAND (SM) *(continued)*.	0									No sample recovery. Chased with SPT sampler to recover material with about 67% recovery.
	27																	
	28							Lean CLAY with SAND (CL); stiff; mottled brown and gray; moist; about 15% coarse to fine GRAVEL; about 15% fine SAND; about 70% medium plasticity, medium toughness fines.										
	29																	
	30		8	8 9 12	21	1.0			100				16.5	116.2				Sand catcher used, sample disturbed.
	31																	
	32																	
	33							CLAYEY GRAVEL with SAND (GC); very dense; brown; wet; about 60% coarse to fine GRAVEL; about 20% coarse to fine SAND; about 20% medium plasticity fines.										Gravel chatter.
	34																	
	35		9	8 15 39	54				39									Sand catcher used, sample disturbed.
	36																	Took a sample of the shoe as the tubes looked like sluff (Poorly graded Gravel). Shoe was a clayey gravel. Loosing a lot of drilling fluid.
	37																	
	38																	
	39																	
	40		10	13 16 18	34			Subangular to subrounded GRAVEL.	39									Sand catcher used and broke. Took a sample of the shoe as the tubes looked like sluff (Poorly graded Gravel). Shoe was a clayey gravel. Gravel pieces were greater than 2 in.
	41																	
	42																	
	43																	
	44																	
	45		11	8 11 18	29				17									The hole caved more than 2 ft.
	46																	
	47																	
	48																	
	49																	
	50							Bottom of borehole at 50.0 ft bgs										The hole caved in 7 ft and could not get sampler to required depth.
	51																	
	52																	
	53																	
	54																	
	55																	

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
Sacramento, CA 95831
(916) 455-4225

PROJECT NUMBER: 17-414.1
PROJECT: Ukiah WWTP CCB Replacement
BORING: B1
ENTRY BY: KKL
CHECKED BY:
SHEET 2 of 2

LOG OF BORING B2

PROJECT NO: 17-414.1
PROJECT: Ukiah WWTP CCB Replacement
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo
LOGGED BY: KKL
DEPTH OF BORING: 26.5(ft)

BEGIN DATE: 9/27/17
COMPLETION DATE: 9/27/17
SURFACE ELEVATION: (ft)
SURFACE CONDITION: Soil
WATER DEPTH: 15 (ft)
READING TAKEN: 9/27/17
HAMMER EFFICIENCY: 82 (%)

DRILLING CONTRACTOR: Taber
DRILLING METHOD: Hollow-Stem Auger
DRILL RIG: CME 55
HAMMER TYPE: Auto, 140-lb, 30-inch drop
SAMPLER TYPE & SIZE: CAL (2.4"ID)
BOREHOLE DIAMETER: 6 (in)
BACKFILL METHOD: Neat Cement Grout with Tremie

ELEVATION (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 IN.	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LABORATORY: PLASTIC LIMIT	LIQUID LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
	1	Bulk						SILTY SAND with GRAVEL (SM); medium dense; brown; dry to moist; about 25% coarse to fine GRAVEL; about 31% coarse to fine SAND; about 44% low plasticity, low toughness fines.	100										R-Value = 40
	2																	
	3		1	7 7 9	16				94				11.8	106.6	44			
	4																	
	5		2	7 8 13	21				83									
	6					+4.5		Lean CLAY (CL); hard; gray; moist; about 10% coarse to fine GRAVEL; about 10% fine SAND; about 80% medium plasticity, medium toughness fines.			18	29	16.8	121.9				
	7																	
	8		3	4 3 4	7	1.75			83									
	9					1.75		Poorly graded SAND with GRAVEL (SP); loose; brown; moist; about 15% fine GRAVEL; about 85% coarse to fine SAND; trace nonplastic fines.					7.4 24.5	114.1 89				pH = 7.17 Minimum Resistivity = 1,820 ohm-cm Chloride = 11.8 ppm Sulfate = 6.7 ppm
	10		4	2 2 4	6	0.75		Lean CLAY (CL); stiff; brownish gray; moist; about 10% fine SAND; about 90% medium plasticity, medium toughness fines.	89									
	11							Mottled brown and gray.			24	39	26.3	98.9				Unconfined Compressive Strength = 1,195 psf.
	12																	
	13																	
	14																	
	15		5	5 9 12	21	2.75		Very stiff; trace fine SAND.	83									
	16																	
	17																	
	18																	
	19																	
	20		6	3 5 7	12	4.25		Hard.	100									
	21					1.5		SANDY lean CLAY (CL); stiff; mottled brown and reddish brown; moist to wet; trace fine GRAVEL; about 50% medium to fine SAND; about 50% medium plasticity, medium toughness fines.					18.8	112.1				
	22																	
	23							SILTY SAND (SM); medium dense; brown; moist to wet; about 80% fine SAND; about 20% nonplastic fines.										
	24																	

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(916) 455-4225

PROJECT NUMBER: 17-414.1
PROJECT: Ukiah WWTP CCB Replacement
BORING: B2
ENTRY BY: KKL
CHECKED BY:
SHEET 1 of 2

ELEVATION (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 IN.	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LABORATORY: PLASTIC LIMIT	LIQUID LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
	26		7	6 9 14	23	1.5		SILTY SAND (SM) *(continued)*.	89									
	27							Lean CLAY (CL); stiff; brown; moist; trace fine GRAVEL; about 5% fine SAND; about 95% medium plasticity fines.										
	28							Bottom of borehole at 26.5 ft bgs										
	29																	
	30																	
	31																	
	32																	
	33																	
	34																	
	35																	
	36																	
	37																	
	38																	
	39																	
	40																	
	41																	
	42																	
	43																	
	44																	
	45																	
	46																	
	47																	
	48																	
	49																	
	50																	
	51																	
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	54																	
	55																	

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Geotechnical Engineering, Design and Construction Services

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
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(916) 455-4225

PROJECT NUMBER: 17-414.1
PROJECT: Ukiah WWTP CCB Replacement
BORING: B2
ENTRY BY: KKL
CHECKED BY:
SHEET 2 of 2

WILDCAT DYNAMIC CONE LOG

Crawford & Associates, Inc.
1100 Corporate Way Suite 230
Sacramento, CA 95831

PROJECT NUMBER: 19-503.1
DATE STARTED: 09-22-2022
DATE COMPLETED: 09-22-2022

HOLE #: DCP-1 (Eastern Pond)
CREW: ABC/OMR
PROJECT: Ukiah WWTP Sludge Lagoon
ADDRESS: (39.111770°, -123.190679°)
LOCATION: Ukiah, CA

SURFACE ELEVATION: 573
WATER ON COMPLETION: N/A
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	TESTED CONSISTENCY COHESIVE
-	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
- 1 ft	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
- 2 ft	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
- 3 ft	0	0.0		0	VERY LOOSE	VERY SOFT
- 1 m	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
- 4 ft	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
- 5 ft	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
- 6 ft	0	0.0		0	VERY LOOSE	VERY SOFT
-	2	7.7	••	2	VERY LOOSE	SOFT
- 2 m	1	3.9	•	1	VERY LOOSE	VERY SOFT
- 7 ft	14	47.9	••••••••••••	13	MEDIUM DENSE	STIFF
-	23	78.7	••••••••••••••••••••••	22	MEDIUM DENSE	VERY STIFF
-	14	47.9	••••••••••••	13	MEDIUM DENSE	STIFF
- 8 ft	13	44.5	•••••••••••	12	MEDIUM DENSE	STIFF
-	10	34.2	•••••••••	9	LOOSE	STIFF
-	10	34.2	•••••••••	9	LOOSE	STIFF
- 9 ft	13	44.5	•••••••••••	12	MEDIUM DENSE	STIFF
-	13	44.5	•••••••••••	12	MEDIUM DENSE	STIFF
-	14	47.9	••••••••••••	13	MEDIUM DENSE	STIFF
- 3 m 10 ft	15	51.3	••••••••••••••	14	MEDIUM DENSE	STIFF
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

19-503.1 Ukiah Recycled Water Pipeline

WILDCAT DYNAMIC CONE LOG

Crawford & Associates, Inc.
1100 Corporate Way Suite 230
Sacramento, CA 95831

PROJECT NUMBER: 19-503.1
DATE STARTED: 09-22-2022
DATE COMPLETED: 09-22-2022

HOLE #: DCP-2 (Western Pond)
CREW: ABC/OMR
PROJECT: Ukiah WWTP Sludge Lagoon
ADDRESS: (39.111694°, -123.191467°)
LOCATION: Ukiah, CA

SURFACE ELEVATION: 573
WATER ON COMPLETION: N/A
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	TESTED CONSISTENCY COHESIVE
-	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
- 1 ft	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
- 2 ft	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
- 3 ft	0	0.0		0	VERY LOOSE	VERY SOFT
- 1 m	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
- 4 ft	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
- 5 ft	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
-	3	11.6	•••	3	VERY LOOSE	SOFT
- 6 ft	8	30.9	••••••••	8	LOOSE	MEDIUM STIFF
-	14	54.0	••••••••••••••	15	MEDIUM DENSE	STIFF
- 2 m	12	46.3	•••••••••••••	13	MEDIUM DENSE	STIFF
- 7 ft	9	30.8	••••••••	8	LOOSE	MEDIUM STIFF
-	9	30.8	••••••••	8	LOOSE	MEDIUM STIFF
-	14	47.9	•••••••••••••	13	MEDIUM DENSE	STIFF
- 8 ft	16	54.7	••••••••••••••	15	MEDIUM DENSE	STIFF
-	16	54.7	••••••••••••••	15	MEDIUM DENSE	STIFF
-	20	68.4	••••••••••••••••••	19	MEDIUM DENSE	VERY STIFF
- 9 ft	19	65.0	•••••••••••••••••	18	MEDIUM DENSE	VERY STIFF
-	18	61.6	••••••••••••••••	17	MEDIUM DENSE	VERY STIFF
-						
- 3 m 10 ft						
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

19-503.1 Ukiah Recycled Water Pipeline

BORING B-15

LACO

CLIENT Carollo Engineers
PROJECT NAME Ukiah Recycled Water
PROJECT NUMBER 7986.00
PROJECT LOCATION Ukiah, CA
DATE STARTED 9/11/14 **COMPLETED** 9/11/14
GROUND ELEVATION 587 feet **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Clear Heart Drilling
GROUND WATER LEVELS:
DRILLING METHOD Rotary Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY DAC **CHECKED BY** EAW
AT END OF DRILLING ---
NOTES Backfilled with neat cement grout ATD

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0						
	SPT B15-S1	37	20-26-19 (45)	CL		(CL) Lean clay with sand (fill), dark to medium brown, fine sand, trace gravel, moist, low plasticity, hard.
5	SPT B15-S2	100	12-13-17 (30)			
7.5						579.5
				GW		(GW) Well graded gravel with sand, dark gray, trace fines, subangular to subrounded gravel, trace cobbles, moist, very dense.
10	MC B15-S3 B15-S4	60	17-50			
12.5						574.5
				CH		(CH) Fat clay with sand, medium brown with dark gray mottling, fine sand, contains trace gravel, moist, stiff, medium to high plasticity. Light brown, saturated, and very sandy (fine to coarse) with no gravel below 17.5'.
15	SPT B15-S5		3-4-5 (9)			
20	SPT B15-S6		1-3-6 (9)			
21.5						565.5
						Bottom of borehole at 21.5 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 9/30/14 17:00 - P:\GINT FILES\PROJECTS\7986.00 UKIAH RECYCLED WATER.GPJ

BORING B-16

LACO

CLIENT Carollo Engineers
PROJECT NAME Ukiah Recycled Water
PROJECT NUMBER 7986.00
PROJECT LOCATION Ukiah, CA
DATE STARTED 9/12/14 **COMPLETED** 9/12/14
GROUND ELEVATION 586 feet **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Clear Heart Drilling
GROUND WATER LEVELS:
DRILLING METHOD Rotary Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY DAC **CHECKED BY** EAW
AT END OF DRILLING ---
NOTES Backfilled with neat cement grout ATD

DEPTH (ft)	SAMPLE TYPE NUMBER	RECOVERY %	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0							
	MC B16-S1	83	6-10-16 (26)	ML		(ML) Sandy silt (fill), medium brown, contains trace gravel, moist, very stiff.	
						3.0	583.0
5				CL		(CL) Sandy lean clay with gravel, medium brown with dark gray mottling, fine to coarse rounded to subrounded gravel, moist, low to medium plasticity, very stiff.	
	MC B16-S2 B16-S3	83	12-14-26 (40)			Plasticity Index: 7.7 Direct Shear: C = 2300 psf, Phi = 21.3 degrees	
						7.5	578.5
10						(CL) Lean clay with sand and gravel, dark gray with trace light gray mottling, moist, medium plasticity, stiff. Very stiff with trace gravel below 12.5'. Hard below 17.5'.	
	SPT B16-S4	100	4-4-6 (10)				
15				CL			
	SPT B16-S5		6-10-17 (27)				
20							
	SPT B16-S6		12-17-19 (36)				
						21.5	564.5
						Bottom of borehole at 21.5 feet.	

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 9/30/14 17:00 - P:\GINT FILES\PROJECTS\7986.00 UKIAH RECYCLED WATER.GPJ

BORING B-17

LACO

CLIENT Carollo Engineers
PROJECT NAME Ukiah Recycled Water
PROJECT NUMBER 7986.00
PROJECT LOCATION Ukiah, CA
DATE STARTED 9/12/14 **COMPLETED** 9/12/14
GROUND ELEVATION 576 feet **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Clear Heart Drilling
GROUND WATER LEVELS:
DRILLING METHOD Rotary Hollow Stem Auger
▽ **AT TIME OF DRILLING** 17.00 feet / Elevation 559.00 feet
LOGGED BY DAC **CHECKED BY** EAW
▼ **AT END OF DRILLING** 12.00 feet / Elevation 564.00 feet
NOTES Backfilled with neat cement grout ATD

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	
0						
	MC B17-S1	12-17-21 (38)	CL		(CL) Sandy lean clay with gravel (fill), medium brown, fine sand, fine to coarse subangular to subrounded gravel, moist, low plasticity, very stiff. Dark brown below 3'. Dark gray and stiff below 7.5'.	
5	SPT	9-10-11 (21)				
					7.5	568.5
			CH		(CH) Fat clay with gravel (fill), dark gray with light gray and orange mottling, moist, medium plasticity, very stiff. Changes lighter brown 17.5'.	
10	SPT	4-10-7 (17)				
					12.5 ▼	563.5
			CL		(CL) Lean clay, dark brown with dark gray and orange mottling, trace gravel, moist medium plasticity, very stiff.	
15	SPT	5-8-12 (20)			▽	
20	SPT	9-14-15 (29)				
					21.5	554.5
					Bottom of borehole at 21.5 feet.	

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 9/30/14 17:00 - P:\GINT FILES\PROJECTS\7986.00 UKIAH RECYCLED WATER.GPJ

BORING B-19

LACO

CLIENT Carollo Engineers
PROJECT NAME Ukiah Recycled Water
PROJECT NUMBER 7986.00
PROJECT LOCATION Ukiah, CA
DATE STARTED 9/11/14 **COMPLETED** 9/11/14
GROUND ELEVATION 588 feet **HOLE SIZE** 6 inches
DRILLING CONTRACTOR Clear Heart Drilling
GROUND WATER LEVELS:
DRILLING METHOD Rotary Hollow Stem Auger
AT TIME OF DRILLING ---
LOGGED BY DAC **CHECKED BY** EAW
AT END OF DRILLING ---
NOTES Backfilled with neat cement grout ATD

DEPTH (ft)	SAMPLE TYPE NUMBER	BLOW COUNTS (N VALUE)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION
0	MC B19-S1	30-22-24 (46)	CL		(CL) Gravelly clay with sand (fill), dark brown to dark purple gray, fine sand, fine to coarse subangular to subround gravel, moist, very dense.
3.0					585.0
5	MC B19-S2 B19-S3	18-20-28 (48)			(CL) Lean clay with gravel and sand, medium brown to dark gray with orange mottling, fine to coarse subangular to subrounded gravel, moist, low plasticity, hard. Dark gray to black and stiff below 7.5'. Bluish gray between 12.5' and 15.75'. Sand is fine to coarse below 12.5'. Light to medium brown and very stiff with less gravel below 15.75'. Plasticity Index: 7.5 Direct Shear: C = 2225 psf, Phi = 34.2 degrees
10	SPT B19-S4	3-3-8 (11)	CL		
15	SPT B19-S5	4-9-14 (23)			
20	SPT B19-S6	10-12-14 (26)			
21.5					566.5

Bottom of borehole at 21.5 feet.

GENERAL BH / TP / WELL - GINT STD US LAB.GDT - 9/30/14 17:00 - P:\GINT FILES\PROJECTS\7986.00 UKIAH RECYCLED WATER.GPJ

APPENDIX III

Laboratory Test Results

Hazardous Materials Laboratory Results

DRAFT

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: City of Ukiah Recycled Water Pipeline - Phase 4 Design Project
CAInc File No: 19-503.1
Date: 10/21/22
Technician: AC/LAD/KVL

MOISTURE-DENSITY TESTS - D2216/D7263

	1	2	3	4	5
Sample No.	A-22-001-3A	A-22-001-4A	A-22-001-5A	A-22-001-6A	A-22-002-1A
USCS Symbol	CL	SC	CL	CL	CL
Depth (ft.)	6	11	16	21	6
Sample Length (in.)	5.333	4.524	5.908	4.820	5.686
Diameter (in.)	2.399	2.398	2.399	2.393	2.394
Sample Volume (ft^3)	0.01395	0.01182	0.01545	0.01255	0.01481
Total Mass Soil+Tube (g)	1100.1	993.0	1165.7	748.2	1121.3
Mass of Tube (g)	279.1	274.1	276.0	0.0	278.5
Tare No.	B3	2036	G12	C15	B19
Tare (g)	13.7	124.2	13.4	13.7	13.6
Wet Soil + Tare (g)	66.0	459.9	72.1	61.5	61.3
Dry Soil + Tare (g)	58.2	415.0	61.0	53.9	53.0
Dry Soil (g)	44.5	290.8	47.7	40.2	39.4
Water (g)	7.8	44.9	11.1	7.6	8.3
Moisture (%)	**17.5**	**15.4**	**23.2**	**18.9**	**21.0**
Dry Density (pcf)	**110.4**	**116.2**	**103.0**	**110.6**	**103.7**

Notes:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: City of Ukiah Recycled Water Pipeline - Phase 4 Design Project
CAInc File No: 19-503.1
Date: 10/21/22
Technician: AC/LAD/KVL

MOISTURE-DENSITY TESTS - D2216/D7263

	1	2	3	4	5
Sample No.	A-22-002- 3	A-22-002-4A			
USCS Symbol	CL	CL			
Depth (ft.)	10	16			
Sample Length (in.)	6.494	5.620			
Diameter (in.)	2.838	2.390			
Sample Volume (ft^3)	0.02376	0.01459			
Total Mass Soil+Tube (g)	1800.0	844.8			
Mass of Tube (g)	455.0	0.0			
Tare No.	G11	C7			
Tare (g)	13.4	13.7			
Wet Soil + Tare (g)	81.4	60.0			
Dry Soil + Tare (g)	66.9	51.1			
Dry Soil (g)	53.5	37.4			
Water (g)	14.5	9.0			
Moisture (%)	**27.1**	**24.0**			
Dry Density (pcf)	**98.2**	**102.9**			

Notes:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: City of Ukiah Recycled Water Pipeline - Phase 4 Design Project
CAInc File No: 19-503.1
Date: 10/31/22
Technician: CAP

200 Wash - ASTM D1140
Method A

Max Particle Size (100% Passing)	Standard Sieve Size	Recommended Min Mass of Test Specimens
2 mm or less	No. 10	20 g
4.75 mm	No. 4	100 g
9.5 mm	3/8 "	500 g
19.0 mm	3/4 "	2.5 kg
37.5 mm	1 1/2 "	10 kg
75.0 mm	3 "	50 kg

Table from 6.2 of ASTM D1140

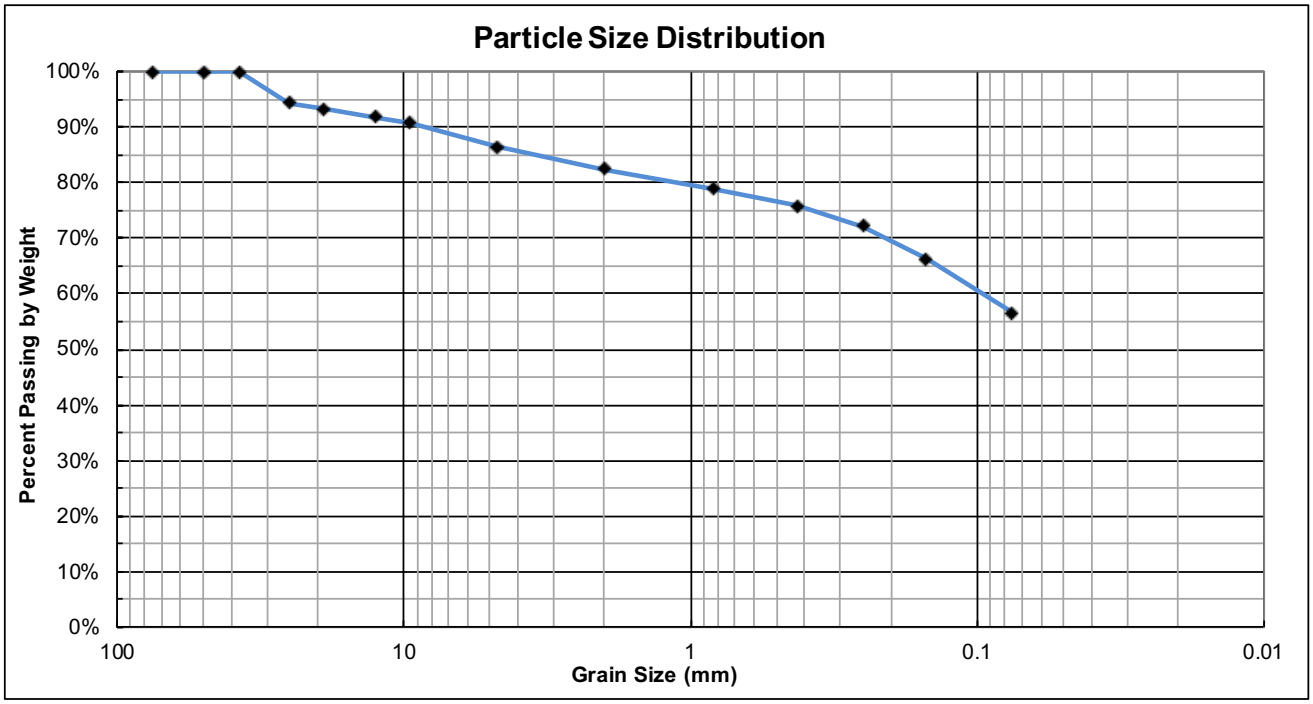
Sample No.	A-22-001-2	A-22-001-4A	A-22-001-7A	A-22-002-4B	A-22-002-6A
USCS Symbol	CL	SC	SC	CL	CL
Depth (ft.)	5	11	26	15.5	26
Tare No.	1016	2030	1002	3020	X21
Tare (g)	126.7	124.2	125.6	121.9	114.7
Dry Soil + Tare (g)	310	415	473.2	343.1	321.5
Dry Mass before (g)	183.3	290.8	347.6	221.2	206.8
Dry Mass after (g)	38.2	197.6	194.5	8.4	16.7
Percent Fines (%)	79	32	44	96	92

Notes:

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: City of Ukiah Recycled Water Pipeline
CAInc File No: 19-503.1
Date: 11/10/22
Technician: zzz
Sample ID: A-22-001-Bulk
Depth (ft): 0-2.5
USCS Classification: Sandy Silt (ML)

ASTM 6913 - Method A



% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	7	7	4	6	19	
0	**14**		**29**			**57**

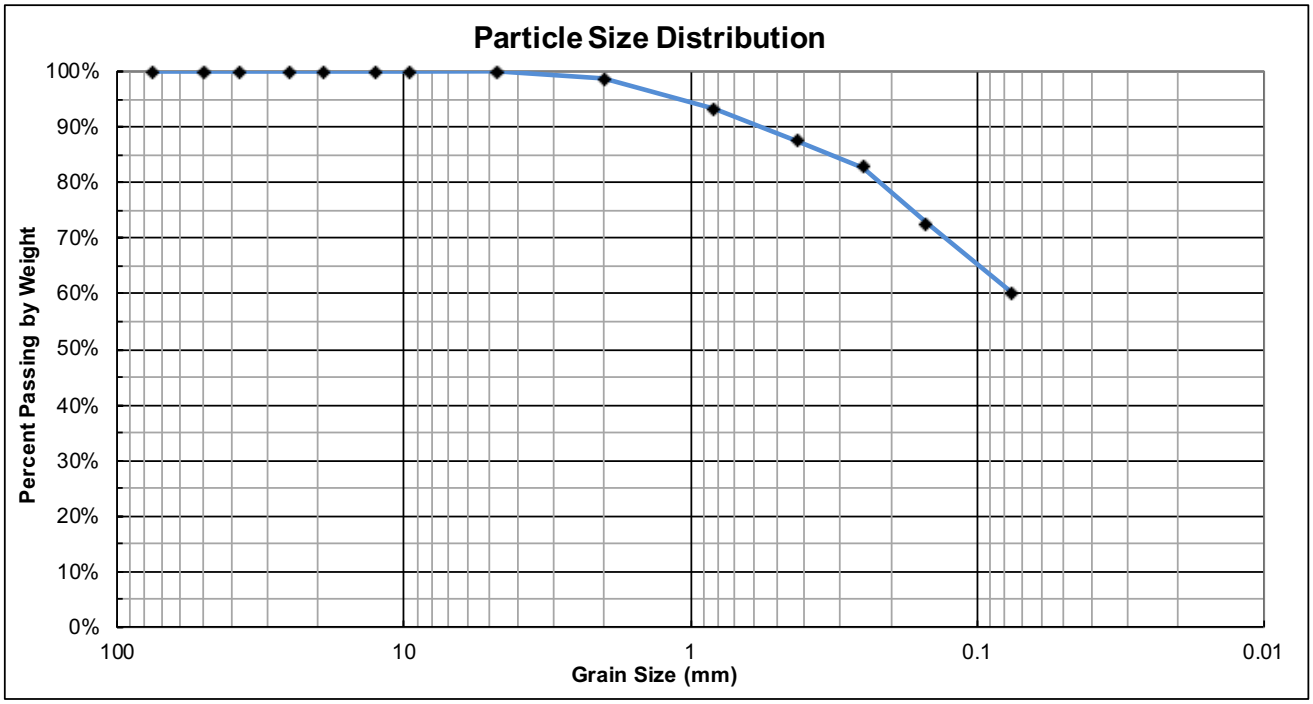
		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	54.7	94%
		3/4"	19.0	65.5	93%
	Fine	**1/2"**	12.5	80.7	92%
		3/8"	9.50	90.0	91%
		#4	4.75	131.6	86%
Sand	Coarse	**#10**	2.00	171.3	82%
	Medium	**#20**	0.825	205.8	79%
		#40	0.425	234.9	76%
	Fine	**#60**	0.250	271.5	72%
		#100	0.150	329.3	66%
Silt/Clay		**#200**	0.075	422.4	57%

Coefficient of Uniformity	Coefficient of Curvature
Cu = NA	Cc = NA

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: City of Ukiah Recycled Water Pipeline
CAInc File No: 19-503.1
Date: 11/10/22
Technician: zzz
Sample ID: A-22-002-1B
Depth (ft): 5.5
USCS Classification: Sandy Silt (ML)

ASTM 6913 - Method A



% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	0	0	1	11	28	
0	**0**		**40**			**60**

		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	0.0	100%
		3/4"	19.0	0.0	100%
	Fine	**1/2"**	12.5	0.0	100%
		3/8"	9.50	0.0	100%
		#4	4.75	0.1	100%
Sand	Coarse	**#10**	2.00	2.9	99%
	Medium	**#20**	0.825	15.1	93%
		#40	0.425	27.8	88%
	Fine	**#60**	0.250	38.8	83%
		#100	0.150	61.4	73%
Silt/Clay		**#200**	0.075	89.5	60%

Coefficient of Uniformity	Coefficient of Curvature
Cu = NA	Cc = NA

Plastic and Liquid Limits of Soils

ASTM D4318

Project Name: Ukiah WWTP Sludge Pond
Project No. : 220328 (19-503.1)
Client: Crawford & Associates
Lab Number: L223499
Sample Description: CL

Sampled By: Client
Date Sampled: 10/21/2022
Sample: 2A
Depth: 5 - 7.5 ft.

	PLASTIC LIMIT		LIQUID LIMIT			
TEST NO.	1	2	1	2	3	4
Number of Blows [N]			32	25	18	
Container No.	A	B	C	D	E	
Wet Wt. of Soil + Cont.(gm)	23.83	23.76	42.01	43.62	44.39	
Dry Wt. of Soil + Cont. (gm)	23.33	23.27	37.06	38.15	38.60	
Weight of Container (gm)	20.83	20.78	20.80	20.70	20.94	
Weight of Water (gm)	0.50	0.49	4.95	5.47	5.79	
Weight of Dry Soil (gm)	2.50	2.49	16.26	17.45	17.66	
Moisture Content (%) [Wn]	20.0	19.7	30.4	31.3	32.8	

PROCEDURES USED

[ ] Wet Preparation
[X] Dry Preparation

Procedure **A** (Single Point) [ ]
Procedure **B** (Multi-Point) [X]

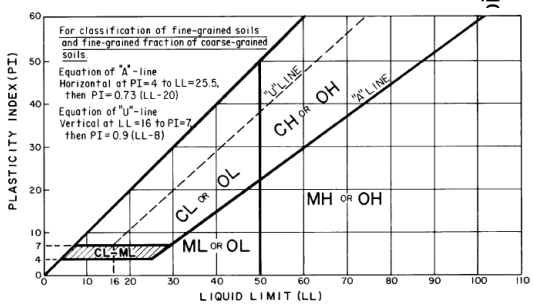
Liquid Limit	**31**
Plastic Limit	**20**
Plasticity Index	**12**
USCS Classification	

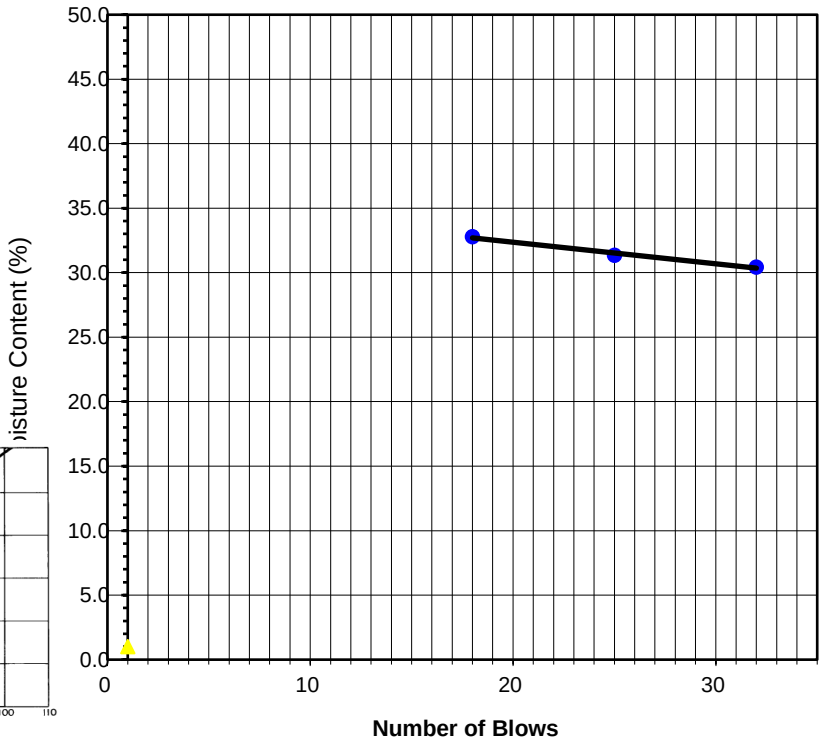
PI at "A" - Line = 0.73(LL-20) =

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$

Wt. Ret. #40	
Wt. Total Smpl.	
% Ret. #40	





Plastic and Liquid Limits of Soils

ASTM D4318

Project Name: Ukiah WWTP Sludge Pond
Project No. : 220328 (19-503.1)
Client: Crawford & Associates
Lab Number: L223499
Sample Description: CL

Sampled By: Client
Date Sampled: 10/21/2022
Sample: 5A
Depth: 16 - 16.5 ft.

	PLASTIC LIMIT		LIQUID LIMIT			
TEST NO.	1	2	1	2	3	4
Number of Blows [N]			29	25	18	
Container No.	A	B	C	D	E	
Wet Wt. of Soil + Cont.(gm)	23.80	23.75	47.05	47.79	48.82	
Dry Wt. of Soil + Cont. (gm)	23.23	23.18	39.89	40.37	40.90	
Weight of Container (gm)	20.72	20.64	20.63	20.69	20.84	
Weight of Water (gm)	0.57	0.57	7.16	7.42	7.92	
Weight of Dry Soil (gm)	2.51	2.54	19.26	19.68	20.06	
Moisture Content (%) [Wn]	22.7	22.4	37.2	37.7	39.5	

PROCEDURES USED

[ ] Wet Preparation
[X] Dry Preparation

Procedure **A** (Single Point) [ ]
Procedure **B** (Multi-Point) [X]

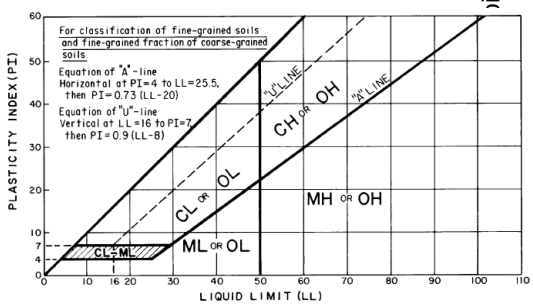
Liquid Limit	**38**
Plastic Limit	**23**
Plasticity Index	**15**
USCS Classification	

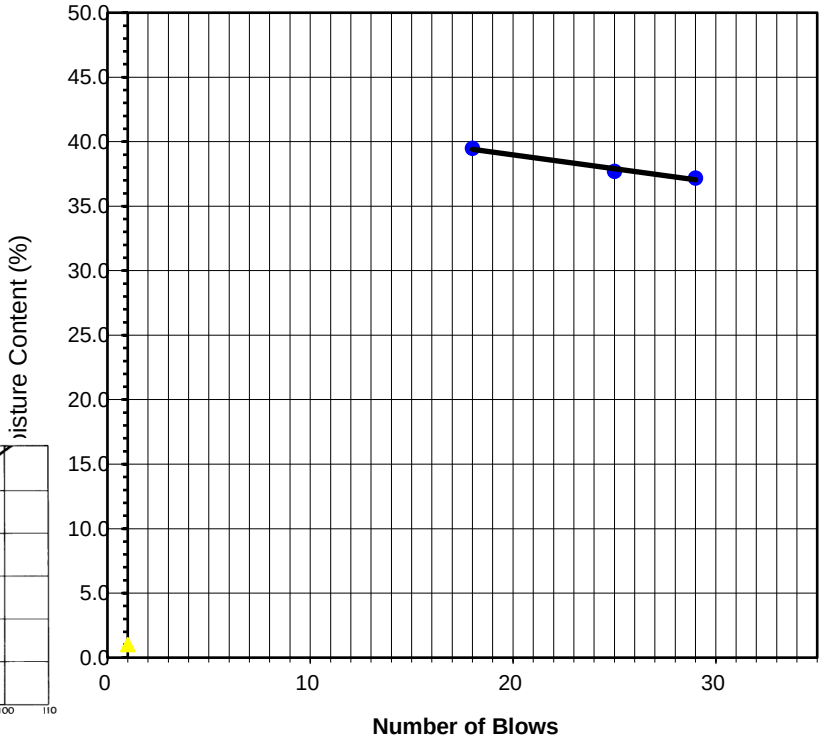
PI at "A" - Line = 0.73(LL-20) =

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$

Wt. Ret. #40	
Wt. Total Smpl.	
% Ret. #40	





Plastic and Liquid Limits of Soils

ASTM D4318

Project Name: Ukiah WWTP Sludge Pond
Project No. : 220328 (19-503.1)
Client: Crawford & Associates
Lab Number: L223499
Sample Description: CL

Sampled By: Client
Date Sampled: 10/21/2022
Sample: 8A
Depth: 30 - 31.5 ft.

	PLASTIC LIMIT		LIQUID LIMIT			
TEST NO.	1	2	1	2	3	4
Number of Blows [N]			31	23	19	
Container No.	A	B	C	D	E	
Wet Wt. of Soil + Cont.(gm)	23.73	23.62	40.55	43.43	45.22	
Dry Wt. of Soil + Cont. (gm)	23.27	23.15	36.30	38.43	39.69	
Weight of Container (gm)	20.82	20.67	20.93	20.84	20.74	
Weight of Water (gm)	0.46	0.47	4.25	5.00	5.53	
Weight of Dry Soil (gm)	2.45	2.48	15.37	17.59	18.95	
Moisture Content (%) [Wn]	18.8	19.0	27.7	28.4	29.2	

PROCEDURES USED

[ ] Wet Preparation
[X] Dry Preparation

Procedure **A** (Single Point) [ ]
Procedure **B** (Multi-Point) [X]

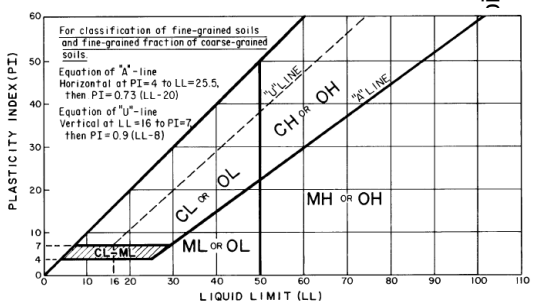
Liquid Limit	**28**
Plastic Limit	**19**
Plasticity Index	**9**
USCS Classification	

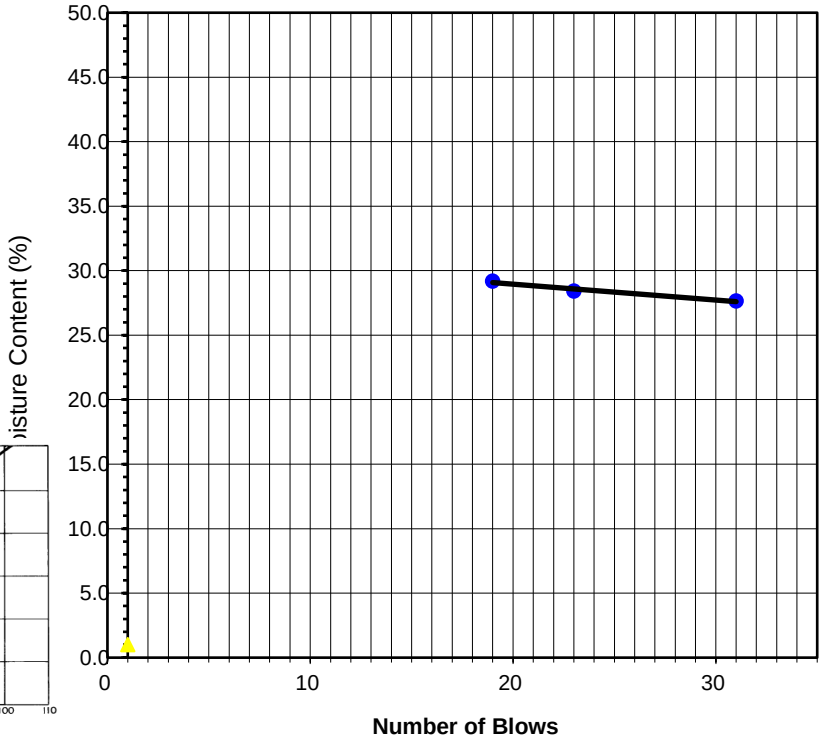
PI at "A" - Line = 0.73(LL-20) =

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$

Wt. Ret. #40	
Wt. Total Smpl.	
% Ret. #40	





Plastic and Liquid Limits of Soils

ASTM D4318

Project Name: Ukiah WWTP Sludge Pond
Project No. : 220328 (19-503.1)
Client: Crawford & Associates
Lab Number: L223499
Sample Description: CL

Sampled By: Client
Date Sampled: 10/21/2022
Sample: 4A
Depth: 16 - 16.5 ft.

	PLASTIC LIMIT		LIQUID LIMIT			
TEST NO.	1	2	1	2	3	4
Number of Blows [N]			35	30	23	
Container No.	A	B	C	D	E	
Wet Wt. of Soil + Cont.(gm)	23.54	23.54	37.02	42.48	48.51	
Dry Wt. of Soil + Cont. (gm)	22.99	22.96	32.31	35.89	39.94	
Weight of Container (gm)	20.70	20.65	20.69	20.49	20.80	
Weight of Water (gm)	0.55	0.58	4.71	6.59	8.57	
Weight of Dry Soil (gm)	2.29	2.31	11.62	15.40	19.14	
Moisture Content (%) [Wn]	24.0	25.1	40.5	42.8	44.8	

PROCEDURES USED

	Wet Preparation	Procedure **A** (Single Point)		Procedure **B** (Multi-Point)	X
X	Dry Preparation				

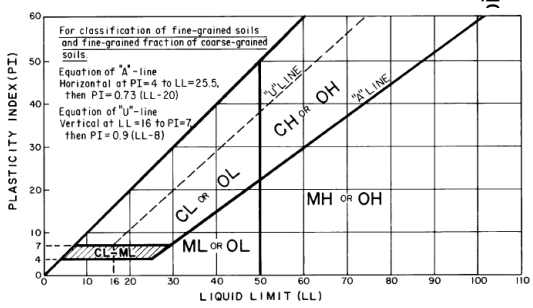
Liquid Limit	**43**
Plastic Limit	**25**
Plasticity Index	**19**
USCS Classification	

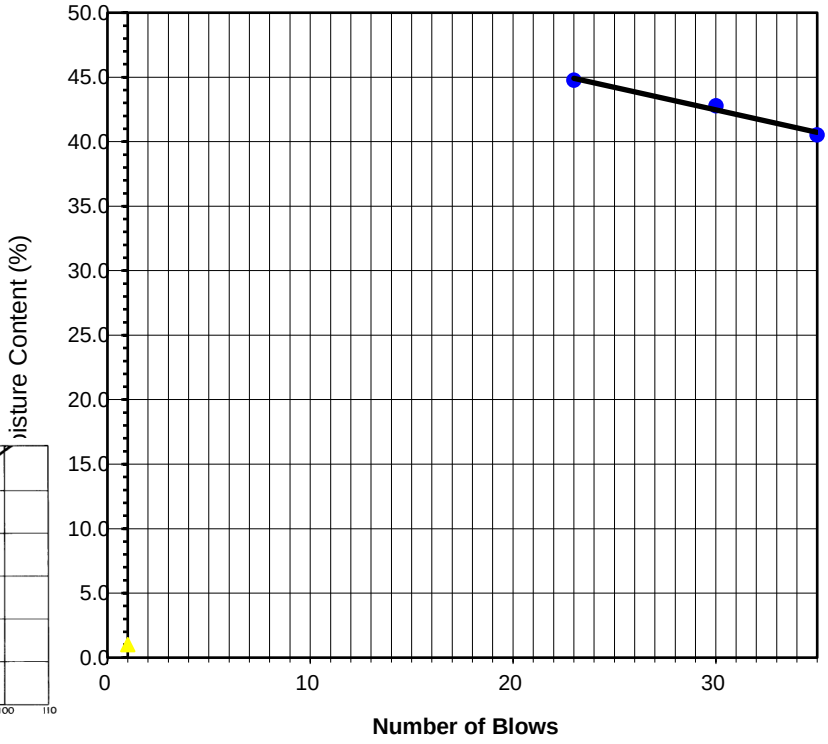
PI at "A" - Line = 0.73(LL-20) =

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$

Wt. Ret. #40	
Wt. Total Smpl.	
% Ret. #40	

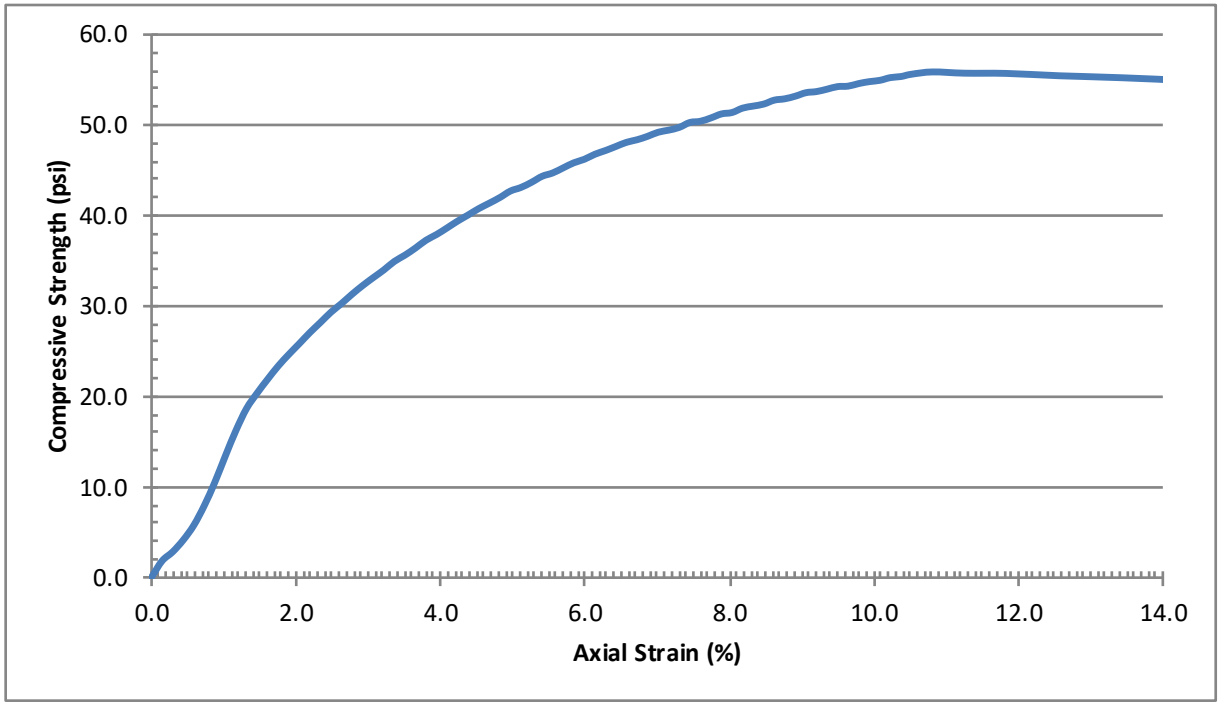




Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

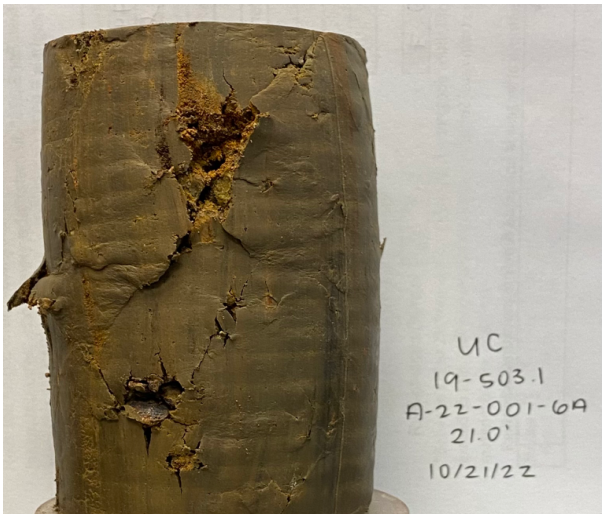
Project Name: City of Ukiah Recycled Water Pipeline - Phase 4 Design Project
CAInc File No: 19-503.1
Date: 10/21/22
Technician: LAD
Sample ID: A-22-001-6A Depth (ft): 21.0
USCS Classification: Lean Clay (CL)

UNCONFINED COMPRESSION TEST - D2166



Dry Density (pcf)	**110.6**
Water Content (%)	**18.9**
Unconfined Compressive Strength (psi)	**55.9**
Unconfined Compressive Strength (psf)	**8050**
Average Height (in)	4.820
Average Diameter (in)	2.393
Rate of strain (%)	0.7
Strain at Failure (%)	10.8

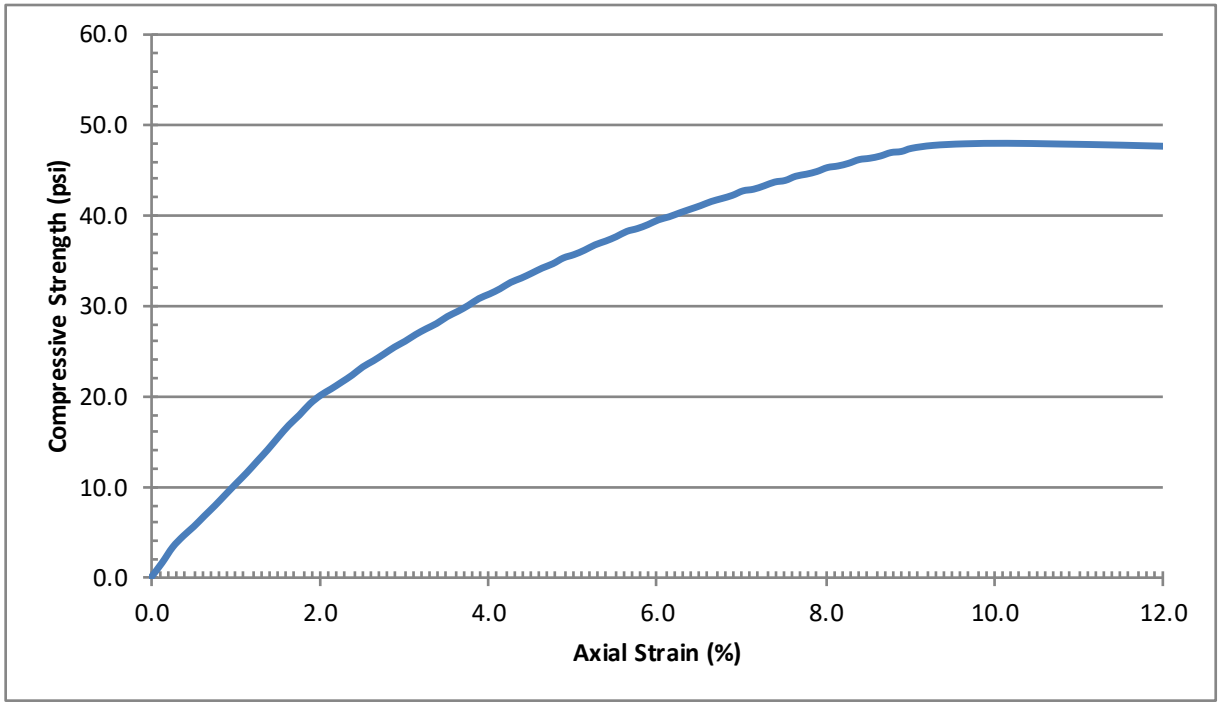
Notes:



Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

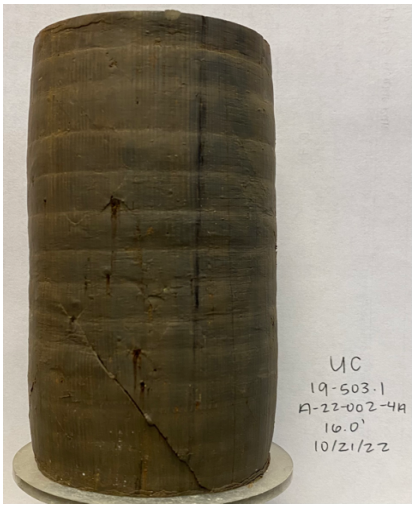
Project Name: City of Ukiah Recycled Water Pipeline - Phase 4 Design Project
CAInc File No: 19-503.1
Date: 10/21/22
Technician: LAD
Sample ID: A-22-002-4A Depth (ft): 16.0
USCS Classification: Lean Clay (CL)

UNCONFINED COMPRESSION TEST - D2166



Dry Density (pcf)	**102.9**
Water Content (%)	**24.0**
Unconfined Compressive Strength (psi)	**48.0**
Unconfined Compressive Strength (psf)	**6912**
Average Height (in)	5.620
Average Diameter (in)	2.390
Rate of strain (%)	0.7
Strain at Failure (%)	10.2

Notes:



Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 10/28/2022
Date Submitted 10/24/2022

To: Kennedy Hauder
Crawford & Associates, Inc.
1100 Corporate Way Suite 230
Sacramento, CA 95831

From: Gene Oliphant, Ph.D. \ Randy Horney RA
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 19-503.1 UKIAH WWTP Site ID : A22-001-3B5.5-6.
Thank you for your business.

* For future reference to this analysis please use SUN # 88419-183786.

EVALUATION FOR SOIL CORROSION

Soil pH	6.84	
Moisture	11.0 %	
Minimum Resistivity	2.95 ohm-cm (x1000)	
Chloride	4.8 ppm	00.00048 %
Sulfate	27.5 ppm	00.00275 %
Redox Potential	(+) 212 mv	
Sulfides	Presence - NEGATIVE	

METHODS
pH and Min.Resistivity CA DOT Test #643 Mod.(Sm.Cell)
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m
Redox Potential ASTM G-200m, Sulfides AWWA C105/A25.5

Sunland Analytical

11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 10/28/2022
Date Submitted 10/24/2022

To: Kennedy Hauder
Crawford & Associates, Inc.
1100 Corporate Way Suite 230
Sacramento, CA 95831

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 19-503.1 UKIAH WWTP Site ID : A22-002-4A6-6.5.
Thank you for your business.

* For future reference to this analysis please use SUN # 88419-183787.

EVALUATION FOR SOIL CORROSION

Soil pH	7.05		
Minimum Resistivity	1.47 ohm-cm (x1000)		
Chloride	15.3 ppm	00.00153	%
Sulfate	31.6 ppm	00.00316	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

Summary of Chemical Analytical Data
Ukiah Recycled Water Pipeline - Phase 4 Design Project
Project 19-503.1

Sample ID: A-22-002-2
Date collected: 9/30/22
Date Analyzed: 10/25/22

Volatile Organics - EPA Method 8260B

	Concentration (mg/kg)
Tetrachloroethene	0.011
Toluene	0.0051
Xylenes	0.0016 J

Purgeable Aromatics and Total Petroleum Hydrocarbons (EPA Method 8015B)

	Concentration (mg/kg)
GRO (C4-C12)	0.78 J

Metals - Total Concentrations (EPA Methods 6010,7471A)

	Concentration (mg/kg)	TTLC (mg/kg)	STLC (mg/l)	10X STLC (mg/l)
Antimony	7.8 J	500	15	150
Arsenic	5.7 J	50	5	50
Barium	410	10,000	100	1,000
Berylliuym	<0.47	75	0.75	7.5
Cadmium	0.88 J	100	1	10
Chromium	47	2,500	5	50
Cobalt	5.2 J	8,000	80	800
Copper	280	2,500	25	250
Lead	26	1,000	5	50
Mercury	1.1 J	20	0.2	2
Molybdenum	0.8	3,500	350	3,500
Nickel	33	2,000	20	200
Selenium	<9.8	100	1	10
Silver	13	500	5	50
Tahllium	<6.4	700	7	70
Vanadiam	29	2,400	24	240
Zinc	1,300	5,000	250	2,500

Explanation

J - estimated value
mg/kg - milligram/kilogram
mg/l - milligram/liter
TTLC - Total Threshold Limit Concentration
STLC - Soluble Threshold Limit Concentration

Date of Report: 11/03/2022

Armando Castro

Crawford & Associates, Inc.
4701 Freeport Blvd
Sacramento, CA 95822

Client Project:	19-503.1 WWTP Sludge Pod
BCL Project:	Sludge
BCL Work Order:	2225679
Invoice ID:	B462077

Enclosed are the results of analyses for samples received by the laboratory on 10/26/2022. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Contact Person: Vanessa Sandoval
Client Service Rep

Stuart Buttram
Operations Manager

Certifications: CA ELAP #1186; NV #CA00014; OR ELAP #4032-001; AK UST101

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.
All results listed in this report are for the exclusive use of the submitting party. Pace Analytical assumes no responsibility for report alteration, separation, detachment or third party interpretation.

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Quality Control Reports

Volatile Organic Analysis (EPA Method 8260B)

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Purgeable Aromatics and Total Petroleum Hydrocarbons

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Precision and Accuracy 18

Total Concentrations (TTLC)

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Laboratory Control Sample 20
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Chain of Custody and Cooler Receipt Form for 2225679 Page 1 of 3

Pace Analytical®

RUSH! Chain of Custody Form

Page 1 of 1

*Required Fields

Report to:		Project Description	WWTP Sludge Pod	Billing
Client:*	Crawford & Associates, Inc.			Client: Crawford & Associates, Inc.
Attn: Amando Castro				Attn: Terri Falcone
Street Adress: 4701 Freeport Blvd		Project Code: 19-503.1		Address: 4701 Freeport Blvd
City: Sacramento	State: CA Zip: 95822			City: Sacramento State:* CA Zip* 95822
Phone#: (916) 835-0714	Fax#:	Sampler (s): Shelby Tube		Are there any tests which normally takes less than or equal to 48 hours? ☐ Yes ☐ No
Email Address: A.Castro@crawford-inc.com				*Standard Turnaround = 10
Submission #: 22-225679				Notes

Sample #	Sample Description	Date	Time	Matrix*	CAM 17 (EPA 6010/747	TPH (EPA8015)	VOC (EPA 8260)								Notes
A-22-002-2	Lean Clay transition from sewage sludge	9/30/22	12:00 PM	S/SL	X	X	X								Please note our new mailing address. Please test the upper half of the shelby tube

Matrix Types S = Soil SL = Sludge DW = Drinking Water WW = Wastewater GW = Groundwater W = Water SW=Stormwater Runoff A=Aqueous

Turnaround # of working days: ☐ 24 Hr Rush ☐ 48Hr Rush ☒ 3-5 Day Rush ☐ Normal (10 - Days)

Lab TAT Approval: _____ *Additional Charges May Apply

Comments:

EDF Required? Contractor ☐ Yes ☐ No

Send Copy to State? (EDT) ☐ Yes ☐ No

Global ID (Needed for EDF)

	Relinquished By	Date	Time	Received By	Date	Time
1.	Loren Dizon PW	10/25/22	3:00PM	Michelle Sauer	10/25/22	1500
2.	M. Sauer PW	10/25/22	15:15	Amaya	10-26-22	9:47
3.		Date	Time		Date	Time

System # (Needed for EDF)

	Received By	Date	Time
1.			
2.		Date	Time
3.		Date	Time

Pace Analytical • 4100 Atlas Court • Bakersfield, CA 93308 • (661) 327-4911 • Fax: (661) 327-1918

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PACE ANALYTICAL — COOLER RECEIPT FORM — Page 1 Of 1

Submission #: 22-25679

SHIPPING INFORMATION
Fed Ex ☐ UPS ☐ GSO / GLS ☑ Hand Delivery ☐
Pace Lab Field Service ☐ Other ☐ (Specify)_____

SHIPPING CONTAINER
Ice Chest ☐ None ☐ Box ☒
Other ☐ (Specify)_____

FREE LIQUID
YES ☐ NO ☒
W / S

Refrigerant: Ice ☐ Blue Ice ☐ None ☒ Other ☐ Comments: No ice

Custody Seals: Ice Chest ☐ Intact? Yes ☐ No ☐ | Containers ☐ Intact? Yes ☐ No ☐ | None ☒ Comments:

All samples received? Yes ☑ No ☐ All samples containers intact? Yes ☑ No ☐ Description(s) match COC? Yes ☑ No ☐

COC Received ☒ YES ☐ NO

Emissivity: 0.30 Container: Soil sleeve Thermometer ID: 337 VMD Date/Time: 10-26-22

Temperature: (A) 16.5 °C / (C) 16.5 °C 10/26/22 Analyst Init: SMH 9:49

SAMPLE CONTAINERS	SAMPLE NUMBERS 1	2	3	4	5	6	7	8	9	10
QT PE UNPRES										
4oz / 8oz / 16oz PE UNPRES										
2oz Cr+6										
QT INORGANIC CHEMICAL METALS										
INORGANIC CHEMICAL METALS 4oz / 8oz / 16oz										
PT CYANIDE										
PT NITROGEN FORMS										
PT TOTAL SULFIDE										
2oz. NITRATE / NITRITE										
PT TOTAL ORGANIC CARBON										
PT CHEMICAL OXYGEN DEMAND										
PtA PHENOLICS										
40ml VOA VIAL TRAVEL BLANK										
40ml VOA VIAL										
QT EPA 1664B										
PT ODOR										
RADIOLOGICAL										
BACTERIOLOGICAL										
40 ml VOA VIAL- 504										
QT EPA 508/608.3/8081A										
QT EPA 515.1/8151A										
QT EPA 525.2										
QT EPA 525.2 TRAVEL BLANK										
40ml EPA 547										
40ml EPA 531.1										
8oz EPA 548.1										
QT EPA 549.2										
QT EPA 8015M										
QT EPA 8270C										
8oz / 16oz / 32oz AMBER										
8oz / 16oz / 32oz JAR										
SOIL SLEEVE x99	A									
PCB VIAL										
PLASTIC BAG										
TEDLAR BAG										
FERROUS IRON										
ENCORE										
SMART KIT										
SUMMA CANISTER										

Comments:_____

Sample Numbering Completed By: JDD Date/Time: 10/26/22 1641

A = Actual / C = Corrected

Rev 23 05/20/22

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Pace ANALYTICAL SERVICES	DC#_Title: ENV-FRM-SACR-0030 CA Regulated Soil Notification
	Effective Date: 09/30/2022 22-25679

USDA / APHIS regulates material with organic matter, including soil, from specific counties that have invasive species, pests, or plant diseases present in the county. In order to process your project, we need to determine if special handling applies to your project.

Any soils received without this completed form cannot be received or processed until the site address is confirmed.

Receipt of Soils from California:

Are samples soil or other regulated material?

☒ Yes ☐ No If no, matrix description: _____

County

☐ Alameda ☐ Contra Costa ☐ Del Norte ☐ Humboldt ☐ Lake Los Angeles [1]
☐ Marin ☒ Mendocino ☐ Monterey ☐ Napa Orange [1,2] Riverside [1]
☐ San Diego [2] ☐ San Francisco ☐ San Mateo Santa Clara Santa Cruz
☐ Solano ☐ Sonoma ☐ Trinity

Other (specify): _____

(If soils are from one of the counties specified above, the site address is required.)

Site Address: 391 Plant Road, Ukiah, CA

Fire Ant [1] and Fruit Fly [2] quarantines may be partial county quarantines. The site address must be checked against APHIS interactive maps to determine if the site is within the quarantine area.

To be completed by Pace National: Client: Crawford

Lab ID (if applicable): _____

Are Samples Regulated? ☐ No ☒ Yes

Regulated for? ☒ Phytophthora Ramorum ☐ Fire Ants ☐ Fruit Flies*

Amount of soil received: ~ 6500 grams. Received on: 10/25/22

Will any analysis be done at another lab? ☐ Yes ☐ No

If yes, complete the following for each lab that will receive the regulated samples:

Receiving Lab	Amount Shipped	Shipment sent with the receiving lab's Soil Permit / Compliance Agreement.
Pace Bakersfield	~ 6500 g	☐ Yes MMS 10/25/22 (initial / date)
	~ g	☐ Yes _____ (initial / date)
	~ g	☐ Yes _____ (initial / date)
	~ g	☐ Yes _____ (initial / date)

* Soils cannot be transferred to another destination without either a PPQ 530 or PPQ 540 form. Contact APHIS before proceeding.

Initial / date after a copy of form has been sent to Luis Oquendo, USDA APHIS PPQ MMS 10/25/22

Qualtrax ID: 71192

Page 1 of 1

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Pace Analytical
ENVIRONMENTAL SCIENCES

Crawford & Associates, Inc. 4701 Freeport Blvd Sacramento, CA 95822	**Reported:** 11/03/2022 15:30 Project: Sludge Project Number: 19-503.1 WWTP Sludge Pod Project Manager: Armando Castro

Laboratory / Client Sample Cross Reference

Laboratory	Client Sample Information			
2225679-01	**COC Number:**	---	**Receive Date:**	10/26/2022 09:49
	Project Number:	---	**Sampling Date:**	09/30/2022 12:00
	Sampling Location:	---	**Sample Depth:**	---
	Sampling Point:	LEAN CLAY TRANSITION FROM SEWAGE SLUDGE	**Lab Matrix:**	Solids
	Sampled By:	Shelby Tube	**Sample Type:**	Soil

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Pace Analytical
ENVIRONMENTAL SCIENCES

Crawford & Associates, Inc.
4701 Freeport Blvd
Sacramento, CA 95822

Reported: 11/03/2022 15:30
Project: Sludge
Project Number: 19-503.1 WWTP Sludge Pod
Project Manager: Armando Castro

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2225679-01 | **Client Sample Name:** LEAN CLAY TRANSITION FROM SEWAGE SLUDGE, 9/30/2022 12:00:00PM, Shelby Tube

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	DCN
Benzene	ND	mg/kg	0.0050	0.00067	EPA-8260B	ND	A26	1
Bromobenzene	ND	mg/kg	0.0050	0.00087	EPA-8260B	ND	A26	1
Bromochloromethane	ND	mg/kg	0.0050	0.00081	EPA-8260B	ND	A26	1
Bromodichloromethane	ND	mg/kg	0.0050	0.00078	EPA-8260B	ND	A26	1
Bromoform	ND	mg/kg	0.0050	0.00070	EPA-8260B	ND	A26	1
Bromomethane	ND	mg/kg	0.0050	0.0017	EPA-8260B	ND	A26	1
n-Butylbenzene	ND	mg/kg	0.0050	0.00076	EPA-8260B	ND	A26	1
sec-Butylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B	ND	A26	1
tert-Butylbenzene	ND	mg/kg	0.0050	0.00085	EPA-8260B	ND	A26	1
Carbon tetrachloride	ND	mg/kg	0.0050	0.00078	EPA-8260B	ND	A26	1
Chlorobenzene	ND	mg/kg	0.0050	0.00077	EPA-8260B	ND	A26	1
Chloroethane	ND	mg/kg	0.0050	0.0011	EPA-8260B	ND	A26	1
Chloroform	ND	mg/kg	0.0050	0.00090	EPA-8260B	ND	A26	1
Chloromethane	ND	mg/kg	0.0050	0.0011	EPA-8260B	ND	A26	1
2-Chlorotoluene	ND	mg/kg	0.0050	0.00087	EPA-8260B	ND	A26	1
4-Chlorotoluene	ND	mg/kg	0.0050	0.00070	EPA-8260B	ND	A26	1
Dibromochloromethane	ND	mg/kg	0.0050	0.00080	EPA-8260B	ND	A26	1
1,2-Dibromo-3-chloropropane	ND	mg/kg	0.0050	0.00096	EPA-8260B	ND	A26	1
1,2-Dibromoethane	ND	mg/kg	0.0050	0.00082	EPA-8260B	ND	A26	1
Dibromomethane	ND	mg/kg	0.0050	0.0014	EPA-8260B	ND	A26	1
1,2-Dichlorobenzene	ND	mg/kg	0.0050	0.00079	EPA-8260B	ND	A26	1
1,3-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B	ND	A26	1
1,4-Dichlorobenzene	ND	mg/kg	0.0050	0.00073	EPA-8260B	ND	A26	1
Dichlorodifluoromethane	ND	mg/kg	0.0050	0.00079	EPA-8260B	ND	A26	1
1,1-Dichloroethane	ND	mg/kg	0.0050	0.00064	EPA-8260B	ND	A26	1
1,2-Dichloroethane	ND	mg/kg	0.0050	0.00073	EPA-8260B	ND	A26	1
1,1-Dichloroethene	ND	mg/kg	0.0050	0.0011	EPA-8260B	ND	A26	1
cis-1,2-Dichloroethene	ND	mg/kg	0.0050	0.00054	EPA-8260B	ND	A26	1
trans-1,2-Dichloroethene	ND	mg/kg	0.0050	0.0037	EPA-8260B	ND	A26	1
1,2-Dichloropropane	ND	mg/kg	0.0050	0.00080	EPA-8260B	ND	A26	1
1,3-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B	ND	A26	1
2,2-Dichloropropane	ND	mg/kg	0.0050	0.00067	EPA-8260B	ND	A26	1
1,1-Dichloropropene	ND	mg/kg	0.0050	0.00067	EPA-8260B	ND	A26	1

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Pace Analytical
ENVIRONMENTAL SCIENCES

Crawford & Associates, Inc.
4701 Freeport Blvd
Sacramento, CA 95822

Reported: 11/03/2022 15:30
Project: Sludge
Project Number: 19-503.1 WWTP Sludge Pod
Project Manager: Armando Castro

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2225679-01 | **Client Sample Name:** LEAN CLAY TRANSITION FROM SEWAGE SLUDGE, 9/30/2022 12:00:00PM, Shelby Tube

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	DCN
cis-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00058	EPA-8260B	ND	A26	1
trans-1,3-Dichloropropene	ND	mg/kg	0.0050	0.00066	EPA-8260B	ND	A26	1
Ethylbenzene	ND	mg/kg	0.0050	0.00069	EPA-8260B	ND	A26	1
Hexachlorobutadiene	ND	mg/kg	0.0050	0.00067	EPA-8260B	ND	A26	1
Isopropylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B	ND	A26	1
p-Isopropyltoluene	ND	mg/kg	0.0050	0.00059	EPA-8260B	ND	A26	1
Methylene chloride	ND	mg/kg	0.010	0.0011	EPA-8260B	ND	A26	1
Methyl t-butyl ether	ND	mg/kg	0.0050	0.00056	EPA-8260B	ND	A26	1
Naphthalene	ND	mg/kg	0.0050	0.00099	EPA-8260B	ND	A26	1
n-Propylbenzene	ND	mg/kg	0.0050	0.00071	EPA-8260B	ND	A26	1
Styrene	ND	mg/kg	0.0050	0.00062	EPA-8260B	ND	A26	1
1,1,1,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00095	EPA-8260B	ND	A26	1
1,1,2,2-Tetrachloroethane	ND	mg/kg	0.0050	0.00084	EPA-8260B	ND	A26	1
Tetrachloroethene	**0.011**	**mg/kg**	**0.0050**	**0.00097**	**EPA-8260B**	ND	**A26**	1
Toluene	**0.0051**	**mg/kg**	**0.0050**	**0.00069**	**EPA-8260B**	ND	**A26**	1
1,2,3-Trichlorobenzene	ND	mg/kg	0.0050	0.0015	EPA-8260B	ND	A26	1
1,2,4-Trichlorobenzene	ND	mg/kg	0.0050	0.0014	EPA-8260B	ND	A26	1
1,1,1-Trichloroethane	ND	mg/kg	0.0050	0.00067	EPA-8260B	ND	A26	1
1,1,2-Trichloroethane	ND	mg/kg	0.0050	0.00094	EPA-8260B	ND	A26	1
Trichloroethene	ND	mg/kg	0.0050	0.00074	EPA-8260B	ND	A26	1
Trichlorofluoromethane	ND	mg/kg	0.0050	0.0015	EPA-8260B	ND	A26	1
1,2,3-Trichloropropane	ND	mg/kg	0.0050	0.0019	EPA-8260B	ND	A26	1
1,1,2-Trichloro-1,2,2-trifluoroethane	ND	mg/kg	0.0050	0.0010	EPA-8260B	ND	A26	1
1,2,4-Trimethylbenzene	ND	mg/kg	0.0050	0.00080	EPA-8260B	ND	A26	1
1,3,5-Trimethylbenzene	ND	mg/kg	0.0050	0.00066	EPA-8260B	ND	A26	1
Vinyl chloride	ND	mg/kg	0.0050	0.00059	EPA-8260B	ND	A26	1
Total Xylenes	ND	mg/kg	0.010	0.0025	EPA-8260B	ND	A26	1
p- & m-Xylenes	**0.0016**	**mg/kg**	**0.0050**	**0.0015**	**EPA-8260B**	ND	**J,A26**	1
o-Xylene	ND	mg/kg	0.0050	0.00093	EPA-8260B	ND	A26	1
1,2-Dichloroethane-d4 (Surrogate)	113	%	70 - 121 (LCL - UCL)		EPA-8260B			1
Toluene-d8 (Surrogate)	88.0	%	81 - 117 (LCL - UCL)		EPA-8260B			1
4-Bromofluorobenzene (Surrogate)	80.4	%	74 - 121 (LCL - UCL)		EPA-8260B			1

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Pace Analytical
ENVIRONMENTAL SCIENCES

Crawford & Associates, Inc. 4701 Freeport Blvd Sacramento, CA 95822	**Reported:** 11/03/2022 15:30 Project: Sludge Project Number: 19-503.1 WWTP Sludge Pod Project Manager: Armando Castro

Volatile Organic Analysis (EPA Method 8260B)

BCL Sample ID: 2225679-01 | **Client Sample Name:** LEAN CLAY TRANSITION FROM SEWAGE SLUDGE, 9/30/2022 12:00:00PM, Shelby Tube

DCN	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	
1	EPA-8260B	10/27/22 11:30	10/27/22 17:34	EAB	MS-V17	1	B152390	EPA 5030 Soil MS

DCN = Data Continuation Number

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Pace Analytical
ENVIRONMENTAL SCIENCES

Crawford & Associates, Inc.
4701 Freeport Blvd
Sacramento, CA 95822

Reported: 11/03/2022 15:30
Project: Sludge
Project Number: 19-503.1 WWTP Sludge Pod
Project Manager: Armando Castro

Purgeable Aromatics and Total Petroleum Hydrocarbons

BCL Sample ID: 2225679-01 | **Client Sample Name:** LEAN CLAY TRANSITION FROM SEWAGE SLUDGE, 9/30/2022 12:00:00PM, Shelby Tube

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	DCN
Gasoline Range Organics (C4 - C12)	**0.78**	**mg/kg**	**1.0**	**0.20**	**EPA-8015B**	ND	**J,A26**	1
a,a,a-Trifluorotoluene (FID Surrogate)	50.0	%	70 - 130 (LCL - UCL)		EPA-8015B		A20,S09	1

DCN	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-8015B	10/27/22 08:37	10/27/22 12:36	SEM	GC-V8	1	B152311	EPA 5030 Soil GC

DCN = Data Continuation Number

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Pace Analytical
ENVIRONMENTAL SCIENCES

Crawford & Associates, Inc.
4701 Freeport Blvd
Sacramento, CA 95822

Reported: 11/03/2022 15:30
Project: Sludge
Project Number: 19-503.1 WWTP Sludge Pod
Project Manager: Armando Castro

Total Concentrations (TTLC)

BCL Sample ID: 2225679-01 | **Client Sample Name:** LEAN CLAY TRANSITION FROM SEWAGE SLUDGE, 9/30/2022 12:00:00PM, Shelby Tube

Constituent	Result	Units	PQL	MDL	Method	MB Bias	Lab Quals	DCN
Antimony	**7.8**	**mg/kg**	**50**	**3.3**	**EPA-6010B**	ND	**J,A10**	1
Arsenic	**5.7**	**mg/kg**	**10**	**4.0**	**EPA-6010B**	ND	**J,A10**	1
Barium	**410**	**mg/kg**	**5.0**	**1.8**	**EPA-6010B**	ND	**A10**	1
Beryllium	ND	mg/kg	5.0	0.47	EPA-6010B	ND	A10	1
Cadmium	**0.88**	**mg/kg**	**5.0**	**0.52**	**EPA-6010B**	ND	**J,A10**	1
Chromium	**47**	**mg/kg**	**5.0**	**0.50**	**EPA-6010B**	ND	**A10**	1
Cobalt	**5.2**	**mg/kg**	**25**	**0.98**	**EPA-6010B**	ND	**J,A10**	1
Copper	**280**	**mg/kg**	**10**	**0.50**	**EPA-6010B**	2.5	**A10**	1
Lead	**26**	**mg/kg**	**25**	**4.1**	**EPA-6010B**	ND	**A10**	1
Mercury	**1.1**	**mg/kg**	**0.16**	**0.016**	**EPA-7471A**	0.061	**S05**	2
Molybdenum	**0.80**	**mg/kg**	**25**	**0.50**	**EPA-6010B**	ND	**J,A10**	1
Nickel	**33**	**mg/kg**	**5.0**	**1.5**	**EPA-6010B**	1.8	**A10**	1
Selenium	ND	mg/kg	10	9.8	EPA-6010B	ND	A10	1
Silver	**13**	**mg/kg**	**5.0**	**0.67**	**EPA-6010B**	ND	**A10**	1
Thallium	ND	mg/kg	50	6.4	EPA-6010B	ND	A10	1
Vanadium	**29**	**mg/kg**	**5.0**	**1.1**	**EPA-6010B**	ND	**A10**	1
Zinc	**1300**	**mg/kg**	**25**	**0.87**	**EPA-6010B**	5.0	**A10**	1

DCN	Method	Prep Date	Run Date/Time	Analyst	Instrument	Dilution	QC Batch ID	Prep Method
1	EPA-6010B	11/01/22 19:25	11/02/22 11:33	JCC	PE-OP3	9.259	B152776	EPA 3050B
2	EPA-7471A	11/03/22 08:05	11/03/22 10:16	TMT	CETAC3	1.008	B152995	EPA 7471A

DCN = Data Continuation Number

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Crawford & Associates, Inc.
4701 Freeport Blvd
Sacramento, CA 95822

Reported: 11/03/2022 15:30
Project: Sludge
Project Number: 19-503.1 WWTP Sludge Pod
Project Manager: Armando Castro

Volatile Organic Analysis (EPA Method 8260B)

Quality Control Report - Method Blank Analysis

Constituent	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
QC Batch ID: B152390						
Benzene	B152390-BLK1	ND	mg/kg	0.0050	0.00067	
Bromobenzene	B152390-BLK1	ND	mg/kg	0.0050	0.00087	
Bromochloromethane	B152390-BLK1	ND	mg/kg	0.0050	0.00081	
Bromodichloromethane	B152390-BLK1	ND	mg/kg	0.0050	0.00078	
Bromoform	B152390-BLK1	ND	mg/kg	0.0050	0.00070	
Bromomethane	B152390-BLK1	ND	mg/kg	0.0050	0.0017	
n-Butylbenzene	B152390-BLK1	ND	mg/kg	0.0050	0.00076	
sec-Butylbenzene	B152390-BLK1	ND	mg/kg	0.0050	0.00071	
tert-Butylbenzene	B152390-BLK1	ND	mg/kg	0.0050	0.00085	
Carbon tetrachloride	B152390-BLK1	ND	mg/kg	0.0050	0.00078	
Chlorobenzene	B152390-BLK1	ND	mg/kg	0.0050	0.00077	
Chloroethane	B152390-BLK1	ND	mg/kg	0.0050	0.0011	
Chloroform	B152390-BLK1	ND	mg/kg	0.0050	0.00090	
Chloromethane	B152390-BLK1	ND	mg/kg	0.0050	0.0011	
2-Chlorotoluene	B152390-BLK1	ND	mg/kg	0.0050	0.00087	
4-Chlorotoluene	B152390-BLK1	ND	mg/kg	0.0050	0.00070	
Dibromochloromethane	B152390-BLK1	ND	mg/kg	0.0050	0.00080	
1,2-Dibromo-3-chloropropane	B152390-BLK1	ND	mg/kg	0.0050	0.00096	
1,2-Dibromoethane	B152390-BLK1	ND	mg/kg	0.0050	0.00082	
Dibromomethane	B152390-BLK1	ND	mg/kg	0.0050	0.0014	
1,2-Dichlorobenzene	B152390-BLK1	ND	mg/kg	0.0050	0.00079	
1,3-Dichlorobenzene	B152390-BLK1	ND	mg/kg	0.0050	0.00073	
1,4-Dichlorobenzene	B152390-BLK1	ND	mg/kg	0.0050	0.00073	
Dichlorodifluoromethane	B152390-BLK1	ND	mg/kg	0.0050	0.00079	
1,1-Dichloroethane	B152390-BLK1	ND	mg/kg	0.0050	0.00064	
1,2-Dichloroethane	B152390-BLK1	ND	mg/kg	0.0050	0.00073	
1,1-Dichloroethene	B152390-BLK1	ND	mg/kg	0.0050	0.0011	
cis-1,2-Dichloroethene	B152390-BLK1	ND	mg/kg	0.0050	0.00054	
trans-1,2-Dichloroethene	B152390-BLK1	ND	mg/kg	0.0050	0.0037	
1,2-Dichloropropane	B152390-BLK1	ND	mg/kg	0.0050	0.00080	
1,3-Dichloropropane	B152390-BLK1	ND	mg/kg	0.0050	0.00067	
2,2-Dichloropropane	B152390-BLK1	ND	mg/kg	0.0050	0.00067	
1,1-Dichloropropene	B152390-BLK1	ND	mg/kg	0.0050	0.00067	
cis-1,3-Dichloropropene	B152390-BLK1	ND	mg/kg	0.0050	0.00058	

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Crawford & Associates, Inc.
4701 Freeport Blvd
Sacramento, CA 95822

Reported: 11/03/2022 15:30
Project: Sludge
Project Number: 19-503.1 WWTP Sludge Pod
Project Manager: Armando Castro

Volatile Organic Analysis (EPA Method 8260B)

Quality Control Report - Method Blank Analysis

Constituent	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
QC Batch ID: B152390						
trans-1,3-Dichloropropene	B152390-BLK1	ND	mg/kg	0.0050	0.00066	
Ethylbenzene	B152390-BLK1	ND	mg/kg	0.0050	0.00069	
Hexachlorobutadiene	B152390-BLK1	ND	mg/kg	0.0050	0.00067	
Isopropylbenzene	B152390-BLK1	ND	mg/kg	0.0050	0.00080	
p-Isopropyltoluene	B152390-BLK1	ND	mg/kg	0.0050	0.00059	
Methylene chloride	B152390-BLK1	ND	mg/kg	0.010	0.0011	
Methyl t-butyl ether	B152390-BLK1	ND	mg/kg	0.0050	0.00056	
Naphthalene	B152390-BLK1	ND	mg/kg	0.0050	0.00099	
n-Propylbenzene	B152390-BLK1	ND	mg/kg	0.0050	0.00071	
Styrene	B152390-BLK1	ND	mg/kg	0.0050	0.00062	
1,1,1,2-Tetrachloroethane	B152390-BLK1	ND	mg/kg	0.0050	0.00095	
1,1,2,2-Tetrachloroethane	B152390-BLK1	ND	mg/kg	0.0050	0.00084	
Tetrachloroethene	B152390-BLK1	ND	mg/kg	0.0050	0.00097	
Toluene	B152390-BLK1	ND	mg/kg	0.0050	0.00069	
1,2,3-Trichlorobenzene	B152390-BLK1	ND	mg/kg	0.0050	0.0015	
1,2,4-Trichlorobenzene	B152390-BLK1	ND	mg/kg	0.0050	0.0014	
1,1,1-Trichloroethane	B152390-BLK1	ND	mg/kg	0.0050	0.00067	
1,1,2-Trichloroethane	B152390-BLK1	ND	mg/kg	0.0050	0.00094	
Trichloroethene	B152390-BLK1	ND	mg/kg	0.0050	0.00074	
Trichlorofluoromethane	B152390-BLK1	ND	mg/kg	0.0050	0.0015	
1,2,3-Trichloropropane	B152390-BLK1	ND	mg/kg	0.0050	0.0019	
1,1,2-Trichloro-1,2,2-trifluoroethane	B152390-BLK1	ND	mg/kg	0.0050	0.0010	
1,2,4-Trimethylbenzene	B152390-BLK1	ND	mg/kg	0.0050	0.00080	
1,3,5-Trimethylbenzene	B152390-BLK1	ND	mg/kg	0.0050	0.00066	
Vinyl chloride	B152390-BLK1	ND	mg/kg	0.0050	0.00059	
Total Xylenes	B152390-BLK1	ND	mg/kg	0.010	0.0025	
p- & m-Xylenes	B152390-BLK1	ND	mg/kg	0.0050	0.0015	
o-Xylene	B152390-BLK1	ND	mg/kg	0.0050	0.00093	
1,2-Dichloroethane-d4 (Surrogate)	**B152390-BLK1**	**98.4**	%	**70 - 121 (LCL - UCL)**		
Toluene-d8 (Surrogate)	**B152390-BLK1**	**99.6**	%	**81 - 117 (LCL - UCL)**		
4-Bromofluorobenzene (Surrogate)	**B152390-BLK1**	**99.2**	%	**74 - 121 (LCL - UCL)**		

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4701 Freeport Blvd
Sacramento, CA 95822

Reported: 11/03/2022 15:30
Project: Sludge
Project Number: 19-503.1 WWTP Sludge Pod
Project Manager: Armando Castro

Volatile Organic Analysis (EPA Method 8260B)

Quality Control Report - Laboratory Control Sample

Constituent	QC Sample ID	Type	Result	Spike Level	Units	Percent Recovery	RPD	Control Limits Percent Recovery	Control Limits RPD	Lab Quals
QC Batch ID: B152390										
Benzene	B152390-BS1	LCS	0.13708	0.12500	mg/kg	110		70 - 130		
Bromodichloromethane	B152390-BS1	LCS	0.14381	0.12500	mg/kg	115		70 - 130		
Chlorobenzene	B152390-BS1	LCS	0.13978	0.12500	mg/kg	112		70 - 130		
Chloroethane	B152390-BS1	LCS	0.14427	0.12500	mg/kg	115		70 - 130		
1,4-Dichlorobenzene	B152390-BS1	LCS	0.14223	0.12500	mg/kg	114		70 - 130		
1,1-Dichloroethane	B152390-BS1	LCS	0.13597	0.12500	mg/kg	109		70 - 130		
1,1-Dichloroethene	B152390-BS1	LCS	0.14655	0.12500	mg/kg	117		70 - 130		
Toluene	B152390-BS1	LCS	0.14644	0.12500	mg/kg	117		70 - 130		
Trichloroethene	B152390-BS1	LCS	0.15456	0.12500	mg/kg	124		70 - 130		
1,2-Dichloroethane-d4 (Surrogate)	B152390-BS1	LCS	0.045020	0.050000	mg/kg	90.0		70 - 121		
Toluene-d8 (Surrogate)	B152390-BS1	LCS	0.048760	0.050000	mg/kg	97.5		81 - 117		
4-Bromofluorobenzene (Surrogate)	B152390-BS1	LCS	0.049490	0.050000	mg/kg	99.0		74 - 121		

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Reported: 11/03/2022 15:30
Project: Sludge
Project Number: 19-503.1 WWTP Sludge Pod
Project Manager: Armando Castro

Volatile Organic Analysis (EPA Method 8260B)

Quality Control Report - Precision & Accuracy

Constituent	Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
QC Batch ID: B152390	Used client sample: N										
Benzene	MS	2224765-22	ND	0.14902	0.12500	mg/kg		119		70 - 130	
	MSD	2224765-22	ND	0.14447	0.12500	mg/kg	3.1	116	20	70 - 130	
Bromodichloromethane	MS	2224765-22	ND	0.15677	0.12500	mg/kg		125		70 - 130	
	MSD	2224765-22	ND	0.14188	0.12500	mg/kg	10.0	114	20	70 - 130	
Chlorobenzene	MS	2224765-22	ND	0.15099	0.12500	mg/kg		121		70 - 130	
	MSD	2224765-22	ND	0.14167	0.12500	mg/kg	6.4	113	20	70 - 130	
Chloroethane	MS	2224765-22	ND	0.14009	0.12500	mg/kg		112		70 - 130	
	MSD	2224765-22	ND	0.13792	0.12500	mg/kg	1.6	110	20	70 - 130	
1,4-Dichlorobenzene	MS	2224765-22	ND	0.15418	0.12500	mg/kg		123		70 - 130	
	MSD	2224765-22	ND	0.14521	0.12500	mg/kg	6.0	116	20	70 - 130	
1,1-Dichloroethane	MS	2224765-22	ND	0.14913	0.12500	mg/kg		119		70 - 130	
	MSD	2224765-22	ND	0.14578	0.12500	mg/kg	2.3	117	20	70 - 130	
1,1-Dichloroethene	MS	2224765-22	ND	0.15412	0.12500	mg/kg		123		70 - 130	
	MSD	2224765-22	ND	0.14789	0.12500	mg/kg	4.1	118	20	70 - 130	
Toluene	MS	2224765-22	ND	0.16058	0.12500	mg/kg		128		70 - 130	
	MSD	2224765-22	ND	0.14508	0.12500	mg/kg	10.1	116	20	70 - 130	
Trichloroethene	MS	**2224765-22**	**ND**	**0.16861**	**0.12500**	**mg/kg**		**135**		**70 - 130**	**Q03**
	MSD	**2224765-22**	**ND**	**0.14995**	**0.12500**	**mg/kg**	**11.7**	**120**	**20**	**70 - 130**	
1,2-Dichloroethane-d4 (Surrogate)	MS	2224765-22	ND	0.045010	0.050000	mg/kg		90.0		70 - 121	
	MSD	2224765-22	ND	0.045300	0.050000	mg/kg	0.6	90.6		70 - 121	
Toluene-d8 (Surrogate)	MS	2224765-22	ND	0.049360	0.050000	mg/kg		98.7		81 - 117	
	MSD	2224765-22	ND	0.048210	0.050000	mg/kg	2.4	96.4		81 - 117	
4-Bromofluorobenzene (Surrogate)	MS	2224765-22	ND	0.051680	0.050000	mg/kg		103		74 - 121	
	MSD	2224765-22	ND	0.051340	0.050000	mg/kg	0.7	103		74 - 121	

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Reported: 11/03/2022 15:30
Project: Sludge
Project Number: 19-503.1 WWTP Sludge Pod
Project Manager: Armando Castro

Purgeable Aromatics and Total Petroleum Hydrocarbons

Quality Control Report - Method Blank Analysis

Constituent	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
QC Batch ID: B152311						
Gasoline Range Organics (C4 - C12)	B152311-BLK1	ND	mg/kg	1.0	0.20	
a,a,a-Trifluorotoluene (FID Surrogate)	**B152311-BLK1**	**80.0**	%	**70 - 130 (LCL - UCL)**		

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Reported: 11/03/2022 15:30
Project: Sludge
Project Number: 19-503.1 WWTP Sludge Pod
Project Manager: Armando Castro

Purgeable Aromatics and Total Petroleum Hydrocarbons

Quality Control Report - Laboratory Control Sample

Constituent	QC Sample ID	Type	Result	Spike Level	Units	Percent Recovery	RPD	Control Limits Percent Recovery	Control Limits RPD	Lab Quals
QC Batch ID: B152311										
Gasoline Range Organics (C4 - C12)	B152311-BS1	LCS	5.1770	5.0000	mg/kg	104		85 - 115		
a,a,a-Trifluorotoluene (FID Surrogate)	B152311-BS1	LCS	0.038000	0.040000	mg/kg	95.0		70 - 130		

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Purgeable Aromatics and Total Petroleum Hydrocarbons

Quality Control Report - Precision & Accuracy

Constituent	Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
QC Batch ID: B152311	Used client sample: N										
Gasoline Range Organics (C4 - C12)	MS	2224765-02	ND	5.1980	5.0000	mg/kg		104		70 - 130	
	MSD	2224765-02	ND	5.1910	5.0000	mg/kg	0.1	104	20	70 - 130	
a,a,a-Trifluorotoluene (FID Surrogate)	MS	2224765-02	ND	0.038000	0.040000	mg/kg		95.0		70 - 130	
	MSD	2224765-02	ND	0.038000	0.040000	mg/kg	0	95.0		70 - 130	

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Reported: 11/03/2022 15:30
Project: Sludge
Project Number: 19-503.1 WWTP Sludge Pod
Project Manager: Armando Castro

Total Concentrations (TTLC)

Quality Control Report - Method Blank Analysis

Constituent	QC Sample ID	MB Result	Units	PQL	MDL	Lab Quals
QC Batch ID: B152776						
Antimony	B152776-BLK1	ND	mg/kg	5.0	0.33	
Arsenic	B152776-BLK1	ND	mg/kg	1.0	0.40	
Barium	B152776-BLK1	ND	mg/kg	0.50	0.18	
Beryllium	B152776-BLK1	ND	mg/kg	0.50	0.047	
Cadmium	B152776-BLK1	ND	mg/kg	0.50	0.052	
Chromium	**B152776-BLK1**	**0.052190**	**mg/kg**	**0.50**	**0.050**	**J**
Cobalt	B152776-BLK1	ND	mg/kg	2.5	0.098	
Copper	**B152776-BLK1**	**0.26533**	**mg/kg**	**1.0**	**0.050**	**J**
Lead	B152776-BLK1	ND	mg/kg	2.5	0.41	
Molybdenum	B152776-BLK1	ND	mg/kg	2.5	0.050	
Nickel	**B152776-BLK1**	**0.19101**	**mg/kg**	**0.50**	**0.15**	**J**
Selenium	B152776-BLK1	ND	mg/kg	1.0	0.98	
Silver	B152776-BLK1	ND	mg/kg	0.50	0.067	
Thallium	B152776-BLK1	ND	mg/kg	5.0	0.64	
Vanadium	B152776-BLK1	ND	mg/kg	0.50	0.11	
Zinc	**B152776-BLK1**	**0.54072**	**mg/kg**	**2.5**	**0.087**	**J**
QC Batch ID: B152995						
Mercury	**B152995-BLK1**	**0.060160**	**mg/kg**	**0.16**	**0.016**	**J**

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Reported: 11/03/2022 15:30
Project: Sludge
Project Number: 19-503.1 WWTP Sludge Pod
Project Manager: Armando Castro

Total Concentrations (TTLC)

Quality Control Report - Laboratory Control Sample

Constituent	QC Sample ID	Type	Result	Spike Level	Units	Percent Recovery	RPD	Control Limits Percent Recovery	Control Limits RPD	Lab Quals
QC Batch ID: B152776										
Antimony	B152776-BS1	LCS	105.08	100.00	mg/kg	105		75 - 125		
Arsenic	B152776-BS1	LCS	19.457	20.000	mg/kg	97.3		75 - 125		
Barium	B152776-BS1	LCS	106.13	100.00	mg/kg	106		75 - 125		
Beryllium	B152776-BS1	LCS	10.057	10.000	mg/kg	101		75 - 125		
Cadmium	B152776-BS1	LCS	10.630	10.000	mg/kg	106		75 - 125		
Chromium	B152776-BS1	LCS	108.63	100.00	mg/kg	109		75 - 125		
Cobalt	B152776-BS1	LCS	109.49	100.00	mg/kg	109		75 - 125		
Copper	B152776-BS1	LCS	103.60	100.00	mg/kg	104		75 - 125		
Lead	B152776-BS1	LCS	114.12	100.00	mg/kg	114		75 - 125		
Molybdenum	B152776-BS1	LCS	107.53	100.00	mg/kg	108		75 - 125		
Nickel	B152776-BS1	LCS	113.63	100.00	mg/kg	114		75 - 125		
Selenium	B152776-BS1	LCS	18.784	20.000	mg/kg	93.9		75 - 125		
Silver	B152776-BS1	LCS	10.308	10.000	mg/kg	103		75 - 125		
Thallium	B152776-BS1	LCS	121.11	100.00	mg/kg	121		75 - 125		
Vanadium	B152776-BS1	LCS	103.96	100.00	mg/kg	104		75 - 125		
Zinc	B152776-BS1	LCS	106.54	100.00	mg/kg	107		75 - 125		
QC Batch ID: B152995										
Mercury	B152995-BS1	LCS	0.83680	0.80000	mg/kg	105		80 - 120		

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Reported: 11/03/2022 15:30
Project: Sludge
Project Number: 19-503.1 WWTP Sludge Pod
Project Manager: Armando Castro

Total Concentrations (TTLC)

Quality Control Report - Precision & Accuracy

Constituent	Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
QC Batch ID: B152776	Used client sample: N										
Antimony	DUP	2226003-01	3.1699	2.8378		mg/kg	11.1		20		J
	MS	2226003-01	3.1699	27.446	100.00	mg/kg		24.3		16 - 119	
	MSD	2226003-01	3.1699	28.774	100.00	mg/kg	4.7	25.6	20	16 - 119	
Arsenic	DUP	2226003-01	49.659	52.349		mg/kg	5.3		20		
	MS	2226003-01	49.659	66.009	20.000	mg/kg		81.7		75 - 125	
	MSD	2226003-01	49.659	66.334	20.000	mg/kg	0.5	83.4	20	75 - 125	
Barium	DUP	**2226003-01**	**81.456**	**84.850**		**mg/kg**	**4.1**		**20**		
	MS	**2226003-01**	**81.456**	**140.93**	**100.00**	**mg/kg**		**59.5**		**75 - 125**	**Q03**
	MSD	**2226003-01**	**81.456**	**144.17**	**100.00**	**mg/kg**	**2.3**	**62.7**	**20**	**75 - 125**	**Q03**
Beryllium	DUP	2226003-01	0.34819	0.35475		mg/kg	1.9		20		J
	MS	2226003-01	0.34819	8.6702	10.000	mg/kg		83.2		75 - 125	
	MSD	2226003-01	0.34819	8.8178	10.000	mg/kg	1.7	84.7	20	75 - 125	
Cadmium	DUP	2226003-01	0.75360	0.74293		mg/kg	1.4		20		
	MS	2226003-01	0.75360	9.9102	10.000	mg/kg		91.6		75 - 125	
	MSD	2226003-01	0.75360	9.9587	10.000	mg/kg	0.5	92.1	20	75 - 125	
Chromium	DUP	2226003-01	9.5226	9.9237		mg/kg	4.1		20		
	MS	2226003-01	9.5226	95.956	100.00	mg/kg		86.4		75 - 125	
	MSD	2226003-01	9.5226	96.117	100.00	mg/kg	0.2	86.6	20	75 - 125	
Cobalt	DUP	2226003-01	4.1017	4.3320		mg/kg	5.5		20		
	MS	2226003-01	4.1017	94.204	100.00	mg/kg		90.1		75 - 125	
	MSD	2226003-01	4.1017	89.162	100.00	mg/kg	5.5	85.1	20	75 - 125	
Copper	DUP	2226003-01	9.6953	9.5397		mg/kg	1.6		20		
	MS	2226003-01	9.6953	102.40	100.00	mg/kg		92.7		75 - 125	
	MSD	2226003-01	9.6953	103.70	100.00	mg/kg	1.3	94.0	20	75 - 125	
Lead	DUP	2226003-01	3.1428	3.3825		mg/kg	7.3		20		
	MS	2226003-01	3.1428	90.280	100.00	mg/kg		87.1		75 - 125	
	MSD	2226003-01	3.1428	90.606	100.00	mg/kg	0.4	87.5	20	75 - 125	
Molybdenum	DUP	2226003-01	ND	ND		mg/kg			20		
	MS	2226003-01	ND	84.174	100.00	mg/kg		84.2		75 - 125	
	MSD	2226003-01	ND	85.211	100.00	mg/kg	1.2	85.2	20	75 - 125	
Nickel	DUP	2226003-01	7.0980	7.2357		mg/kg	1.9		20		
	MS	2226003-01	7.0980	93.441	100.00	mg/kg		86.3		75 - 125	
	MSD	2226003-01	7.0980	93.723	100.00	mg/kg	0.3	86.6	20	75 - 125	
Selenium	DUP	2226003-01	ND	ND		mg/kg			20		
	MS	2226003-01	ND	17.017	20.000	mg/kg		85.1		75 - 125	
	MSD	2226003-01	ND	15.841	20.000	mg/kg	7.2	79.2	20	75 - 125	
Silver	DUP	2226003-01	ND	ND		mg/kg			20		
	MS	2226003-01	ND	8.8415	10.000	mg/kg		88.4		75 - 125	
	MSD	2226003-01	ND	8.9242	10.000	mg/kg	0.9	89.2	20	75 - 125	

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Reported: 11/03/2022 15:30
Project: Sludge
Project Number: 19-503.1 WWTP Sludge Pod
Project Manager: Armando Castro

Total Concentrations (TTLC)

Quality Control Report - Precision & Accuracy

Constituent	Type	Source Sample ID	Source Result	Result	Spike Added	Units	RPD	Percent Recovery	Control Limits RPD	Control Limits Percent Recovery	Lab Quals
QC Batch ID: B152776	Used client sample: N										
Thallium	DUP	2226003-01	ND	ND		mg/kg			20		
	MS	2226003-01	ND	87.788	100.00	mg/kg		87.8		75 - 125	
	MSD	2226003-01	ND	88.225	100.00	mg/kg	0.5	88.2	20	75 - 125	
Vanadium	DUP	2226003-01	20.042	20.682		mg/kg	3.1		20		
	MS	2226003-01	20.042	109.35	100.00	mg/kg		89.3		75 - 125	
	MSD	2226003-01	20.042	109.54	100.00	mg/kg	0.2	89.5	20	75 - 125	
Zinc	DUP	2226003-01	28.891	29.104		mg/kg	0.7		20		
	MS	2226003-01	28.891	118.51	100.00	mg/kg		89.6		75 - 125	
	MSD	2226003-01	28.891	118.61	100.00	mg/kg	0.1	89.7	20	75 - 125	
QC Batch ID: B152995	Used client sample: N										
Mercury	DUP	2225805-01	0.46825	0.46984		mg/kg	0.3		20		
	MS	2225805-01	0.46825	1.3667	0.79365	mg/kg		113		80 - 120	
	MSD	2225805-01	0.46825	1.3603	0.79365	mg/kg	0.5	112	20	80 - 120	

The results in this report apply to the samples analyzed in accordance with the chain of custody document. This analytical report must be reproduced in its entirety.
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Crawford & Associates, Inc.
4701 Freeport Blvd
Sacramento, CA 95822

Reported: 11/03/2022 15:30
Project: Sludge
Project Number: 19-503.1 WWTP Sludge Pod
Project Manager: Armando Castro

Notes And Definitions

J	Estimated Value (CLP Flag)
MDL	Method Detection Limit
ND	Analyte Not Detected
PQL	Practical Quantitation Limit
A10	Detection and quantitation limits were raised due to matrix interference.
A20	Surrogate is low due to matrix interference. Interference verified through second extraction/analysis.
A26	Sample received past holding time.
Q03	Matrix spike recovery(s) was(were) not within the control limits.
S05	The sample holding time was exceeded.
S09	The surrogate recovery for this compound was not within the control limits.

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APPENDIX IV

Site-Specific Ground Motion Hazard Analysis

DRAFT

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Geotechnical Engineering, Design and Construction Services
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APPENDIX IV
DRAFT SITE-SPECIFIC GROUND MOTION HAZARD MEMORANDUM
CITY OF UKIAH RECYCLED WATER PIPELINE – PHASE 4 DESIGN PROJECT
SLUDGE BASIN
UKIAH, CALIFORNIA

1 INTRODUCTION

Crawford completed two borings in 2022 at the City of Ukiah Wastewater Treatment Plant to supplement the two Crawford borings completed in 2017 and a site-specific ground motion hazard analysis for compliancy with ASCE 7-16 (with Supplement 1) and 2019 CBC.

2 SITE SPECIFIC ANALYSIS

The following sections describe the site-specific ground motion analysis.

2.1 INITIAL SEISMIC HAZARD ANALYSIS

2.1.1 SEISMIC DESIGN CRITERIA

Seismic design criteria are included in Section 11 of ASCE 7-16 (Sections referenced hereafter refer to ASCE 7-16), including mapped acceleration parameters. These mapped parameters are available online through the SEAOC/OSHPD[1] Seismic Design website, which interpolates values from the ASCE 7-16 maps using the site location.

2.1.2 SITE CLASS AND RISK CATEGORY

The site was classified as Site Class D according to Section 20.3.13. Boring A-22-001 and B-1 (2017) shows discontinuous potentially liquefiable layers from 28 to 33 feet below ground surface (bgs); based on the discontinuous layers of loose and we consider the liquefaction risk to be low and classify the site as Site Class D.

The shear wave velocity of 210 meters per second (m/s) in the upper 30 meters or 100 feet (V_{S30}) used for the site was developed from 2017 boring data. Crawford used correlations with SPT blow count N-values corrected for hammer efficiency to determine V_S values in soil per Caltrans correlations[2]. The Risk Category for the structure was assumed to be III.

2.1.3 MAPPED ACCELERATION PARAMETERS

Crawford accessed the SEAOC/OSHPD Seismic Design Map website considering the site location latitude 37.1117°N and longitude 123.1900°W, Site Class D, and Risk Category III to determine the Mapped Maximum Considered Earthquake (MCE) Spectral Response Short Period (S_S), Mapped MCE Spectral Response at 1 second period (S_1), Long Period (T_L), and mapped risked coefficients (C_{RS} and C_{R1}). The S_S, S_1, T_L, C_{RS}, and C_{R1} are coordinate specific and are taken from ASCE 7-16 figures independently of site class. The mapped acceleration parameters are based on an MCE which is roughly equivalent to an earthquake with a 2% chance of

[1] https://seismicmaps.org
[2] Caltrans "Methodology for Developing Design Response Spectrum for Use in Seismic Design Recommendations", Appendix A, pgs 15-18, November 2012.

exceedance in 50 years (2,475-year return period). Table 1 summarizes the mapped acceleration parameters.

Table 1: Mapped Acceleration Parameters

Mapped Acceleration Parameter	Value	Source
Mapped MCE_R Spectral Response Short Period (S_S)	1.88	Figure 21-1
Mapped MCE_R Spectral Response at 1 Second Period (S_1)	0.719	Figure 21-2
Long Period (T_L)	8	Figure 21-14
Mapped Risk Coefficient at Short Period (C_{RS})	0.887	Figure 22-17
Mapped Risk Coefficient at 1 Second Period (C_{R1})	0.881	Figure 22-18

2.2 HORIZONTAL GROUND MOTION HAZARD ANALYSIS

A ground motion hazard analysis accounts for the regional tectonic setting, geology, and seismicity of a specific site as well as the expected recurrence of the maximum magnitudes of the earthquakes on known faults and source zones, considering ground motion attenuation and near source effects. The methodology included in ASCE 7-16 was used to determine the site-specific ground motions of the project site, generally consisting of the following steps:

- Determine the probabilistic MCE ground motions
- Determine the deterministic MCE ground motions
- Adjust MCE ground motions to maximum horizontal response
- Adjust probabilistic MCE ground motions to risk-targeted maximum considered earthquake ground motions (MCE_R)
- Compare and scale the site-specific deterministic MCE ground motion with minimum spectral responses to ASCE 7-16 Supplement 1 Section 21.2.2
- Calculate design spectral response ground motion (2/3 of MCE_R)
- Compare the Section 21.2 design spectral response ground motion to the Section 11.4.6 design spectral response ground motion (cannot be lower than 80% Section 11.4.6 design spectral response ground motion)
- Determine the design spectral response spectrum and design acceleration parameters
- Calculate peak ground acceleration (PGA_M)

2.2.1 GROUND MOTION HAZARD ANALYSIS

Crawford performed a seismic hazard analyses and site response analyses using EZ-FRISK software Version 8.07. Crawford used the following next generation attenuation relationships (NGA) all equally weighted for the nearby strike-slip and reverse faults:

- Boore-et al (2014)
- Campbell and Bozorgnia (2014)
- Chiou and Youngs (2014)

Table 2: Summary of Seismic Sources

Attenuation Relationship Type	Source	Distance (km)	Maximum Magnitude	Mechanism	Dip Angle (degree)	Dips Direction	Site Lies
NGA	California Gridded	0	7	SS|R	90	--	Above
	Great Valley 2	11.16	6.501	Reverse	15	W	E
	Great Valley 3, Mysterious Ridge	11.25	7.1	Reverse	20	SW	NE
	Great Valley 1	22.01	6.8	Reverse	15	W	S
	Hunting Creek-Berryessa	33.58	7.1	Strike Slip	90	--	NE
	Bartlett Springs	33.76	7.3	Strike Slip	90	--	NE
	Great Valley 4a, Trout Creek	48.67	6.6	Reverse	20	SW	N
	Collayomi	55.80	6.7	Strike Slip	90	--	NE
	Shear 1 Gridded	61.34	7.6	Strike Slip	90	--	SW
	Great Valley 4b, Gordon Valley	66.59	6.8	Reverse	20	W	N
	Maacama-Gerberville	71.53	7.4	Strike Slip	90	--	NE
	Hayward-Rodgers Creek	78.97	7.334	Strike Slip	90	--	NE
	West Napa	79.32	6.7	Strike Slip	90	--	N
	Great Valley Connected	81.12	6.8	Strike Slip	90	--	N
	Great Valley 5, Pittsburg Kirby Hills	94.36	6.7	Strike Slip	90	--	N
	Northern San Andreas	110.96	8.05	Strike Slip	90	--	NE
	Shear 3 Gridded	121.95	7.6	Strike Slip	90	--	SW
	Shear 2 Gridded	124.76	7.6	Strike Slip	90	--	SW
	Point Reyes	130.47	6.9	Reverse	50	NE	NE

Attenuation Relationship Type	Source	Distance (km)	Maximum Magnitude	Mechanism	Dip Angle (degree)	Dips Direction	Site Lies
	Mount Diablo Thrust	131.91	6.7	Reverse	38	NE	N
	Greenville Connected	139.94	7	Strike Slip	90	--	N
	Greenville Connected U	139.94	7	Strike Slip	90	--	N
	Shear 4 Gridded	140.52	7.6	Strike Slip	90	--	W
	Battle Creek	141.30	6.7	Normal	75	S	S
	Calaveras	144.71	7.025	Strike Slip	90	--	N
	Mendocino Gridded, Reverse	150.45	7.3	Reverse	90	--	SE
	Mendocino Gridded, Strike Slip	150.45	7.3	Reverse	90	--	SE
	San Gregorio Connected	153.85	7.5	Strike Slip	90	--	N
	Great Valley 7	163.82	6.9	Reverse	15	SW	N
	Hat Creek-McArthur-Mayfield	178.61	7.2	Normal	60	W	S
	West Tahoe	179.06	7.1	Normal	50	E	W
	North Tahoe	184.55	6.7	Normal	50	E	W
	Monte Vista-Shannon	186.13	6.501	Reverse	45	SW	N
	Honey Lake	194.33	7	Strike Slip	90	--	SW

The following parameters were common to all analyses for each of the attenuation relationships:

The V_{S30} of the site of 210 m/s

Depth to soil with a V_S of 1,000 m/s was calculated to be 336 meters based on the methodology proposed by Chiou and Youngs (2008)

Depth to soil with a V_S of 2,500 m/s was calculated to be 1.72 kilometers based on the methodology proposed by Campbell and Bozorgnia (2008)

2.2.2 PROBABILISTIC MCER GROUND MOTION

Seismic sources within 200 kilometers were used to determine the site-specific ground motions. The NGA analyses considered the following faults in Table 2.

EZ-FRISK software was used to determine geometric mean spectral response acceleration predicted using NGA from a 5% damped response spectrum with a 2% in 50-year exceedance

probability. Crawford scaled the NGA geometric mean spectral response to the maximum rotated spectral using the scale factors in Section 21.1.

A. RISK COEFFICIENTS

Method 1 of Section 21.2 was used to determine the probabilistic MCE_R ground motion

Mapped risk coefficients (C_{RS} and C_{R1}) were used to adjust the response accelerations to a 1% chance of collapse in 50 years per Section 21.2.1.1. The risk coefficients are summarized in Table 1, along with the source figure from ASCE 7-16.

C_{RS} was applied to accelerations at spectral periods less than or equal to 0.2 seconds. C_{R1} was applied accelerations at spectral periods greater than or equal to 1 second. For spectral periods between 0.2 and 1 seconds, the C_R value was linearly interpolated.

B. PROBABILISTIC MCE_R GROUND MOTION

Figure IV-1 shows the geometric mean spectral response for the 2% in 50-year event developed using EZ-FRISK for each of the attenuation relationships described above. Also shown is the risk-adjusted response spectrum adjusting the response to a 1% in 50-year probability of collapse, which is equivalent to the site-specific probabilistic ground motion MCE_R.

2.2.3 DETERMINISTIC MCER GROUND MOTION

The deterministic spectral response acceleration is defined as the 84th-percentile 5% damped spectral response in the direction of maximum horizontal response for the characteristic earthquake on all known active faults within the region. EZ-FRISK was used to calculate the deterministic ground motion per Section 21.2.2. The NGA controlled deterministic spectral response was taken as the largest amplitude of ground motion considering all sources using the weighted mean of NGA attenuation relationships stated in Section 2.2.1 of this memorandum. Crawford scaled the deterministic 84th-percentile 5% damped spectral response to the maximum rotated spectral using the scale factors in Section 21.1. The controlling seismic source for the project site is the California Gridded fault from periods 0 through 10 seconds. Figure IV-2 shows the 84th-percentile 5% damped spectral response for the NGA attenuation relationships.

DETERMINISTIC MCE_R GROUND MOTION SCALING

Per the Exception within ASCE 7-16 Supplement 1 Section 21.2.2, the deterministic ground motion response spectrum need not be calculated when the largest spectral response acceleration of the probabilistic ground motion response spectrum of 21.2.1 is less than 1.2Fa. Fa was taken as 1.0 using Table 11.4.1 with a S_S of 1.5 according to Supplement 1 Section 21.2.2. Figure 3 in Appendix IV compares the 1.2 Fa with the probabilistic ground motion from 21.2.1 (MCE_R ground motion). The largest response acceleration of the probabilistic ground motion (1.15g) is less than the 1.2Fa (1.2g), therefore, the deterministic ground motion response spectrum was not further calculated.

2.2.4 SITE-SPECIFIC SPECTRAL RESPONSE ACCELERATION MCER

The site-specific spectral response acceleration is defined as the lower of the probabilistic and deterministic ground motions in Section 21.2.3, however, per the Exemption within Supplement 1

Section 21.2.3, the site-specific MCRR ground motion response spectrum was taken as the probabilistic ground motion response spectrum of 21.2.1.

2.2.5 DESIGN RESPONSE SPECTRUM

The design response spectrum is defined in Section 21.3 as the higher of two values:

- Two-thirds of the site-specific design spectral response acceleration per Section 21.2
- 80% of the design spectral response acceleration per Section 11.4.6 where F_a is calculated in Table 11.4-1 and $F_v = 2.5$ for $S_1 > 0.2$ for Site Class D

Crawford first calculated the design spectral response acceleration by taking 2/3 of the site-specific response acceleration MCE_R as shown in Figure IV-4.

Crawford then calculated the design response accelerations per Section 11.4.6 with $F_a = 1.0$ and $F_v = 2.5$ and reduced the spectral accelerations by 80% to adjust for the minimum design spectral accelerations for Site Class D. We then compared Section 11.4.6 design spectral accelerations for Site Class D with our site-specific design spectral response accelerations (Figure IV-6). The reduced design spectral response accelerations based on Chapter 11.4 controlled at all periods.

The design response spectrum is shown on Figure IV-5 and Table 3.

Table 3: Design Response Spectrum

Period, s	Sa, g
0.005	0.42
0.05	0.56
0.1	0.72
0.19	1
0.2	1
0.3	1
0.4	1
0.5	1
0.75	1
0.96	1
1.0	0.96
2.0	0.48
3.0	0.32
4.0	0.24
5.0	0.19
6.0	0.16
7.0	0.14
8.0	0.12
9.0	0.1
10.0	0.08

2.2.6 DESIGN ACCELERATION PARAMETERS

Design acceleration parameters were calculated in accordance with Section 21.4. The S_{DS} value was taken as 90% the peak spectral acceleration value from periods 0.2 to 5 seconds. The S_{D1} value was taken as the maximum product of $T*S_a$ (period * spectral acceleration) from periods 1 to 5 seconds. Per Section 21.4, the S_{DS} and S_{D1} values cannot be less than 80% of the S_{DS} and S_{D1} calculated from Section 11.4.5. The S_{DS} and S_{D1} values in Section 11.4.5 were calculated from using $F_a = 1.0$ and $F_v = 2.5$ for a Site Class D, as given in Section 21.3.

S_{MS} and S_{M1} were calculated as 1.5 times S_{DS} and S_{D1}, respectively. Per Section 21.4, the S_{MS} and S_{M1} values cannot be less than 80% of the S_{MS} and S_{M1} calculated from Section 11.4.3. The S_{MS} and S_{M1} values in Section 11.4.3 was calculated from using $F_a = 1.0$ and $F_v = 2.5$ for a Site Class D, as given in Section 21.3.

The design acceleration parameters are summarized in Table 4.

Table 4: Preliminary Horizontal Site-Specific Spectral Accelerations

Design Acceleration Parameter	Value (g)
Design Spectral Acceleration for Short Period (S_{DS})	1.004
Design Spectral Acceleration for 1 Second Period (S_{D1})	0.959
MCE Spectral Response Acceleration for Short Period (S_{MS})	1.506
MCE Spectral Response Acceleration for 1 Second Period (S_{M1})	1.438

2.2.7 MAXIMUM CONSIDERED EARTHQUAKE MCEG PEAK GROUND ACCELERATION (PGA)

A. PROBABILISTIC MCEG PGA

Per Section 21.5.1, the probabilistic geometric mean PGA shall be taken as geometric mean peak ground acceleration with a 2% probability of exceedance within a 50-year period. The probabilistic MCE_G PGA is 0.46g.

B. DETERMINISTIC MCEG PGA

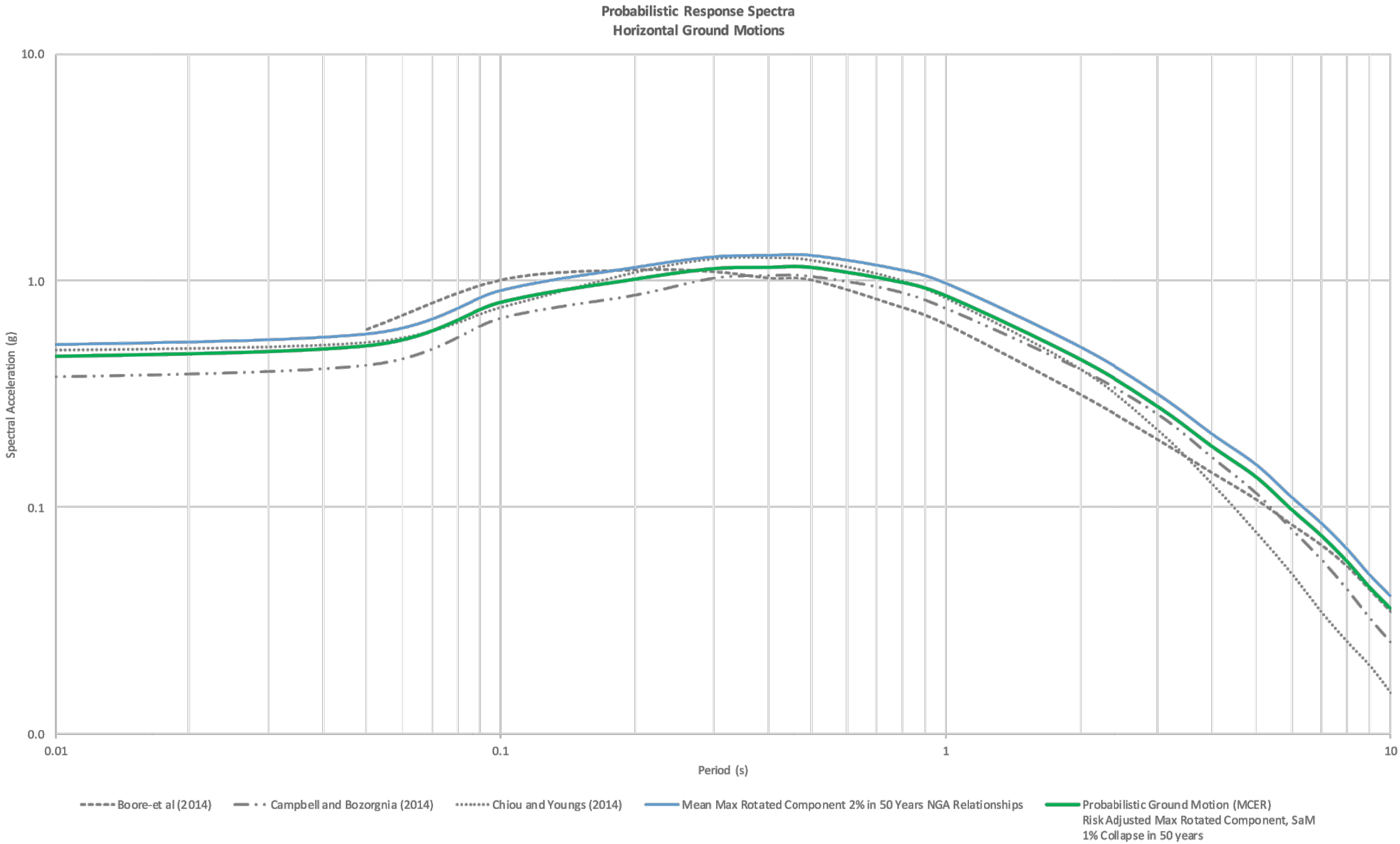
Per Section 21.5.2, the deterministic geometric mean PGA shall be taken as the largest 84th-percentile geometric mean peak PGA but not lower than $0.5*F_{PGA}$ where F_{PGA} is determined using ASCE 7-16 Table 11.8-1 and PGA is taken as 0.5g. The deterministic MCE_G PGA was taken as 0.55g.

C. SITE-SPECIFIC MCEG PGA

The site-specific MCE_G PGA (PGA_M) taken as the lesser of the probabilistic MCE_G PGA and deterministic MCE_G PGA but not less than 80% of the PGA_M determined from Equation 11.8-1 in ASCE 7-16. The site-specific PGA_M was taken as 0.7g.

ATTACHMENTS

Figure IV-1: Probabilistic Response Spectra
Figure IV-2: Deterministic Response Spectra
Figure IV-3: Site-Specific Probabilistic MCE_R Spectrum
Figure IV-4: Risk Targeted MCE_R vs. Design Response Spectrum
Figure IV-5: Design Response Spectrum



Probablistic Response Spectra
Horizontal Ground Motions

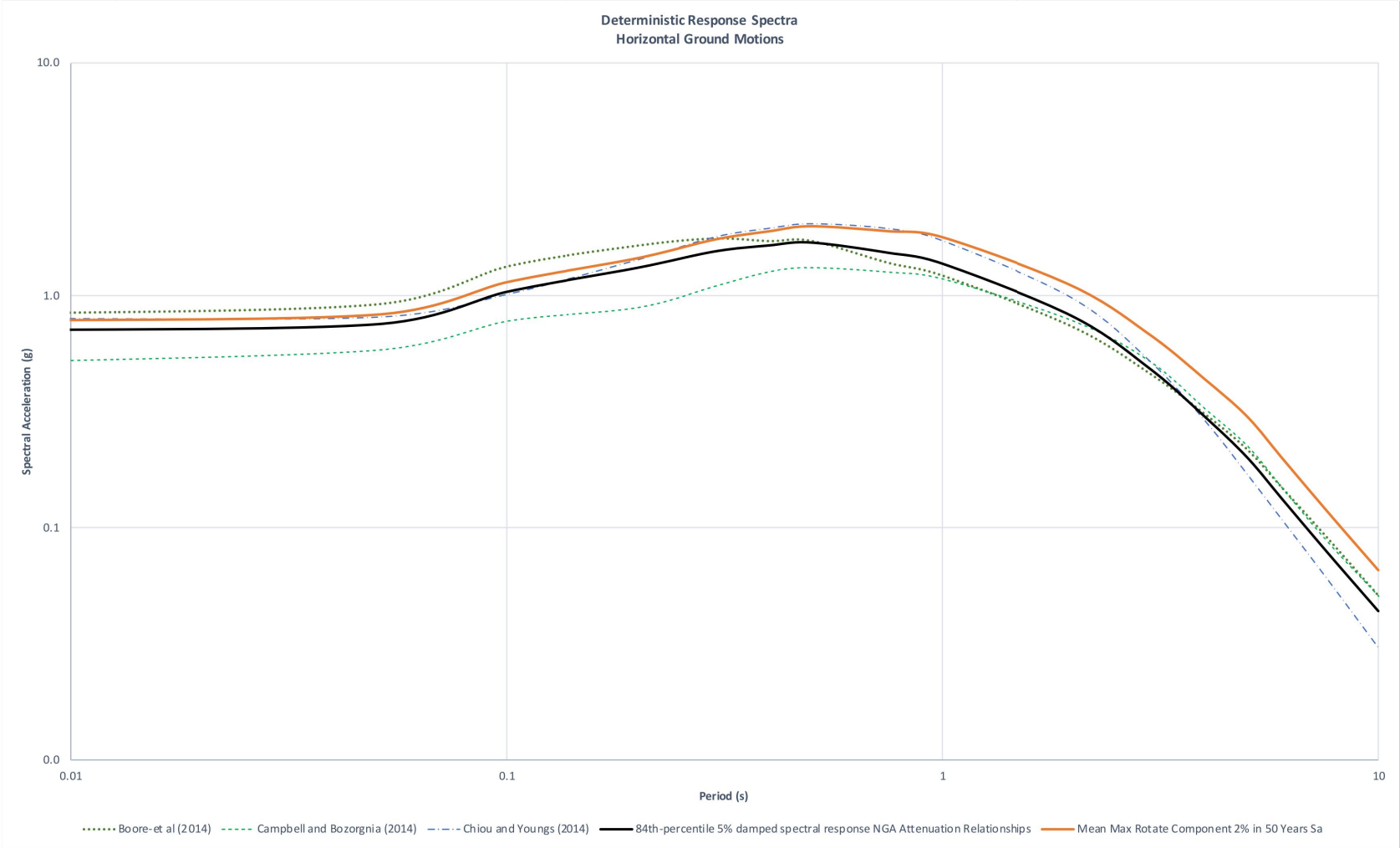
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City of Ukiah Recycled Water Pipeline - Phase 4 Design Project

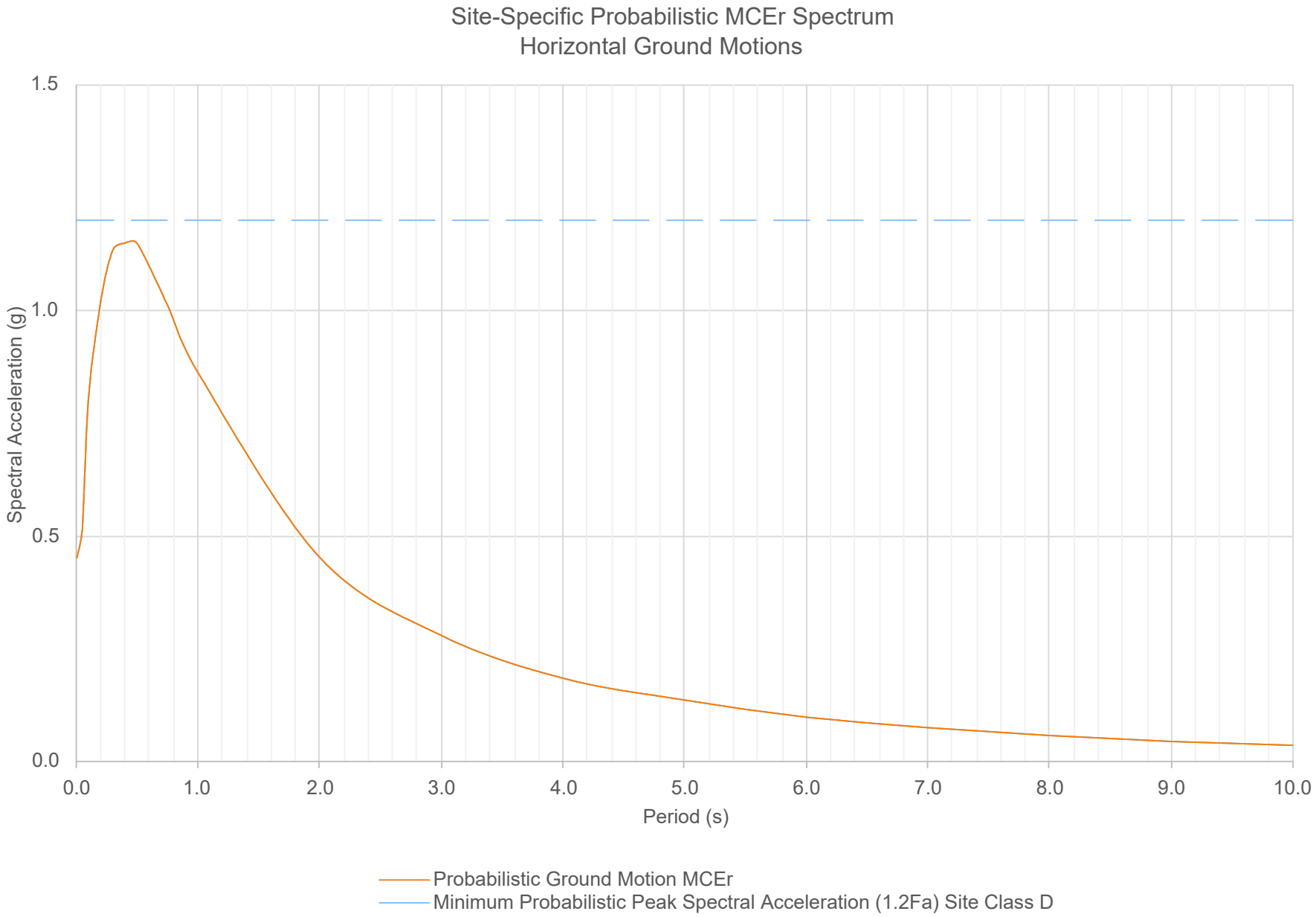
Ukiah, CA

Figure IV-1

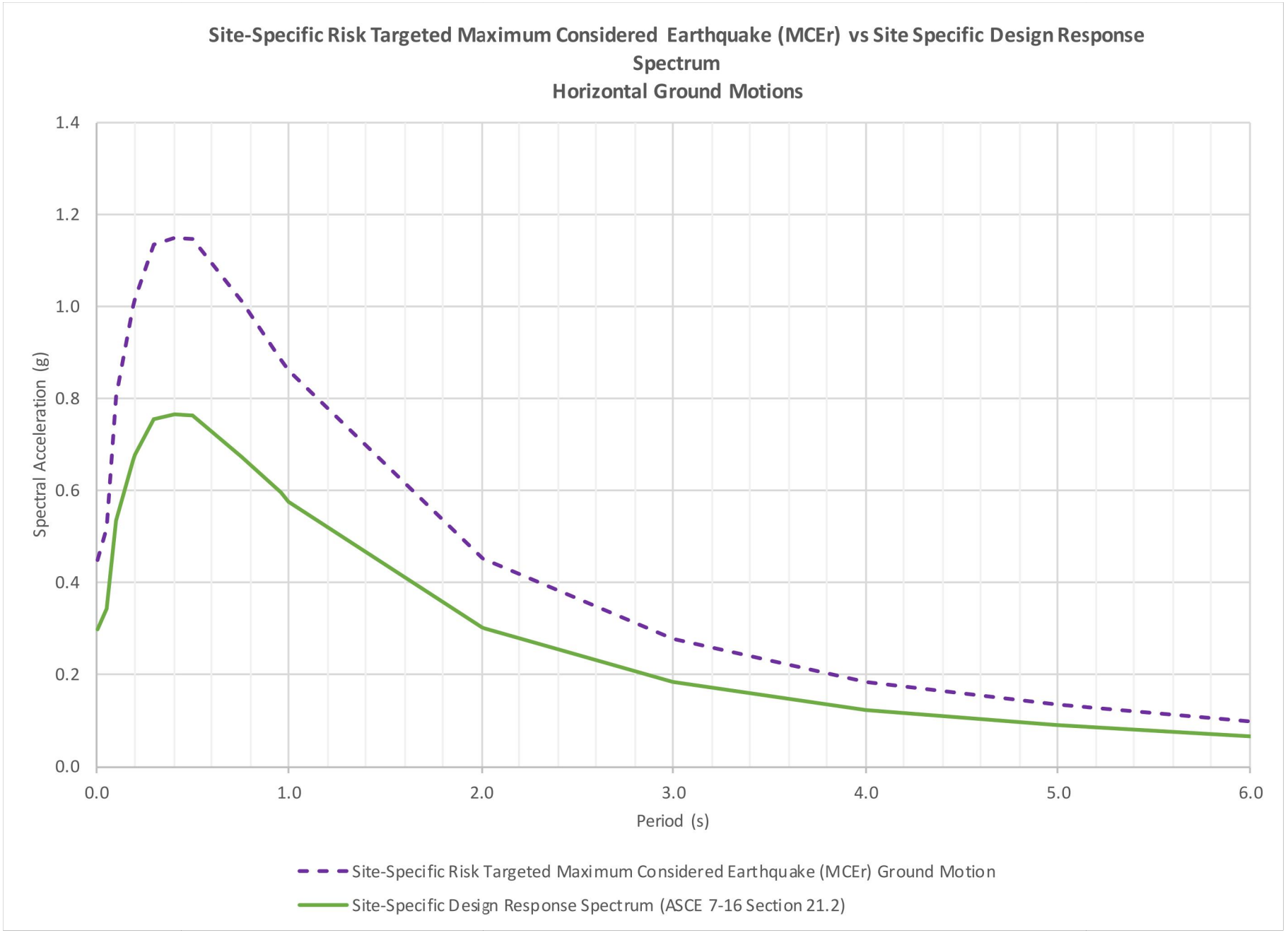
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Date: 11/10/2022



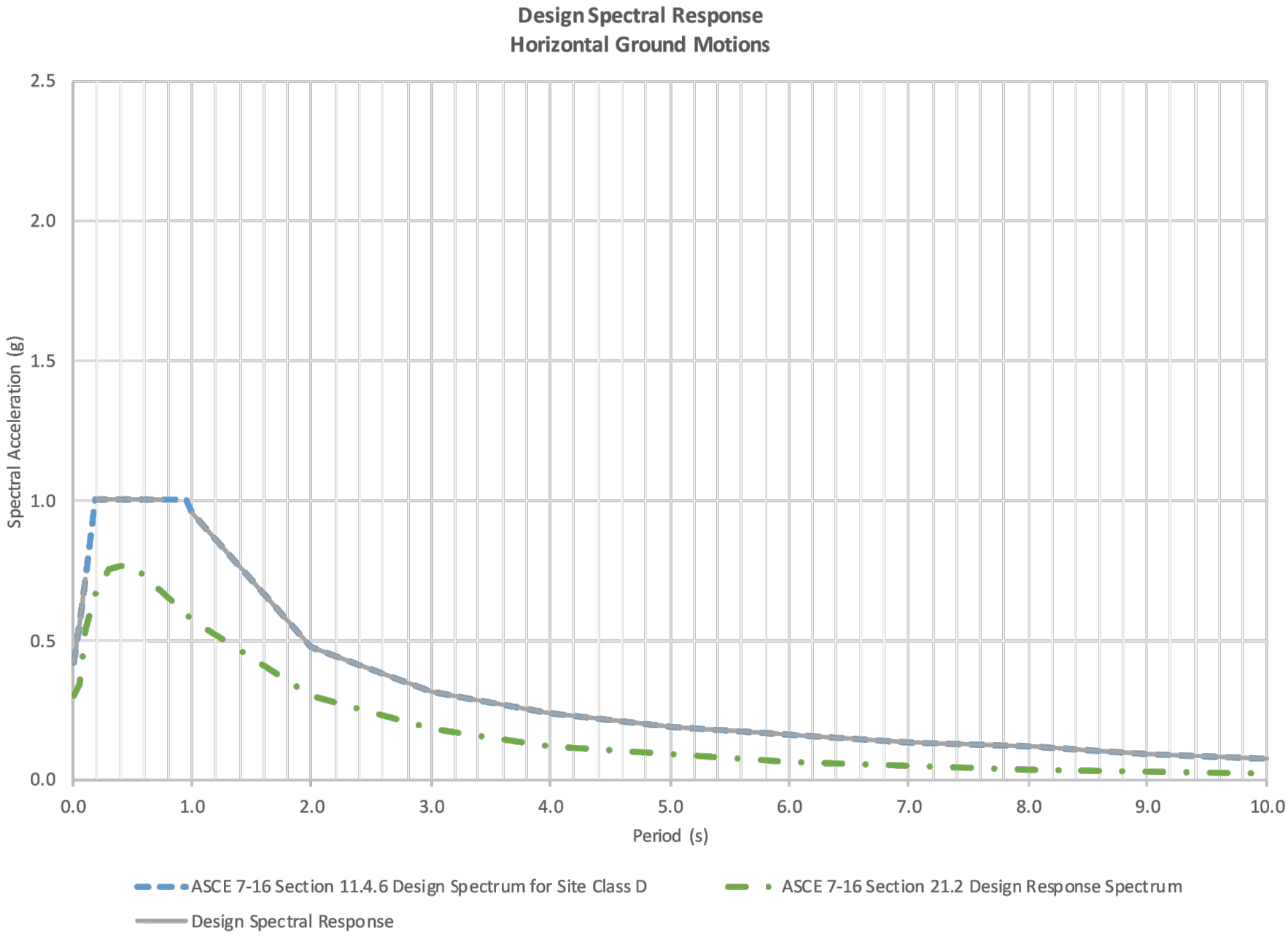
	Deterministic Response Spectra Horizontal Ground Motions	Crawford & Associates, Inc. Geotechnical Engineering, Design and Construction Services. Taber Since 1954 www.crawford-inc.com	City of Ukiah Recycled Water Pipeline - Phase 4 Design Project Ukiah, CA	**Figure IV-2** Prj. No: 19-503.1 Date: 11/10/2022



	Site Specific Deterministic MCEr Spectrum HorizontalGround Motions	Crawford & Associates, Inc. Geotechnical Engineering, Design and Construction Services; Taber Since 1954; www.crawford-inc.com	City of Ukiah Recycled Water Pipeline - Phase 4 Design Project Ukiah, CA	**Figure IV-3** Prj. No: 19-503.1 Date: 11/10/2022



	Site Specific Risk Targeted Maximum Considered Earthquake (MCEr) vs. Site Specific Design Response Spectrum	Crawford & Associates, Inc. Geotechnical Engineering, Design and Construction Services. Taber Since 1954 www.crawford-inc.com	City of Ukiah Recycled Water Pipeline - Phase 4 Design Project Ukiah, CA	**Figure IV-4** Prj. No: 19-503.1 Date: 11/10/2022



	Design Spectral Response	Crawford & Associates, Inc. Geotechnical Engineering, Design and Construction Services. Taber Since 1954 www.crawford-inc.com	City of Ukiah Recycled Water Pipeline - Phase 4 Design Project Ukiah, CA	**Figure IV-5** Prj. No: 19-503.1 Date: 11/10/2022

APPENDIX C
RECYCLED WATER PIPELINE GEOTECHNICAL REPORT

DRAFT GEOTECHNICAL REPORT

City of Ukiah Recycled Water Pipeline - Phase 4 Design Project

Ukiah, California

Prepared by:

Crawford & Associates, Inc.
1100 Corporate Way, Suite 230
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August 2021

Prepared for:

Carollo Engineers, Inc.
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DRAFT

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August 20, 2021
Crawford File No. 19-503.1

Mr. Mike Lonergan, PE
Carollo Engineers, Inc.
2700 Ygnacio Valley Road, Suite 300
Walnut Creek, CA 94598

Subject: **DRAFT GEOTECHNICAL REPORT**
City of Ukiah Recycled Water Pipeline – Phase 4 Design Project
Ukiah, California

Dear Mr. Lonergan,

Attached is our DRAFT Geotechnical Report for the City of Ukiah Recycled Water Pipeline – Phase 4 Design Project in Ukiah, California. We prepared this report to provide geotechnical data, conclusions, and recommendations for advancing the project to final design. Crawford & Associates, Inc. (Crawford) completed this report in accordance with our agreement dated January 18, 2019. This Draft Geotechnical Report supersedes our January 29, 2020 Draft Geotechnical Report. We will issue a final report after receiving your comments on this draft.

Please call if you have questions or require additional information.

Sincerely,

Crawford & Associates, Inc.,

Keiko Lewis, PE
Project Manager

Benjamin Crawford, PE, GE
Principal Geotechnical Engineer

Hailey Wagenman
Project Engineer

DRAFT

Taber Since 1954

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1 INTRODUCTION

1.1 PURPOSE

Crawford & Associates, Inc. (Crawford) prepared this **DRAFT** Geotechnical Report for the City of Ukiah Recycled Water Pipeline – Phase 4 Design Project in Ukiah, California. This report is to provide geotechnical and geologic data and provide conclusions and recommendations for design aspects of the project. This report supersedes our January 29, 2020 Draft Geotechnical Report. We will issue a final report after receiving comment on this draft report.

1.2 SCOPE OF SERVICES

To prepare this report, Crawford:

- Reviewed geologic, soils, and seismic maps pertaining to the alignment corridor;
- Discussed the project with Carollo engineers Mike Lonergan, P.E., and Jason Benson, P.E.;
- Reviewed available historical subsurface data;
- Drilled, logged, and sampled 24 exploratory borings in 2019 along the proposed pipeline alignment, trenchless crossings, and structure locations to a maximum depth of about 51.5 feet below ground surface (bgs) in Borings R-19-004 and R-19-017;
- Drilled, logged, and sampled three exploratory borings in 2020 at proposed structure locations to a maximum depth of about 81.5 feet bgs in Boring R-20-002;
- Performed laboratory testing on soil samples recovered from the field explorations in 2019 and 2020;
- Reviewed “City of Ukiah Improvement Plans for Recycled Water Project Phase 4,” prepared by Carollo dated June 2019;
- Reviewed preliminary “Pump Station and Storage Site Plan” for the proposed water tank prepared by Carollo (undated);
- Performed geotechnical engineering analysis for design and construction of the pipeline alignments, site specific analysis for the proposed storage tank, and foundation elements for the proposed storage tank, and pedestrian bridge at Orr Creek; and
- Developed conclusions and recommendations based on the data and test results.

2 PROJECT DESCRIPTION

The City of Ukiah plans to construct a recycled water system pipeline to serve agricultural and urban irrigation and frost protection demand throughout the city. The project will convey recycled water from local municipal treatment plants to the surrounding areas of Ukiah. The project vicinity and approximate alignment is shown on Figure 1 in Appendix I.

Currently, the overall recycled water pipeline project has been separated into four phases for design and construction. At the time of this report the first 3 phases have been designed. Phase 4 of the project – the focus of this report – will collect (in a new storage tank) and convey recycled water from the City water treatment plant to the surrounding areas of Ukiah, west of Highway (Hwy) 101.

More specifically, the Phase 4 portion of the project will tie into existing pipeline at the City Water Treatment Plant located about 1,000 feet east of Hwy 101. The pipeline alignment will:

- Travel west from the treatment plant, with a trenchless crossing underneath Hwy 101, towards Brush Street;
- Travel west along Brush Street for another 2,000 feet undergoing a second trenchless crossing along underneath a railroad crossing between Mazzoni Street and Orr Street;
- Brush Street transitions into Low Gap Road after Mazzoni Street and the alignment heads west following Low Gap Road until Despina Drive;
- At Despina Drive, the pipeline travels north approximately 1,000 feet and terminates at the Ukiah High School;
- At the intersection of Low Gap Road and North Bush Street, the pipeline breaks away into two segments heading north and south along North Brush Street. The north segment turns east onto Arlington Drive to terminate at the Ukiah Fairgrounds Park. The south segment turns west through Pomolita Field and crosses over Orr Creek supported on a new single-span pedestrian bridge; and
- Travel through sections of the Ukiah Valley Golf Course and terminates near the Anton Stadium.

The pipeline will be about 20,000 linear feet of PVC pipe with the diameters below in Table 1 and constructed with a minimum of 4 feet of cover. Figure 2 in Appendix I shows the pipeline alignment with stationing.

Table 1: Recycled Water Pipeline Diameters

Pipeline Location	Pipeline Stationing	Pipeline Outer Diameter (in)
Bush St and Low Gap Rd	A10+00 to A58+00	18
Low Gap Rd and Despina Dr	A58+00 to A90+20	10
N Bush St, Arlington Dr and N Pine St	B10+00 to B25+90	4
N Bush St, and the Golf Course	C10+00 to C31+20	12
The Golf Course, Maple Ave and Club House Dr	C31+20 to C52+40	6
Club House Dr and Park Blvd	C52+40 to C66+50	4
N Bush St	D10+00 to D15+40	4
The Golf Course	E10+00 to E22+28	10

Key project components include:

- About 20,000 lineal feet of open-cut trench along Brush Street, Low Gap Road, North Bush Street, Arlington Drive, North Pine Street, Despina Drive, Maple Avenue, Clubhouse Drive, Park Boulevard, Pomolita Field, and through sections of the Ukiah Valley Golf Course;

- Trenchless crossings at Hwy 101 and the railroad crossing along Brush Street, east of Mazzoni Street;
- 2 MG domed roof concrete reservoir tank (approximately 120 feet in diameter with a height of ±25 feet), partially buried, supported on a ring foundation located at the City water treatment plant;
- Pump station, partially buried, supported on mat foundation;
- New single-span pedestrian bridge supported on cast-in-drilled-hole (CIDH) piles crossing over Orr Creek.

The new pedestrian bridge across Orr Creek is proposed to be 78 feet long by 12 feet wide, pre-manufactured rail car bridge along a similar alignment to the existing bridge. The new pedestrian bridge will clear span the channel with abutments set around 5 feet behind the existing bridge abutments and be supported on pile foundations. Each abutment will be supported on two 36-inch diameter cast-in-drilled-holes (CIDH) pile foundations spaced 9 feet. The new bridge deck grade is planned to be 6-inches above the top of the existing bridge foundations. The new bridge approaches are anticipated to require only nominal new fill (1±foot). The new pedestrian bridge will carry the proposed pipeline over Orr Creek

3 SITE GEOLOGY

The project is within the Coast Ranges Geomorphic Province of California[1], which is characterized by a series of northwest trending mountain ranges sub-parallel to the San Andres Fault. The Coast Ranges are composed of thick Mesozoic and Cenozoic sedimentary strata. The northern Coast Ranges are dominated by the irregular, knobby, landslide-topography of the Franciscan Complex. The project site is located within the Ukiah Valley, an alluvial valley situated within the Coast Ranges.

Published regional geologic mapping[2] shows surface materials as three distinct geologic units in the region that includes the project. These consist of:

- Quaternary age Alluvium,
- Quaternary (Pleistocene) age Non-marine Terrace Deposits, and
- Undivided Cretaceous age Marine Sedimentary Rock.

Quaternary age Alluvium are the youngest deposits and are mapped to occur along the eastern portion of the project alignment (from the railroad crossing at Brush Street to the treatment plant) as well as the southeast portion of the Ukiah Municipal Golf Course. The alluvium consists of predominately unconsolidated gravel, sand, silt, and clay deposited in channels and on floodplains of the Russian River (located approximately 600 feet east of the project alignment). Recent alluvium is thickest in the central portion of the Ukiah basin and extends from the surface to depths of 50 to 80 feet.[3]

[1] California Geologic Survey (2002), *California Geomorphic Province*, Note 36
[2] Jennings, C.W. and Strand, R.G., Geologic Map of California: Ukiah Sheet, 1960, Division of Mines and Geology
[3] California Department of Water Resources (2004), Ukiah Valley Ground Water Basin, California Groundwater Bulletin 118

Quaternary (Pleistocene) age non-marine terrace deposits are the predominant surficial deposits mapped along the project alignment (west of the Railroad crossing on Brush Street). These deposits generally consist of gravelly clay to sandy/silty gravel up to 200 feet thick[4]. Terrace deposits generally overlie older (Pliocene and Pleistocene-age) alluvium and occur discontinuously along the Ukiah Valley.

Undivided Cretaceous aged Marine Sedimentary Rock is mapped west of the project alignments. This unit is comprised predominantly of sandstone, shale, and conglomerate deposits.

We present a Geologic Map as Figure 3 in Appendix I.

4 EXPLORATION

Crawford retained Geo-Ex Subsurface Exploration (Geo-Ex) to drill twenty-four exploratory borings in 2019 and three exploratory borings in 2020 along the proposed pipeline alignment, trenchless crossings, and structure locations. Table 2 provides a subsurface exploration summary.

Table 2: Subsurface Exploration Summary

CAInc Exploratory Borings (2019)						
Boring Number	**Completion Date**	**Drill Rig Type/ Drilling Equipment Type**	**Hammer Type**	**Hammer Efficiency (%)**	**Approx. Ground Surface Elevation (ft)**	**Boring Depth (ft)**
R-19-001	03/14/2021	CME 75 (Track Mounted)	Auto	70.0[1]	608.0	50.5
R-19-002	03/22/2019	CME 55 (Truck Mounted)		77.0[2]	603.2	41.5
A-19-003	03/20/2019	CME 75 (Track Mounted)		70.0[1]	605.0	21.3
R-19-004	03/21/2019	CME 55 (Truck Mounted)		77.0[2]	613.0	51.5
A-19-005	03/21/2019				638.5	21.6
A-19-006	03/20/2019				649.1	21.0
A-19-007	03/20/2019				654.3	21.5
A-19-008	03/20/2019				668.0	21.5
R-19-009	03/18/2019	CME 75 (Track Mounted)		70.0[1]	600.0	35.5
A-19-010	03/20/2019	CME 55 (Truck Mounted)		77.0[2]	687.3	21.5
A-19-011	03/20/2019				653.3	21.5
A-19-012	03/21/2019				654.9	21.5
A-19-013	03/21/2019	CME 75 (Track Mounted)		70.0[1]	641.4	21.5
A-19-014	03/22/2019				638.2	21.3
A-19-015	03/21/2019				668.7	20.9
A-19-016	03/21/2019				680.2	21.5

[4] California Department of Water Resources (2004), Ukiah Valley Ground Water Basin, California Groundwater Bulletin 118

CAInc Exploratory Borings (2019)						
Boring Number	**Completion Date**	**Drill Rig Type/ Drilling Equipment Type**	**Hammer Type**	**Hammer Efficiency (%)**	**Approx. Ground Surface Elevation (ft)**	**Boring Depth (ft)**
R-19-017	03/19/2019	CME 75 (Track Mounted)	Auto	70.0[1]	601.5	51.5
A-19-018	03/22/2019				704.7	20.8
A-19-019	03/22/2019				709.1	7.8
A-19-020	03/22/2019				632.5	21.5
R-19-021	03/18/2019				596.7	36.0
A-19-022	03/21/2019				695.1	21.5
A-19-023	03/21/2019				646.1	21.5
A-19-024	03/22/2019	CME 55 (Truck Mounted)		77.0[2]	613.2	46.5
CAInc Exploratory Borings (2020)						
A-20-001	11/30/2020	CME 75 (Track Mounted)	Auto	89.1[3]	799.5	60.0
R-20-002	12/02/2020				634.4	81.5
R-20-003	12/03/2020				636.2	76.5

1. A hammer energy calibration test was not performed specifically for this project/site; however, a previous hammer energy testing result provided by Geo-Ex found the hammer to have an energy efficiency of 70.1%.
2. A hammer energy calibration test was not performed specifically for this project/site; however, a previous hammer energy testing result provided by Geo-Ex found the hammer to have an energy efficiency of 77.0%.
3. A hammer energy calibration test was not performed specifically for this project/site; however, a previous hammer energy testing result provided by Geo-Ex found the hammer to have an energy efficiency of 89.1%.

Soil samples were recovered by means of a 2.0-inch O.D. “Standard Penetration” split-spoon sampler with 1.4-inch stainless steel liners and a 3.0-inch O.D. “Modified California” split-spoon sampler with 2.4-inch stainless steel liners. Both samplers were advanced with standard 350 ft-lb striking force using a 140 lb. automatic hammer and a drop height of 30 inches. Sampler penetration resistance was recorded to provide a field measure of relative densities and can be correlated to soils strength and bearing characteristics. Consistency of cohesive soils were obtained in the field by means of pocket penetrometer. The field-recorded (uncorrected) blow counts are shown on our boring logs in Appendix II.

Crawford’s project engineers and geologists logged the exploratory borings consistent with the Unified Soil Classification System (USCS) and the 2010 Caltrans Logging Manual. Crawford retained samples from the borings in sealed constrainers for laboratory testing and reference. Groundwater observations were recorded during drilling operations when encountered. At completion, the exploratory borings were backfilled following Mendocino County Environmental Health requirements.

The exploration boring locations were measured in the field with respect to existing site features. The boring elevations are referenced to project datum provided by Carollo. See Figure 1 in Appendix I for exploratory boring locations. The details of the borings are shown on the boring logs in Appendix II.

5 SURFACE AND SUBSURFACE CONDITIONS

5.1 EXISTING PAVEMENT THICKNESSES

Crawford measured the pavement sections at various locations along the pipeline alignment. We present pavement section data below.

Table 3: Existing Pavement Conditions

Boring Number	Approximate Station[1]	Asphalt Concrete Thickness (in)	Aggregate Base Thickness (in)
R-19-004	A34+37.6 Lt 1.3	5	6
A-19-005	A45+45.1 Lt 15.5	3	3
A-19-006	A54+40.8 Lt 53.0	3	3
A-19-007	A67+16.5 Lt 15.3	3	3
A-19-008	A74+10.6 Lt 12.0	2	3
A-19-010	A88+46.8 Rt 15.7	3	3
A-19-011	B24+50.3 Rt 15.4	3	5
A-19-012	B15+29.6 Rt 19.7	3	3
A-19-013	C15+62.3 Lt 17.8	3	3
A-19-016	C44+24.5 Lt 70.3	3	3
A-19-018	C58+94.6 Lt 10.4	2	2
A-19-019	C62+97.8 Lt 44.4	2	0
A-19-020	D16+34.8 Lt 10.3	3	3
A-19-022	C51+31.3 Lt 50.1	3	3
R-19-024	A32+87.8 Lt 34.4	4	3

[1]Stations correlate with Figure 2 attached.

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5.2 SOIL CONDITIONS

Based on our subsurface investigation, the soils encountered along the alignment seem to generally agree with published geologic maps. We summarize soil descriptions for sections of the project alignment below. Refer to the Boring Logs in Appendix II for more detailed soil conditions.

5.2.1 OPEN CUT PIPELINE ALIGNMENT

The table below describes the soil conditions encountered at the surface down to the total depths of the borings with exception to the Undivided Cretaceous Marine deposit which was encountered at 7 feet bgs in A-19-019.

Table 4: Soil Conditions

Approximate Station[1]	Geologic Deposit	Description
A12+00 to A42+00	Quaternary age Alluvium	Gravel, sand, silt and clays
A42+00 to A90+00; B10+00 to B25+00; C10+00 to C57+00; D10+00 to D15+00; and E10+00 to E27+00	Quaternary age non-marine terrace	Gravelly clay to sandy/silty gravel
C57+00 to C66+00	Undivided Cretaceous Marine	Sedimentary rock (Claystone)

[1]Stations correlate with Figure 2 attached.

5.2.2 TRENCHLESS CROSSINGS

In this portion of the alignment, we encountered Quaternary age alluvium that consists of unconsolidated gravel, sand, silt and clay. In general, soil conditions were as follows:

- At the trenchless crossing for Hwy 101, we encountered approximately 30 feet of stiff to very stiff lean clay. The clay is underlain by very dense, poorly graded gravel with clay and sand to the maximum depth of our borings (50.5 feet).
- At the trenchless crossing for the railroad, we encountered approximately 19 feet of soft to hard, sandy, lean clay and lean clay with sand. In Boring R-19-024, we encountered a loose, poorly graded sand with clay and gravel at a depth of approximately 8 to 13 feet. This correlates with a soft, sandy, lean clay in our other boring for the crossing (R-19-004) at a similar depth. Below a depth of approximately 19 feet, we encountered predominately dense to very dense, poorly graded gravel with sand to a depth of 38 to 41 feet. The gravel is underlain by stiff to very stiff, sandy, lean clay and dense, clayey sand to the maximum depth of our borings (51.5 feet).

5.2.3 WATER TANK AND PUMP STATION

Soils at the concrete tank and pump station at the City water treatment plant are variable. In general, we encountered a soil profile that consists of 28 to 30 feet of medium dense to dense, sand, silty sand, and gravel that is underlain by very dense, gravel, clayey sand, and sand to the maximum depth of our borings (51.5 feet). The water tank and pump station site have existing basins, with unknown depths, that fall within the footprint of the improvements. Fill material may be required to provide level pads around the proposed structures.

5.2.4 PEDESTRIAN BRIDGE

Based on the exploratory boring data, subsurface soils at the proposed pedestrian bridge crossing over Orr Creek can be divided into three general soil units, as follows in Table 5.

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Table 5: Subsurface Soils

Soil Unit	Depth (ft)	Elevation (ft)	Soil Description
1	0.0 – 10.0	636 – 627	Hard, brown, moist, lean clay (CL) and dense silty sand (SM)
2	10.0 – 38.0	627 – 598	Loose to very dense, yellowish brown to reddish brown, dry to wet, silty / clayey gravel (GC), silty / clayey sand (SC), and hard gravelly lean clay (CL)
3	38.0 – 81.5	598 – 553	Medium stiff to hard, yellowish brown to reddish brown, moist, lean clay to gravelly lean clay (CL) and very dense clayey gravel (GC)

5.3 GROUNDWATER

Table 6 depicts the groundwater conditions observed in the field. We also include data from California Department of Water Resources (DWR) wells in the vicinity below. DWR elevations reference NAVD88.

Table 6: Groundwater Conditions

Consultant/ Source	Boring/Well Number	Date Measured	Approximate Location	Groundwater Depth (ft)	Groundwater Elevation (ft) [1]
Crawford	R-19-004	3/21/19	A34+37.6 Lt 1.3	7.6	605.4
Crawford	R-19-009	3/17/19	In Water Treatment Facility	14.0	586.0
Crawford	A-19-012	3/21/19	B15+29.6 Rt 19.7	17.0	637.9
Crawford	A-19-014	3/22/19	C25+10 Rt 76.7	12.0	626.2
Crawford	A-19-015	3/21/19	C36+08.6 Rt 56.8	18.0	650.7
Crawford	A-19-016	3/21/19	C44+24.5 Lt 70.3	9.0	671.2
Crawford	A-19-020	3/22/19	D16+34.8 Lt 10.3	7.0	625.5
Crawford	A-19-022	3/21/19	C51+31.3 Lt 50.1	15.0	680.1
Crawford	A-19-023	3/21/19	E22+29.7 Lt 12.3	9.0	637.1
Crawford	R-20-002	12/02/20	TBD	17.0	617.4
Crawford	R-20-003	12/03/20	TBD	18.5	617.7
Taber	Well WTP-1	5/15/2009	Southern Terminus of City Well Rd	17.5	unknown
DWR	391586N1232003W002	5/7/19	(39.158611, -123.200278)	65.4	542.6 [2]
DWR	391409N1231982W001	4/13/16	(39.140931, -123.198165)	39.0	561.0 [2]
DWR	391411N1231983W001	5/7/19	(39.141111, -123.198333)	49.8	544.2 [2]

[1] Survey data provided by Carollo Engineering.
[2] Using the Department of Water Resources; http://wdl.water.ca.gov/waterdatalibrary/. Accessed July 9, 2019.

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The above groundwater conditions are based on field observations during our exploration and published data. The water treatment plant is located adjacent to (west of) the Russian River with Orrs Creek located just south of the water treatment plant and nearby portions of the alignment. The southernmost portion of the pipeline alignment is in the vicinity of Gibson Creek (south of Anton Stadium). Due to the close proximity of the pipeline to these features, groundwater elevation will likely be influenced by the water levels in the Russian River, Orrs Creek and Gibson Creek. Groundwater conditions will also fluctuate with seasonal precipitation and land use. The above data indicates that groundwater likely will not adversely impact the majority of pipeline construction but may adversely impact pump station construction and trenchless crossings. Dewatering is discussed in Section 8 of this report.

We recognize that the high groundwater levels encountered in our field exploration reflect groundwater conditions after a "heavy" wet season. Groundwater levels will drop during the dry season. Published data on DWR's Water Data Library[5] indicate groundwater readings historically fluctuate approximately 5 feet between wet and dry seasons.

6 SCOUR CONSIDERATIONS

A study was not conducted to evaluate the potential for scour within the limits of the bridge crossing at Orr Creek. For the purpose of this study, we assumed a scour elevation of 621 feet (approximately 2 feet below the bottom of the creek channel) at the proposed abutment locations for foundation analysis.

7 LABORATORY TESTING

7.1 GEOTECHNICAL SOILS TESTING

We completed the following laboratory tests on representative soil samples obtained from the exploratory borings:

- Moisture Content / Dry Density (ASTM D2216 / D2937)
- Particle Size Analysis (ASTM D422)
- No. 200 Sieve Wash (ASTM D1140)
- Atterberg Limits (ASTM D4318)
- Unconfined Compressive Strength (ASTM D2166)
- Direct Shear Strength (ASTM D3080)
- Sulfate/Chloride Content (CTM 417/422)
- pH/Minimum Resistivity (CTM 643)
- R-value (CTM 301)

We show test results on the logs of the borings and in Appendix III.

[5] http://www.water.ca.gov/waterdatalibrary/index.cfm

7.2 CORROSION TESTING RESULTS

The USDA Web Soil Survey[6] estimates the project alignment to be moderately to highly corrosive to ferrous elements and low to moderately corrosive to cementitious elements. Table 7 summarizes the results of soil corrosivity tests on samples from our exploratory borings.

Table 7: Soil Corrosion Test Summary

Boring / Sample Number	Depth (ft)	Approximate Station	pH	Minimum Resistivity (Ohm-cm)	Chloride Content (ppm)	Sulfate Content (ppm)
R-19-002 / 2	11.0	A13+98.8 Rt 35.8	6.14	2,650	1.5	5.7
R-19-004 Bulk	0-5.0	A34+37.6 Lt 1.3	6.89	3,480	1.4	15.0
A-19-008 / 1	6.0	A74+10.6 Lt 12.0	5.71	10,990	0.5	5.9
A-19-018 / 1	3.5	C58+94.6 Lt 10.4	4.90	2,950	1.7	17.6
A-20-001 / 1	3.5	TBD	4.52	4,820	4.3	1.0
R-20-003 / 3	8.5	TBD	6.06	780	120.1	169.7

According to Caltrans Corrosion Guidelines[7], a site is considered corrosive to foundation elements if one or more of the following conditions exist:

- pH is 5.5 or less
- Chloride concentration is greater than or equal to 500 parts per million (ppm),
- Sulfate concentration is greater than or equal to 1500 ppm

Based on the soil types we encountered, test results, Caltrans guidelines, and USDA mapping, the soils in A-19-018-1A and A-21-001-1A are considered “corrosive” to ferrous materials. The soils along the project alignment are considered “non-corrosive” to cementitious materials.

According to Caltrans guidelines, with the exception to MSE wall design, minimum resistivity is not included as a parameter to define a corrosive environment for structures. MSE walls do include the resistivity parameter in defining a potentially corrosive backfill material. Resistivity can serve as an indicator parameter of the possible presence of soluble salts (chlorides and sulfates), with a minimum resistivity value of 1,100 ohm-cm or less indicating the potential presence of high quantities of soluble salts (higher propensity for corrosion), and thus requiring additional testing.

These tests are only an indicator of soil corrosion potential. Section 12 of the Caltrans Corrosion Guidelines provided information regarding corrosion mitigation measures for structural elements and lists additional Caltrans guidelines documents regarding corrosion mitigation if deemed appropriate by the designer. The designer should also consult with a corrosion engineer if these values are considered significant.

[6] https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx
[7] California Department of Transportation, *Corrosion Guidelines, Version 3.0*, March 2018

8 SITE SEISMICITY

8.1 FAULT RUPTURE

The site does not lie within an Alquist–Priolo Earthquake Fault Zone and no known active faults are mapped within or through the project area. The California Geologic Survey (CGS) considers a fault to be active if it has shown movement one or more times during the Holocene period, defined as the last 11,700 years. According to the CGS, the closest active fault is the Maacama Fault Zone north section (Maacama fault) located about one mile northeast of the eastern-most point of the project area in the water treatment plant where the tank and pump stations will be.

8.2 SHEAR WAVE VELOCITY AND CLASSIFICATION OF SOILS

For this site/project, a correlated shear wave velocity (V_{S30}) in the upper 100 ft of the soil profile equal to 290 meters per second (about 950 ft/sec) is considered appropriate for use in design. This value corresponds to a "soft/loose soil profile" with 180 m/s < Vs < 360 m/s (Soil Profile Type F) for the upper 100 feet of the soil profile.

The V_{S30} value was determined for this site based on the soil data obtained from our 2019 test boring data and correlations with SPT N-values (or equivalent SPT N-values) corrected for hammer efficiency using the equations outlined in Appendix A of Caltrans' *Methodology for Developing Design Response Spectrum for Use in Seismic Design Recommendations*, November 2012.

8.3 SEISMIC DESIGN PARAMETERS

Crawford completed a site-specific hazard analysis according to ASCE 7-16 Section 11.4.8. We recommending using the following site-specific hazard values provided in Tables 8.

Table 8: Horizontal Site-Specific Spectral Accelerations

Design Acceleration Parameter	Value (g)
Design Spectral Acceleration for Short Period (S_{DS})	1.48
Design Spectral Acceleration for 1 Second Period (S_{D1})	1.58
MCE Spectral Response Acceleration for Short Period (S_{MS})	2.22
MCE Spectral Response Acceleration for 1 Second Period (S_{M1})	2.37

See Appendix IV for the detailed site-specific hazard analysis.

8.4 LIQUEFACTION

Soil liquefaction can occur when saturated, relatively loose sand and specific soft, fine-grained saturated soils are subject to ground shaking strong enough to create soil particle separation that results from increased pore pressure. This separation and subsequent pore pressure dissipation can lead to decreased soil shear strength and settlement. Liquefaction is known to

occur in soils ranging from low plasticity silts to gravels. However, soils most susceptible to liquefaction are clean sands to silty sands and non-plastic silts.

To evaluate the potential for soil liquefaction to occur at the site, Crawford used the simplified procedure outlined by Youd et al. (2001)[8] and guidelines consistent with liquefaction evaluation outlined in the Caltrans Geotechnical Manual (December 2014), the 2019 and 2020 boring data, laboratory test results, a Magnitude (M) of 7.2, and a Peak Ground Acceleration (PGA) of 0.90g. In our analysis, we modeled the groundwater elevation in each boring at the depth where we encountered it respectively. The maximum moment magnitude was determined using the USGS Deaggregation Unified Hazard Tool[9].

8.4.1 PIPELINE ALIGNMENT

Based on soil and groundwater conditions encountered and current industry accepted liquefaction evaluation methods the potential for liquefaction along the pipeline alignment is low.

8.4.2 CONCRETE TANK AND PUMP STATION

Based on the soil and groundwater conditions encountered, the potential for liquefaction exists within the upper 50 feet of soils at the site in borings R-19-009, R-19-017 and R-19-021 in the saturated gravels and sands. Based on our boring data, there is a trend that shows reduced liquefaction potential and less liquefaction induced settlement towards the south end of the site. Our analysis shows that liquefaction induced settlement on the order of 1 to 2 inches can be expected at the tank location; with differential settlement on the order of ½ to 1 inch across the tank.

8.4.3 PEDESTRIAN BRIDGE OVER ORR CREEK

Based on the soil and groundwater conditions encountered the potential for liquefaction exists within the upper 50 feet of soils at the site in Boring R-20-002 and R-20-003 in the saturated gravels. Our analysis shows that liquefaction induced settlement on the order of 1 to 1.5 inches can be expected at this location; with differential settlement on the order of ½ to ¾-inches across the bridge. We account for the potential liquefaction settlement and associated downdrag in our pile analysis.

9 CONCLUSIONS AND RECOMMENDATIONS

We conclude that the alignment is suitable for construction of the proposed tank, pump station, pipeline, and pedestrian bridge crossing provided the recommendations presented below are included in design and construction. Based on the above information and our analysis, the key geotechnical considerations associated with design and construction of this project included presence of clayey sands and gravels along the alignment which may cause caving, heavy tank loads and potential for settlement, and the potential for liquefaction settlement at the concrete storage tank, pump station, and pedestrian bridge crossing over Orr Creek.

[8] Youd, T. L., et al, Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils, Journal of Geotechnical and Geoenvironmental Engineering, Vol. 127, No. 10, October 2001, pp. 817-833.
[9] https://earthquake.usgs.gov/hazards/interactive/ accessed July 29, 2021.

9.1 FOUNDATION RECOMMENDATIONS

9.1.1 CONCRETE TANK

We understand the tank will be supported by perimeter ring foundations, and concrete slab-on-grade floor. Based on the information provided by DN Tanks (loading distribution dated July 14, 2021), we understand tank loading will result in design bearing capacities of 2,000 psf uniformly distributed along the belly of the tank and a bearing capacity ranging from 4,400 psf to 1,200 psf along the inner and outer perimeter ring foundation; respectively. We also understand the tank will be partially buried, likely to at least the elevation of the bottom of the existing basin (elevation 597 feet). In addition, Crawford recommends a five-foot overexcavation and compaction (down to elevation 592 feet) to provide firm, uniform support to the tank (recommendations for the overexcavation and compaction is provided in Section 9.3.3 of this report). In general, the site is capable of supporting the tank design loads provided.

Crawford performed settlement analysis using RocScience 3D Settlement computer program and the provided bearing capacities, a tank diameter of 120-foot (based on "AWWA D110 Type I Cast In Place Concrete Storage Tank Plans," undated), tank bottom installed near an elevation of 597 feet (existing grade at R-19-021), perimeter foundations embedded a minimum of 18 inches below lowest adjacent grade and 5 ft wide. The tank was analyzed using both borings R-19-017 and R-19-021. We provide results of our settlement analysis in Appendix V. In general, consolidation settlement will be negligible due the presence of coarse-grained materials. We expect about 2 inches of immediate settlement below the tank with a differential settlement of about 1 inch from the center of the tank to the perimeter (about 60 feet). Based on the nature of the onsite soils, we expect 50% to 65% of the immediate settlement to occur during construction. However, with liquefaction we expect approximately 1 to 2 inches of additional liquefaction settlement below the tank with a differential settlement of about ½ to 1 inch.

Lateral forces may be resisted by friction developed between the base of the footing and the underlying soil. Use a coefficient of friction of 0.70 for concrete cast against cohesionless soil to resist sliding. Additional lateral resistance may be provided by assuming a passive pressure based on an equivalent fluid weight of 210 pcf. The passive capacity reduces to an equivalent fluid weight of 170 pcf during a seismic event. In designing the structure to resist lateral loads, the upper 12 inches of soil should be ignored.

9.1.2 PUMP STATION

We understand that the pump station foundation dimensions and loads are still being determined, however support of the new pump station is available using a mat foundation provided they are 12 inches wide and extend a minimum of 18 inches below lowest adjacent grade. Provided that the mat foundation is designed to evenly distribute the pump station contents, equipment, and structure, an allowable bearing capacity of 3,000 psf may be used for design. The bearing capacity value may be increased by one-third if wind and/or seismic loads are included. Total and differential foundation settlement is expected to be less than 1 inch and ½ inch, respectively.

Lateral forces may be resisted by friction developed between the base of the footing and the underlying soil. Use a coefficient of friction of 0.70 for concrete cast against cohesionless soil to

resist sliding. Additional lateral resistance may be provided by assuming a passive pressure based on an equivalent fluid weight of 210 pcf. The passive capacity reduces to an equivalent fluid weight of 170 pcf during a seismic event. In designing the structure to resist lateral loads, the upper 12 inches of soil should be ignored.

9.1.3 BRIDGE FOUNDATIONS

Based on the boring data generated for this study, site conditions are considered suitable for structure support by means of CIDH piles for the abutments established within competent soils. Foundation support for the proposed bridge is available withing the underlying very dense and hard soil layers (Unit 2 and 3). CIDH piles can provide adequate axial capacity and minimize construction noise and vibrations.

Spread footing foundations for the bridge abutments is considered feasible, but would not be as secure as pile foundations due to the potential for liquefaction from medium dense, saturated gravels (Unit 2 materials), the potential for scour/erosion along the creek banks, and large excavations required near the creek channel. Due to the presence of dense to very dense gravel layers above specified design tip elevations, driven displacement-type concrete and steel pipe piles are likely not suitable for this site. Such piles would be expected to experience very hard driving that could result in short piles and/or pile damage. Therefore, we recommend the use of CIDH piles to support the proposed bridge structure.

The proposed bridge over Orr Creek will be supported at each abutment by two 36-inch diameter CIDH piles spaced 9 feet center-to-center (CTC). Such piles would require special installation measures due to the presence of groundwater and on-site gravely soils, including temporary casing, slurry drilling methods (with inspection tubes) and the use of minimum 24-inch diameter CIDH piles for tremie concrete placement. The foundation data and pile capacities for the 36-inch CIDH pile foundation were provided by Carollo and are presented in Table 9 below.

Table 9: Foundation Design Data

Support No.	Design Method	Pile Type	Cut-off Elev. (ft)	Pile Cap Size (ft)		Number of Piles per Support	Lateral (kips)	Compression (kips)	
				B	L			Per Support	Per Pile
Abut 1	LRFD	36” CIDH Pile	633.75	6	12	2	27.7	85	42.5
Abut 2	LRFD	36” CIDH Pile	633.75	6	12	2	27.7	85	42.5

Our evaluation identifies the presence of local/isolated soil layers that are in the range of soil texture and consistency considered susceptible to liquefaction during a design earthquake event. The pile analysis and tip elevations presented below addresses the effects of liquefaction.

When using LRFD loading, we recommend applying a geotechnical resistance factor of 0.7 to the above compression loads when selecting the pile length. The foundation design recommendations for 36-inch diameter CIDH piles are summarized in Table 10 below.

Table 10: Pile Data Table

Support No.	Pile Type	Cut-off Elevation (ft)	Nominal Resistance (kips)		Design Tip Elev. (ft)	Specified Tip Elev. (ft)
			Compression	Tension		
Abut 1	36" CIDH Pile	633.75	70	NA	(a) 579 (b) 588	579
Abut 2	36" CIDH Pile	633.75	70	NA	(a) 579 (b) 588	579

1) Design Tip Elevations are controlled by: (a) Compression, (b) Lateral Load.
2) The Specified Tip Elevation shall not be raised above the design tip elevation.
3) The piles will be founded in competent dense/hard soils

9.1.3.1 COMPRESSIVE RESISTANCE

The side (compressive) resistance for the 36-inch CIDH pile foundations was evaluated using LRFD methods and factors from AASHTO LRFD Bridge Design Specifications[10] (BDS) with Caltrans amendments to determine the design pile tip elevation. End bearing contributions to axial resistance were neglected, consistent with current Caltrans guidelines for CIDH pile design. Actual contributions to skin friction vary depending on load transfer along the pile shaft. A geotechnical resistance factor (φ) of 0.7 was used to evaluate compressive resistance consistent with Caltrans amendments to AASHTO LRFD method for the CIDH piles.

Consistent with AASHTO LRFD BDS 10.8.3.5.1b and C10.8.3.5.1b (Side Resistance), the top 5 feet of the pile is excluded from contributing to geotechnical capacity. For our analysis, the bottom 5 feet of the pile is also excluded from contributing to geotechnical capacity.

We present the CIDH Pile Nominal Resistance (Axial Compression) graphs in Appendix V.

9.1.3.2 LATERAL RESISTANCE

The LPILE Version 2018.10.09 computer program was used to estimate lateral pile design loads for vertical piles which would produce approximately ¼-inch and ½-inch pile head deflection at the provided cut-off elevation assuming a fixed-head condition. For the proposed bridge, pile response in the longitudinal and transverse bridge directions was computed using elastic pile stiffness (basic modeling) with an axial compression value of 17.5 kips, approximately 1.6% steel, and a pile diameter of 36 inches. The idealized geotechnical parameters that were used in the lateral pile analysis are shown below in Table 11.

[10] American Association of State Highway and Transportation Officials, AASHTO LRFD Bridge Design Specifications, 8th Edition, November 2017.

Table 11: Bridge Idealized Geotechnical Parameters

Elevation (ft)	LPILE Soil Type	Unit Weight (lb/ft^3)	Friction Angle (degrees)	Cohesion / Residual Strength (psf)	Strain Factor, E50 (dim.)	p-y Modulus, k (lb/in^3)
636 to 627	Stiff Clay w/o Free Water	115	--	4,000	0.004	--
627 to 618	Sand (Reese)	115	36	--	--	225
618 to 613	Sand (Reese)	53	36	--	--	125
613 to 608	Soft Clay (Matlock)	68	--	1,000	0.02	--
608 to 598	Sand (Reese)	68	38	--	--	125
598 to 553	Stiff Clay w/o Free Water	63	--	3,000	0.005	--

Notes:
1. Elevations are based on project datum.
2. Design groundwater at elev. 618 feet).
3. Unit Weight equals Total Unit Weight above the groundwater and the Buoyant Unit Weight below the groundwater.
4. Buoyant Unit Weight = Total Unit Weight - 62.4 pcf.
5. Liquefied layer modeled as soft clay with residual strength.

The results of our lateral pile analysis for both the longitudinal and transverse bridge directions for the abutments are presented in Table 12.

Table 12: Abutment Pile Head Deflection vs. Lateral Load – Abut 1 & 2

Condition	Spacing	Pile Row	P-multiplier	Deflection, in	Shear, kips
Longitudinal	3.0B	1	0.90	0.25	28.7
				0.50	38.2
Transverse	3.0B	1	0.75	0.25	27.1
				0.50	36.2
		2	0.55	0.25	24.4
				0.50	33.1

Note: B = pile diameter

The LPILE output graphs are presented in Appendix IV.

9.1.3.3 TENSION RESISTANCE

No tension demands are indicated for the pile foundations.

9.1.3.4 SETTLEMENT

For this project, the nominal resistance of the CIDH piles is designed to be derived through side resistance with no end-bearing contributions. All piles will be founded in competent materials

that consist of dense to very dense granular and medium stiff to hard cohesive layers. Theoretically, the vertical load on the CIDH piles for this structure will not exceed the nominal side resistance of the pile shaft. Therefore, pile settlement is expected to be less than 1.0-inch for the CIDH piles. Since the piles will be embedded adequately into dense/hard soils, a detailed assessment of the pile group settlement is not considered warranted.

9.1.3.5 NEGATIVE SKIN FRICTION

We anticipate negative skin friction (downdrag) at the abutments as a result of the settlement due to liquified, saturated, medium dense granular soil layers encountered at the site.

9.1.3.6 GROUP EFFECTS

The foundation soils predominately consist of dense to very dense granular layers and medium stiff to hard cohesive layers. The pile center-to-center spacing is greater than 2.5 times the pile diameter.

According to AASHTO LRFD BDS (Section 10.7.3.9 – Resistance of Pile Groups in Compression) with California amendments:

- For Cohesive Soil – If the pile cap is in firm contact with the ground, no reduction in efficiency shall be required. If the pile cap is not in firm contact with the ground and if the soil is stiff, no reduction in efficiency shall be required.
- For Granular Soil – The efficiency factor, η, shall be 1.0 where the pile cap is or is not in contact with the ground for a center-to-center pile spacing of 2.5 diameters or greater.

Therefore, no reduction in efficiency is required and a group efficiency factor (η) of 1.0 was used in our compressive resistance pile analysis.

9.1.3.7 CONSTRUCTION CONSIDERATIONS

Consideration for CIDH pile installation/excavation for this site/project includes:

- Potential for caving soils due to presence of loose to medium dense soil layers within pile foundation depths,
- Presence of gravel layers withing pile foundation depths, and
- Presence of groundwater within pile foundation depths.

Due to the anticipated presence of groundwater around elev. 618 feet, we recommend installing CIDH piles by the “wet” method, including slurry drilling and concrete placed under slurry using tremie pipe. We recommend constructing CIDH piles in conformance with Section 49-3 of the Caltrans Standard Specifications[11], Revised Standard Specifications, and Standard Special Provisions. The slurry construction method (“wet” method) requires placement of inspection tubes to permit Gamma-Gamma Logging (GGL) and Cross-hole Sonic Logging (CSL) of the CIDH pile.

For CIDH piles with center-to-center spacing less than 4.0 diameters, the sequence of shaft installation should be specified in the contract documents (Section 10.8.1.2, California Amendments to AASHTO LRFD BDS).

[11] California Department of Transportation, *Standard Specifications*, 2018.

The contractor should anticipate variable drilling conditions in all CIDH pile excavations due to the presence of medium stiff to hard cohesive soils (lean clay) and loose to very dense non-cohesive soils (sand and gravel) . Variable drilling conditions may include alternating between soft and hard drilling techniques.

To reduce the magnitude of downdrag, permanent casing for CIDH pile can be installed to/below the bottom of the liquefiable layer. At the abutment locations, permanent steel casing is permissible no lower than elev. 608 feet. The permanent steel casing may be specified as either a permanent smooth-wall casing or a Corrugated Metal Pipe (CMP). The permanent steel casing should be at least 8-inches greater than the CIDH pile to help prevent binding of the drilling tool. The permanent steel casing may be placed in drilled hole, and annual space backfilled with grout (Standard Specifications Section 49-3.02B(5), 49-3.02C(6). It is also permissible to drill/oscillate/rotate the permanent casing into place. Installation by driving or vibration is not recommended.

The contractor is responsible for the design and installation of temporary casing (if used), including actual length(s) and diameter(s), to install CIDH piles according to the above specifications without defects or damage to existing utilities/facilities.

Temporary casing (if used), should be noncorrugated steel with smooth surfaces and the casing diameter should be at least 8-inches greater than the CIDH pile to help prevent binding of the drilling tool. Install temporary casing below the specified pile tip elevation is not permissible. Temporary casing should be removed during placement of concrete.

The project specifications should explicitly exclude vibration and impact installations methods if noise or vibrations are of concern or otherwise not allowed due to environmental constraints, proximity of nearby residences or to protect existing facilities (e.g., underground utilities potentially susceptible to vibration damage).

If an oscillator or rotator is used to construct the CIDH piles:

- The contractor should be prepared for subsurface conditions that include layers of clays and coarse granular materials (e.g., sand, gravel).
- The contractor should maintain a positive fluid head within the drill road at all times. The fluid should be mineral or polymer slurry; water is not permitted.
- The contractor is to maintain a minimum 10-foot soil plug within the drill rod. The 10-foot plug is to be maintained until the drill rod reaches the specified tip elevation. It may be necessary to extend the casing below the bottom of the pile tip to maintain a soil plug to help maintain stability at the base.
- The contractor must provide access to the top of the oscillator/rotator drill rod, as requested by the Engineer, to verify the positive head and minimum soil plug are being maintained.
- It is important to maintain continuous rotation/oscillation and place rebar/concrete expeditiously to avoid lockup. The contractor should take into account the work window allowed by the project specifications to install foundations when proposing oscillator/ rotator method installation.

The CIDH piles are designed to obtain their geotechnical capacity through side resistance. Nonetheless, the bottom of drilled holes must be cleaned in accordance with Section 49-3.02C(2), "Drilled Holes," of Caltrans 2018 Standard Specifications. Prior to approval, the Engineer must verify the bottom of the drilled holes are cleaned before placement of the concrete.

Excavation of the CIDH piles, placement of the rebar cage, and concrete pour should be completed in one continuous operation.

Prior to mobilization to the site, the foundation contractor should prepare a Pile Installation Plan in accordance with Section 49-3.02A(3)(b) of the Caltrans Standard Specifications. The drilled shaft installation plane to be submitted by the contractor should include a description of the tools and equipment planned to be used by the contractor for CIDH pile installation. The actual tools and equipment used during CIDH pile excavation/installation should be documented in the construction records. If oscillator/rotator method is used, the contractor's workplan should include/outline measures to extract a seized casing without compromising the integrity of the CIDH excavation.

9.2 LATERAL EARTH PRESSURES

We present equivalent fluid weights (EFWs) in the table below for the buried structures and bridge abutments. These values assume fully drained and level backfill conditions.

Table 13: Recommended Equivalent Fluid Weight (EFW)

Condition	Static		Incremental Seismic	
	Coefficient k (dim.)	EFW (pcf)	Coefficient Δk (dim.)	ΔEFW_{EQ} (pcf)
Active	0.28	34	0.22	27
At-Rest	0.44	53	NA	43

The EFW values shown above assume:

- Level backfill condition;
- Structure Backfill with soil unit weight (γ) = 120 pcf and minimum angle of internal friction (ϕ) = 34°. This is considered to be achievable from the native silty sands;
- Horizontal seismic acceleration coefficient (k_h) ≤ 0.2; and
- Vertical seismic acceleration coefficient (k_v) = 0.0.

The passive fluid weight is only applicable if the retained earth is allowed to strain at least 0.02H.

For *static design*, apply the resultant of the static earth pressure at a depth of 0.33H from the base of the wall where H equals the wall height. At-rest and Active earth pressures do not

include a factor of safety. Use a static passive earth pressure of 210 pcf which has been reduced by a factor of safety of 2.0 and a coefficient of friction of 0.70 for lateral restraint.

For *seismic design*, calculate the resultant of incremental/additional lateral soil pressure due to seismic loading based on the equivalent fluid weights above and apply the magnitude of the resultant at 0.66H from the base of the wall where H equals the wall height. Add the resultant of the seismic earth pressure to the resultant of the static active or "at-rest" earth pressure. Reduce the static passive pressure to 170 pcf for a seismic event.

For permanent surcharge loads, apply a uniform load to the wall equal to 0.45-times the surcharge load. Apply an additional 200 psf to accommodate transient and construction surcharge loading (comparable with AASHTO H-20).

9.3 GRADING

9.3.1 CLEARING

Prior to grading, demolish and clear the site to remove structures, fences, vegetation, tree roots, debris, abandoned utilities, soft or unstable areas, and other deleterious materials.

9.3.2 SUBGRADE

Scarify and compact the upper 10 inches of soil in areas to receive fill (outside of the tank pad) to at least 90 percent relative compaction with at least optimum moisture content per ASTM D1557. The excavation bottom must be firm and unyielding prior to placing concrete.

Place fill in maximum 8-inch-thick loose lifts, moisture condition to within 2% of optimum moisture content and compact to a minimum 90% relative compaction per ASTM D1557. Increase the relative compaction to 95% in the upper 6-inches beneath the pavement areas.

Native materials, minus organics, debris, and other deleterious materials, are suitable for engineered fill with a maximum particle size of 4 inches. Excavated materials unsuitable for use as structural fill should be placed outside the structure limits.

9.3.3 OVEREXCAVATION – TANK PAD

To reduce the amount of settlement to within the required tolerances provided by DN Tanks, the near surface soils are recommended to be removed, processed and recompacted below the planned tank. Our analysis shows that an overexcavation to a depth of 5 feet below existing grade (to an elevation of approximately 592 feet) is recommended. In addition to the area below the tank, extend the overexcavation to a minimum of 5 feet laterally beyond the tank and foundation footprint in all directions.

Scarify the exposed subgrade to a depth of 10 inches and compact to at least 95% percent relative compaction with at least optimum moisture content per ASTM D1557. The excavation bottom is recommended to be firm and unyielding prior to placing concrete. Place and compact fill per Section 9.2.5 below.

9.3.4 OVER-OPTIMUM SOIL MOISTURE

Excessively over-optimum (wet) soil conditions can make proper compaction difficult or impossible.

In general, wet soil can be mitigated by:

- Discing the soil during prolonged periods of dry weather,
- Over-excavating and replacing with drier material,
- Stabilization using aggregate and stabilization fabric or grid.

Crawford should be consulted for further recommendations if these conditions are encountered during grading.

9.3.5 BACKFILL

Native silty sands or select import can be used as backfill. Moisture condition backfill to within 2 percent of optimum and place in maximum 8-inch thick, horizontal, loose lifts. Compact backfill to a minimum 95 percent relative compaction based on the ASTM D 1557 test procedure.

In order to minimize the residual lateral earth pressures on structure walls, compaction equipment used behind the walls must be restricted (by load and distance from wall) so that wall design values are not exceeded. For this reason, we recommend compaction within a horizontal distance equal to one-half of the wall height, up to a distance of 5 feet, to be completed with hand-operated equipment (i.e., jumping jack). To minimize the potential for significant settlement around deep walls, controlled low strength material (CLSM) can be used to backfill to the surface or to a manageable depth (e.g. 5 to 10 feet below grade).

9.3.6 IMPORT MATERIAL

Import fill shall be granular soil, free of organic material and debris, have an Expansion Index (per ASTM D4829) of less than 25, an R-value greater than XX, and conform to the following gradation:

Sieve Size	Percentage Passing
2-inch	100
No. 4	35 – 100
No. 30	20 – 100
No. 200	10 – 45

Caltrans Class 2 aggregate base is considered acceptable and does not need to meet these gradation requirements. Import fill must be observed and tested by Crawford prior to its approval.

9.4 OPEN-CUT PIPELINE RECOMMENDATIONS

Generally, the open-cut portions of the pipeline will have a minimum of 4 feet of cover along the all the segments of the pipeline.

9.4.1 SOIL LOADS ON RIGID BURIED PIPES

Due to the lack of ductility of rigid pipelines, the dead loads and associated strain are important to analyze. The soil deadload (W_D) on the rigid pipeline in a trench may be evaluated by Marston's Formula:

$$W_D = C_d \gamma {B_d}^2$$

Where:
C_d = load coefficient based on ${K_\mu}'$
γ = moist unit weight of backfill material (pcf)
B_d = width of trench at top of pipe (ft)

Use a moist unit weight of 135 pcf for the above calculation.

Similar to Composite Modulus of Soil Reaction, the backfill material and compaction, trench width, and installation depth are components to designing the pipeline. For an open cut installation with a ratio of the backfill depth to trench width at the top of the pipe (H/B_d) of at least 1 (i.e. backfill depth is greater than the trench width) and for a trench width at top of pipe no greater than 3 times the pipe diameter, C_d[12] may be calculated by:

$$C_d = \frac{1 - e^{-2K\mu' \frac{H}{B}}}{2K\mu'}$$

Where:
K = rankine's lateral earth pressure coefficient
μ' = friction coefficient between fill material and sides of trench
H = backfill height above the pipe crown (feet)

The combined $K\mu'$ value is dependent on backfill type, compaction, and moisture content. Using the backfill recommendations in this report, the estimated $K\mu'$ values are 0.120 for clay, 0.130 for silt, and 0.150 for sands and aggregate base.

9.4.2 SOIL LOADS ON FLEXIBLE BURIED PIPES

Soil loads on flexible buried pipes should be analyzed as well. Based on AWWA M11, if the flexible pipe is buried in a trench less than two times the width of the pipe, the load is computed as:

$$W_c = C_d \gamma {B_d}^2 (\frac{B_c}{B_d})$$

Where:
W_c = dead load on the conduit (lb/lin ft)
C_d = load coefficient based on ${K_\mu}'$ (presented in Section 9.4.1)
γ = moist unit weight of backfill material (pcf)
B_d = width of trench at top of pipe (ft)

[12] American Concrete Pipe Association (2000)

B_c = diameter of pipe (ft)

If the flexible pipe is installed with trenchless techniques or a wide trench (i.e. trench width is greater than two times the width of the pipe):

$$W_c = \gamma H B_c$$

Where:

W_c = dead load on the conduit (lb/lin ft)
γ = moist unit weight of backfill material (pcf)
H = height of fill above top of pipe (ft)
B_c = diameter of pipe (ft)

9.4.3 THRUST RESTRAINT

Unbalanced thrust forces develop in a pipeline due to internal pressures, particularly around change of direction in the pipeline alignment. For large diameter pipelines, these thrust forces are typically counteracted by frictional resistance along the pipe and restrained joints.

Restrained joints resist thrust forces through friction between the pipe and the soil surrounding it. Per AWWA M11, the length of pipeline required to restrain each side of an alignment bend is:

$$L = \frac{PA(cos\Delta)}{\mu(W_e + W_w + W_p)}$$

Where:

L = length of restrained or harnessed joints on each side of the bend or elbow (ft)
P = internal pressure (psi)
A = cross-sectional area of the pipe (in^2)
Δ = bend or elbow deflection (degrees), 0° to 90°
μ = coefficient of friction between the pipe and the soil
W_e = horizontal bends: two times the weight of the prism of soil over the pipe (lb/ft of pipe length)
= vertical bends: weight of the prism of soil over the pipe (lb/ft of pipe length)
W_p = weight of the pipe (lb/ft)
W_w = weight of the contained water (lb/ft)

The coefficient of friction between a steel pipe and the surrounding soil is modeled as: $\mu = tan\,(0.6\phi)$, where ϕ is the soil friction angle. Assuming a soil friction angle of 36° for compacted coarse grained, angular backfill soil, we recommend using a coefficient of friction of 0.40.

Although likely unnecessary for the majority of this project, thrust blocks may also be used if additional thrust resistance is needed. Thrust block design is governed by two factors – the total thrust force and the allowable passive pressure of the soil. Allowable passive pressure will be variable throughout the alignment due to varying soil conditions. We calculated passive pressures at each of our boring locations to assess trending values along the alignment. Based on this trend, we recommend a passive pressure of 205 pcf for borings classified with clayey and 250 pcf for the borings classified with sandy materials for thrust block design; see the table

below for the recommended passive pressures associated with each boring. The upper 12 inches of soils should be ignored.

Table 14: Recommended Passive Pressure Values

Boring Number	Approximate Station[1]	Recommended Passive Pressure (pcf)
A-19-003	A20+74.8 Lt 50.8	205
A-19-005	A45+45.1 Lt 15.5	250
A-19-006	A54+40.8 Lt 53.0	205
A-19-007	A67+16.5 Lt 15.3	250
A-19-008	A74+10.6 Lt 12.0	205
A-19-010	A88+46.8 Rt 15.7	250
A-19-011	B24+50.3 Rt 15.4	205
A-19-012	B15+29.6 Rt 19.7	250
A-19-013	C15+62.3 Lt 17.8	205
A-19-014	C25+10 Rt 76.7	250
A-19-015	C36+08.6 Rt 56.8	205
A-19-016	C44+24.5 Lt 70.3	250
A-19-018	C58+94.6 Lt 10.4	205
A-19-019	C62+97.8 Lt 44.4	205
A-19-020	D16+34.8 Lt 10.3	250
A-19-022	C51+31.3 Lt 50.1	205
A-19-023	E22+29.7 Lt 12.3	250

[1]Stations correlate with Figure 2 attached.

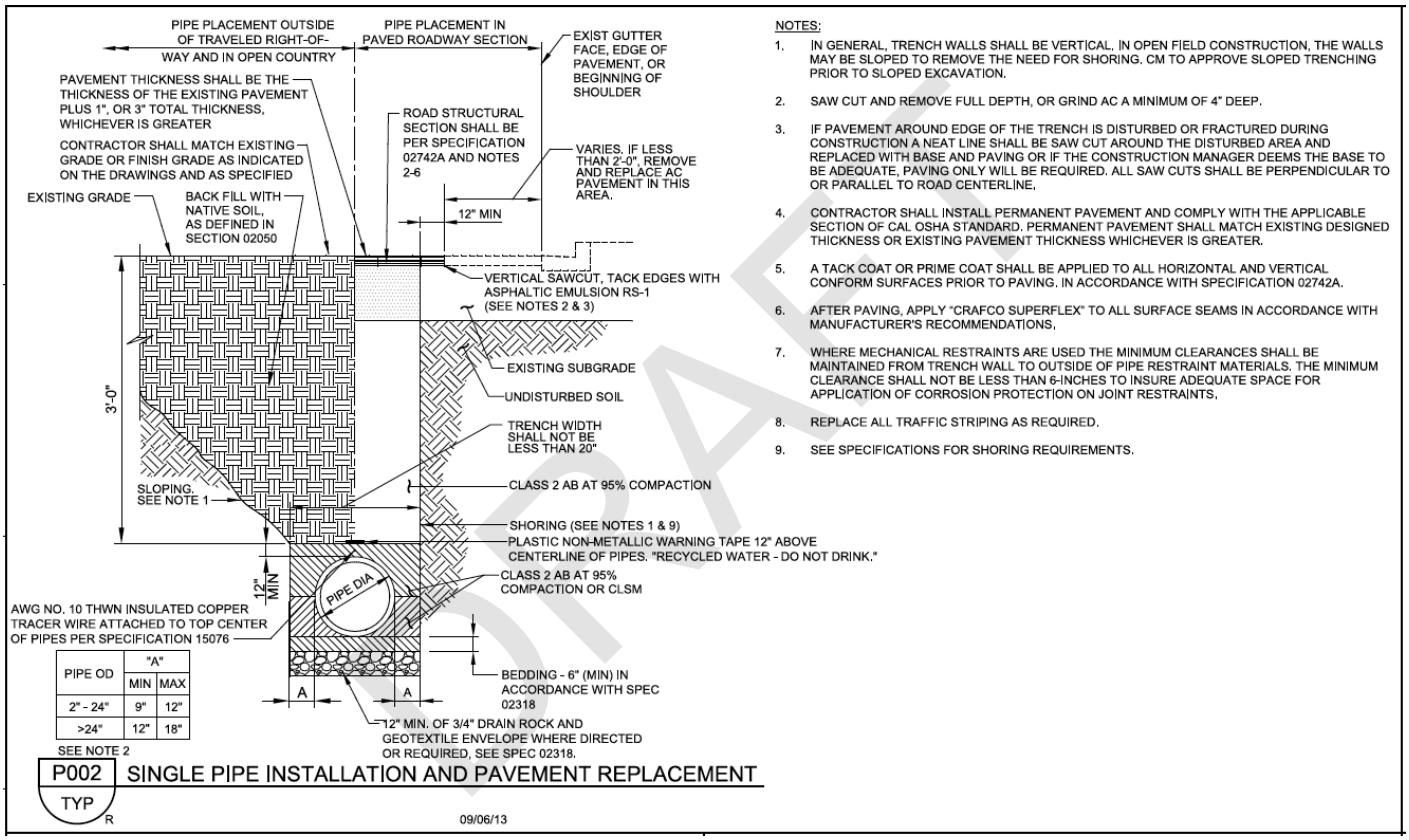
9.4.4 COMPOSITE MODULUS OF SOIL REACTION

Semi-rigid and flexible pipes are designed to withstand a certain amount of deflection from applied earth loads. One of the input parameters to pipe deflection equations is the Composite Modulus of Soil Reaction (CMSR). The CMSR value is influenced by native soil properties, backfill soil properties, and trench/pipe geometry. We calculated composite modulus of soil reaction values using the Howard (2011) and AWWA M11 and M45 method. This approach multiplies the modulus of soil reaction for the embedment soil (i.e. trench backfill) by a soil support combining factor, S. Using the above parameters, we selected our S values from Table 1 of "Amster Howard, TECH NOTE, A supplement to Pipeline Installation," dated October 3, 2011. For these calculations, we assume the trench specifications provided by Carollo Engineers in the June 2019 plans page TP01. We provide a brief summary of the specifications below:

- Trench Geometry
  - For pipe diameters, less than 24-inches, the trench width will be between 18 and 24-inches greater than the pipe diameter. We calculated the CMSR using a minimum trench width equal to 18-inches wider (9-inches per side) than the pipe diameter.

- Backfill Material
  - Sand or aggregate base course
- Compaction
  - Pipe bedding will have a relative compaction (per ASTM D1557) greater than or equal to 90%
  - Trench backfill will have a relative compaction (per ASTM D1557) greater than or equal to 95%

Below is the pipe trench profile geometry as provided by Carollo.



Using these assumptions, pipe depth, size, installation type, and the geotechnical information presented herein, we calculated Composite Modulus of Soil Reaction values at each exploration location. We present our CMSR values in Table 15.

Table 15: Composite Modulus of Soil Reaction Values

Boring Number	Pipe Outer Diameter (in)	Approximate Station[1]	CMSR (psi)
R-19-001	18	A10+95.2 Rt 21.9	4,000
R-19-002	18	A13+98.8 Rt 35.8	4,000

Boring Number	Pipe Outer Diameter (in)	Approximate Station[1]	CMSR (psi)
A-19-003	18	A20+74.8 Lt 50.8	2,000
R-19-004	18	A34+37.6 Lt 1.3	4,000
A-19-005	18	A45+45.1 Lt 15.5	1,700
A-19-006	18	A54+40.8 Lt 53.0	1,450
A-19-007	10	A67+16.5 Lt 15.3	2,000
A-19-008	10	A74+10.6 Lt 12.0	1,950
A-19-010	10	A88+46.8 Rt 15.7	1,650
A-19-011	4	B24+50.3 Rt 15.4	1,600
A-19-012	4	B15+29.6 Rt 19.7	1,600
A-19-013	12	C15+62.3 Lt 17.8	2,100
A-19-014	12	C25+10 Rt 76.7	1,700
A-19-015	6	C36+08.6 Rt 56.8	1,550
A-19-016	6	C44+24.5 Lt 70.3	1,650
A-19-018	4	C58+94.6 Lt 10.4	1,600
A-19-019	4	C62+97.8 Lt 44.4	1,600
A-19-020	4	D16+34.8 Lt 10.3	1,600
A-19-022	6	C51+31.3 Lt 50.1	1,600
A-19-023	10	E22+29.7 Lt 12.3	1,900
R-19-024	18	A32+87.8 Lt 34.4	4,000

[1]Stations correlate with Figure 2 attached.

To calculate the above results, we assumed a sand backfill and applied an E_b' (trench backfill Modulus of Soil Reaction) value of 1,600 psi. Native Moduli of Soil Reaction varied from 800 in loose clayey sands to 5,000 in hard clays and dense gravels with silt. Final design values should be calculated based on actual backfill Modulus of Soil Reaction and trench/pipe dimensions.

9.5 TRENCHLESS PIPELINE RECOMMENDATIONS

There are two locations along the alignment where trenchless technology will be used to install the 18-inch OD pipeline where traditional open-cut trenching methods are not feasible. Many trenchless technologies are feasible for construction at these locations. The contractor is responsible for selecting appropriate trenchless installation methods. The chosen trenchless method should not cause differential settlement, surface soil heaving, or damage to existing facilities and utilities. The method and approach must maintain pipeline vertical and horizontal alignment within design tolerances.

Crawford completed four explorations at the following trenchless crossing locations:

- Trenchless Crossing 1 at Highway 101 (Borings R-19-001 and R-19-002)
- Trenchless Crossing 2 at Bush Street (Borings R-19-004 and R-19-024)

Trenchless crossing locations are presented on Figure 2.

At each trenchless crossing, launching and receiving shafts (pits) will need to be excavated to house the trenchless installation equipment if direct access trenchless methods (e.g., horizontal auger bore, jack-and-bore, micro tunneling, etc.) are used instead of Horizontal Direction Drilling (HDD). Although the contractor would likely have launching and receiving pits for HDD to control hydraulic fracture of the drilling mud, the pits would be less significant and likely not require shoring. With the advantage of less expensive pits, HDD comes with the disadvantage of needing substantial staging area to lay out the pipe prior to installation.

9.5.1 SHAFTS

Shoring should be designed to prevent material from entering the shaft during all construction operations. Dewatering will likely be necessary during excavation of the launching and receiving shafts.

Based on our understanding of the project, the bottom of pipe elevation at Trenchless Crossing 1 will be about 592 feet. The bottom of pipe elevation at Trenchless Crossings 2 will be about 598 feet. We assume entry and receiving pit bottoms will be at elevation 590 feet at Trenchless Crossing 1 and 596 feet at Trenchless Crossing 2 to provide space for the installation equipment.

We provide the following bearing capacities and shallowest groundwater condition we anticipate at each crossing. The shallowest groundwater level was encountered in boring R-19-004 during our March 21, 2019 field exploration. We estimate approximately 1 inch of immediate and less than ¾ inches of differential settlement. The following bearing capacities are for the support of drilling/driving equipment at the base of the pit.

Table 16: Trenchless Locations Bearing Capacity

Trenchless Location	Allowable Bearing Capacity, psf	Static Groundwater Elevation, ft
Crossing 1	2,500	600
Crossing 2	2,000	600

With proper shoring in place, the base of the shafts should be reviewed to see if the in-situ soil is suitable for the stability of the trenchless installation equipment. If the soil is found to be unstable, (excavate one foot of in-situ soil) place a 12” layer of aggregate base course compacted to at least 85% relative compaction on top of a nonwoven geotextile fabric layer (Mirafi S1000 or similar product).

We present the following passive pressure for the walls of the trenchless shafts assuming fully drained conditions.

Table 17: Trenchless Passive Pressures

Trenchless Crossing 1	
Passive Pressure	195 psf
Trenchless Crossing 2	
Passive Pressure	200 psf

Once the trenchless portion of the pipe is installed, the launching and receiving shafts must be backfilled per Mendocino County or City of Ukiah requirements.

9.6 PAVEMENT

We completed two R-Value tests (CTM 301) on bulk samples of near surface soil. Test results indicate R-values of 21 to 35 by stabilometer. Therefore, we recommend using R-Value 21 for project pavement design.

Using varying Traffic Indices and Chapter 600 of the Caltrans Highway Design Manual (CHDM), 6th Edition, we recommend the sections shown in Table 18 below for pavement design.

Table 18: Pavement Sections

Traffic Index	Pavement Sections R-Value 21	
	Hot Mix Asphalt (ft)	Aggregate Base (ft)
5.0	0.20	0.70
5.5	0.25	0.75
6.0	0.25	0.90
6.5	0.30	0.90
7.0	0.30	1.05
7.5	0.35	1.10
8.0	0.40	1.15
8.5	0.40	1.25
9.0	0.45	1.30

*The upper 0.2 feet of HMA may be replaced with rubberized hot mix asphalt.

Design by the Caltrans method presumes materials and construction in accordance with Caltrans “Standard Specifications”, including 95% relative compaction on all materials within 30-inches of finished grade. Inability to achieve the required compaction on the scarified materials may be used as a field criterion to identify areas requiring additional removal and/or re-compaction.

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The subgrade soils should be field reviewed with respect to uniformity and suitability by the soils engineer. Any loose, disturbed or otherwise unsuitable materials should be removed to full depth and replaced with imported fill meeting the requirements of the Standard Specifications or Class 2 Aggregate Base compacted to at least 90% relative compaction.

The above pavement design assumes that free water will be absent from the structural section. Suitable surface drainage is of particular importance to limit subgrade saturation and excess free water.

9.7 CONSTRUCTION CONSIDERATIONS

9.7.1 DEWATERING

Based on our observed groundwater levels in Spring 2019, we encountered groundwater within trench excavation limits in boring A-19-020 as well as at the Trenchless Crossing location in boring R-19-004. Groundwater will adversely affect construction of portions of the pipeline and trenchless crossings located near these borings. In addition, we encountered groundwater at an approximate elevation of 575 feet in R-19-009, potentially impacting the pump station and tank constructions. Isolated areas of groundwater seepage are likely to be encountered along other portions of the alignment.

The contractor will be responsible for designing and implementing a dewatering system to meet the requirements of the project. Dewatering operations will need to draw down the groundwater down to a minimum of 3 feet below the planned excavation during construction. Dewatering operations may enter into layers of clean sands that may yield significant water.

9.7.2 EXCAVATABILITY

Based on the conditions observed in our subsurface explorations and our experience, the on-site soil should be excavatable with typical equipment such as backhoes and excavators. Depending on county easement dimensions and pavement configurations, the contractor may need to shore the existing roadway to accommodate traffic if there is insufficient room to properly slope the trench excavation.

9.7.3 SHORING AND TEMPORARY CONSTRUCTION SLOPES

At a minimum, all shoring and temporary construction slopes should be in accordance with current OSHA requirements. Our data indicates Cal OSHA Soil Type C will be encountered throughout the project alignment with the exception of the stiff fine-grained soil layers we encountered. Isolated locations of unstable soils can be encountered, particularly where the trench is adjacent to existing utilities or other improvements. Traffic and construction vibrations need to be considered in shoring applications.

The contractor is responsible for all shoring and temporary slope design based on actual excavation conditions encountered during construction. Shoring will need to be conducive to the contractor's approach to managing groundwater (where needed) and the excavation.

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10 LIMITATIONS

Crawford performed services in accordance with generally accepted geotechnical engineering principles and practices currently used in this area. Do not use this report for different locations and/or projects without the written consent of Crawford. Where referenced, we used ASTM or Caltrans standards as a general (not strict) *guideline* only.

Crawford based this report on the current site conditions. We assumed the soil and groundwater conditions are representative of the subsurface conditions on the site. Actual conditions between explorations will vary along the project alignment.

Our scope did not include evaluation of on-site hazardous materials.

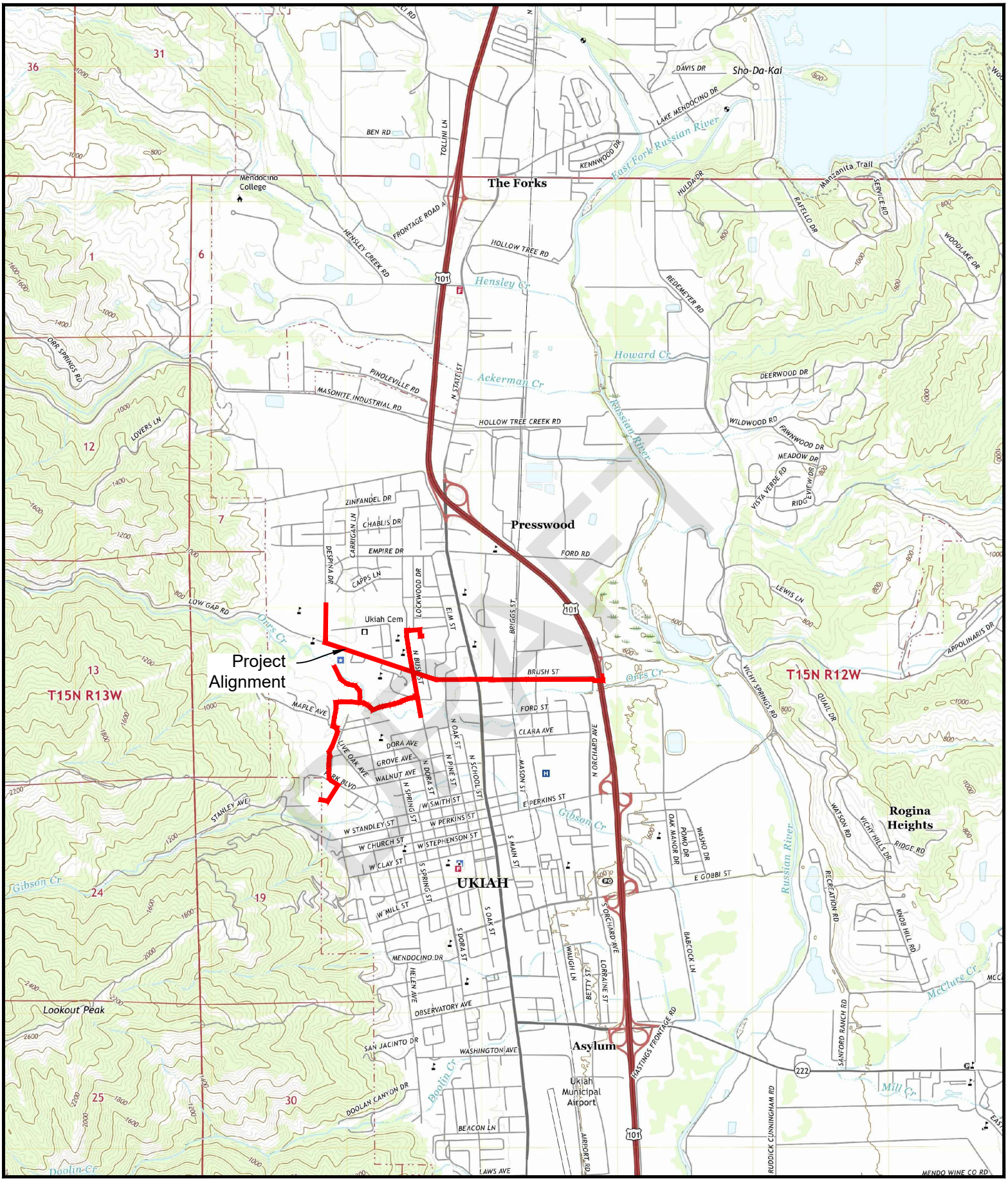
Logs of our explorations are presented as Appendix II. The lines designating the interface between soil types are approximate. The transition between soil types may be abrupt or gradual. Our recommendations are based on the final logs, which represent our interpretation of the field logs and general knowledge of the site and geological conditions

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APPENDIX I - FIGURES

Figure 1: Vicinity Map
Figure 2: Exploration Location Map
Figure 3: Geologic Map
Figure 4: Fault Activity Map

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North

Source: USGS 7.5' Topographic Maps, Ukiah, Mendocino County, California, 2018, Scale: 1:24,000

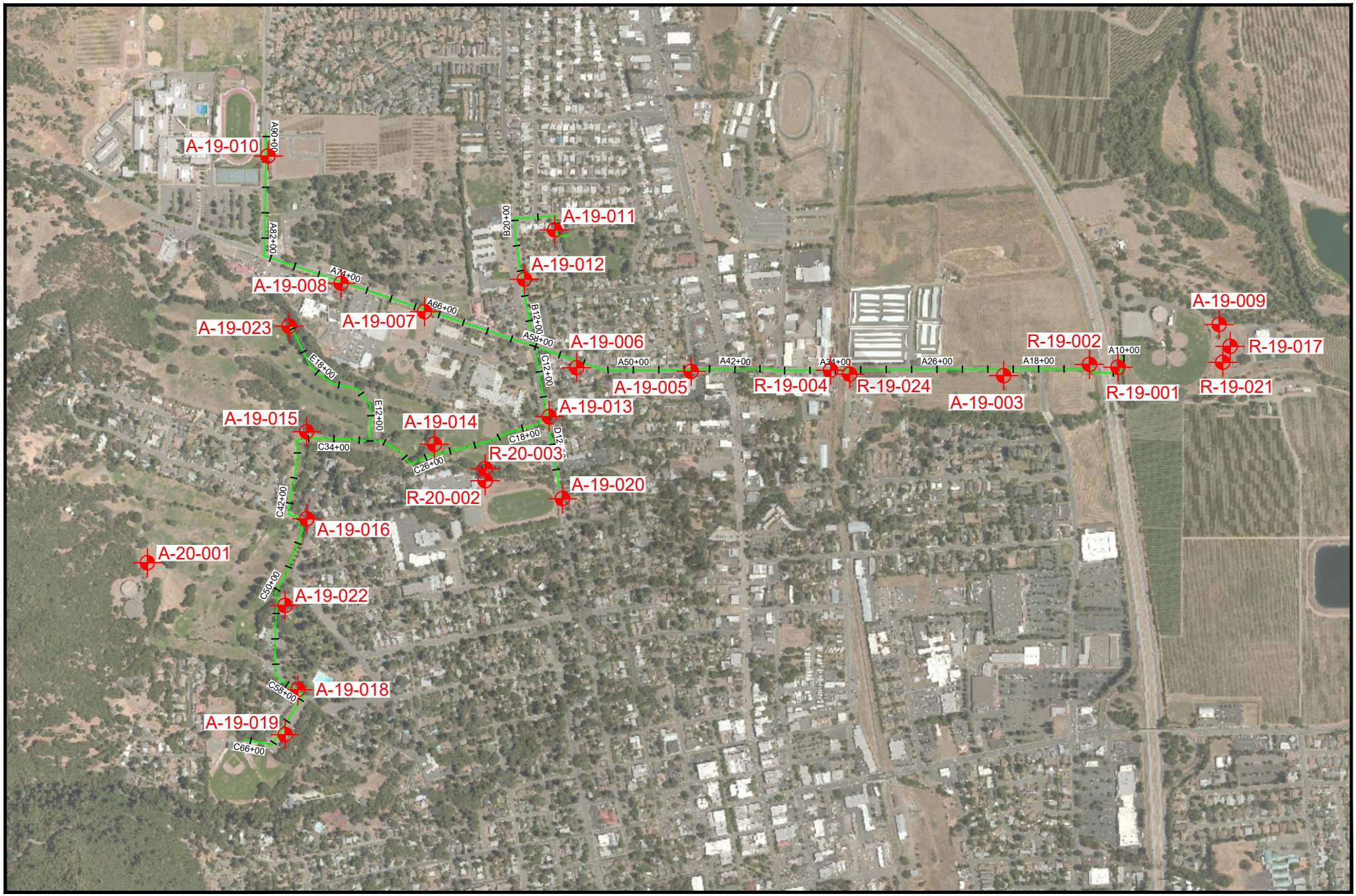
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City of Ukiah Recycled Water Pipeline

Ukiah, California

Figure 1
Vicinity Map

Proj. No: 19-503.1
Scale: 1"=3,000'
Date: 7/9/19



North

LEGEND

R-19-001 BORING LOCATIONS

A10+00 PROJECT ALIGNMENT

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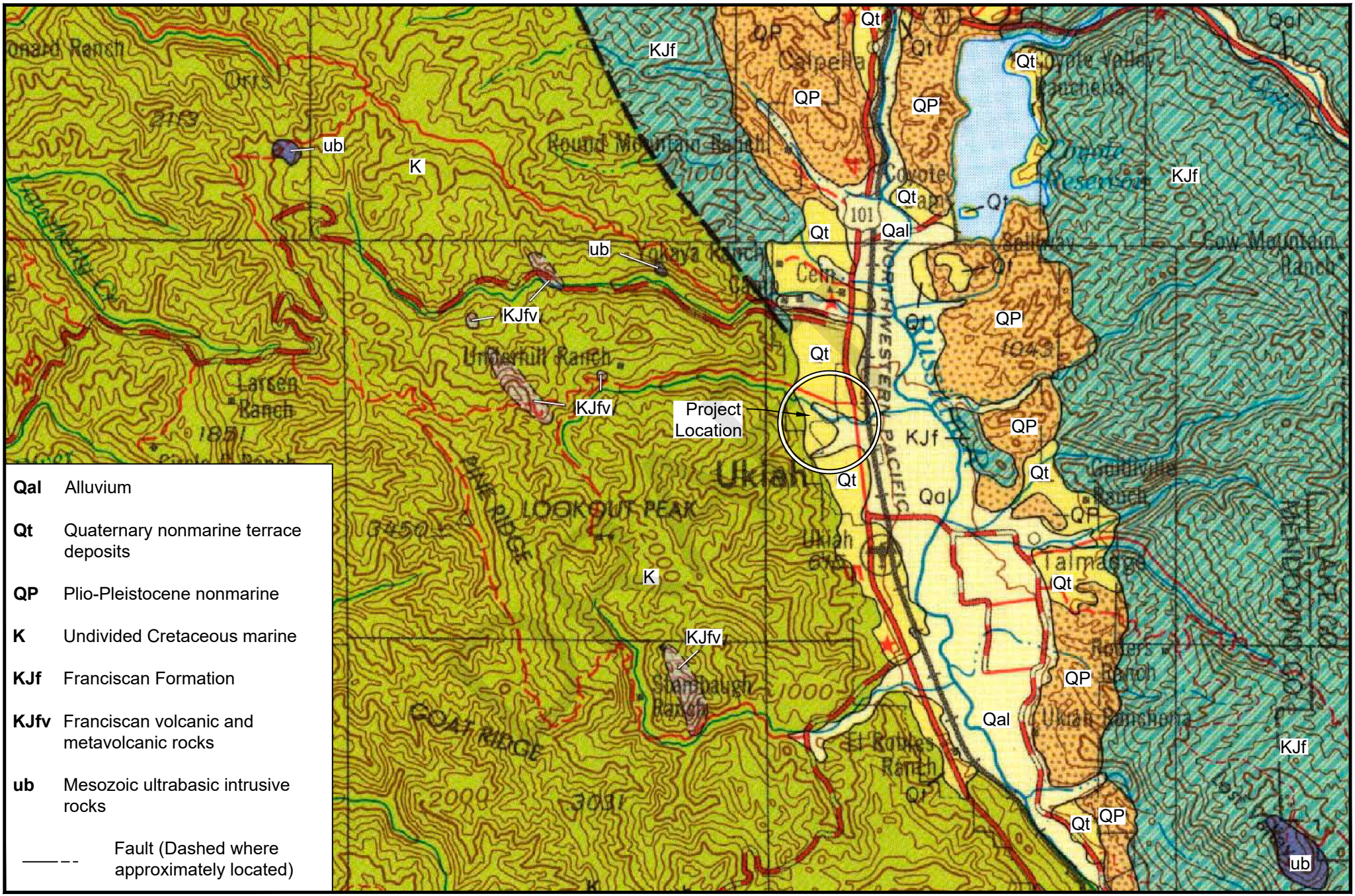
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City of Ukiah Recycled Water Pipeline

Ukiah, California

Figure 2
Site Map

Proj. No:	19-503.1
Scale:	1"=1,000'
Date:	12/11/19



Source: Jennings, C.W., and Strand, R.G.. Geologic map of California : Ukiah sheet. Scale: 1:250,000. California: California Division of Mines and Geology, 1960.

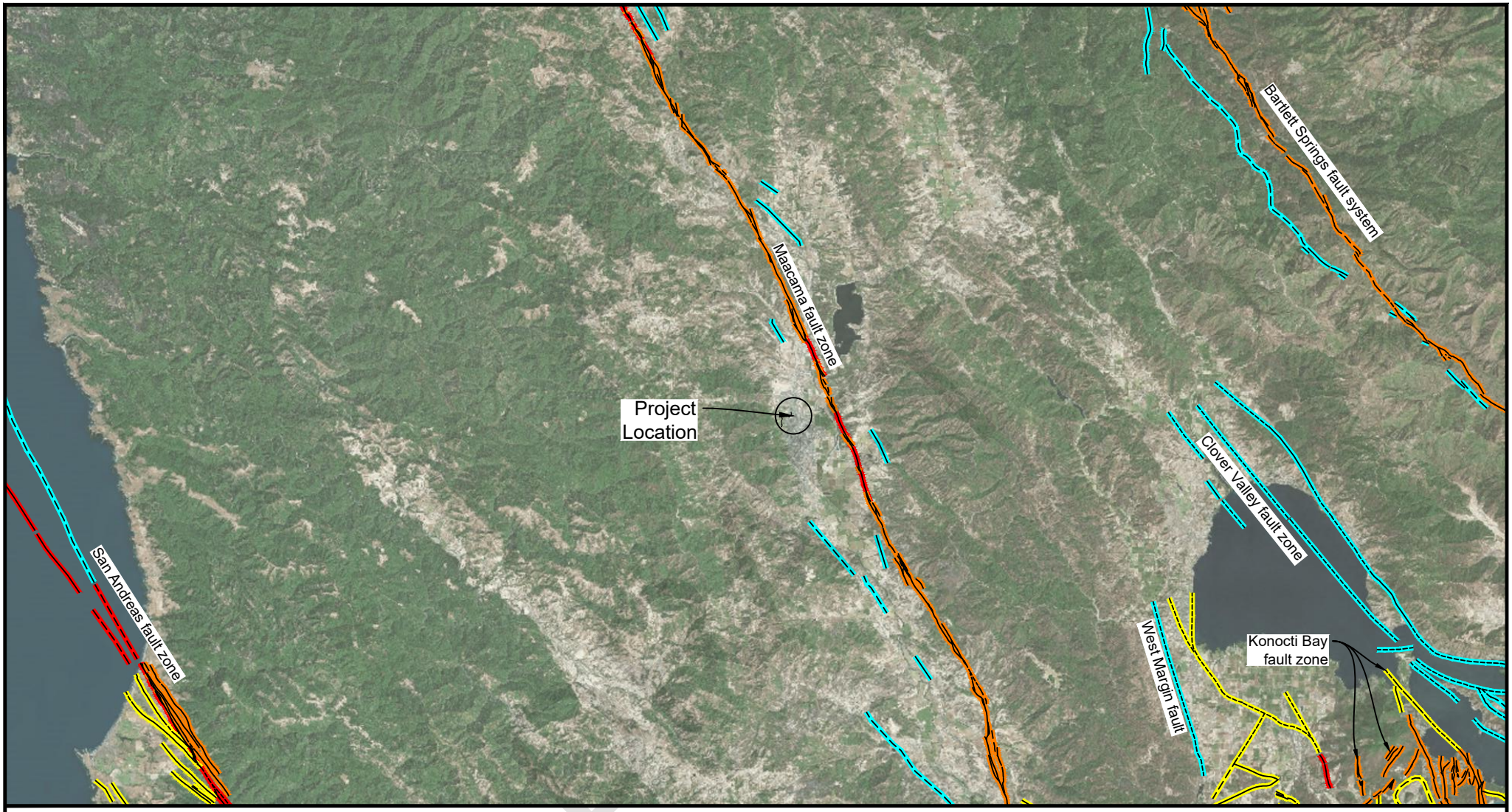
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City of Ukiah Recycled Water Pipeline

Ukiah, California

Figure 3
Geologic Map

Proj. No: 19-503.1
Scale: 1"=10,000'
Date: 12/14/20



LEGEND

Quaternary Fault (Age)	Quaternary Fault (Age)	Location
<150 years	<1.6 million years	Well Constrained
<15,000 years		Moderately Constrained
<130,000 years		Inferred

North

Source:
Basemap: AutoCAD Civil3D Geolocation Tool, using Bing Maps

Fault Data: USGS GIS Data

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City of Ukiah Recycled Water Pipeline

Ukiah, California

Figure 4
Fault Activity Map

Proj. No: 19-503.1
Scale: 1"=30,000'
Date: 12/14/20

APPENDIX II

Boring Log Legend
Boring Logs

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GROUP SYMBOLS AND NAMES

Graphic / Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic / Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY elastic ELASTIC SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTS

C	Consolidation
CL	Collapse Potential
CP	Compaction Curve
CR	Corrosion, Sulfates, Chlorides
CU	Consolidated Undrained Triaxial
DR	Drained Residual Shear Strength
DS	Direct Shear
EI	Expansion Index
M	Moisture Content
OC	Organic Content
P	Permeability
PA	Particle Size Analysis
PI	Liquid Limit, Plastic Limit, Plasticity Index
PL	Point Load Index
PM	Pressure Meter
PP	Pocket Penetrometer
R	R-Value
SE	Sand Equivalent
SG	Specific Gravity
SW	Swell Potential
TV	Pocket Torvane
UC	Unconfined Compression - Soil
	Unconfined Compression - Rock
UU	Unconsolidated Undrained Triaxial
UW	Unit Weight

SAMPLER GRAPHIC SYMBOLS

- Standard Penetration Test (SPT)
- Standard California Sampler (ID 2.0 in.)
- Modified California Sampler (ID 2.5 in.)
- Shelby Tube
- Piston Sampler
- NX Rock Core
- HQ Rock Core
- Bulk Sample
- Other (see remarks)

DRILLING METHOD SYMBOLS

- Auger Drilling
- Rotary Drilling
- Dynamic Cone or Hand Driven
- Diamond Core

WATER LEVEL SYMBOLS

- First Water Level Reading (during drilling)
- Static Water Level Reading (short-term)
- Static Water Level Reading (long-term)

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010) with Errata Sheet (2015).

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Boring Record Legend

Soil Legend | Sheet 1 of 2

CONSISTENCY OF COHESIVE SOILS				
Descriptor	**Unconfined Compressive Strength (tsf)**	**Pocket Penetrometer (tsf)**	**Torvane (tsf)**	**Field Approximation**
Very Soft	< 0.25	< 0.25	< 0.12	Easily penetrated several inches by fist
Soft	0.25 - 0.50	0.25 - 0.50	0.12 - 0.25	Easily penetrated several inches by thumb
Medium Stiff	0.50 - 1.0	0.50 - 1.0	0.25 - 0.50	Can be penetrated several inches by thumb with moderate effort
Stiff	1.0 - 2.0	1.0 - 2.0	0.50 - 1.0	Readily indented by thumb but penetrated only with great effort
Very Stiff	2.0 - 4.0	2.0 - 4.0	1.0 - 2.0	Readily indented by thumbnail
Hard	> 4.0	> 4.0	> 2.0	Indented by thumbnail with difficulty

APPARENT DENSITY OF COHESIONLESS SOILS	
Descriptor	**SPT N_{60} (blows / 12 inches)**
Very Loose	0 - 5
Loose	5 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

MOISTURE	
Descriptor	**Criteria**
Dry	No discernable moisture
Moist	Moisture present, but no free water
Wet	Visible free water

PERCENT OR PROPORTION OF SOILS	
Descriptor	**Criteria**
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

SOIL PARTICLE SIZE		
Descriptor		**Size**
Boulder		> 12 inches
Cobble		3 to 12 inches
Gravel	Coarse	3/4 inch to 3 inches
	Fine	No. 4 Sieve to 3/4 inch
Sand	Coarse	No. 10 Sieve to No. 4 Sieve
	Medium	No. 40 Sieve to No. 10 Sieve
	Fine	No. 200 Sieve to No. 40 Sieve
Silt and Clay		Passing No. 200 Sieve

PLASTICITY OF FINE-GRAINED SOILS	
Descriptor	**Criteria**
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll, and not much time is required to reach the plastic limit; it cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

CEMENTATION	
Descriptor	**Criteria**
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).

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Boring Record Legend

Soil Legend

Sheet 2 of 2

LOG OF BORING R-19-001

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: AC
DEPTH OF BORING: 50.5 (ft)

BEGIN DATE: 3/14/2019
COMPLETION DATE: 3/14/2019
SURFACE ELEVATION: 608 (ft)*
SURFACE CONDITION: Soil
WATER DEPTH: Not Established
READING TAKEN: N/A
HAMMER EFFICIENCY: 70 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger & Rotary Wash
DRILL RIG: CME 75 Track
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: Bulk; CAL (2.4" ID); SPT (1.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Tremie Grout

FIELD									LABORATORY							
ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
605	0	Bulk	1					Lean CLAY (CL); very stiff; brown; moist; few SAND; mostly medium plasticity, very high dry strength, low toughness fines.	100								
	5		1	5 10 10	20	2.50		About 14% SAND; mostly medium plasticity fines.	56				19.5	97.9	86		
600			2	5 7 8	15	1.50		Stiff.	83		30	17	18	109.7			Unconfined Compressive Strength Unconfined = 5,069 psf
	10		3	8 15 15	30	3.50		Very stiff; trace fine GRAVEL.	67				17.9	111.9			Proposed trenchless crossing pipe invert depth.
595			4	6 9 13	22	3.50			94				20.4	108.7			
	15		5	12 19 21	40	2.75		Little fine SAND.	67				19.8	106.6			Unconfined Compressive Strength Unconfined = 6,840 psf
590			6	5 6 8	14	2.00			100				22.7	107			
	20		7	9 12 12	24	1.50		Stiff.	83				22	107			Switched to end discharge (94mm) mud rotary.
585	25		8	4 9 5	14			Some medium to fine SAND.	33								
580			9	7 24 50/5	74/11	2.00		Very stiff. Some SAND.	100								
	30		10	24 50/5	50/5			Poorly graded GRAVEL with CLAY and SAND (GP-GC); very dense; brown; moist; mostly coarse to fine GRAVEL; little medium SAND; few low to medium plasticity fines.	100								Drill Chatter
575	35		11	22 50				Trace low to medium plasticity fines.	100								

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: R-19-001
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 2

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LABORATORY: LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
570	40		12	30 35 31	66			Poorly graded GRAVEL with CLAY and SAND (GP-GC) *(continued)*. Some medium to fine SAND; little low to medium plasticity fines.	67									
565																		
560	45		13	44 50/4	50/4				80									
555	50		14	50				Bottom of borehole at 50.5 ft bgs Groundwater not established due to drilling method.	67									
550	55																	
545	60																	
540	65																	
535	70																	
530	75																	
	80																	

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: R-19-001
ENTRY BY: AC
CHECKED BY: KKL SHEET 2 of 2

LOG OF BORING R-19-002

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: AC
DEPTH OF BORING: 41.5 (ft)

BEGIN DATE: 3/22/2019
COMPLETION DATE: 3/22/2019
SURFACE ELEVATION: 603.2 (ft)*
SURFACE CONDITION: Soil
WATER DEPTH: Not Established
READING TAKEN: N/A
HAMMER EFFICIENCY: 77 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger & Rotary
DRILL RIG: CME 55 Truck
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Tremie Grout

FIELD									LABORATORY							
ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
600	0							Lean CLAY (CL); stiff; brown; moist; few medium to fine SAND; mostly medium plasticity fines.									
	5		1	3 5 6	11	1.50		About 7% medium to fine SAND.	67				25.2	98.1	93		Unconfined Compressive Strength Unconfined = 2,016 psf
595																	
	10		2	5 7 12	19	3.00		Very stiff; about 28% coarse to fine SAND; mostly medium plasticity fines.	100				18.6	111	72		Proposed trenchless crossing pipe invert depth. Corrosion pH = 6.14 Min. Resist. = 2,650 ohm-cm Chlorides = 1.5 ppm Sulfates = 5.7 ppm
590																	
	15		3	PUSH 9 16	25	3.00		Few fine GRAVEL.	100				25.9	98.5			Switched to end discharge (94mm) mud rotary.
585																	
	20		4	7 11 12	23	1.00		Stiff; mottled gray.	72				23.4	105.4			
580																	
	25		5	4 4 7	11	0.50		Soft to medium stiff; gray.	100				24.1	98.1			
575																	
	30		6	PUSH 2 20	22			CLAYEY SAND (SC); medium dense; gray; wet; mostly medium SAND; little nonplastic to low plasticity fines.	67								Drill Chatter
570								Poorly graded GRAVEL with CLAY (GP-GC); very dense; gray; moist; mostly fine GRAVEL; some medium SAND; little nonplastic to low plasticity fines.									
	35		7	27 46 40	86				67								

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: R-19-002
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 2

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
								Poorly graded GRAVEL with CLAY (GP-GC) *(continued)*.										
565	40		8	30 32 35	67			CLAYEY GRAVEL (GC); very dense; moist; mostly fine GRAVEL; little medium SAND; some low plasticity fines.	83									
								Bottom of borehole at 41.5 ft bgs Groundwater not established due to drilling method.										
560	45																	
555	50																	
550	55																	
545	60																	
540	65																	
535	70																	
530	75																	
525	80																	

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: R-19-002
ENTRY BY: AC
CHECKED BY: KKL SHEET 2 of 2

LOG OF BORING A-19-003

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: HFW
DEPTH OF BORING: 21.3 (ft)

BEGIN DATE: 3/20/2019
COMPLETION DATE: 3/20/2019
SURFACE ELEVATION: 605 (ft)*
SURFACE CONDITION: Soil
WATER DEPTH: Not Encountered
READING TAKEN: N/A
HAMMER EFFICIENCY: 70 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger
DRILL RIG: CME 75 Track
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Free Fall

FIELD								LABORATORY								
ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
	0							Lean CLAY (CL); stiff; brown; moist; mostly medium plasticity, medium toughness fines.									
			1	4 7 10	17	1.75			100				32.1	89			Unconfined Compressive Strength Unconfined = 2,477 psf
600	5		2	4 4 7	11	2.00		Very stiff.	100				25.4	104.4			
			3	5 10 14	24	2.50			67				25	101			
595	10		4	4 7 9	16	2.00			100								
590	15		5	8 15 31	46	3.75		Few fine SAND; mottled orange brown and gray.	50								
								CLAYEY SAND (SC); medium dense; gray; moist; little coarse to fine, subrounded GRAVEL; mostly coarse to fine SAND; some medium plasticity fines.									
585	20		6	36 41 50/4	91/10			Little medium plasticity fines.	38								
								Bottom of borehole at 21.3 ft bgs									
580	25																
575	30																
570	35																

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: A-19-003
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING R-19-004

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: AC
DEPTH OF BORING: 51.5 (ft)

BEGIN DATE: 3/21/2019
COMPLETION DATE: 3/21/2019
SURFACE ELEVATION: 613.0 (ft)*
SURFACE CONDITION: Asphalt
WATER DEPTH: 7.6(ft.)
READING TAKEN: 3/21/19
HAMMER EFFICIENCY: 77 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger & Rotary
DRILL RIG: CME 55 Truck
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: Bulk; CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Tremie Grout

FIELD									LABORATORY							
ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
610	0		Bulk 1					ASPHALT.	100		25	14	23.5	106.9			AC = 5" AB = 6" Corrosion pH = 6.89 Min. Resist. = 3,480 ohm-cm Chlorides = 1.4 ppm Sulfates = 15.0 ppm
								Aggregate Base (AB).									
								SANDY lean CLAY (CL); soft; brown; moist; trace GRAVEL; few fine SAND; mostly medium plasticity, low to medium toughness fines.									
	5		1	3 3 8	11	0.50		About 3% fine GRAVEL; about 44% coarse to fine SAND; mostly medium plasticity fines.	83				19.9	101.7	53		
605								SANDY lean CLAY (CL); gray; some medium to fine SAND.									
	10		2	PUSH 4 4	8	0.50			100				22.8	103.8			Unconfined Compressive Strength Unconfined = 749 psf
600								Lean CLAY with SAND (CL); very stiff to hard; little fine SAND; mostly medium to high plasticity, medium toughness fines.									
	15		3	6 13 20	33	+4.50			72				23.5	106.9			Switched to end discharge (94mm) mud rotary.
595								Poorly graded GRAVEL with SAND (GP); very dense; light reddish brown; moist; mostly coarse to fine GRAVEL; some medium SAND; few medium plasticity fines.									
	20		4	24 28 44	72				78								
590								Poorly graded SAND with GRAVEL (SP); very dense; brown; moist; some fine GRAVEL; mostly coarse to medium SAND; few fines.									
	25		5	15 40 44	84				89								Drill Chatter
585								Poorly graded GRAVEL with SAND (GP); very dense; gray; moist; mostly coarse to fine GRAVEL; some medium SAND; few fines.									
	30		6	10 20 50/4	70/10				100								Driller Note: Drilling material became very soft.
580																	
	35		7	7 11 26	37			Dense.	0								

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: R-19-004
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 2

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
								Poorly graded GRAVEL with SAND (GP) *(continued)*.										
575								Poorly graded GRAVEL with CLAY (GP-GC); dense; gray; moist; mostly coarse to fine GRAVEL; little low to medium plasticity fines.										
	40		8	11 22 13	35	3.00			67									
570								Lean CLAY (CL); very stiff; brown; moist; trace medium to fine SAND; mostly medium plasticity, medium toughness fines; varigated gray.										
	45		9	11 16 21	37			CLAYEY SAND (SC); dense; gray; moist; trace fine GRAVEL; mostly medium SAND; little low to medium plasticity fines.	50									
565								Lean CLAY (CL); very stiff; gray; moist; trace fine SAND; mostly medium plasticity, medium toughness fines.										
	50		10	10 16 24	40	3.00			67									
								Bottom of borehole at 51.5 ft bgs										
560	55																	
555	60																	
550	65																	
545	70																	
540	75																	
535	80																	

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: R-19-004
ENTRY BY: AC
CHECKED BY: KKL SHEET 2 of 2

LOG OF BORING A-19-005

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: AC
DEPTH OF BORING: 21.6 (ft)

BEGIN DATE: 3/21/2019
COMPLETION DATE: 3/21/2019
SURFACE ELEVATION: 638.5 (ft)*
SURFACE CONDITION: Asphalt
WATER DEPTH: Not Encountered
READING TAKEN: N/A
HAMMER EFFICIENCY: 77 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger
DRILL RIG: CME 55 Truck
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Free Fall

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
	0							ASPHALT.										AC = 3"
								Aggregate Base (AB).										AB = 3"
635								CLAYEY SAND (SC); medium dense; brown; moist; mostly medium to fine SAND; little low to medium plasticity fines; weak cementation.										
	5		1	14 19 15	34				89				10.7	119.8	18			
630			2	13 28 26	54			Very dense.	94				11.3	128.7				
	10		3	20 18 16	34			Dense.	94									
625																		
	15		4	21 29 28	57			Very dense; moderate cementation.	100									
620								Poorly graded SAND with CLAY and GRAVEL (SP-SC); dense; brown; moist; little coarse to fine GRAVEL; mostly medium SAND; little low to medium plasticity fines.										
	20		5	14 16 23	39				100									
615								Lean CLAY (CL); medium stiff; brown; moist; mostly medium plasticity, medium toughness fines.										Soil classification at bottom of boring classified via shoe of sampler.
	25							Bottom of borehole at 21.6 ft bgs										
610																		
	30																	
605																		
	35																	

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: A-19-005
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING A-19-006

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: AC
DEPTH OF BORING: 21 (ft)

BEGIN DATE: 3/20/2019
COMPLETION DATE: 3/20/2019
SURFACE ELEVATION: 649.1 (ft)*
SURFACE CONDITION: Asphalt
WATER DEPTH: Not Encountered
READING TAKEN: N/A
HAMMER EFFICIENCY: 77 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger
DRILL RIG: CME 55 Truck
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Free Fall

FIELD									LABORATORY							
ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
649	0							ASPHALT.									AC = 3"
								Aggregate Base (AB).									AB = 3"
								CLAYEY SAND with GRAVEL (SC); medium dense; brown; moist; few fine GRAVEL; mostly fine SAND; some low plasticity fines.									
645	5		1	5 6 12	18				100				13.5	116.7	21		
			2	7 5 20	25	+4.50		GRAVELLY lean CLAY (CL); very stiff to hard; brown; moist; little coarse to fine GRAVEL; few fine SAND; mostly medium plasticity, medium toughness fines.	56				10	118.3			
640	10		3	12 32 22	54	+4.50		Little medium to fine SAND.	72								
635	15		4	2 4 22	26	+4.50		Trace fine SAND.	67								
								Lean CLAY with GRAVEL (CL); very stiff; brown; moist; little coarse to fine GRAVEL; mostly medium plasticity, low toughness fines.									
630	20		5	4 50/5	50/5	+4.50		Bottom of borehole at 21.0 ft bgs	100								Coarse Gravel found in shoe.
625	25																
620	30																
615	35																

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: A-19-006
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING A-19-007

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: AC
DEPTH OF BORING: 21.5 (ft)

BEGIN DATE: 3/20/2019
COMPLETION DATE: 3/20/2019
SURFACE ELEVATION: 654.3 (ft)*
SURFACE CONDITION: Asphalt
WATER DEPTH: Not Encountered
READING TAKEN: N/A
HAMMER EFFICIENCY: 77 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger
DRILL RIG: CME 55 Truck
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Free Fall

FIELD									LABORATORY							
ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
654	0							Poorly graded GRAVEL with CLAY and SAND (GP-GC); dense; brown; moist; mostly GRAVEL; some SAND; few low to medium plasticity, low to medium toughness fines.									
650	5		1	13 18 23	41			About 52% mostly coarse to fine GRAVEL; about 34% some coarse to fine SAND; few low to medium plasticity fines.	83				8.2	134.2	14		
								Poorly graded GRAVEL with SILT (GP-GM); dense; brown; moist; mostly GRAVEL; little low to medium plasticity, low to medium toughness fines.									
645			2	22 24 20	44				83								
	10		3	5 9 16	25	+4.50		Lean CLAY with SAND (CL); hard; brown; moist; trace fine GRAVEL; little medium to fine SAND; mostly medium plasticity, medium toughness fines.	83								
640								SANDY lean CLAY (CL); very stiff; few fine GRAVEL.									
	15		4	8 15 20	35	4.00			100								
635																	
	20		5	7 6 7	13	1.50		Little fine GRAVEL; some coarse to fine SAND.	61								
								Bottom of borehole at 21.5 ft bgs									
630	25																
625	30																
620	35																

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: A-19-007
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING A-19-008

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: AC
DEPTH OF BORING: 21.5 (ft)

BEGIN DATE: 3/20/2019
COMPLETION DATE: 3/20/2019
SURFACE ELEVATION: 668 (ft)*
SURFACE CONDITION: Asphalt
WATER DEPTH: Not Encountered
READING TAKEN: N/A
HAMMER EFFICIENCY: 77 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger
DRILL RIG: CME 55 Truck
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Free Fall

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
668	0							ASPHALT.										AC = 3"
								Aggregate Base (AB).										AB = 3"
665								SANDY lean CLAY (CL); very stiff; reddish brown; moist; little medium to fine SAND; mostly medium plasticity, medium toughness fines.										
	5		1	3 5 8	13	3.50			83		23	15	13.3	118.9				
660			2	7 13 20	33	+4.50		Hard; some medium SAND.	94									Corrosion pH = 5.71 Min. Resist. = 10,990 ohm-cm Chlorides = 0.5 ppm Sulfates = 5.9 ppm
	10		3	17 27 30	57	+4.50			100									
655																		
	15		4	16 32 43	75	+4.50			89									
650																		
	20		5	12 21 40	61	+4.50		Some fine GRAVEL.	100									
								Bottom of borehole at 21.5 ft bgs										
645																		
	25																	
640																		
	30																	
635																		
	35																	

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: A-19-008
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING A-19-009

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: AC
DEPTH OF BORING: 35.5 (ft)

BEGIN DATE: 3/18/2019
COMPLETION DATE: 3/18/2019
SURFACE ELEVATION: 600 (ft)*
SURFACE CONDITION: Soil
WATER DEPTH: 14(ft.)
READING TAKEN: 3/17/19
HAMMER EFFICIENCY: 70 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger & Rotary
DRILL RIG: CME 75 Track
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: Bulk; CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Tremie Grout

FIELD									LABORATORY							
ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
600	0		Bulk 1					Poorly graded GRAVEL with SILT (GP-GM); medium dense; brown; moist; mostly GRAVEL; some coarse to fine SAND; few low plasticity fines.	100								
595	5		1	9 10 13	23			About 60% mostly coarse to fine GRAVEL; about 34% some coarse to fine SAND; few low plasticity fines.	89				3.4	115.9	6		
590	10		2	13 17 19	36			Dense.	94								
		▽															Ground water encountered.
585	15		3	5 8 11	19			Medium dense.	67				9.3	135.2	9		Switched to end discharge (94mm) mud rotary.
580	20		4	13 9 8	17				19				17.5				
575	25		5	20 22 25	47			Dense.	61								
570	30		6	28 35 42	77			Very dense; few fines.									
565	35		7	50				Very dense.	50								
								Bottom of borehole at 35.5 ft bgs									

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: A-19-009
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING A-19-010

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: AC
DEPTH OF BORING: 21.5 (ft)

BEGIN DATE: 3/20/2019
COMPLETION DATE: 3/20/2019
SURFACE ELEVATION: 687.3 (ft)*
SURFACE CONDITION: Asphalt
WATER DEPTH: Not Encountered
READING TAKEN: N/A
HAMMER EFFICIENCY: 77 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger
DRILL RIG: CME 55 Truck
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: Bulk; CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Free Fall

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LABORATORY: LIQUID LIMIT	LABORATORY: PLASTIC LIMIT	LABORATORY: MOISTURE (%)	LABORATORY: D. DENSITY (PCF)	LABORATORY: % PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
687.3	0	Bulk	1					ASPHALT.	100						23		AC = 3"
								Aggregate Base (AB).									AB = 3"
685								CLAYEY SAND with GRAVEL (SC); dense; brown; moist; about 31% mostly fine GRAVEL; about 46% little medium SAND; some low to medium plasticity fines.									
	5		1	11 16 21	37				83				13.8	112.2			
680								SILT with GRAVEL (ML); dense; brown; moist; little fine GRAVEL; mostly low to medium plasticity fines.									
			2	18 13 17	30	+4.50			83								
	10							Poorly graded SAND with SILT (SP-SM); very dense; brown; moist; some GRAVEL; few medium SAND; mostly low to medium plasticity fines.									
			3	8 23 29	52				94								
675								Poorly graded SAND with GRAVEL (SP); medium dense; brown; moist; little fine GRAVEL; mostly medium SAND; trace fines.									
	15		4	3 8 21	29				83								
670								Poorly graded GRAVEL with CLAY (GP-GC); medium dense; brown; moist; mostly GRAVEL; little medium SAND; few fines.									
	20		5	5 14 13	27				100								
665								Bottom of borehole at 21.5 ft bgs									
	25																
660																	
	30																
655																	
	35																

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: A-19-010
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING A-19-011

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: AC
DEPTH OF BORING: 21.5 (ft)

BEGIN DATE: 3/20/2019
COMPLETION DATE: 3/20/2019
SURFACE ELEVATION: 653.3 (ft)*
SURFACE CONDITION: Asphalt
WATER DEPTH: 12(ft.)
READING TAKEN: 3/2019
HAMMER EFFICIENCY: 77 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger
DRILL RIG: CME 55 Truck
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Free Fall

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LABORATORY: LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
653.3	0							ASPHALT.									AC = 3"
								Aggregate Base (AB).									AB = 5"
								SANDY lean CLAY (CL); very stiff; brown; moist; trace fine SAND; mostly medium plasticity, medium toughness fines.									
650	5		1	6 10 17	27	3.50			100		35	23	20.7	106.2	52		
								Lean CLAY with GRAVEL (CL); hard; brown; moist; some fine GRAVEL; mostly medium plasticity fines.									
645			2	12 16 16	32	+4.50			100								
	10		3	11 14 15	29	+4.50			100								
640		▼															Ground water encountered.
	15		4	5 4 32	36				0								Sample came back soaked. Large gravel found in shoe. No recovery.
635																	
	20		5	18 24 28	52	+4.50			44								
630								Bottom of borehole at 21.5 ft bgs									
	25																
625																	
	30																
620																	
	35																

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: A-19-011
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING A-19-012

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: AC
DEPTH OF BORING: 21.5 (ft)

BEGIN DATE: 3/21/2019
COMPLETION DATE: 3/21/2019
SURFACE ELEVATION: 654.9 (ft)*
SURFACE CONDITION: Asphalt
WATER DEPTH: 17(ft.)
READING TAKEN: 3/21/19
HAMMER EFFICIENCY: 77 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger
DRILL RIG: CME 55 Truck
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Free Fall

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LABORATORY: LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
	0							CLAYEY SAND with GRAVEL (SC); dense; tan; moist; some fine GRAVEL; mostly fine SAND; some low plasticity fines; weak cementation.										AC=3" AB=3"
650	5		1	7 14 20	34			About 26% fine GRAVEL; about 52% mostly fine SAND; some low plasticity fines.	89				12.3	120.4	22			
			2	21 30 35	65			Very dense; moderate cementation.	100									
645	10		3	19 25 26	51			Some fine GRAVEL.	100									
640	15		4	15 15 16	31			Poorly graded GRAVEL with CLAY and SAND (GP-GC); dense; brown; moist to wet; mostly coarse to fine GRAVEL; some coarse to fine SAND; little low to medium plasticity fines.	94									Ground water encountered.
635	20		5	15 30 33	63			CLAYEY SAND (SC); very dense; tan; moist; few fine GRAVEL; mostly medium SAND; some low to medium plasticity, low to medium toughness fines.	100									
630	25							Bottom of borehole at 21.5 ft bgs										
625	30																	
620	35																	

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: A-19-012
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING A-19-013

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: HFW
DEPTH OF BORING: 21.5 (ft)

BEGIN DATE: 3/21/2019
COMPLETION DATE: 3/21/2019
SURFACE ELEVATION: 641.4 (ft)*
SURFACE CONDITION: Asphalt
WATER DEPTH: Not Encountered
READING TAKEN: N/A
HAMMER EFFICIENCY: 70 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger
DRILL RIG: CME 75 Track
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Free Fall

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LABORATORY: LIQUID LIMIT	LABORATORY: PLASTIC LIMIT	LABORATORY: MOISTURE (%)	LABORATORY: D. DENSITY (PCF)	LABORATORY: % PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
640	0							ASPHALT.									AC = 3"
								Aggregate Base (AB).									AB = 3"
								CLAYEY SAND with GRAVEL (SC); brown; moist; little coarse to fine GRAVEL; mostly coarse to fine SAND; some medium plasticity fines.	89								
			1	8 10 17	27	+4.50		Lean CLAY (CL); hard; orange brown; moist; little fine SAND; mostly medium plasticity fines.			29	18	21.3	104.3	79		
635	5		2	11 19 27	46	+4.50			78				19	111.1			
			3	12 16 22	38	+4.50		GRAVELLY lean CLAY (CL); hard; brown; dry to moist; some fine, rounded GRAVEL; little coarse to fine SAND; mostly medium plasticity fines.	83								
630	10		4	8 17 24	41			CLAYEY SAND with GRAVEL (SC); dense; moist; little coarse to fine GRAVEL; mostly coarse to fine SAND; some medium plasticity fines; weak cementation; mottled brownish orange and brown.	83								
625	15		5	12 21 32	53			Very dense.	100								
620	20		6	11 14 22	36			Dense.	100								
								Bottom of borehole at 21.5 ft bgs									
615	25																
610	30																
605	35																

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: A-19-013
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING A-19-014

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: HFW
DEPTH OF BORING: 21.33 (ft)

BEGIN DATE: 3/22/2019
COMPLETION DATE: 3/22/2019
SURFACE ELEVATION: 638.2 (ft)*
SURFACE CONDITION: Soil
WATER DEPTH: 12(ft.)
READING TAKEN: 3/22/19
HAMMER EFFICIENCY: 70 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger
DRILL RIG: CME 75 Track
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Free Fall

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LABORATORY: LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
638	0							Poorly graded GRAVEL with CLAY and SAND (GP-GC); medium dense; brown; moist; mostly coarse to fine GRAVEL; mostly coarse to fine SAND; some medium plasticity fines.										
635			1	4 7 9	16			About 54% mostly coarse to fine GRAVEL; about 32% mostly coarse to fine SAND; some medium plasticity fines.	78						14			
	5		2	5 4 3	7			Loose.	50				14.3	113.6				
630			3	5 6 6	12			Medium dense.	61				14.7	122.3				
	10		4	4 7 10	17				67									Ground water encountered.
625																		Cobbles coming up in cuttings.
	15		5	11 12 23	35			CLAYEY GRAVEL with SAND (GC); dense; brown; wet; mostly coarse to fine GRAVEL; little coarse to fine SAND; some medium plasticity fines.	100									
620																		
	20		6	21 40 50/4	90/10			Very dense.	38									
								Bottom of borehole at 21.3 ft bgs										
615																		
	25																	
610																		
	30																	
605																		
	35																	

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: A-19-014
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING A-19-015

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: HFW
DEPTH OF BORING: 20.92 (ft)

BEGIN DATE: 3/21/2019
COMPLETION DATE: 3/21/2019
SURFACE ELEVATION: 668.7 (ft)*
SURFACE CONDITION: Soil
WATER DEPTH: 19(ft.)
READING TAKEN: 3/21/19
HAMMER EFFICIENCY: 70 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger
DRILL RIG: CME 75 Track
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Free Fall

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LABORATORY: LIQUID LIMIT	LABORATORY: PLASTIC LIMIT	LABORATORY: MOISTURE (%)	LABORATORY: D. DENSITY (PCF)	LABORATORY: % PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
	0							CLAYEY SAND (SC); loose; brown; moist; trace fine GRAVEL; mostly coarse to fine SAND; some medium plasticity fines; weak cementation.										
665			1	6 6 9	15				61				10.6		23			
	5		2	3 4 5	9	0.50		SANDY lean CLAY (CL); medium stiff; dark brown; moist; trace fine, subrounded GRAVEL; some coarse to fine SAND; mostly medium plasticity, very high dry strength, medium toughness fines.	89		23	15						
660			3	5 9 13	22	3.50		Very stiff.	100									
	10		4	4 16 20	36	+4.50		GRAVELLY lean CLAY with SAND (CL); hard; dark brown; dry to moist; some fine, subangular to subrounded GRAVEL; little coarse to medium SAND; mostly medium plasticity fines.	89									
655																		
	15		5	7 21 50/5.5	71/12	+4.50		Dark brown, black; moderate cementation.	100									Driller note: Material was very hard.
650		▽																Ground water encountered.
	20		6	19 50/5	50/5				100									Decomposed Rock.
								Bottom of borehole at 20.9 ft bgs										
645																		
	25																	
640																		
	30																	
635																		
	35																	

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: A-19-015
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING A-19-016

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: HFW
DEPTH OF BORING: 21.5 (ft)

BEGIN DATE: 3/21/2019
COMPLETION DATE: 3/21/2019
SURFACE ELEVATION: 680.2 (ft)*
SURFACE CONDITION: Asphalt
WATER DEPTH: 9(ft.)
READING TAKEN: 3/21/19
HAMMER EFFICIENCY: 70 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger
DRILL RIG: CME 75 Track
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: Bulk; CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Free Fall

FIELD									LABORATORY							
ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
680	0	Bulk	1					ASPHALT.	100								AC = 3"
								Aggregate Base (AB).									AB = 3"
								Poorly graded SAND with CLAY and GRAVEL (SP-SC); medium dense; brown; dry; little fine, subrounded GRAVEL; mostly coarse to fine SAND; few nonplastic fines. Some coarse to fine GRAVEL.								
			1	12 15 12	27				67				4.3	116.8			
675	5		2	6 14 19	33			Poorly graded GRAVEL with CLAY and SAND (GP-GC); medium dense; brown; moist; mostly coarse to fine, rounded GRAVEL; some coarse to fine SAND; few nonplastic fines.	67				4.7	121.7			
			3	5 7 8	15				56				4.3				Ground water encountered.
670	10		4	2 2 2	4			Lean CLAY (CL); stiff; orangish brown; moist to wet; trace fine SAND; mostly medium plasticity fines.	0								Driller Note: Material became very soft.
665	15		5	1 1 27	28	1.50			100								
660	20		6	22 35 46	81	2.50		Very stiff.	100								
								Bottom of borehole at 21.5 ft bgs									
655	25																
650	30																
645	35																

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: A-19-016
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING R-19-017

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: AC
DEPTH OF BORING: 51.5 (ft)

BEGIN DATE: 3/19/2019
COMPLETION DATE: 3/19/2019
SURFACE ELEVATION: 601.5 (ft)*
SURFACE CONDITION: Soil
WATER DEPTH: Not Established
READING TAKEN: N/A
HAMMER EFFICIENCY: 70 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger & Rotary
DRILL RIG: CME 75 Track
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: Bulk; CAL (2.4" ID); SPT (1.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Tremie Grout

FIELD									LABORATORY							
ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
600	0		Bulk 1					Poorly graded SAND with CLAY and GRAVEL (SP-SC); dense; gray; moist; mostly coarse to fine GRAVEL; some medium SAND; trace fines.	100								
595	5		1	6 17 18	35			SILTY SAND with GRAVEL (SM); dense; gray; moist; about 36% some fine GRAVEL; about 45% mostly medium SAND; little fines.	72				5	124.6	19		
590	10		2	6 10 17	27			Medium dense; few fines.	67				3.6				Switched to end discharge (94mm) mud rotary.
585	15		3	15 24 27	51			Very dense; wet.	22								
580	20		4	15 15 18	33			Poorly graded SAND with SILT and GRAVEL (SP-SM); medium dense; brown; wet; some fine GRAVEL; mostly medium SAND; little fines.	50				8.2	141.9	13		
575	25		5	11 15 7	22				17				10.9	139.2			
570	30		6	15 12 7	19				17				9.8	140.7	10		
565	35		7	30 33 38	71			CLAYEY SAND with GRAVEL (SC); very dense; tan; wet; little fine GRAVEL; mostly medium SAND; some fines.	47								

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: R-19-017
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 2

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
								CLAYEY SAND with GRAVEL (SC) *(continued)*.										
	40							Poorly graded GRAVEL with CLAY and SAND (GP-GC); dense; tan; wet; mostly GRAVEL; some medium SAND; few fines.										
560			8	17 21 28	49				50									
	45		9	37 50				Very dense.	50									
555																		
	50		10	20 33 35	68				58									
550								Bottom of borehole at 51.5 ft bgs Groundwater not established due to drilling method.										
545	55																	
	60																	
540																		
	65																	
535																		
	70																	
530																		
	75																	
525																		
	80																	

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: R-19-017
ENTRY BY: AC
CHECKED BY: KKL SHEET 2 of 2

LOG OF BORING A-19-018

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: HFW
DEPTH OF BORING: 20.75 (ft)

BEGIN DATE: 3/22/2019
COMPLETION DATE: 3/22/2019
SURFACE ELEVATION: 704.7 (ft)*
SURFACE CONDITION: Asphalt
WATER DEPTH: Not Encountered
READING TAKEN: N/A
HAMMER EFFICIENCY: 70 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger
DRILL RIG: CME 75 Track
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Free Fall

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LABORATORY: LIQUID LIMIT	LABORATORY: PLASTIC LIMIT	LABORATORY: MOISTURE (%)	LABORATORY: D. DENSITY (PCF)	LABORATORY: % PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
	0							ASPHALT.									AC = 2"
								Aggregate Base (AB).									AB = 2"
								Lean CLAY (CL); hard; brownish orange; moist; some fine SAND; mostly medium plasticity fines.									
			1	5 10 18	28	+4.50			100		33	17	17.4	114.2			Corrosion pH = 4.90 Min. Resist. = 2,950 ohm-cm Chlorides =1.7 ppm Sulfates = 17.6 ppm
700	5		2	15 21 27	48	+4.50			83				14.9	123.3			
								Poorly graded SAND (SP); very dense; brown; moist; few coarse to fine GRAVEL; mostly fine SAND; trace nonplastic fines; weak cementation.									
			3	40 50					100								
695	10		4	50					100								
								Lean CLAY (CL); hard; brownish orange; dry; little fine SAND; mostly medium plasticity fines.									
690	15		5	42 50/4	50/4				100								
								SEDIMENTARY ROCK (CLAYSTONE), intensely weathered, very soft to soft, Friable, Dark brown, moderately soft nodules.									
685	20		6	40 50/3	50/3				100								
								Bottom of borehole at 20.8 ft bgs									
680	25																
675	30																
670	35																

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: A-19-018
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING A-19-019

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: HFW
DEPTH OF BORING: 7.75 (ft)

BEGIN DATE: 3/22/2019
COMPLETION DATE: 3/22/2019
SURFACE ELEVATION: 709.1 (ft)*
SURFACE CONDITION: Asphalt
WATER DEPTH: Not Encountered(ft.)
READING TAKEN: N/A
HAMMER EFFICIENCY: 70 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger
DRILL RIG: CME 75 Track
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Free Fall

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
								ASPHALT.										AC = 2"
								Lean CLAY (CL); hard; brownish orange; moist; some fine SAND; mostly medium plasticity fines.										
			1	10 14 19	33	+4.50			83									
705								Poorly graded SAND (SP); dense; light gray; dry; mostly fine SAND; trace nonplastic fines.					17	115			
	5		2	13 17 23	40				83									
			3	50/3	REF			Very dense.	100									
700								Bottom of borehole at 7.8 ft bgs										
	10																	
695																		
	15																	
690																		
	20																	
685																		
	25																	
680																		
	30																	
675																		
	35																	

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: A-19-019
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING A-19-020

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: HFW
DEPTH OF BORING: 21.5 (ft)

BEGIN DATE: 3/22/2019
COMPLETION DATE: 3/22/2019
SURFACE ELEVATION: 632.5 (ft)*
SURFACE CONDITION: Asphalt
WATER DEPTH: 7(ft.)
READING TAKEN: 3/22/19
HAMMER EFFICIENCY: 70 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger
DRILL RIG: CME 75 Track
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Free Fall

FIELD									LABORATORY							
ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
630	0							ASPHALT.									AC = 3"
								Aggregate Base (AB).									AB = 3"
								Poorly graded SAND with CLAY and GRAVEL (SP-SC); medium dense; brown; dry; some fine GRAVEL; mostly coarse to fine SAND; trace nonplastic fines.								
	5		1	11 14 14	28				39				5.2	98.4			
625		▽															Ground water encountered.
			2	11 18 18	36			Dense; wet.	72				4.9	107.6			
	10		3	5 6 18	24			CLAYEY SAND with GRAVEL (SC); medium dense; brown; wet; little coarse to fine GRAVEL; mostly coarse to fine SAND; some medium plasticity fines.	83								
620								Poorly graded GRAVEL with SAND (GP); medium dense; brown; wet; mostly coarse to fine GRAVEL; some coarse to fine SAND; trace nonplastic fines.									
	15		4	9 11 16	27				39								
615																	
	20		5	10 22 18	40			Dense.	100								
610								Bottom of borehole at 21.5 ft bgs									
	25																
605																	
	30																
600																	
	35																

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: A-19-020
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING R-19-021

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: AC
DEPTH OF BORING: 36 (ft)

BEGIN DATE: 3/15/2019
COMPLETION DATE: 3/18/2019
SURFACE ELEVATION: 596.7 (ft)*
SURFACE CONDITION: Soil
WATER DEPTH: Not Established
READING TAKEN: N/A
HAMMER EFFICIENCY: 70 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger & Rotary
DRILL RIG: CME 75 Track
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: Bulk; CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Tremie Grout

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LABORATORY: LIQUID LIMIT	LABORATORY: PLASTIC LIMIT	LABORATORY: MOISTURE (%)	LABORATORY: D. DENSITY (PCF)	LABORATORY: % PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
595	0	Bulk	1					SILTY SAND (SM); brown; moist.	100								
								Poorly graded SAND (SP); medium dense; brown; moist; few fine GRAVEL; mostly medium to fine SAND; few low plasticity fines.									
590	5		1	Push 7 7	14				83								
								CLAYEY GRAVEL with SAND (GC); medium dense; brown; moist; mostly fine GRAVEL; little medium SAND; little nonplastic to low plasticity fines.									
585	10		2	9 17 9	26				56				15.9		24		
								Poorly graded GRAVEL with SAND (GP); dense; brown; moist; mostly fine GRAVEL; some medium SAND; trace low plasticity fines.									
580	15		3	13 23 23	46				67				12.1		3		Boring caved. Switched to side discharge mud rotary with no ground water measurement.
								Poorly graded GRAVEL with CLAY and SAND (GP-GC); wet.									
575	20		4	17 18 22	40				47				13.1		7		
								Little fine SAND.	67								
570	25		5	20 25 24	49												
								Poorly graded SAND with GRAVEL (SP); very dense; brown; wet; some GRAVEL; mostly medium SAND; few fines.									
565	30		6	27 40 50/5	90/11				71								
	35		7	38 50					50								
560								Bottom of borehole at 36.0 ft bgs									

Groundwater not established due to drilling method.

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: R-19-021
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING A-19-022

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: HFW
DEPTH OF BORING: 21.5 (ft)

BEGIN DATE: 3/21/2019
COMPLETION DATE: 3/21/2019
SURFACE ELEVATION: 695.1 (ft)*
SURFACE CONDITION: Asphalt
WATER DEPTH: 15(ft.)
READING TAKEN: 3/21/19
HAMMER EFFICIENCY: 70 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger
DRILL RIG: CME 75 Track
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: Bulk; CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Free Fall

FIELD									LABORATORY							
ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
695	0		Bulk 1					ASPHALT. Aggregate Base (AB). CLAYEY SAND with GRAVEL (SC); medium dense; brown; moist; few fine GRAVEL; mostly fine SAND; some medium plasticity fines.	100								AC = 3" AB = 3" R-Value = 35
690	5		1	6 12 13	25			About 19% fine GRAVEL; about 52% mostly coarse to fine SAND; some medium plasticity fines.	100				15.5	116.2	29		
			2	11 16 27	43	+4.50		SANDY lean CLAY (CL); hard; orange brown; moist; some fine SAND; mostly medium plasticity fines.	83				18.1	113.9			
685	10		3	6 16 25	41	+4.50			94								
680	15		4	15 22 27	49			CLAYEY SAND (SC); dense; orange brown; moist; few fine GRAVEL; mostly fine SAND; some medium plasticity fines.	100								Ground water encountered.
675	20		5	7 8 8	16			CLAYEY SAND with GRAVEL (SC); medium dense; little fine, subangular to subrounded GRAVEL.	50								
670	25							Bottom of borehole at 21.5 ft bgs									
665	30																
660	35																

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: A-19-022
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING A-19-023

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: HFW
DEPTH OF BORING: 21.5 (ft)

BEGIN DATE: 3/21/2019
COMPLETION DATE: 3/21/2019
SURFACE ELEVATION: 646.1 (ft)*
SURFACE CONDITION: Grass
WATER DEPTH: 9(ft.)
READING TAKEN: 3/21/19
HAMMER EFFICIENCY: 70 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger
DRILL RIG: CME 75 Track
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: CAL (2.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Free Fall

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LABORATORY: LIQUID LIMIT	LABORATORY: PLASTIC LIMIT	LABORATORY: MOISTURE (%)	LABORATORY: D. DENSITY (PCF)	LABORATORY: % PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
645	0							Poorly graded SAND with CLAY (SP-SC); medium dense; brown; dry to moist; few fine GRAVEL; mostly coarse to fine SAND; few nonplastic fines.										
			1	5 5 13	18				67				6.9		12			
	5							Poorly graded SAND with GRAVEL (SP); medium dense; brown, black, red; dry.										
640			2	14 17 12	29				67				7.3	118				
								Poorly graded GRAVEL with CLAY and SAND (GP-GC); dense; brown; wet; mostly coarse to fine, subangular to subrounded GRAVEL; some coarse to fine SAND; few nonplastic fines.										
			3	12 17 19	36				100									Ground water encountered.
	10																	
635			4	5 5 13	18			Medium dense; about 67% mostly coarse to fine GRAVEL; about 26% some fine SAND; few low plasticity fines.	100				7.4	135.1	7			
	15		5	50/1	REF			Dense.	0									Logger noted same material from 10-ft. sample falling out of sampler.
630								Lean CLAY (CL); very stiff; gray; moist; trace fine GRAVEL; mostly medium SAND.										
	20		6	6 6 6	12	2.50			11									
625								Bottom of borehole at 21.5 ft bgs										
	25																	
620																		
	30																	
615																		
	35																	
610																		

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: A-19-023
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 1

LOG OF BORING R-19-024

PROJECT NO: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers
LOGGED BY: AC
DEPTH OF BORING: 46.5 (ft)

BEGIN DATE: 3/22/2019
COMPLETION DATE: 3/22/2019
SURFACE ELEVATION: 613.2 (ft)*
SURFACE CONDITION: Asphalt
WATER DEPTH: Not Established
READING TAKEN: N/A
HAMMER EFFICIENCY: 77 (%)

DRILLING CONTRACTOR: Geo-Ex Subsurface
DRILLING METHOD: Solid-Stem Auger & Rotary
DRILL RIG: CME 55 Truck
HAMMER TYPE: Auto: 140 lb; 30 in Drop
SAMPLER TYPE & SIZE: CAL (2.4" ID); SPT (1.4" ID)
BOREHOLE DIAMETER: 4 in
BACKFILL METHOD: Tremie Grout

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LIQUID LIMIT	PLASTIC LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
	0							ASPHALT.									AC = 4"
								Aggregate Base (AB).									AB = 3"
610								Lean CLAY with SAND (CL); hard; dark brown; moist; trace GRAVEL; few medium to fine SAND; mostly medium plasticity, medium toughness fines.									
	5		1	5 20 19	39			SANDY lean CLAY (CL); hard; dark brown; moist; about 10% fine GRAVEL; about 35% coarse to fine SAND; mostly low plasticity fines.	72				11.4	124.5	55		
605																	
	10		2	2 3 3	6			Poorly graded SAND with CLAY and GRAVEL (SP-SC); loose; brown; moist; little fine GRAVEL; mostly medium SAND; few low plasticity fines.	100		28	17					Sample retrieved wet. Switched to side discharge mud rotary. No ground water measured.
600																	Direct Shear Friction Angle (phi) = 31 degrees Cohesion (c) = 500 psf
	15		3	6 11 16	27	2.50		Lean CLAY (CL); very stiff; tan; moist; trace fine GRAVEL; few fine SAND; mostly medium plasticity, medium toughness fines.	44				22.2	108.7			
595																	
	20		4	33 39 41	80			Poorly graded GRAVEL with SAND (GP); very dense; brown; moist; mostly fine GRAVEL; some medium SAND; few low plasticity fines.	72								Drill Chatter
590																	
	25		5	39 50/5	50/5				64								
585																	
	30		6	31 44 50/5	94/11				76								
580																	
	35		7	14 22 22	44				33								

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: R-19-024
ENTRY BY: AC
CHECKED BY: KKL SHEET 1 of 2

ELEV (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 INCH	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	LABORATORY: LIQUID LIMIT	LABORATORY: PLASTIC LIMIT	LABORATORY: MOISTURE (%)	LABORATORY: D. DENSITY (PCF)	LABORATORY: % PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
								Poorly graded GRAVEL with SAND (GP) *(continued)*.									Driller Note: Material became softer.
575								SANDY lean CLAY (CL); very stiff; tan; moist; little fine SAND; mostly low to medium plasticity, low toughness fines.									
	40		8	3 4 10	14				61								Something blocked sampler. Chase with SPT
			9	10 9 13	22	2.50			67								
570																	
	45		10	3 6 9	15	1.00		Stiff; trace fine GRAVEL; few fine SAND.	83								
								Bottom of borehole at 46.5 ft bgs									
								Groundwater not established due to drilling method.									
565	50																
560																	
	55																
555																	
	60																
550																	
	65																
545																	
	70																
540																	
	75																
535																	
	80																

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PROJECT NUMBER: 19-503.1
PROJECT: Ukiah RW Pipeline-Phase 4
BORING: R-19-024
ENTRY BY: AC
CHECKED BY: KKL SHEET 2 of 2

LOG OF BORING A-20-001

PROJECT NO: 19-503.1
PROJECT: Ukiah Recycled Water Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers, Inc.
LOGGED BY: KBH
DEPTH OF BORING: 60.00 (ft)

BEGIN DATE: 11/30/2020
COMPLETION DATE: 11/30/2020
SURFACE ELEVATION: 799.50 (ft)
SURFACE CONDITION: Grass/Soil
WATER DEPTH: Not Encountered
READING TAKEN: N/A
HAMMER EFFICIENCY: 89.1 (%)

DRILLING CONTRACTOR: GeoEx Subsurface Exploration
DRILLING METHOD: SS Augers (4"), Rotary (4")
DRILL RIG: CME 75 (Track Mounted)
HAMMER TYPE: Automatic; 140 lbs; 30 in. drop
SAMPLER TYPE & SIZE: Bulk, MCAL (2.4" ID), SPT (1.4" ID)
BOREHOLE DIAMETER: 4.0 in.
BACKFILL METHOD: Neat Cement Grout

FIELD									LABORATORY							
ELEVATION (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 IN.	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	PLASTIC LIMIT	LIQUID LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
799	0		Bulk					CLAYEY SAND with GRAVEL (SC); brown; moist; mostly medium to fine SAND; little fine, subrounded GRAVEL; little fines.	100								Grinding observed from 1.5-2.5'
798	1																Corrosion
797	2																Soil pH: 4.52
796	3		1	2 10 17	27			medium dense	83								Min. Resistivity: 4820 ohm-cm
795	4																Chloride: 4.3 ppm
794	5		2	10 19 18	37			Poorly-graded SAND with CLAY and GRAVEL (SP-SC); dense; brown; dry to moist; mostly medium to fine SAND; little coarse to fine GRAVEL; few fines.	83								Sulfate: 1.0 ppm
793	6																
792	7							CLAYEY GRAVEL with SAND (GC); dense; orangish brown; moist; mostly GRAVEL; some medium to fine SAND; little fines.									
791	8		3	12 17 20	37				83		17	32	8.0	121.0	25		
790	9																
789	10		4	11 15 21	36				94				7.3	115.6			
788	11							CLAYEY SAND (SC); dense; purplish brown; moist; mostly medium to fine SAND; few subangular coarse GRAVEL; little fines.									
787	12																
786	13																
785	14																
784	15		5	9 14 26	40			brown	72				11.1	121.2	34		
783	16																
782	17																
781	18																
780	19																
779	20		6	9 18 24	42			orangish brown; few coarse to fine GRAVEL	83								Driller notes easy drilling from 2.5-20'
778	21																
777	22																
776	23																
775	24																
774	25		7	13 27 25	52			very dense; trace fine GRAVEL	78								
773	26																
772	27																
771	28																

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PROJECT NO: 19-503.1
PROJECT: Ukiah Recycled Water Pipeline-Phase 4
BORING: A-20-001
ENTRY BY: KBH
CHECKED BY: HFW
SHEET # 1 of 2

ELEVATION (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 IN.	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	PLASTIC LIMIT	LIQUID LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
770	30							CLAYEY SAND (SC); dense; purplish brown; moist; mostly medium to fine SAND; few subangular coarse GRAVEL; little fines.										
769	31		8	10 18 24	42			dense; brown	78									Driller notes harder drilling from 29-30'
768	32																	
767	33																	
766	34							CLAYEY SAND with GRAVEL (SC); medium dense; brown; moist; mostly medium to fine SAND; some fines; little coarse to fine, subangular GRAVEL.										
765	35																	
764	36		9	9 10 11	21				67									Driller notes softer drilling at 35'
763	37																	
762	38																	
761	39																	
760	40																	
759	41		10	6 10 15	25	2.25			50				19.1	109.7				Switch to mud rotary at 40'- used 5' of 5" diameter casing
758	42							SANDY lean CLAY (CL); very stiff; grayish brown; moist; mostly fines; some medium to fine SAND; few coarse to fine GRAVEL.										
757	43																	
756	44																	
755	45																	
754	46		11	5 9 9	18	2.00			39				19.7	104.7	50			
753	47							bluish gray reddish brown; fine GRAVEL										
752	48																	
751	49							Sedimentary (sandstone); orangish brown; decomposed; very soft to soft. (CLAYEY SAND (SC); very dense; moist; mostly medium to fine SAND; little fines; few fine, subangular GRAVEL)										Driller notes harder drilling from 48-52.5', softer drilling from 52.5-53.5', and then harder drilling after 53.5'
750	50																	
749	51		12	16 50/3	50/3				56									
748	52																	
747	53																	
746	54																	
745	55																	
744	56		13	50/5	50/5				60									Slow and hard drilling from 55-60 with drill chatter observed
743	57																	
742	58																	
741	59																	
740	60																	
739	61		14	50/0	50/0			Bottom of borehole at 60.0 ft bgs	0									Sampler rebounding at 60'; auger refusal encountered after 60'
738	62																	
737	63																	
736																		

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Geotechnical Engineering, Design and Construction Services

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PROJECT NO: 19-503.1
PROJECT: Ukiah Recycled Water Pipeline-Phase 4
BORING: A-20-001
ENTRY BY: KBH
CHECKED BY: HFW
SHEET # 2 of 2

LOG OF BORING R-20-002

PROJECT NO: 19-503.1
PROJECT: Ukiah Recycled Water Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers, Inc.
LOGGED BY: MEA
DEPTH OF BORING: 81.50 (ft)

BEGIN DATE: 12/02/2020
COMPLETION DATE: 12/02/2020
SURFACE ELEVATION: 634.40 (ft)
SURFACE CONDITION: Soil
WATER DEPTH: 17.0 ft
READING TAKEN: 12/02/20
HAMMER EFFICIENCY: 89.1 (%)

DRILLING CONTRACTOR: GeoEx Subsurface Exploration
DRILLING METHOD: SS Augers (4"), Rotary (4")
DRILL RIG: CME 75 (Track Mounted)
HAMMER TYPE: Automatic; 140 lbs; 30 in. drop
SAMPLER TYPE & SIZE: Bulk, MCAL (2.4" ID), SPT (1.4" ID)
BOREHOLE DIAMETER: 4.0 in.
BACKFILL METHOD: Neat Cement Grout

FIELD									LABORATORY							
ELEVATION (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 IN.	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	PLASTIC LIMIT	LIQUID LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
634	0		Bulk					Lean CLAY with SAND (CL); brown; moist; mostly fines; little fine SAND; trace organics.	100								
633	1																
632	2																
631	3		1	12 21 21	42	+4.5		hard	78								
630	4																
629	5		2	13 19 25	44	+4.5			78		18	32	9.0	111.2			UC = 9,115 psf
628	6																
627	7							SANDY SILT (ML); dense; brown; dry; mostly fines; some fine SAND.									
626	8		3	14 17 18	35				100				8.5	103.1	70		
625	9																
624	10		4	15 28 24	52	+4.5		Lean CLAY (CL); hard; brown; moist; mostly fines; trace fine SAND.	67								Light rig chatter observed
623	11							CLAYEY GRAVEL with SAND (GC); very dense; dry to moist; mostly coarse to fine, angular to subangular GRAVEL; little coarse to fine SAND; little fines.					3.0	128.9			
622	12																
621	13																Driller notes fine gravels at 13', coarse gravels at 14', and then easy drilling to 15'
620	14																
619	15		5	14 20 22	42			dense	67								
618	16																
617	17																
616	18							CLAYEY SAND with GRAVEL (SC); medium dense; moist; mostly coarse to fine SAND; some coarse to fine, angular to subangular GRAVEL; little fines.									
615	19																
614	20		6	7 11 13	24				100				10.9	125.8	16		Switched to Mud Rotary at 20'- used 5' of 5" diameter casing
613	21																
612	22																
611	23							CLAYEY GRAVEL with SAND (GC); very dense; yellowish brown; moist; mostly coarse to fine, angular to subangular GRAVEL; little medium SAND; little fines.									
610	24																
609	25		7	17 32 50/5	82/11				71								
608	26																
607	27																
606	28																

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PROJECT NO: 19-503.1
PROJECT: Ukiah Recycled Water Pipeline-Phase 4
BORING: R-20-002
ENTRY BY: KBH
CHECKED BY: HFW
SHEET # 1 of 3

ELEVATION (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 IN.	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	PLASTIC LIMIT	LIQUID LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
605	30							CLAYEY GRAVEL with SAND (GC); very dense; yellowish brown; moist; mostly coarse to fine, angular to subangular GRAVEL; little medium SAND; little fines.									
604	31		8	16 25 26	51			dense	67								
603	32																
602	33																
601	34																
600	35																
599	36		9	push push push	push			loose	50								
598	37																
597	38																
596	39							Lean CLAY (CL); very stiff; brown; moist; mostly fines; trace fine SAND.									
595	40																
594	41		10	10 19 26	45	3.00			44				21.5	107.5	81		
593	42																
592	43																
591	44							Lean CLAY with GRAVEL (CL); reddish brown; moist; mostly fines; little fine, angular to subangular GRAVEL.									
590	45																
589	46		11	7 8 8	16				0								
588	47		12	10 11 14	25	0.75 4.25		medium stiff hard	100								
587	48																
586	49																
585	50							Lean CLAY (CL); hard; brown; moist; mostly fines; trace fine SAND.									
584	51		13	8 14 25	39	4.00			83								
583	52																
582	53																
581	54																
580	55																
579	56		14	9 18 28	46	+4.5		few fine SAND	50								
578	57																
577	58																
576	59																
575	60																
574	61		15	14 25 40	65	+4.5 1.50		stiff; trace angular to subangular, coarse GRAVEL	50								
573	62							GRAVELLY lean CLAY with SAND (CL); hard; reddish brown; moist; mostly fines; some coarse to fine, angular to subangular GRAVEL; little coarse to fine SAND.									
572	63																
571																	

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PROJECT NO: 19-503.1
PROJECT: Ukiah Recycled Water Pipeline-Phase 4
BORING: R-20-002
ENTRY BY: KBH
CHECKED BY: HFW
SHEET # 2 of 3

ELEVATION (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 IN.	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	PLASTIC LIMIT	LIQUID LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
570	65							GRAVELLY lean CLAY with SAND (CL); hard; reddish brown; moist; mostly fines; some coarse to fine, angular to subangular GRAVEL; little coarse to fine SAND.										
569			16	15 28 33	61	+4.5			50									
568	66																	
567	67																	
566	68							CLAYEY GRAVEL (GC); very dense; reddish brown; moist; mostly coarse to fine, angular to subangular GRAVEL; some fines; few coarse to fine SAND.										
565	69																	
564	70		17	20 74 50	124				50									
563	71																	
562	72																	
561	73							Lean CLAY with SAND (CL); very stiff; brown; moist; mostly fines; little medium to fine SAND.										
560	74																	
559	75		18	17 24 30	54				0									
558	76																	
557	77		19	16 21 19	40	2.00			33									
556	78																	
555	79							GRAVELLY lean CLAY with SAND (CL); hard; moist; gray; mostly fines; some coarse to fine, angular to subangular GRAVEL; little medium to fine SAND.										
554	80		20	17 32 40	72	+4.5			100									
553	81																	
552	82							Bottom of borehole at 81.5 ft bgs										
551	83																	
550	84																	
549	85																	
548	86																	
547	87																	
546	88																	
545	89																	
544	90																	
543	91																	
542	92																	
541	93																	
540	94																	
539	95																	
538	96																	
537	97																	
536	98																	

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PROJECT NO: 19-503.1
PROJECT: Ukiah Recycled Water Pipeline-Phase 4
BORING: R-20-002
ENTRY BY: KBH
CHECKED BY: HFW
SHEET # 3 of 3

LOG OF BORING R-20-003

PROJECT NO: 19-503.1
PROJECT: Ukiah Recycled Water Pipeline-Phase 4
LOCATION: Ukiah, CA
COUNTY: Mendocino
CLIENT: Carollo Engineers, Inc.
LOGGED BY: MEA
DEPTH OF BORING: 76.50 (ft)

BEGIN DATE: 12/03/2020
COMPLETION DATE: 12/03/2020
SURFACE ELEVATION: 636.20 (ft)
SURFACE CONDITION: Soil
WATER DEPTH: 18.5 ft
READING TAKEN: 12/03/20
HAMMER EFFICIENCY: 89.1 (%)

DRILLING CONTRACTOR: GeoEx Subsurface Exploration
DRILLING METHOD: SS Augers (4"), Rotary (4")
DRILL RIG: CME 75 (Track Mounted)
HAMMER TYPE: Automatic; 140 lbs; 30 in. drop
SAMPLER TYPE & SIZE: Bulk, MCAL (2.4" ID)
BOREHOLE DIAMETER: 4.0 in.
BACKFILL METHOD: Neat Cement Grout

FIELD									LABORATORY							
ELEVATION (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 IN.	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	PLASTIC LIMIT	LIQUID LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD / CASING DEPTH	REMARKS
635	1		Bulk					Lean CLAY with SAND (CL); brown; moist; mostly fines; little fine SAND.	100								
634	2																
633	3		1	16 20 25	45	+4.5		hard	100								
632	4																
631	5		2	16 29 30	59	+4.5			67								
630	6										17	33	11.0	112.1	81		
629	7																
628	8		3	11 21 21	42	+4.5			67								
627	9												10.9	97.4			Corrosion Soil pH: 6.06 Min. Resistivity: 780 ohm-cm Chloride: 120.1 ppm Sulfate: 169.7 ppm
626	10		4	11 19 29	48			SILTY SAND with GRAVEL (SM); dense; brown; dry; mostly coarse to fine SAND; little coarse to fine GRAVEL; little fines; trace organics.	67								
625	11												6.1	114.2	26		
624	12																
623	13							GRAVELLY lean CLAY with SAND (CL); hard; light brown; dry; mostly fines; some fine GRAVEL; little coarse to fine SAND.									
622	14																
621	15		5	8 19 13	32	+4.5			67								
620	16												7.6	88.8			
619	17							SILTY GRAVEL with SAND (GM); dense; reddish brown; moist; mostly coarse to fine GRAVEL; little coarse to fine SAND; little fines.									
618	18	▽						CLAYEY GRAVEL with SAND (GC); very dense; brown; wet; mostly coarse to fine GRAVEL; little coarse to fine SAND; little fines.									
617	19																
616	20		6	17 50					75						12		Switched to Mud Rotary at 20'- used 5' of 5" diameter casing Drill chatter and slow drilling at 22'
615	21																
614	22																
613	23							CLAYEY SAND with GRAVEL (SC); medium dense; brown; moist; mostly coarse to fine SAND; some coarse to fine GRAVEL; little fines.									
612	24																
611	25		7	13 14 15	29				50								
610	26												13.7	123.9			
609	27							CLAYEY GRAVEL with SAND (GC); very dense; brown; moist; mostly coarse to fine GRAVEL; little coarse to fine SAND; little fines.									
608	28																

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PROJECT NO: 19-503.1
PROJECT: Ukiah Recycled Water Pipeline-Phase 4
BORING: R-20-003
ENTRY BY: KBH
CHECKED BY: HFW
SHEET # 1 of 3

FIELD									LABORATORY								
ELEVATION (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 IN.	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	PLASTIC LIMIT	LIQUID LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
606	30							CLAYEY GRAVEL with SAND (GC); very dense; brown; moist; mostly coarse to fine GRAVEL; little coarse to fine SAND; little fines.										
605	31		8	17 28 35	63				67									
604	32																	
603	33																	
602	34																	
601	35		9	16 26 34	60				56									
600	36																	
599	37																	
598	38							SANDY lean CLAY (CL); very stiff; yellowish brown; moist; mostly fines; some medium to fine SAND; few fine, angular to subangular GRAVEL.										
597	39																	
596	40		10	10 20 28	48	3.50			50									
595	41																	
594	42																	
593	43																	
592	44																	
591	45		11	8 10 11	21	2.25			50				19.9	110.6				
590	46																	
589	47																	
588	48							Lean CLAY with SAND (CL); stiff; blueish gray variegated with reddish brown; moist; mostly fines; little medium to fine SAND.										
587	49																	
586	50		12	11 18 23	41	1.75			50									
585	51																	
584	52																	
583	53							Lean CLAY (CL); hard; yellowish brown; moist; mostly fines; trace fine SAND.										
582	54																	
581	55		13	10 17 34	51	+4.5			50									
580	56																	
579	57																	
578	58							GRAVELLY lean CLAY with SAND (CL); very stiff; yellowish brown; moist; mostly fines; some coarse to fine GRAVEL; little coarse to fine SAND.										
577	59																	
576	60		14	11 18 25	43	3.25			44									
575	61																	
574	62																	
573	63																	

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PROJECT NO: 19-503.1
PROJECT: Ukiah Recycled Water Pipeline-Phase 4
BORING: R-20-003
ENTRY BY: KBH
CHECKED BY: HFW
SHEET # 2 of 3

ELEVATION (ft)	DEPTH (ft)	SAMPLE	SAMPLE NO	BLOWS PER 6 IN.	BLOWS PER FOOT	POCKET PEN. (TSF)	GRAPHIC LOG	DESCRIPTION	RECOVERY(%)	RQD (%)	PLASTIC LIMIT	LIQUID LIMIT	MOISTURE (%)	D. DENSITY (PCF)	% PASSING 200 SIEVE	DRILL METHOD	CASING DEPTH	REMARKS
								GRAVELLY lean CLAY with SAND (CL); very stiff; yellowish brown; moist; mostly fines; some coarse to fine GRAVEL; little coarse to fine SAND. hard											
571	65		15	12 24 40	64	+4.5			67									
570	66																	
569	67																	
568	68																	
567	69																	
566	70		16	14 26 39	65	4.00			50									
565	71																	
564	72																	
563	73																	
562	74																	
561	75		17	14 25 40	65	4.00			50									
560	76																	
559	77							Bottom of borehole at 76.5 ft bgs										
558	78																	
557	79																	
556	80																	
555	81																	
554	82																	
553	83																	
552	84																	
551	85																	
550	86																	
549	87																	
548	88																	
547	89																	
546	90																	
545	91																	
544	92																	
543	93																	
542	94																	
541	95																	
540	96																	
539	97																	
538	98																	

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PROJECT NO: 19-503.1
PROJECT: Ukiah Recycled Water Pipeline-Phase 4
BORING: R-20-003
ENTRY BY: KBH
CHECKED BY: HFW
SHEET # 3 of 3

APPENDIX III

Laboratory Test Results

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 6/10/19
Technician: CAP,GW, MA

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	R-19-001-1A	R-19-001-2A	R-19-001-3A	R-19-001-4A	R-19-001-5A
USCS Symbol	CL	CL	CL	CL	CL
Depth (ft.)	6	7.5	11	12.5	16
Sample Length (in.)	5.994	3.173	5.458	5.436	5.741
Diameter (in.)	2.410	1.378	2.381	1.369	2.397
Sample Volume (ft^3)	0.01582	0.00274	0.01406	0.00463	0.01499
Total Mass Soil+Tube (g)	1113.2	160.7	1117.2	275.0	868.6
Mass of Tube (g)	273.7	0.0	275.7	0.0	0.0
Tare No.	1016	A6	H4	C20	G13
Tare (g)	126.9	13.5	13.3	13.5	13.5
Wet Soil + Tare (g)	367.5	51.0	76.6	79.7	72.4
Dry Soil + Tare (g)	328.3	45.2	67.0	68.5	62.6
Dry Soil (g)	201.4	31.8	53.7	55.0	49.2
Water (g)	39.2	5.7	9.6	11.2	9.7
Moisture (%)	**19.5**	**18.0**	**17.9**	**20.4**	**19.8**
Dry Density (pcf)	**97.9**	**109.7**	**111.9**	**108.7**	**106.6**

Notes:

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 6/10/19
Technician: CAP,GW, MA

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	R-19-001-6A	R-19-001-7A	R-19-002-1A	R-19-002-2A	R-19-002-3A
USCS Symbol	CL	CL	CL	CL	CL
Depth (ft.)	17.5	21	6	11	16
Sample Length (in.)	5.220	4.956	5.439	5.981	6.026
Diameter (in.)	1.392	2.383	2.384	2.396	2.409
Sample Volume (ft^3)	0.00460	0.01279	0.01404	0.01560	0.01589
Total Mass Soil+Tube (g)	407.0	1032.8	782.0	1207.5	894.1
Mass of Tube (g)	133.5	273.5	0.0	275.5	0.0
Tare No.	D19	D2	1014.0	R15	D8
Tare (g)	20.6	20.8	125.6	130.6	20.6
Wet Soil + Tare (g)	81.6	82.4	505.5	392.9	86.2
Dry Soil + Tare (g)	70.4	71.3	429.1	351.7	72.7
Dry Soil (g)	49.8	50.5	303.5	221.1	52.0
Water (g)	11.3	11.1	76.4	41.2	13.5
Moisture (%)	**22.7**	**22.0**	**25.2**	**18.6**	**25.9**
Dry Density (pcf)	**107.0**	**107.3**	**98.1**	**111.0**	**98.5**

Notes:

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 6/10/19
Technician: GW,MA

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	R-19-002-4A	R-19-002-5A	A-19-003-1A	A-19-003-2A	A-19-003-3A
USCS Symbol	CL	CL	CL	CL	CL
Depth (ft.)	21	26	3.5	6	8.5
Sample Length (in.)	5.622	5.484	5.638	4.853	5.096
Diameter (in.)	2.391	2.364	2.383	2.364	2.387
Sample Volume (ft^3)	0.01460	0.01393	0.01455	0.01233	0.01319
Total Mass Soil+Tube (g)	1135.1	1046.3	775.5	1007.5	1031.9
Mass of Tube (g)	273.8	276.8	0.0	275.1	276.2
Tare No.	G24	C12	F3	G23	G163
Tare (g)	20.6	20.8	13.4	20.3	20.3
Wet Soil + Tare (g)	88.6	83.0	52.5	85.3	80.5
Dry Soil + Tare (g)	75.7	70.9	43.0	72.1	68.5
Dry Soil (g)	55.1	50.2	29.6	51.8	48.2
Water (g)	12.9	12.1	9.5	13.2	12.1
Moisture (%)	**23.4**	**24.1**	**32.1**	**25.4**	**25.0**
Dry Density (pcf)	**105.4**	**98.1**	**89.0**	**104.4**	**101.0**

Notes:

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 6/10/19
Technician: CAP

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	R-19-004-1A	R-19-004-2A	R-19-004-3A	A-19-005-1A	A-19-005-2A
USCS Symbol	CL	CL	CL	SC	SC
Depth (ft.)	6	11	16	6	8.5
Sample Length (in.)	5.981	5.472	5.548	4.080	5.647
Diameter (in.)	2.398	2.358	2.360	2.382	2.348
Sample Volume (ft^3)	0.01562	0.01383	0.01405	0.01052	0.01415
Total Mass Soil+Tube (g)	1092.0	799.4	1116.2	914.1	1194.5
Mass of Tube (g)	227.9	0.0	274.8	280.8	275.2
Tare No.	R14	G1	A18	2023	B13
Tare (g)	129.9	13.3	20.5	125.3	20.7
Wet Soil + Tare (g)	356.9	74.2	80.5	475.2	80.0
Dry Soil + Tare (g)	319.3	62.9	69.1	441.4	74.0
Dry Soil (g)	189.4	49.6	48.6	316.1	53.3
Water (g)	37.6	11.3	11.4	33.8	6.0
Moisture (%)	**19.9**	**22.8**	**23.5**	**10.7**	**11.3**
Dry Density (pcf)	**101.7**	**103.8**	**106.9**	**119.8**	**128.7**

Notes:

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 6/10/19
Technician: GW, MA, HFW

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	A-19-006-1A	A-19-006-2A	A-19-007-1A	A-19-008-1A	R-19-009-1A
USCS Symbol	SC	CL	GP-GC	CL	GW-GC
Depth (ft.)	6	8.5	6	5.5	6
Sample Length (in.)	4.415	5.040	3.750	5.999	2.388
Diameter (in.)	2.369	2.361	2.380	2.385	2.383
Sample Volume (ft^3)	0.01126	0.01277	0.00965	0.01551	0.00616
Total Mass Soil+Tube (g)	953.1	1029.2	911.9	1223.5	591.5
Mass of Tube (g)	276.8	275.6	276.0	275.3	256.5
Tare No.	R15	C1	2011	D12	2010
Tare (g)	130.6	20.7	122.7	13.5	126.2
Wet Soil + Tare (g)	508.7	81.4	482.6	50.3	543.7
Dry Soil + Tare (g)	463.8	75.9	455.3	45.9	530.1
Dry Soil (g)	333.2	55.1	332.6	32.5	403.9
Water (g)	44.9	5.5	27.3	4.3	13.6
Moisture (%)	**13.5**	**10.0**	**8.2**	**13.3**	**3.4**
Dry Density (pcf)	**116.7**	**118.3**	**134.2**	**118.9**	**115.9**

Notes:

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 6/10/19
Technician: GW, BJU,

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	R-19-009-2A	R-19-009-3A	R-19-009-4A	A-19-010-1A	A-19-011-1A
USCS Symbol	GP-GM	GP-GM	GP-GM	SC	CL
Depth (ft.)	11	16	21	6	6
Sample Length (in.)	2.077	4.890	-	5.487	5.966
Diameter (in.)	2.367	2.370	-	2.385	2.352
Sample Volume (ft^3)	0.00529	0.01249	-	0.01419	0.01500
Total Mass Soil+Tube (g)	679.9	1126.1	-	1095.2	1145.5
Mass of Tube (g)	282.8	288.8	-	273.7	273.6
Tare No.	H18	2014	2015	N/A	C18
Tare (g)	13.2	123.1	122.2	20.9	13.3
Wet Soil + Tare (g)	115.5	585.7	720.6	83.7	47.7
Dry Soil + Tare (g)	111.8	546.3	631.5	76.1	41.8
Dry Soil (g)	98.6	423.2	509.3	55.3	28.5
Water (g)	3.6	39.4	89.1	7.6	5.9
Moisture (%)	**3.7**	**9.3**	**17.5**	**13.8**	**20.7**
Dry Density (pcf)	**159.7**	**135.2**	**-**	**112.2**	**106.2**

Notes:

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 6/10/19
Technician: GW, BJU,

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	A-19-012-1A	A-19-013-1A	A-19-013-2A	A-19-014-2A	A-19-014-3A
USCS Symbol	SC	CL	CL	GP-GC	GP-GC
Depth (ft.)	6	3.5	6	6	8.5
Sample Length (in.)	5.466	5.978	5.730	4.676	3.825
Diameter (in.)	2.364	2.401	2.373	2.359	2.340
Sample Volume (ft^3)	0.01388	0.01566	0.01467	0.01183	0.00952
Total Mass Soil+Tube (g)	850.8	1174.0	1154.6	972.3	882.4
Mass of Tube (g)	0.0	274.9	275.2	275.8	276.2
Tare No.	2009	1020	G20	B5	H22
Tare (g)	122.5	126.5	20.4	21.1	20.7
Wet Soil + Tare (g)	449.6	346.8	86.5	82.0	86.2
Dry Soil + Tare (g)	413.8	308.1	75.9	74.4	77.8
Dry Soil (g)	291.3	181.6	55.5	53.2	57.1
Water (g)	35.8	38.7	10.5	7.6	8.4
Moisture (%)	**12.3**	**21.3**	**19.0**	**14.3**	**14.7**
Dry Density (pcf)	**120.4**	**104.3**	**111.1**	**113.6**	**122.3**

Notes:

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 6/10/19
Technician: GW, BJU,

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	A-19-015-1A	A-19-016-1A	A-19-016-2A	A-19-016-3A	R-19-017-1A
USCS Symbol	SC	SP-SC	GP-GC	GP-GC	SM
Depth (ft.)	3.5	3.5	6	8.5	6
Sample Length (in.)	-	4.917	3.907	-	4.166
Diameter (in.)	-	2.389	2.366	-	2.399
Sample Volume (ft^3)	-	0.01275	0.00994	-	0.01090
Total Mass Soil+Tube (g)	-	980.0	857.1	-	907.5
Mass of Tube (g)	-	275.4	282.3	-	260.8
Tare No.	R5	H1	H20	H19	2011
Tare (g)	126.1	20.3	20.2	20.3	122.9
Wet Soil + Tare (g)	341.0	87.6	79.9	87.6	655.4
Dry Soil + Tare (g)	320.4	84.9	77.2	84.9	629.9
Dry Soil (g)	194.3	64.5	57.0	64.5	507.0
Water (g)	20.6	2.8	2.7	2.8	25.5
Moisture (%)	**10.6**	**4.3**	**4.7**	**4.3**	**5.0**
Dry Density (pcf)	**-**	**116.8**	**121.7**	**-**	**124.6**

Notes:

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 6/10/19
Technician: GW, MA

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	R-19-017-2A	R-19-017-4A	R-19-017-5A	R-19-017-6A	A-19-018-1A
USCS Symbol		SP-SC	SP-SC	SP-SC	CL
Depth (ft.)	11	21	26	31	3.5
Sample Length (in.)	-	4.606	5.378	5.157	5.750
Diameter (in.)	-	1.404	1.392	1.401	2.328
Sample Volume (ft^3)	-	0.00413	0.00474	0.00460	0.01416
Total Mass Soil+Tube (g)	-	419.8	464.4	463.9	1134.6
Mass of Tube (g)	-	132.4	132.7	141.4	274.1
Tare No.	F9	1003	B19	R14	E7
Tare (g)	21.0	126.0	20.6	129.5	13.6
Wet Soil + Tare (g)	82.2	410.8	83.5	376.8	78.3
Dry Soil + Tare (g)	80.1	389.3	77.3	354.7	68.7
Dry Soil (g)	59.0	263.3	56.7	225.2	55.2
Water (g)	2.1	21.5	6.2	22.1	9.6
Moisture (%)	**3.6**	**8.2**	**10.9**	**9.8**	**17.4**
Dry Density (pcf)	**-**	**141.9**	**139.2**	**140.7**	**114.2**

Notes:

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 6/10/19
Technician: GW, MA

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	A-19-018-2A	A-19-019-1A	A-19-020-1A	A-19-020-2A	R-19-021-2A
USCS Symbol	CL	SP	SP-SC	SP-SC	GC
Depth (ft.)	6	3.5	6	8.5	11
Sample Length (in.)	5.738	5.017	3.100	5.976	-
Diameter (in.)	2.360	2.337	2.364	2.370	-
Sample Volume (ft^3)	0.01452	0.01246	0.00787	0.01525	-
Total Mass Soil+Tube (g)	1209.2	1043.4	652.2	1055.2	-
Mass of Tube (g)	276.2	282.6	282.8	274.6	-
Tare No.	G11	H7	B20	H4	2007
Tare (g)	20.3	20.1	13.7	20.1	122.7
Wet Soil + Tare (g)	87.9	82.6	86.3	81.8	325.7
Dry Soil + Tare (g)	79.1	73.5	82.7	78.9	297.9
Dry Soil (g)	58.9	53.4	69.0	58.8	175.2
Water (g)	8.7	9.1	3.6	2.9	27.8
Moisture (%)	**14.9**	**17.0**	**5.2**	**4.9**	**15.9**
Dry Density (pcf)	**123.3**	**115.0**	**98.4**	**107.6**	**-**

Notes:

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 6/10/19
Technician: GW, MA

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	R-19-021-3A	R-19-021-4A	A-19-022-1A	A-19-022-2A	A-19-023-1A
USCS Symbol	GP	GP	SC	CL	SP-SC
Depth (ft.)	16	21	6	8.5	3.5
Sample Length (in.)	-	-	5.245	5.659	-
Diameter (in.)	-	-	2.364	2.363	-
Sample Volume (ft^3)	-	-	0.01332	0.01436	-
Total Mass Soil+Tube (g)	-	-	1086.1	1151.2	-
Mass of Tube (g)	-	-	274.8	275.0	-
Tare No.	R16	2025	2004	D5	1012
Tare (g)	131.1	125.6	125.9	20.6	126.1
Wet Soil + Tare (g)	337.5	343.6	336.0	81.8	335.0
Dry Soil + Tare (g)	315.2	318.4	307.8	72.4	321.5
Dry Soil (g)	184.1	192.8	181.9	51.8	195.4
Water (g)	22.3	25.2	28.2	9.4	13.5
Moisture (%)	**12.1**	**13.1**	**15.5**	**18.1**	**6.9**
Dry Density (pcf)	**-**	**-**	**116.2**	**113.9**	**-**

Notes:

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 6/10/19
Technician: GW, MA

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	A-19-023-2A	A-19-023-4A	R-19-024-1A	R-19-024-3A	
USCS Symbol	SP	GP-GC	CL	CL	
Depth (ft.)	6	11	6	16	
Sample Length (in.)	4.503	5.517	5.940	5.588	
Diameter (in.)	2.373	2.374	2.361	2.358	
Sample Volume (ft^3)	0.01153	0.01413	0.01505	0.01412	
Total Mass Soil+Tube (g)	936.7	1215.2	1222.3	1126.5	
Mass of Tube (g)	274.6	284.4	275.8	275.8	
Tare No.	A5	R13	C19	A8	
Tare (g)	20.9	129.1	13.7	20.5	
Wet Soil + Tare (g)	85.5	381.5	51.7	93.6	
Dry Soil + Tare (g)	81.1	364.0	47.8	80.3	
Dry Soil (g)	60.2	234.9	34.1	59.9	
Water (g)	4.4	17.5	3.9	13.3	
Moisture (%)	**7.3**	**7.4**	**11.4**	**22.2**	
Dry Density (pcf)	**118.0**	**135.1**	**124.5**	**108.7**	

Notes:

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 1/18/21
Technician: MCC

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	A-20-001-3B	A-20-001-4B	A-20-001-5B	A-20-001-10A	A-20-001-11A
USCS Symbol	GC	GC	SC	CL	CL
Depth (ft.)	8	10.5	15.5	41	46
Sample Length (in.)	6.001	4.970	5.559	5.488	5.970
Diameter (in.)	2.405	2.393	2.387	2.389	2.400
Sample Volume (ft^3)	0.01578	0.01294	0.01440	0.01424	0.01563
Total Mass Soil+Tube (g)	1208.1	1012.7	1155.1	1120.4	1163.4
Mass of Tube (g)	272.9	285.3	275.5	277.2	275.2
Tare No.	X7	L4	X1	K5	X3
Tare (g)	147.9	13.7	152.6	13.6	151.4
Wet Soil + Tare (g)	509.7	81.3	622.8	64.8	528.4
Dry Soil + Tare (g)	483.0	76.7	575.8	56.6	466.4
Dry Soil (g)	335.1	63.1	423.2	43.0	315.0
Water (g)	26.7	4.6	47.0	8.2	62.0
Moisture (%)	**8.0**	**7.3**	**11.1**	**19.1**	**19.7**
Dry Density (pcf)	**121.0**	**115.6**	**121.2**	**109.7**	**104.7**

Notes: A-20-001-11A had a 1.0" diameter wood piece in sample.

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 12/31/20
Technician: MCC

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	R-20-002-2A	R-20-002-3A	R-20-002-4A	R-20-002-6A	R-20-002-10A
USCS Symbol	CL	ML	GC	SC	CL
Depth (ft.)	5.5	8.5	11	21	41
Sample Length (in.)	5.631	5.987	4.258	5.511	5.503
Diameter (in.)	2.380	2.399	2.393	2.393	2.389
Sample Volume (ft^3)	0.01450	0.01566	0.01108	0.01434	0.01428
Total Mass Soil+Tube (g)	796.7	1070.0	943.1	1184.2	1119.4
Mass of Tube (g)	0.0	275.3	275.3	276.2	273.7
Tare No.	D17	R21	J5	Q3	X8
Tare (g)	13.7	126.2	13.5	126.5	150.6
Wet Soil + Tare (g)	70.1	519.3	107.6	590.6	495.0
Dry Soil + Tare (g)	65.5	488.4	104.8	544.8	434.0
Dry Soil (g)	51.7	362.2	91.3	418.3	283.4
Water (g)	4.6	30.9	2.8	45.8	61.0
Moisture (%)	**9.0**	**8.5**	**3.0**	**10.9**	**21.5**
Dry Density (pcf)	**111.2**	**103.1**	**128.9**	**125.8**	**107.5**

Notes: R-20-002-6A has a strong gasoline odor.

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 12/31/20
Technician: MCC

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	R-20-003-2A	R-20-003-3A	R-20-003-4A	R-20-003-5B	R-20-003-7A
USCS Symbol	CL	CL	SM	CL	SC
Depth (ft.)	6	8.5	11	15.5	26
Sample Length (in.)	5.398	3.894	5.276	4.930	5.146
Diameter (in.)	2.377	2.379	2.386	2.397	2.390
Sample Volume (ft^3)	0.01386	0.01002	0.01365	0.01287	0.01336
Total Mass Soil+Tube (g)	1061.3	771.4	1025.8	844.8	1129.9
Mass of Tube (g)	278.6	280.2	275.1	286.9	276.4
Tare No.	X6	A20	X10	J2	J18
Tare (g)	148.4	13.6	150.6	13.5	13.5
Wet Soil + Tare (g)	495.3	64.6	603.7	91.1	80.5
Dry Soil + Tare (g)	460.8	59.6	577.6	85.7	72.5
Dry Soil (g)	312.4	45.9	427.0	72.1	59.0
Water (g)	34.5	5.0	26.1	5.5	8.1
Moisture (%)	**11.0**	**10.9**	**6.1**	**7.6**	**13.7**
Dry Density (pcf)	**112.1**	**97.4**	**114.2**	**88.8**	**123.9**

Notes: R-20-003-4A had few roots in the sample.
R-20-003-5B had material loose in the tube.

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 12/31/20
Technician: MCC

MOISTURE-DENSITY TESTS - D2216

	1	2	3	4	5
Sample No.	R-20-003-11A				
USCS Symbol	CL				
Depth (ft.)	46				
Sample Length (in.)	5.469				
Diameter (in.)	2.381				
Sample Volume (ft^3)	0.01409				
Total Mass Soil+Tube (g)	1127.7				
Mass of Tube (g)	279.7				
Tare No.	J13				
Tare (g)	13.5				
Wet Soil + Tare (g)	69.6				
Dry Soil + Tare (g)	60.3				
Dry Soil (g)	46.7				
Water (g)	9.3				
Moisture (%)	**19.9**				
Dry Density (pcf)	**110.6**				

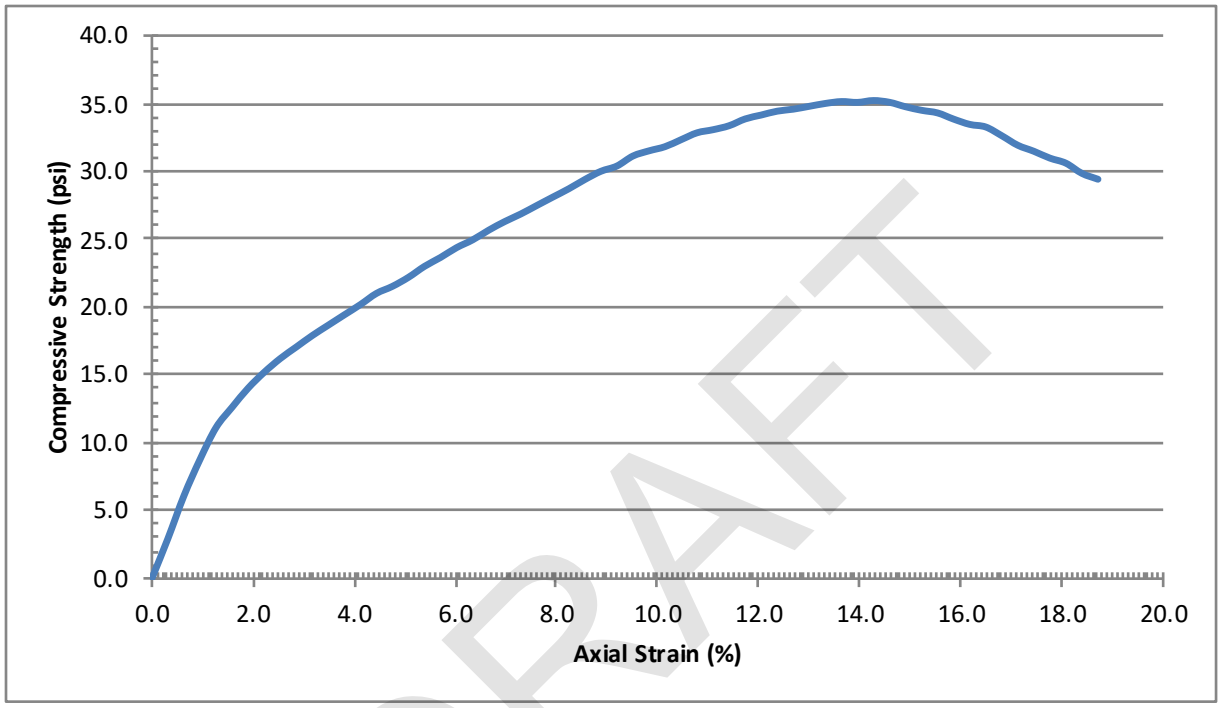
Notes:

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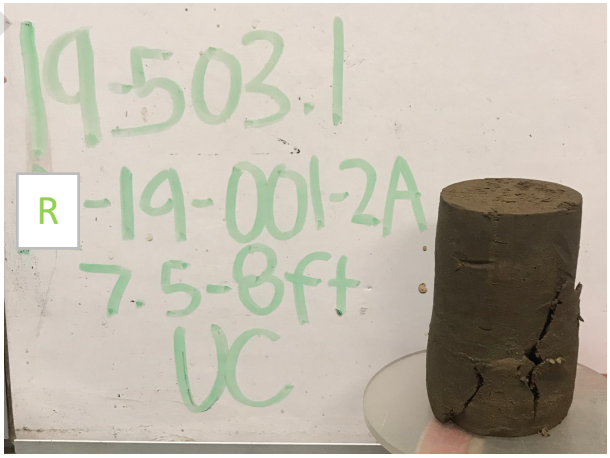
Project Name: Ukiah Recycled Water Pipeline-Phase 4
CAInc File No: 19-503.1
Date: 4/16/19
Technician: HFW
Sample ID: R-19-001-2A Depth (ft): 7.5
USCS Classification: CL

UNCONFINED COMPRESSION TEST - D2166



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Dry Density (pcf)	**109.7**
Water Content (%)	**18.0**
Unconfined Compressive Strength (psi)	**35.2**
Unconfined Compressive Strength (psf)	**5069**
Shear Strength (psf)	**2534.4**
Average Height (in)	3.173
Average Diameter (in)	1.378
Rate of strain (%)	1.0
Strain at Failure (%)	14.3

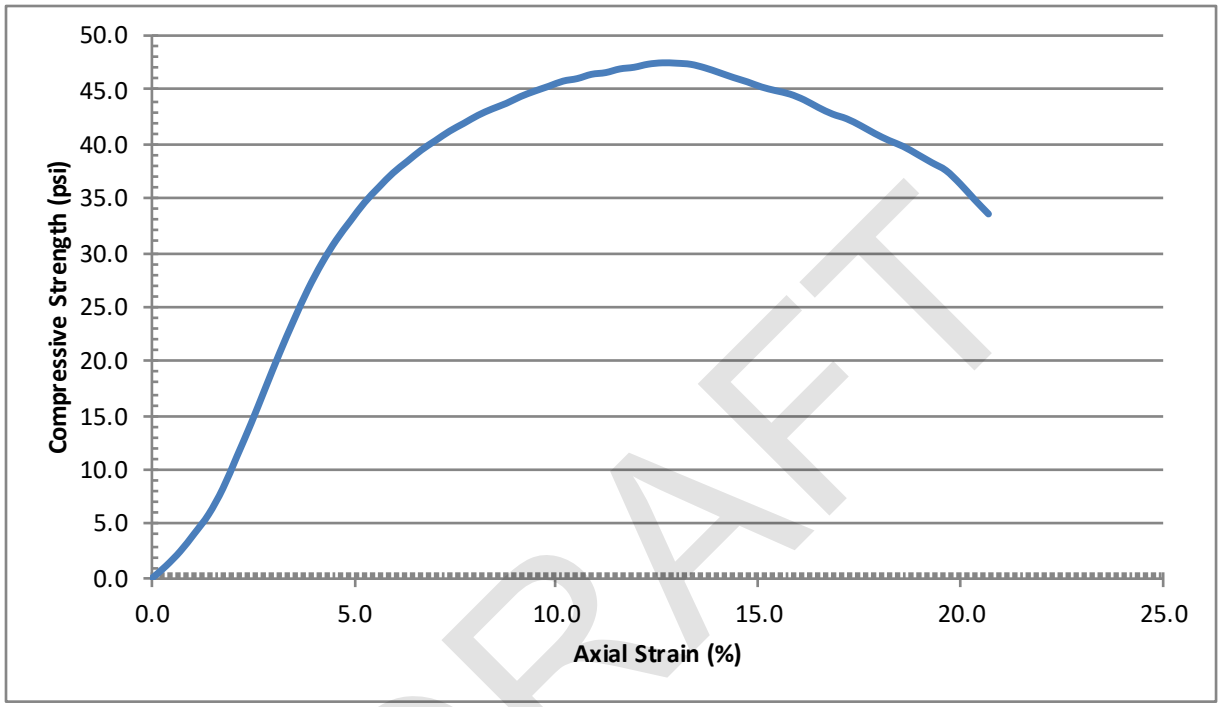


Notes:

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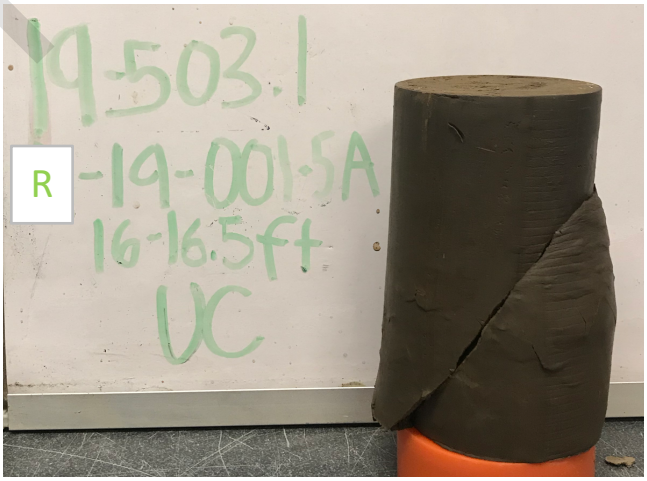
Project Name: Ukiah Recycled Water Pipeline-Phase 4
CAInc File No: 19-503.1
Date: 4/17/19
Technician: HFW
Sample ID: R-19-001-5A Depth (ft): 16.0
USCS Classification: CL

UNCONFINED COMPRESSION TEST - D2166



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Dry Density (pcf)	**106.6**
Water Content (%)	**19.8**
Unconfined Compressive Strength (psi)	**47.5**
Unconfined Compressive Strength (psf)	**6840**
Shear Strength (psf)	**3420**
Average Height (in)	5.741
Average Diameter (in)	2.397
Rate of strain (%)	2.0
Strain at Failure (%)	12.6

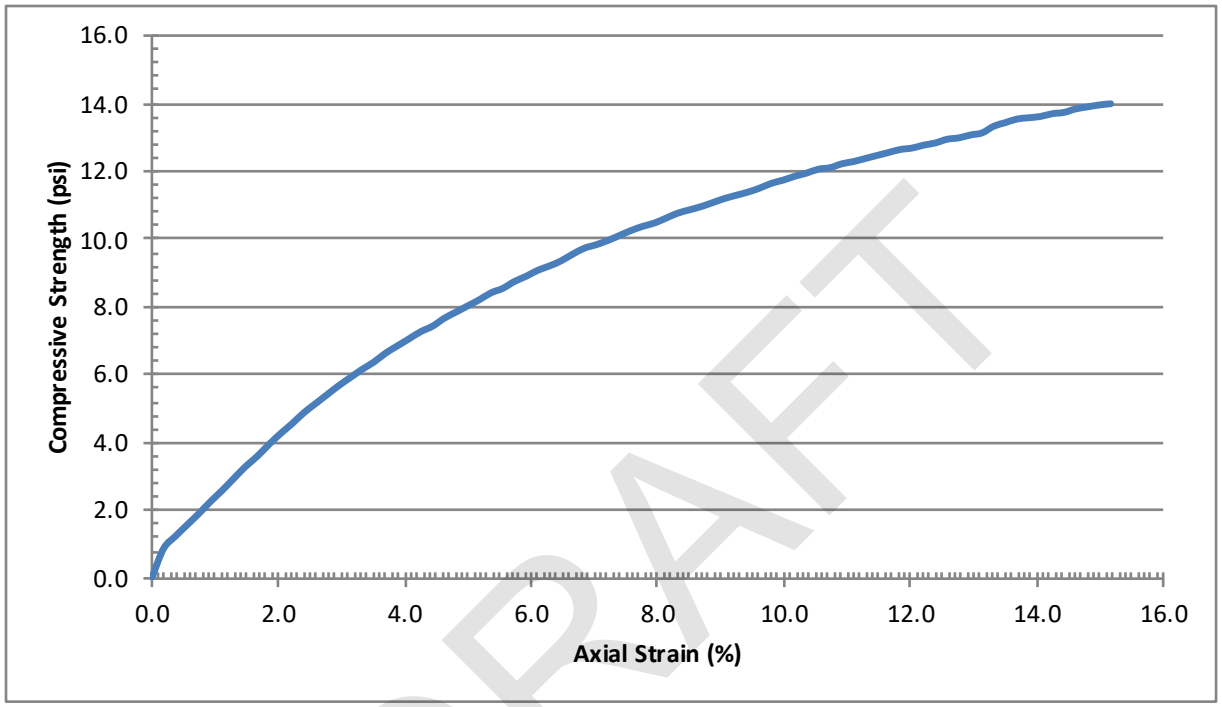


Notes:

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Geotechnical Engineering, Design and Construction Services

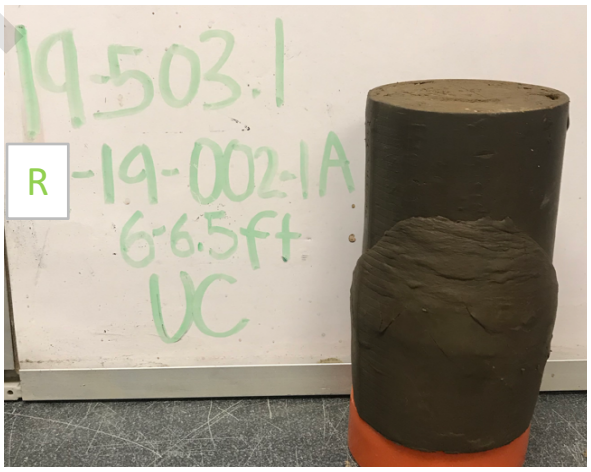
Project Name: Ukiah Recycled Water Pipeline-Phase 4
CAInc File No: 19-503.1
Date: 4/16/19
Technician: HFW
Sample ID: R-19-002-1A Depth (ft): 6.0
USCS Classification: CL

UNCONFINED COMPRESSION TEST - D2166



DRAFT

Dry Density (pcf)	**98.1**
Water Content (%)	**25.2**
Unconfined Compressive Strength (psi)	**14.0**
Unconfined Compressive Strength (psf)	**2016**
Shear Strength (psf)	**1008**
Average Height (in)	5.439
Average Diameter (in)	2.384
Rate of strain (%)	1.0
Strain at 15%	

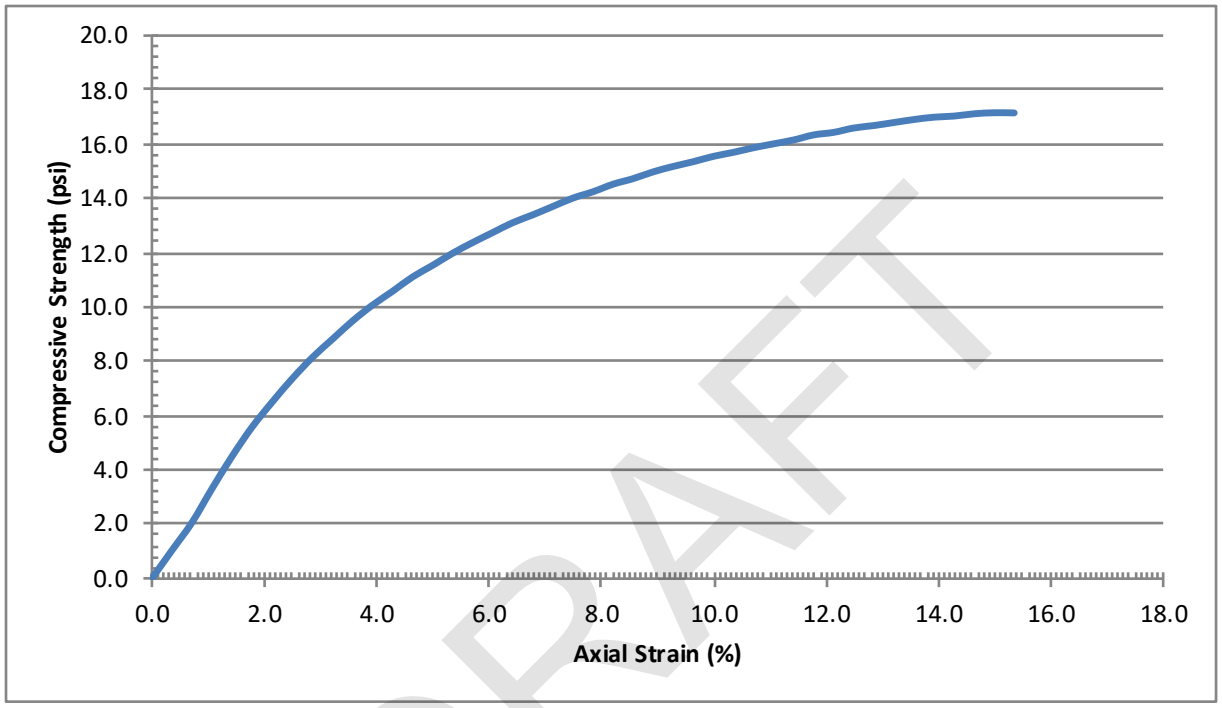


Notes:

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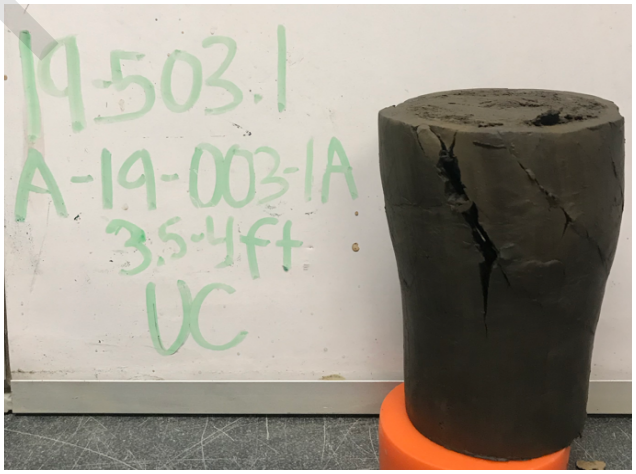
Project Name: Ukiah Recycled Water Pipeline-Phase 4
CAInc File No: 19-503.1
Date: 4/18/19
Technician: HFW
Sample ID: A-19-003-1A Depth (ft): 3.5
USCS Classification: CL

UNCONFINED COMPRESSION TEST - D2166



DRAFT

Dry Density (pcf)	**89.0**
Water Content (%)	**32.1**
Unconfined Compressive Strength (psi)	**17.2**
Unconfined Compressive Strength (psf)	**2477**
Shear Strength (psf)	**1238.4**
Average Height (in)	5.638
Average Diameter (in)	2.383
Rate of strain (%)	2.0
Strain at 15%	

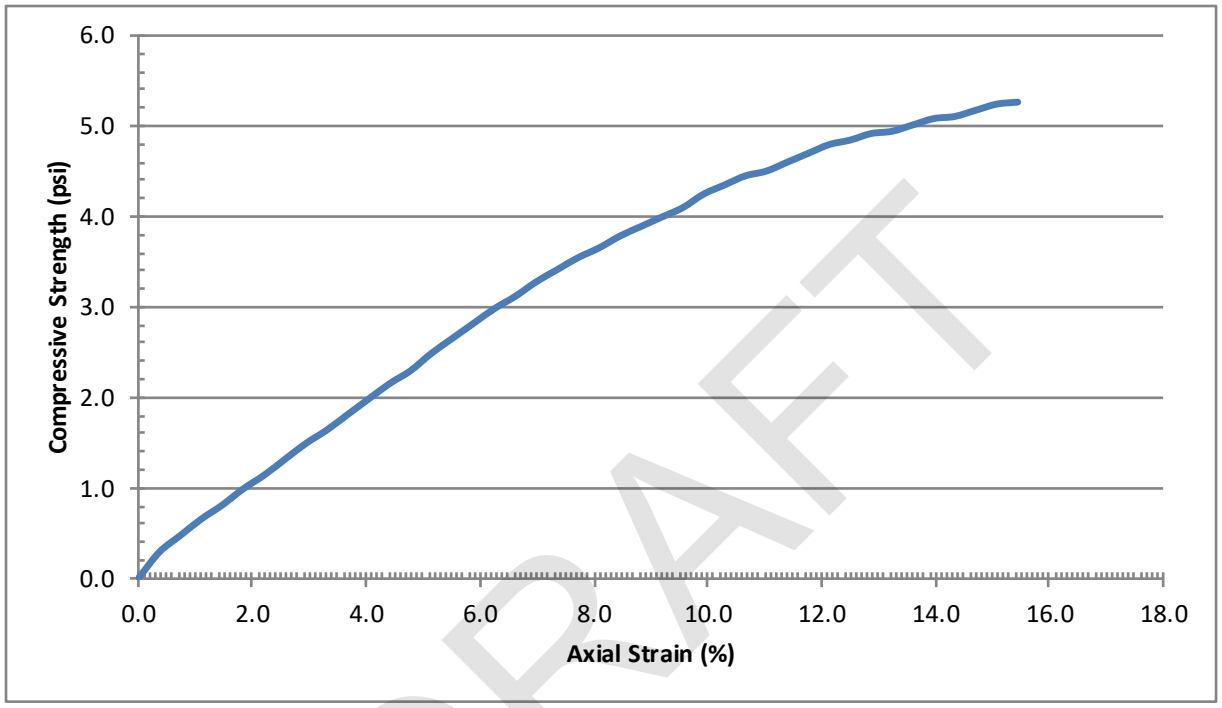


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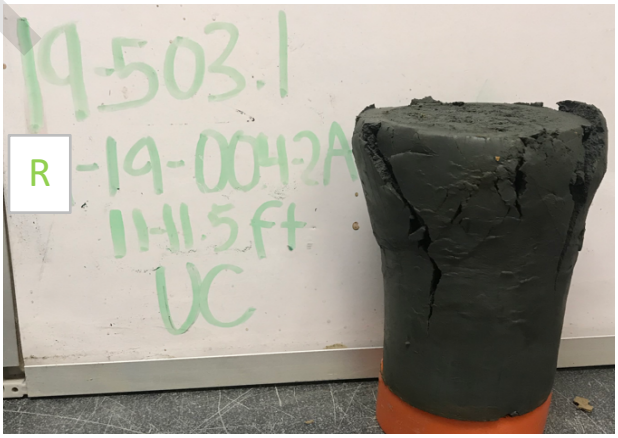
Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline-Phase 4
CAInc File No: 19-503.1
Date: 4/18/19
Technician: HFW
Sample ID: R-19-004-2A Depth (ft): 11.0
USCS Classification: CL

UNCONFINED COMPRESSION TEST - D2166



Dry Density (pcf)	**103.8**
Water Content (%)	**22.8**
Unconfined Compressive Strength (psi)	**5.2**
Unconfined Compressive Strength (psf)	**749**
Shear Strength (psf)	**374.4**
Average Height (in)	5.472
Average Diameter (in)	2.358
Rate of strain (%)	2.0
Strain at 15%	



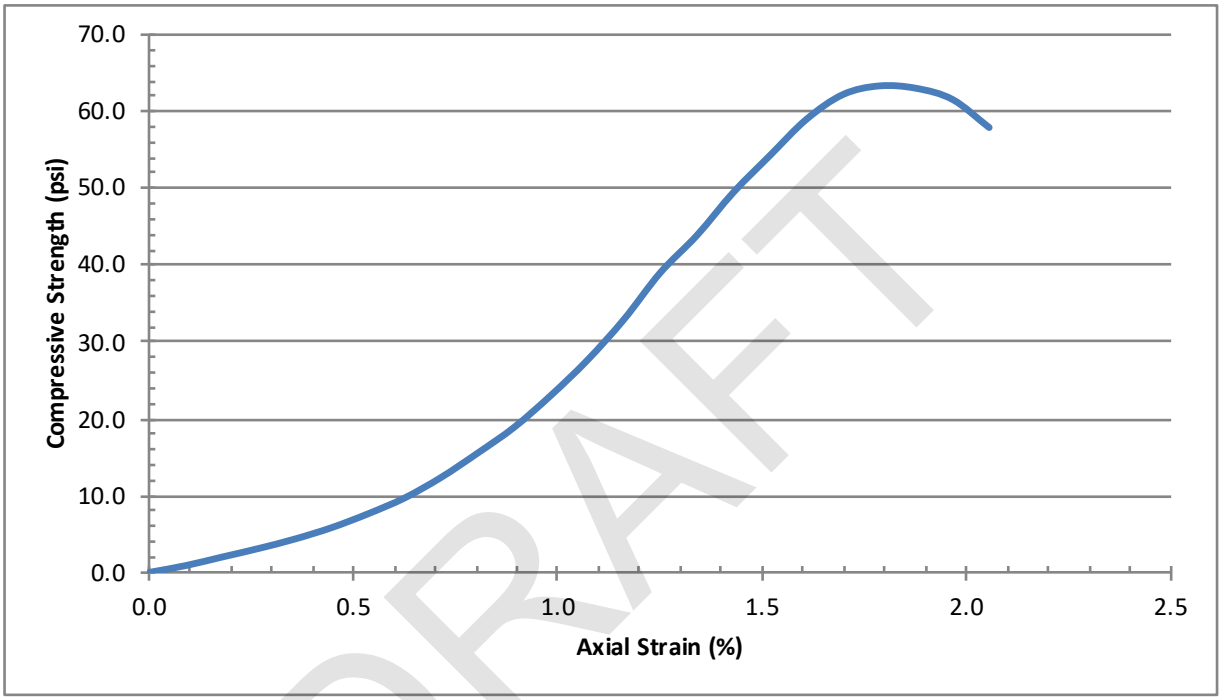
Notes:

DRAFT

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Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 1/8/21
Technician: LAD
Sample ID: R-20-002-2A Depth (ft): 5.5
USCS Classification: Lean CLAY (CL)

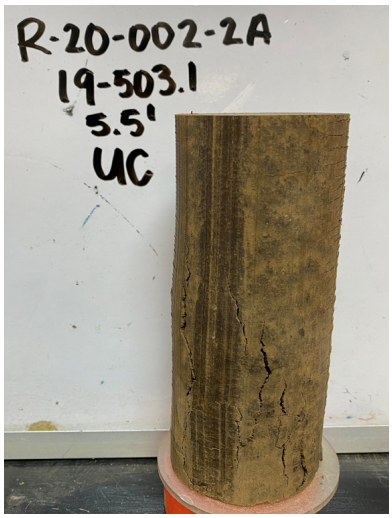
UNCONFINED COMPRESSION TEST - D2166



DRAFT

Dry Density (pcf)	**111.2**
Water Content (%)	**9.0**
Unconfined Compressive Strength (psi)	**63.3**
Unconfined Compressive Strength (psf)	**9115**
Shear Strength (psf)	**4558**
Average Height (in)	5.631
Average Diameter (in)	2.380
Rate of strain (%)	0.5
Strain at Failure (%)	1.8

Notes:



Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukaih Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 4/19/19
Technician: CAP

200 Wash - ASTM D1140
Method A

Max Particle Size (100% Passing)	Standard Sieve Size	Recommended Min Mass of Test Specimens
2 mm or less	No. 10	20 g
4.75 mm	No. 4	100 g
9.5 mm	3/8 "	500 g
19.0 mm	3/4 "	2.5 kg
37.5 mm	1 1/2 "	10 kg
75.0 mm	3 "	50 kg

Table from 6.2 of ASTM D1140

Sample No.	A-19-005-1A	A-19-006-1A	R-19-009-3A	A-19-011-1A	A-19-013-1A
USCS Symbol	SC	SC	GP-GM	CL	CL
Depth (ft.)	6	6	16	6	3.5
Tare No.	2023	R15	2014	1013	1020
Tare (g)	125.3	130.6	123.1	126.2	126.5
Dry Soil + Tare (g)	441.4	463.8	546.3	307.8	308.1
Dry Mass before (g)	316.1	333.2	423.2	181.6	181.6
Dry Mass after (g)	260.5	262.8	383.1	87.5	38.1
Percent Fines (%)	18	21	9	52	79

Notes:

DRAFT

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 6/10/19
Technician: CAP

200 Wash - ASTM D1140
Method A

Max Particle Size (100% Passing)	Standard Sieve Size	Recommended Min Mass of Test Specimens
2 mm or less	No. 10	20 g
4.75 mm	No. 4	100 g
9.5 mm	3/8 "	500 g
19.0 mm	3/4 "	2.5 kg
37.5 mm	1 1/2 "	10 kg
75.0 mm	3 "	50 kg

Table from 6.2 of ASTM D1140

Sample No.	A-19-015-1A	R-19-017-4A	R-19-017-6A	R-19-021-2A	R-19-021-3A
USCS Symbol	SC	SP-SC	SP-SC	GC	GP
Depth (ft.)	3.5	21	31	11	16
Tare No.	R5	1003	R14	2007	R10
Tare (g)	126.1	126	129.5	122.7	131.1
Dry Soil + Tare (g)	320.4	389.3	354.7	313.9	315.2
Dry Mass before (g)	194.3	263.3	225.2	191.2	184.1
Dry Mass after (g)	150.3	230.2	202.7	144.8	178.8
Percent Fines (%)	23	13	10	24	3

Notes:

DRAFT

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 6/10/19
Technician: CAP

200 Wash - ASTM D1140
Method A

Max Particle Size (100% Passing)	Standard Sieve Size	Recommended Min Mass of Test Specimens
2 mm or less	No. 10	20 g
4.75 mm	No. 4	100 g
9.5 mm	3/8 "	500 g
19.0 mm	3/4 "	2.5 kg
37.5 mm	1 1/2 "	10 kg
75.0 mm	3 "	50 kg

Table from 6.2 of ASTM D1140

Sample No.	R-19-021-4A	A-19-023-1A			
USCS Symbol	GP-GC	SP-SC			
Depth (ft.)	21	3.5			
Tare No.	2025	1012			
Tare (g)	125.6	126.1			
Dry Soil + Tare (g)	318.4	321.5			
Dry Mass before (g)	192.8	195.4			
Dry Mass after (g)	179.2	171.0			
Percent Fines (%)	7	12			

Notes:

DRAFT

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 12/31/20
Technician: MCC

200 Wash - ASTM D1140
Method A

Max Particle Size (100% Passing)	Standard Sieve Size	Recommended Min Mass of Test Specimens
2 mm or less	No. 10	20 g
4.75 mm	No. 4	100 g
9.5 mm	3/8 "	500 g
19.0 mm	3/4 "	2.5 kg
37.5 mm	1 1/2 "	10 kg
75.0 mm	3 "	50 kg

Table from 6.2 of ASTM D1140

Sample No.	A-20-001-3B	A-20-001-5B	R-20-002-3A	R-20-002-10A	R-20-003-2A
USCS Symbol	GC	SC	ML	CL	CL
Depth (ft.)	8	15.5	8.5	41	6
Tare No.	X7	X1	R21	X8	X6
Tare (g)	147.9	152.6	126.2	150.6	148.4
Dry Soil + Tare (g)	483	575.8	488.4	434	460.8
Dry Mass before (g)	335.1	423.2	362.2	283.4	312.4
Dry Mass after (g)	249.9	279.1	109.8	52.7	58.9
Percent Fines (%)	25	34	70	81	81

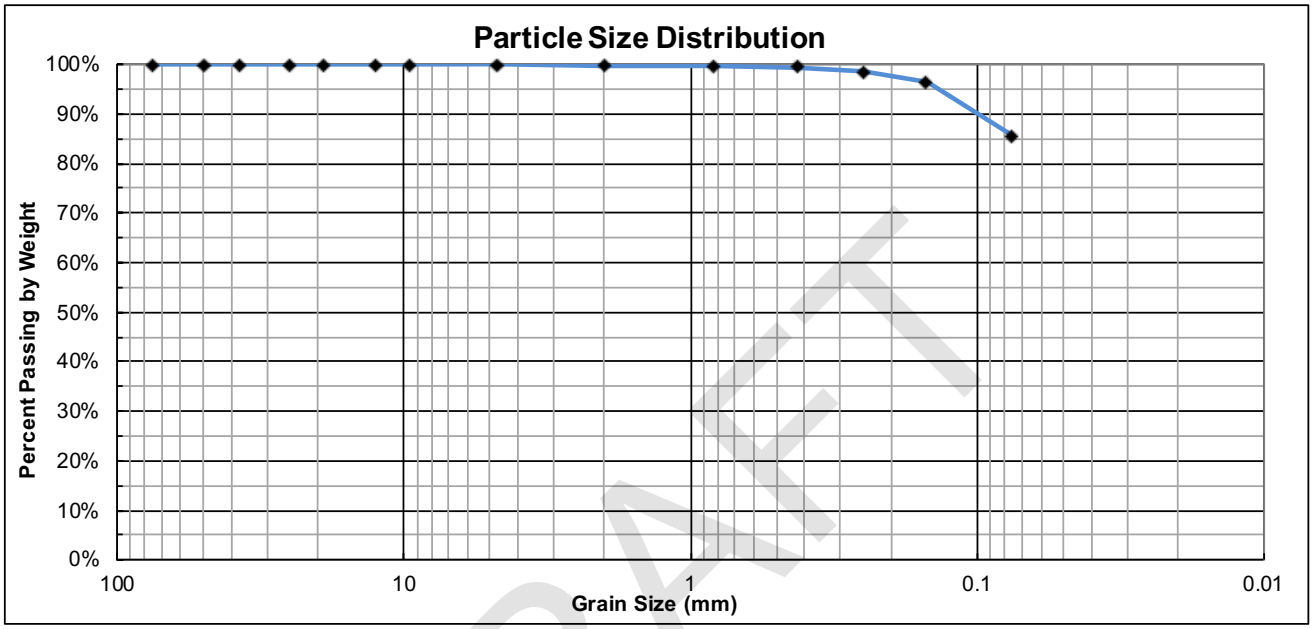
Notes:

DRAFT

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 4/24/19
Technician: CAP
Sample ID: R-19-001-1A
Depth (ft): 6
USCS Classification: Lean CLAY (CL)

ASTM 6913 - Method A



DRAFT

% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	0	0	0	1	13	
0	**0**		**14**			**86**

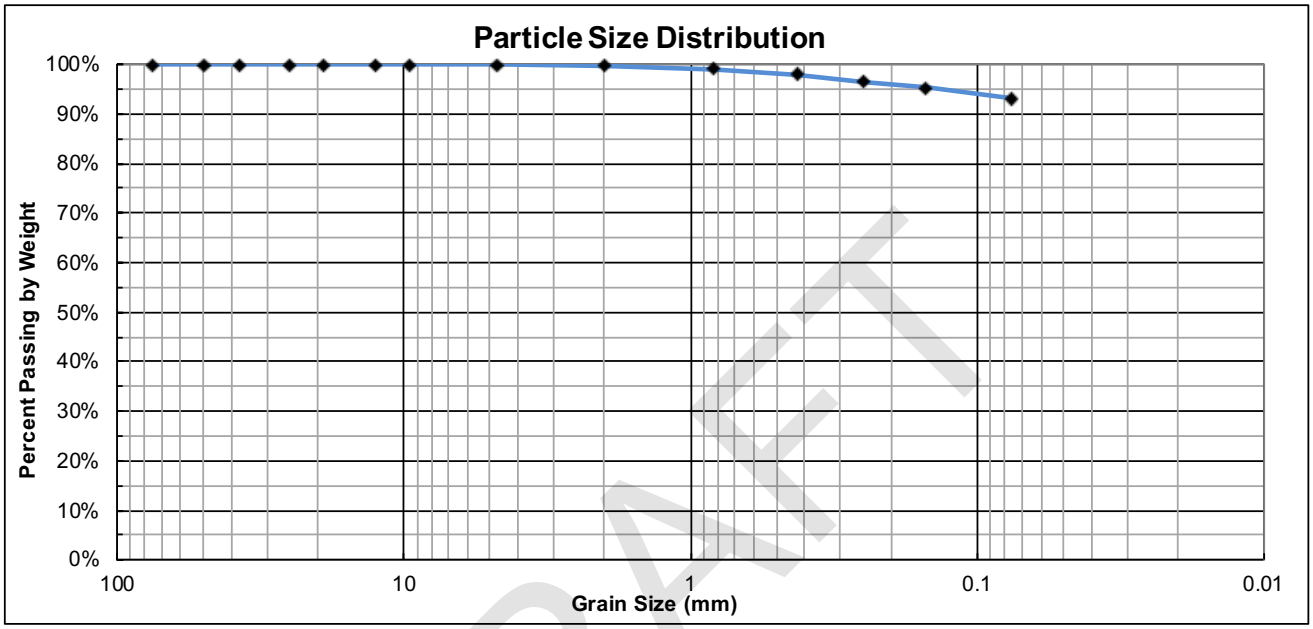
		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	0.0	100%
		3/4"	19.0	0.0	100%
	Fine	**1/2"**	12.5	0.0	100%
		3/8"	9.50	0.0	100%
		#4	4.75	0.0	100%
Sand	Coarse	**#10**	2.00	0.4	100%
	Medium	**#20**	0.825	1.0	100%
		#40	0.425	1.3	99%
	Fine	**#60**	0.250	3.0	99%
		#100	0.150	7.5	96%
		#200	0.075	29.1	86%

Coefficient of Uniformity	Coefficient of Curvature
Cu = NA	Cc = NA

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 4/19/19
Technician: CAP
Sample ID: R-19-002-1A
Depth (ft): 6
USCS Classification: Lean CLAY (CL)

ASTM 6913 - Method A



DRAFT

% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	0	0	0	2	5	
0	**0**		**7**			**93**

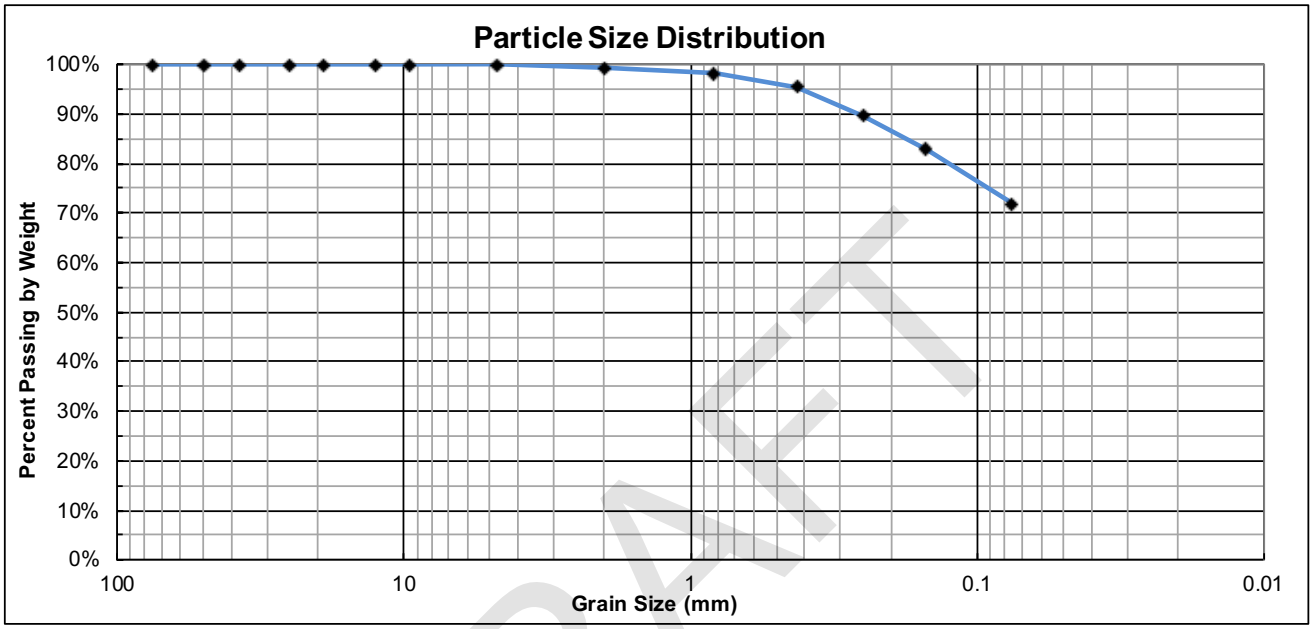
		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	0.0	100%
		3/4"	19.0	0.0	100%
	Fine	**1/2"**	12.5	0.0	100%
		3/8"	9.50	0.0	100%
		#4	4.75	0.0	100%
Sand	Coarse	**#10**	2.00	0.6	100%
	Medium	**#20**	0.825	2.9	99%
		#40	0.425	6.2	98%
	Fine	**#60**	0.250	10.4	97%
		#100	0.150	14.4	95%
		#200	0.075	20.9	93%

Coefficient of Uniformity	Coefficient of Curvature
Cu = NA	Cc = NA

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 4/19/19
Technician: CAP
Sample ID: R-19-002-2A
Depth (ft): 11
USCS Classification: Lean CLAY (CL)

ASTM 6913 - Method A



% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	0	0	1	4	23	
0	**0**		**28**			**72**

		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	0.0	100%
		3/4"	19.0	0.0	100%
	Fine	**1/2"**	12.5	0.0	100%
		3/8"	9.50	0.0	100%
		#4	4.75	0.3	100%
Sand	Coarse	**#10**	2.00	1.8	99%
	Medium	**#20**	0.825	4.3	98%
		#40	0.425	10.2	95%
	Fine	**#60**	0.250	22.8	90%
		#100	0.150	37.9	83%
		#200	0.075	62.2	72%

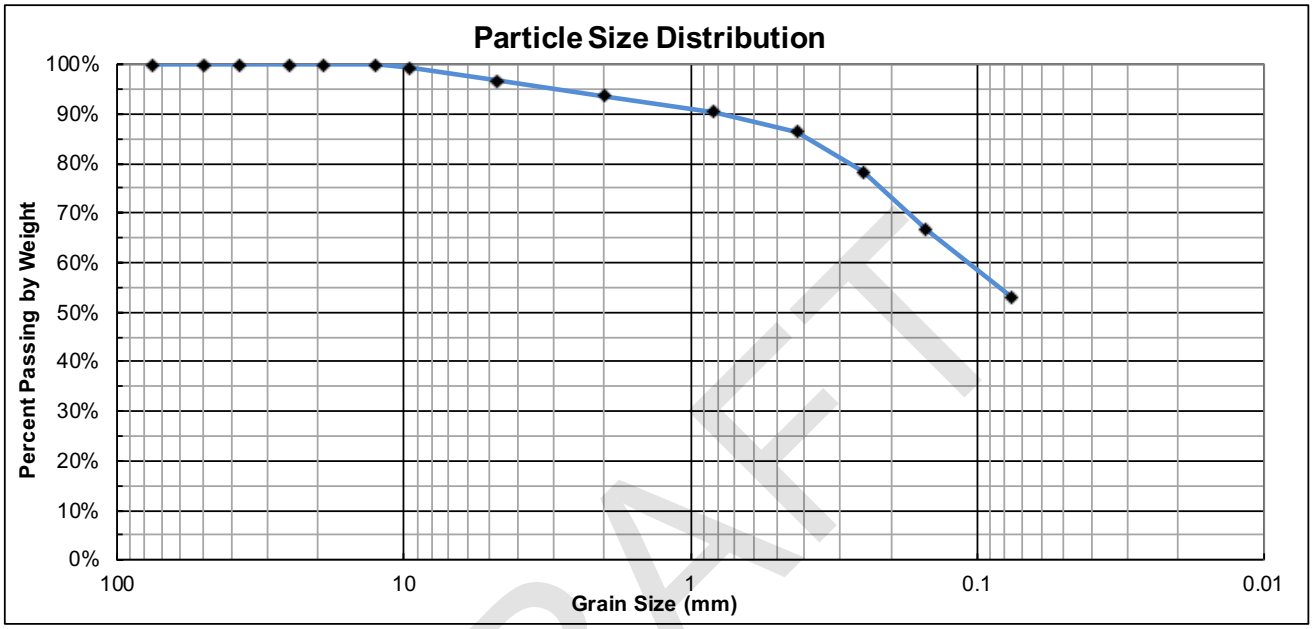
Coefficient of Uniformity	Coefficient of Curvature
Cu = NA	Cc = NA

DRAFT

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 4/24/19
Technician: CAP
Sample ID: R-19-004-1A
Depth (ft): 6
USCS Classification: SANDY lean CLAY (CL)

ASTM 6913 - Method A



% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	0	3	3	8	33	
0	**3**		**44**			**53**

		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	0.0	100%
		3/4"	19.0	0.0	100%
	Fine	**1/2"**	12.5	0.0	100%
		3/8"	9.50	1.3	99%
		#4	4.75	6.4	97%
Sand	Coarse	**#10**	2.00	12.2	94%
	Medium	**#20**	0.825	18.1	90%
		#40	0.425	25.6	86%
	Fine	**#60**	0.250	41.2	78%
		#100	0.150	63.2	67%
		#200	0.075	89.4	53%

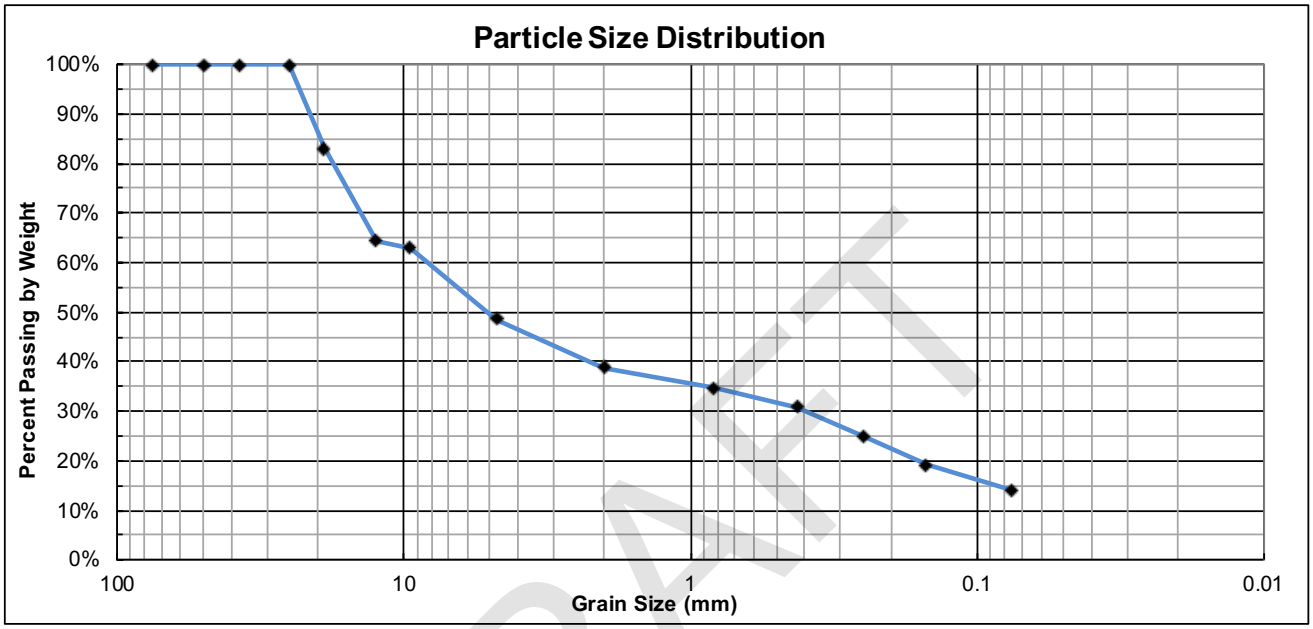
Coefficient of Uniformity	Coefficient of Curvature
Cu = NA	Cc = NA

DRAFT

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 5/1/19
Technician: AC
Sample ID: A-19-007-1A
Depth (ft): 6
USCS Classification: Poorly-graded GRAVEL with CLAY and SAND (GP-GC)

ASTM 6913 - Method A



DRAFT

% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	17	35	9	8	17	
0	**52**		**34**			**14**

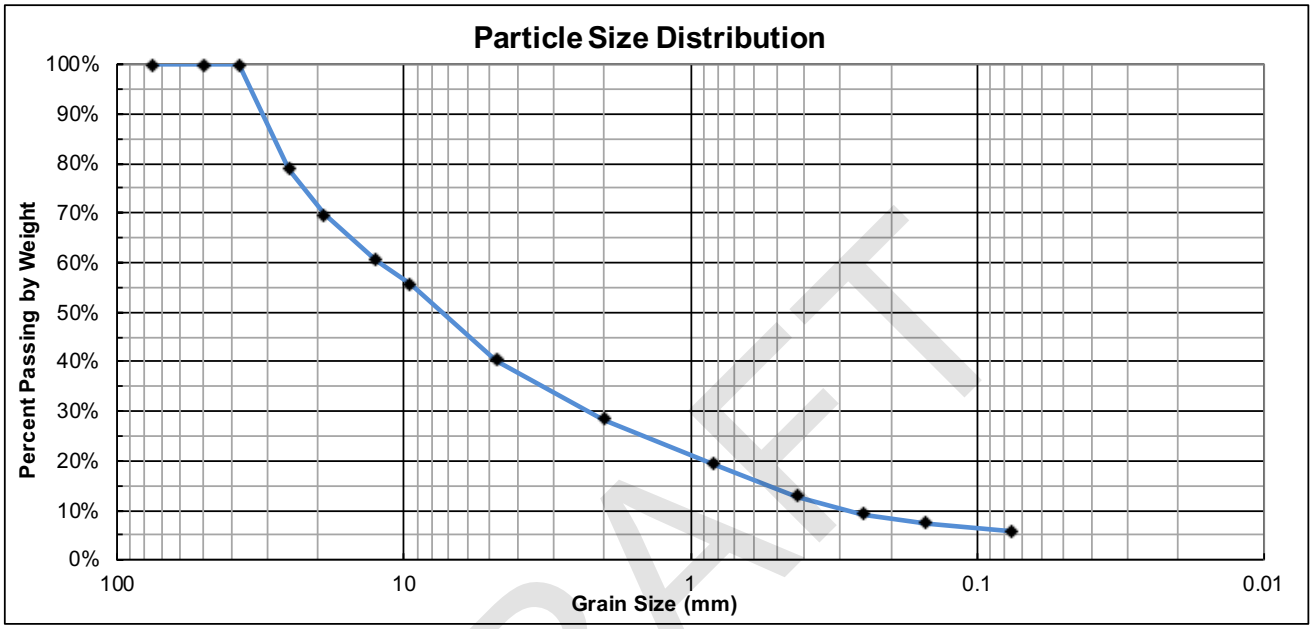
		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	0.0	100%
		3/4"	19.0	56.4	83%
	Fine	**1/2"**	12.5	118.4	64%
		3/8"	9.50	123.1	63%
		#4	4.75	171.3	48%
Sand	Coarse	**#10**	2.00	203.8	39%
	Medium	**#20**	0.825	217.2	35%
		#40	0.425	230.1	31%
	Fine	**#60**	0.250	249.8	25%
		#100	0.150	268.7	19%
		#200	0.075	286.0	14%

Coefficient of Uniformity	Coefficient of Curvature
Cu = NA	Cc = NA

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 5/1/19
Technician: AC
Sample ID: R-19-009-1A
Depth (ft): 6
USCS Classification: Well-graded GRAVEL with CLAY and SAND (GW-GC)

ASTM 6913 - Method A



DRAFT

% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	30	30	12	15	7	
0	**60**		**34**			**6**

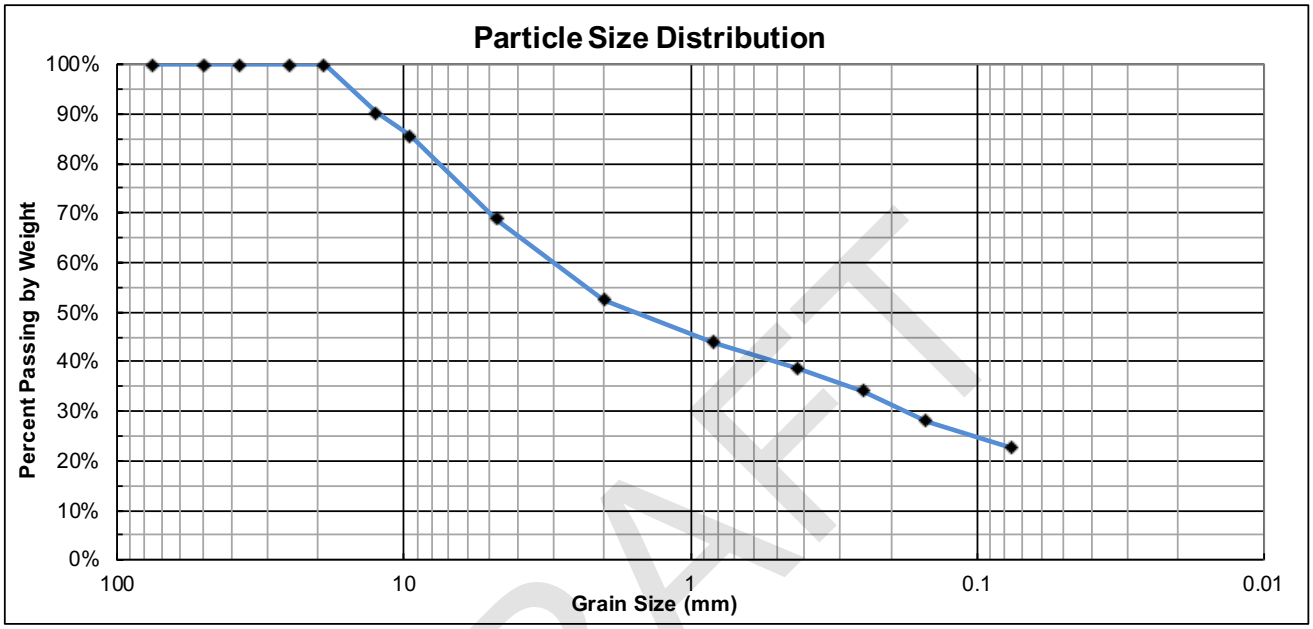
		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	85.5	79%
		3/4"	19.0	122.9	70%
	Fine	**1/2"**	12.5	159.5	61%
		3/8"	9.50	179.6	56%
		#4	4.75	241.5	40%
Sand	Coarse	**#10**	2.00	289.5	28%
	Medium	**#20**	0.825	325.8	19%
		#40	0.425	352.2	13%
	Fine	**#60**	0.250	366.4	9%
		#100	0.150	373.8	7%
		#200	0.075	380.6	6%

Coefficient of Uniformity	Coefficient of Curvature
Cu = 42.7	Cc = 1.6

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 6/13/19
Technician: GW
Sample ID: A-19-010-Bulk
Depth (ft): 0-5'
USCS Classification: CLAYEY SAND With GRAVEL (SC)

ASTM 6913 - Method A



DRAFT

% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	0	31	16	14	16	
0	**31**		**46**			**23**

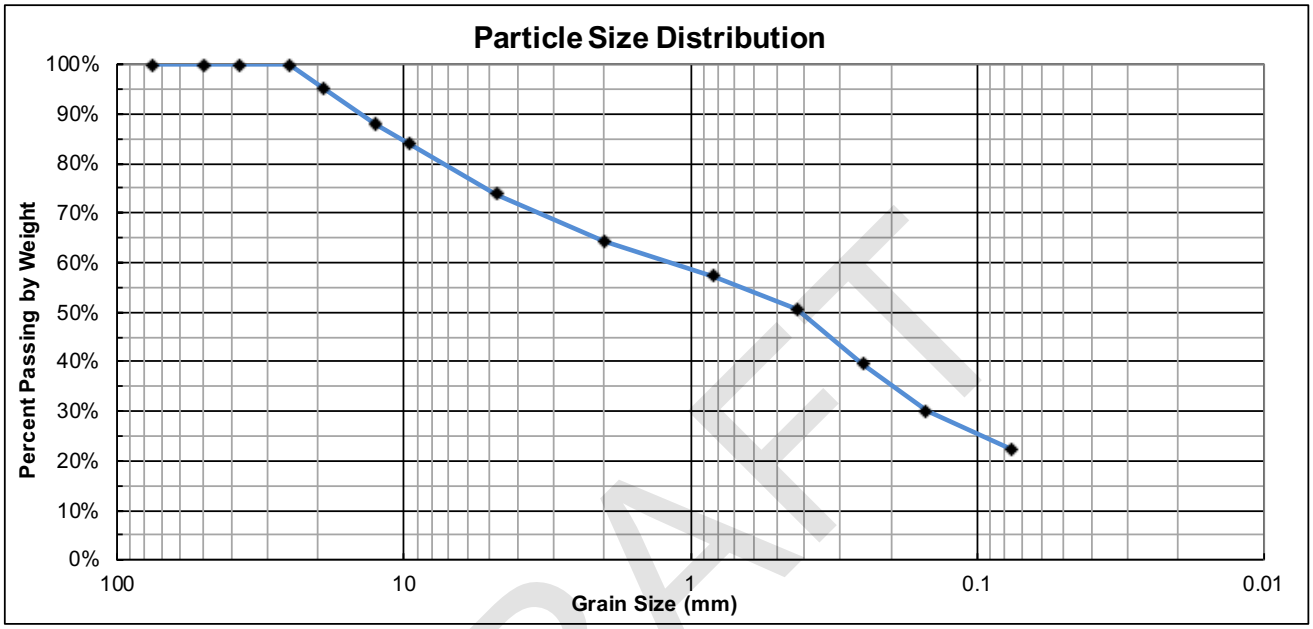
		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	0.0	100%
		3/4"	19.0	0.0	100%
	Fine	**1/2"**	12.5	36.7	90%
		3/8"	9.50	53.9	86%
		#4	4.75	116.9	69%
Sand	Coarse	**#10**	2.00	176.9	53%
	Medium	**#20**	0.825	209.6	44%
		#40	0.425	228.8	39%
	Fine	**#60**	0.250	245.9	34%
		#100	0.150	268.7	28%
		#200	0.075	289.0	23%

Coefficient of Uniformity	Coefficient of Curvature
Cu = NA	Cc = NA

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 5/1/19
Technician: AC
Sample ID: A-19-012-1A
Depth (ft): 6
USCS Classification: CLAYEY SAND with GRAVEL (SC)

ASTM 6913 - Method A



% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	5	21	10	13	29	
0	**26**		**52**			**22**

		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	0.0	100%
		3/4"	19.0	14.6	95%
	Fine	**1/2"**	12.5	35.4	88%
		3/8"	9.50	47.1	84%
		#4	4.75	76.1	74%
Sand	Coarse	**#10**	2.00	104.3	64%
	Medium	**#20**	0.825	124.6	57%
		#40	0.425	144.1	51%
	Fine	**#60**	0.250	176.4	39%
		#100	0.150	203.8	30%
		#200	0.075	226.7	22%

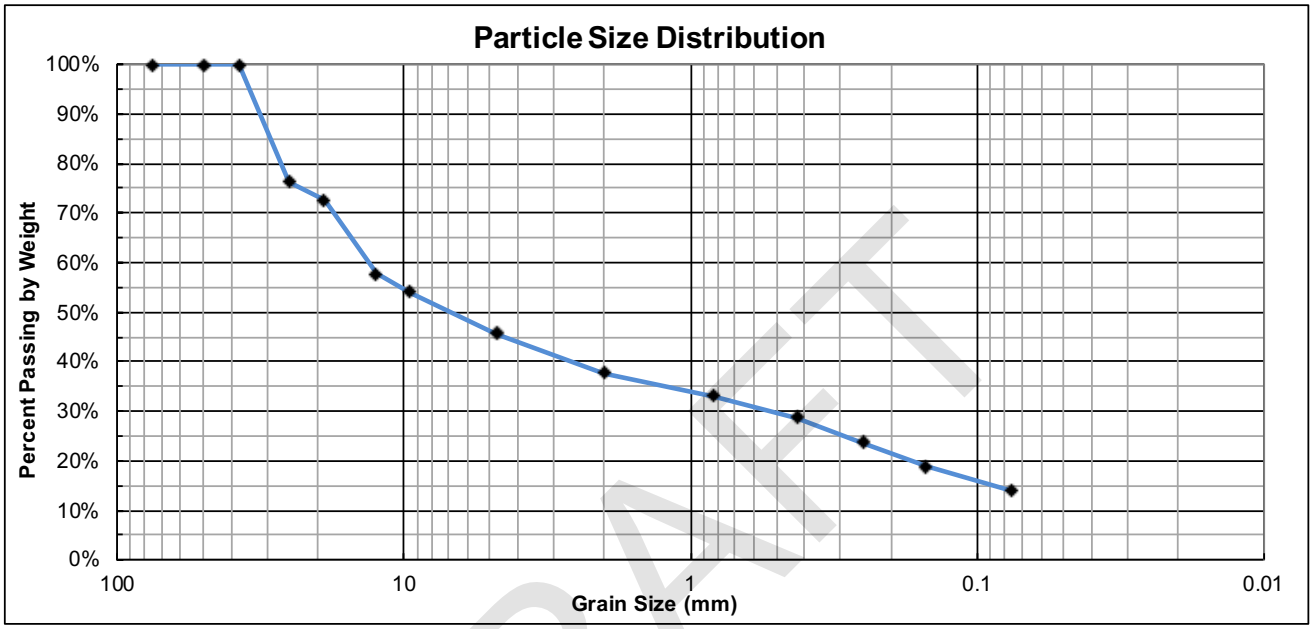
Coefficient of Uniformity	Coefficient of Curvature
Cu = NA	Cc = NA

DRAFT

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 5/1/19
Technician: AC
Sample ID: A-19-014-1A
Depth (ft): 3.5
USCS Classification: Poorly-graded GRAVEL with CLAY and SAND (GP-GC)

ASTM 6913 - Method A



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% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	27	27	8	9	15	
0	**54**		**32**			**14**

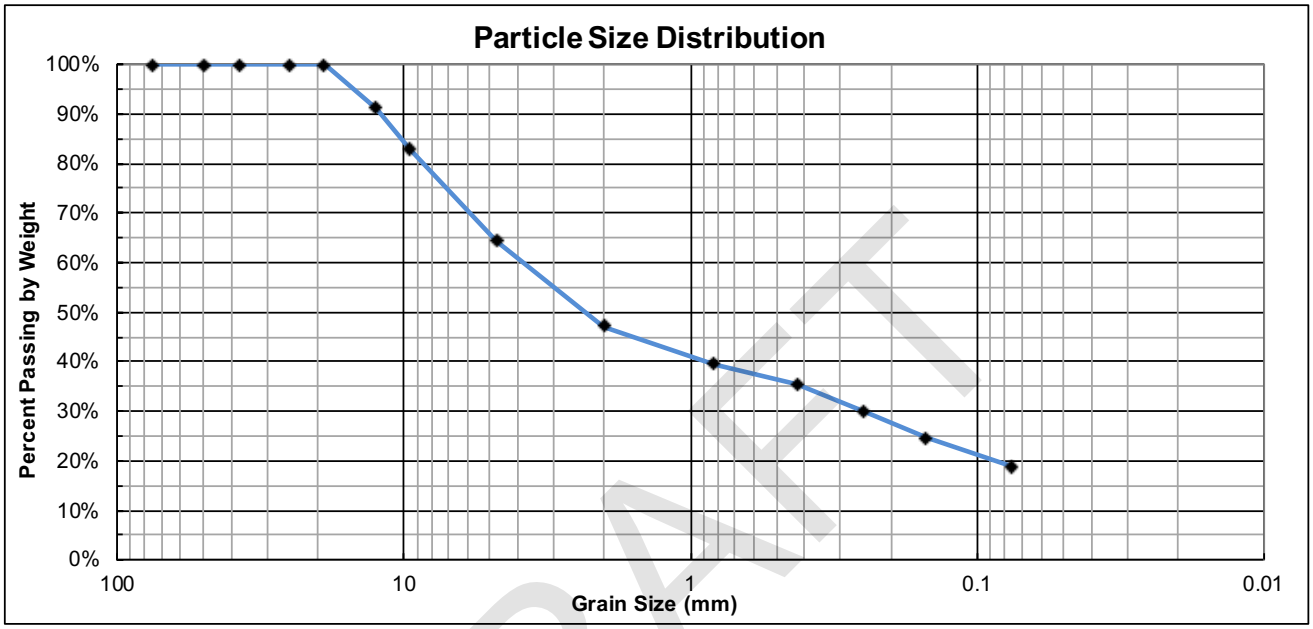
		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	99.5	76%
		3/4"	19.0	114.9	73%
	Fine	**1/2"**	12.5	176.8	58%
		3/8"	9.50	193.1	54%
		#4	4.75	228.1	46%
Sand	Coarse	**#10**	2.00	261.2	38%
	Medium	**#20**	0.825	281.0	33%
		#40	0.425	298.6	29%
	Fine	**#60**	0.250	320.3	24%
		#100	0.150	340.1	19%
		#200	0.075	361.0	14%

Coefficient of Uniformity	Coefficient of Curvature
Cu = NA	Cc = NA

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 6/4/19
Technician: GW
Sample ID: R-19-017-1A
Depth (ft): 21
USCS Classification: SILTY SAND with GRAVEL (SM)

ASTM 6913 - Method A



% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	0	36	17	12	16	
0	**36**		**45**			**19**

		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	0.0	100%
		3/4"	19.0	0.0	100%
	Fine	**1/2"**	12.5	18.0	91%
		3/8"	9.50	34.4	83%
		#4	4.75	71.5	64%
Sand	Coarse	**#10**	2.00	105.9	47%
	Medium	**#20**	0.825	121.2	40%
		#40	0.425	129.5	35%
	Fine	**#60**	0.250	140.6	30%
		#100	0.150	151.3	25%
		#200	0.075	162.8	19%

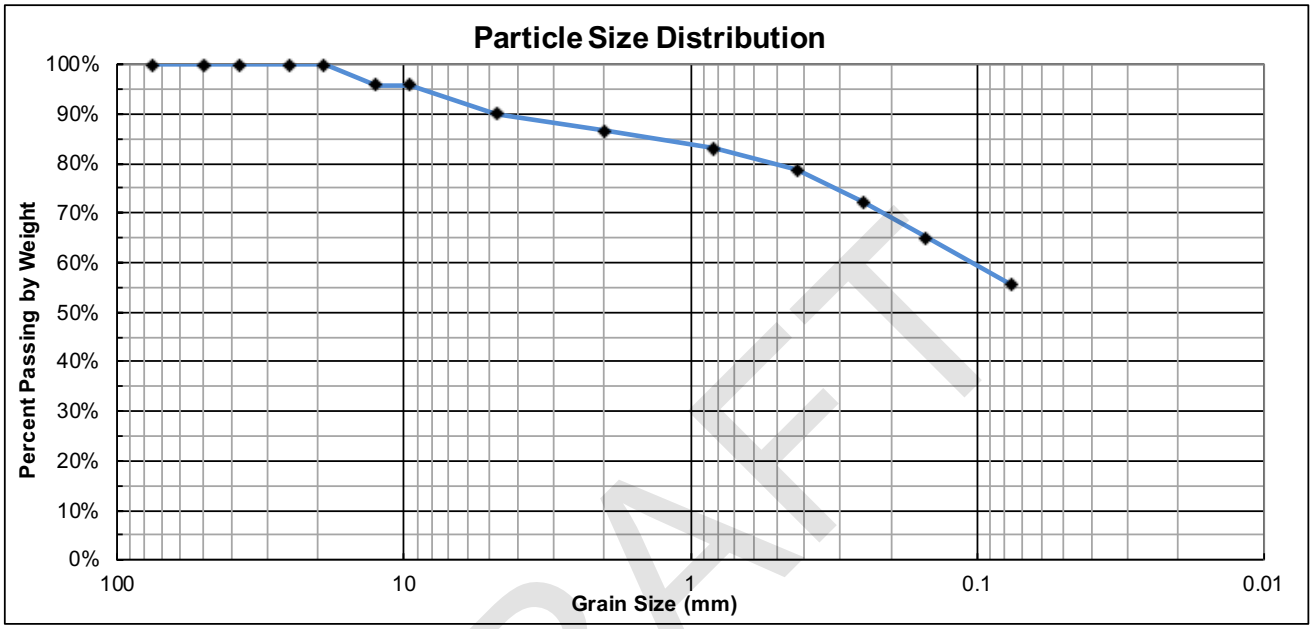
Coefficient of Uniformity	Coefficient of Curvature
Cu = NA	Cc = NA

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 4/19/19
Technician: CAP
Sample ID: R-19-024-1A
Depth (ft): 6
USCS Classification: SANDY lean CLAY (CL)

ASTM 6913 - Method A



% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	0	10	3	8	24	
0	**10**		**35**			**55**

		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	0.0	100%
		3/4"	19.0	0.0	100%
	Fine	**1/2"**	12.5	9.4	96%
		3/8"	9.50	9.4	96%
		#4	4.75	22.7	90%
Sand	Coarse	**#10**	2.00	30.5	87%
	Medium	**#20**	0.825	38.5	83%
		#40	0.425	48.4	79%
	Fine	**#60**	0.250	62.8	72%
		#100	0.150	79.3	65%
		#200	0.075	101.0	55%

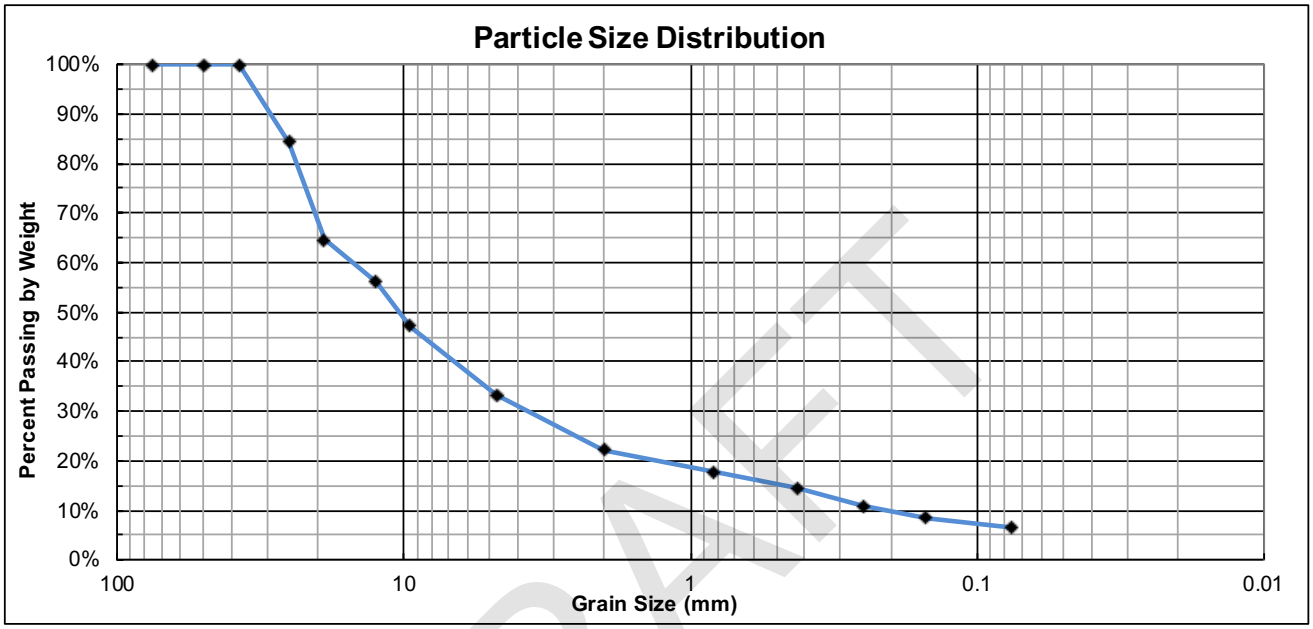
Coefficient of Uniformity	Coefficient of Curvature
Cu = NA	Cc = NA

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 6/6/19
Technician: CAP
Sample ID: A-19-023-4A
Depth (ft): 11
USCS Classification: Poorly-graded GRAVEL with CLAY and SAND (GP-GM)

ASTM 6913 - Method A



% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	35	32	11	8	7	
0	**67**		**26**			**7**

		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	37.1	84%
		3/4"	19.0	83.3	65%
	Fine	**1/2"**	12.5	103.3	56%
		3/8"	9.50	124.1	47%
		#4	4.75	156.7	33%
Sand	Coarse	**#10**	2.00	182.6	22%
	Medium	**#20**	0.825	193.5	18%
		#40	0.425	201.1	14%
	Fine	**#60**	0.250	209.4	11%
		#100	0.150	214.9	9%
		#200	0.075	219.6	7%

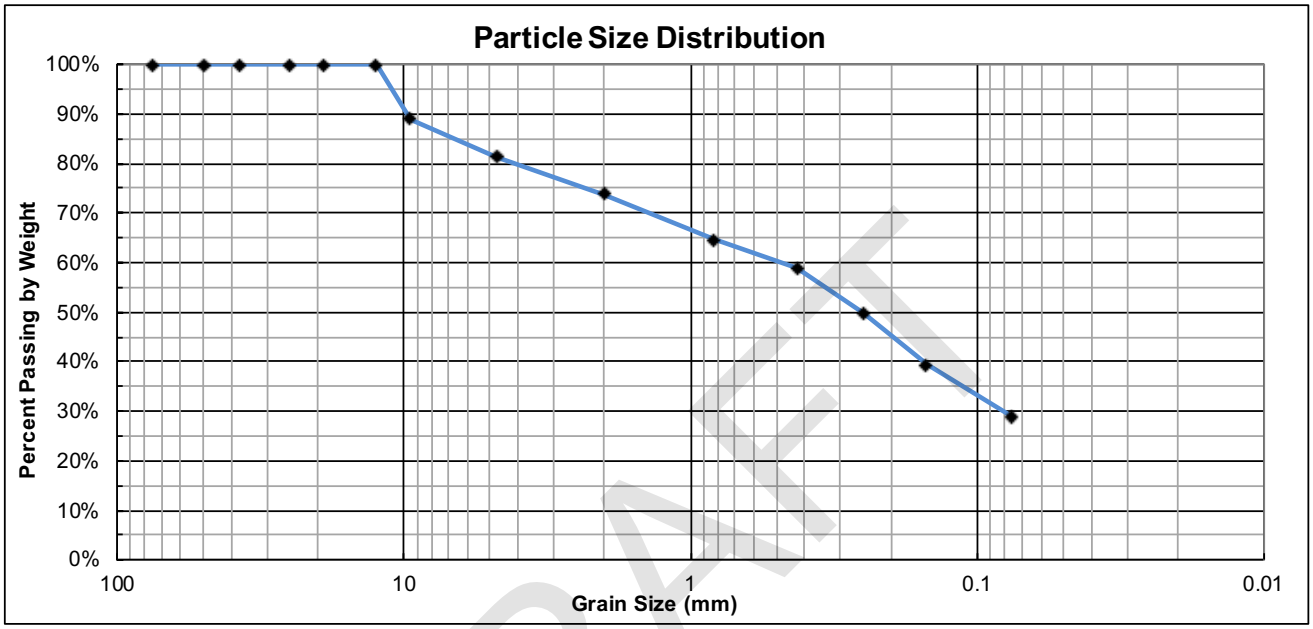
Coefficient of Uniformity	Coefficient of Curvature
Cu = 72.8	Cc = 4.7

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 6/4/19
Technician: CAP
Sample ID: A-19-022-1A
Depth (ft): 6
USCS Classification: CLAYEY SAND with GRAVEL (SC)

ASTM 6913 - Method A



% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	0	19	7	15	30	
0	**19**		**52**			**29**

		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	0.0	100%
		3/4"	19.0	0.0	100%
	Fine	**1/2"**	12.5	0.0	100%
		3/8"	9.50	20.2	89%
		#4	4.75	33.9	81%
Sand	Coarse	**#10**	2.00	47.8	74%
	Medium	**#20**	0.825	64.3	65%
		#40	0.425	74.8	59%
	Fine	**#60**	0.250	91.4	50%
		#100	0.150	110.3	39%
		#200	0.075	129.5	29%

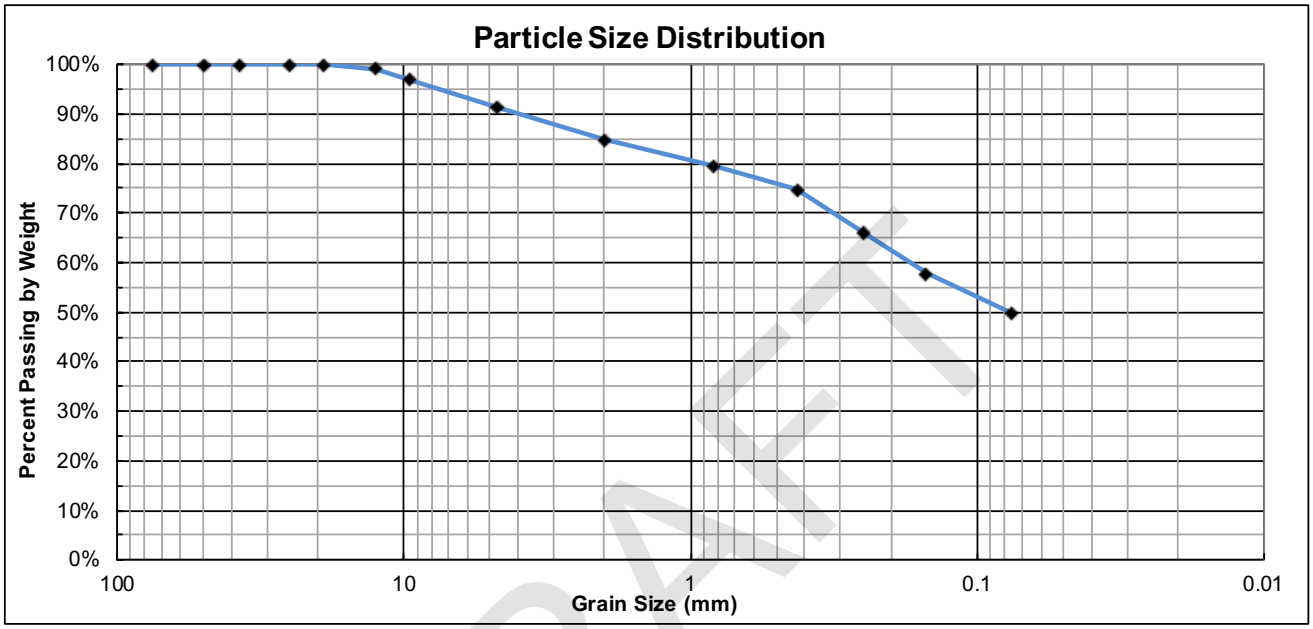
Coefficient of Uniformity	Coefficient of Curvature
Cu = NA	Cc = NA

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 1/18/21
Technician: MCC
Sample ID: A-20-001-11A
Depth (ft): 46
USCS Classification: SANDY lean CLAY (CL)

ASTM 6913 - Method A



% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	0	9	6	10	25	
0	**9**		**41**			**50**

		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	0.0	100%
		3/4"	19.0	0.0	100%
	Fine	**1/2"**	12.5	3.2	99%
		3/8"	9.50	9.9	97%
		#4	4.75	27.2	91%
Sand	Coarse	**#10**	2.00	47.9	85%
	Medium	**#20**	0.825	65.1	79%
		#40	0.425	80.0	75%
	Fine	**#60**	0.250	107.0	66%
		#100	0.150	132.9	58%
		#200	0.075	158.5	50%

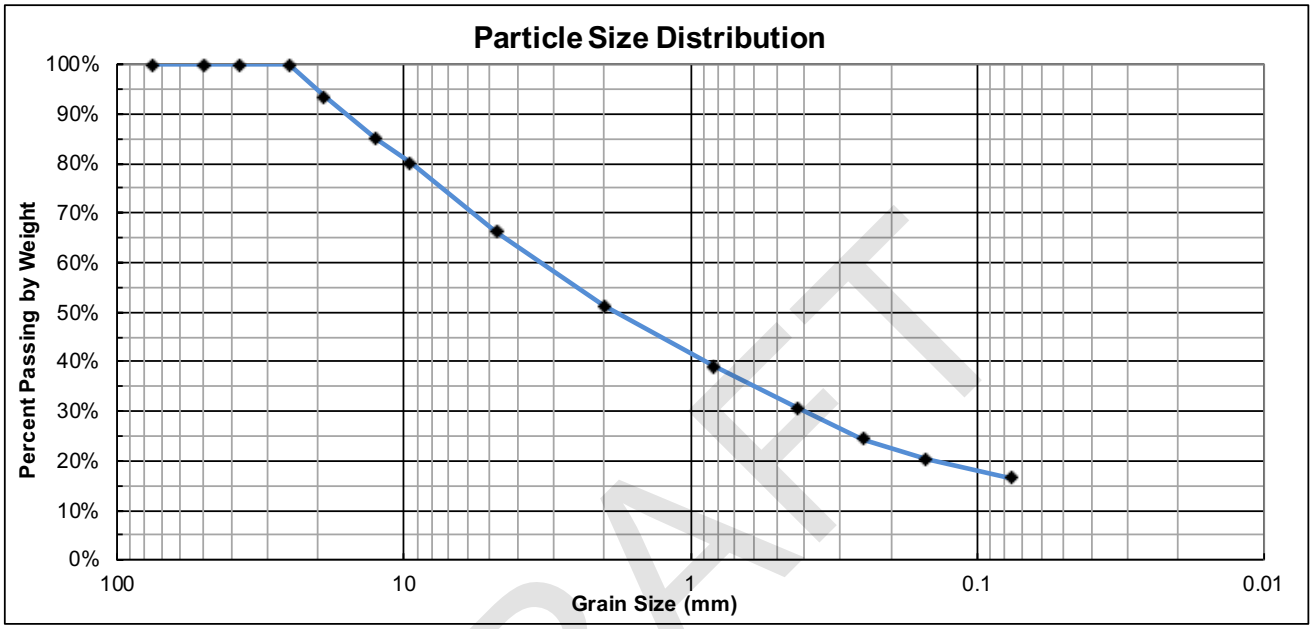
Coefficient of Uniformity	Coefficient of Curvature
Cu = NA	Cc = NA

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 1/4/21
Technician: MCC
Sample ID: R-20-002-6A
Depth (ft): 21
USCS Classification: CLAYEY SAND with GRAVEL (SC)

ASTM 6913 - Method A



% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	7	27	15	20	15	
0	**34**		**50**			**16**

		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	0.0	100%
		3/4"	19.0	27.7	93%
	Fine	**1/2"**	12.5	62.5	85%
		3/8"	9.50	83.4	80%
		#4	4.75	141.2	66%
Sand	Coarse	**#10**	2.00	204.3	51%
	Medium	**#20**	0.825	255.3	39%
		#40	0.425	289.9	31%
	Fine	**#60**	0.250	316.2	24%
		#100	0.150	333.7	20%
		#200	0.075	349.8	16%

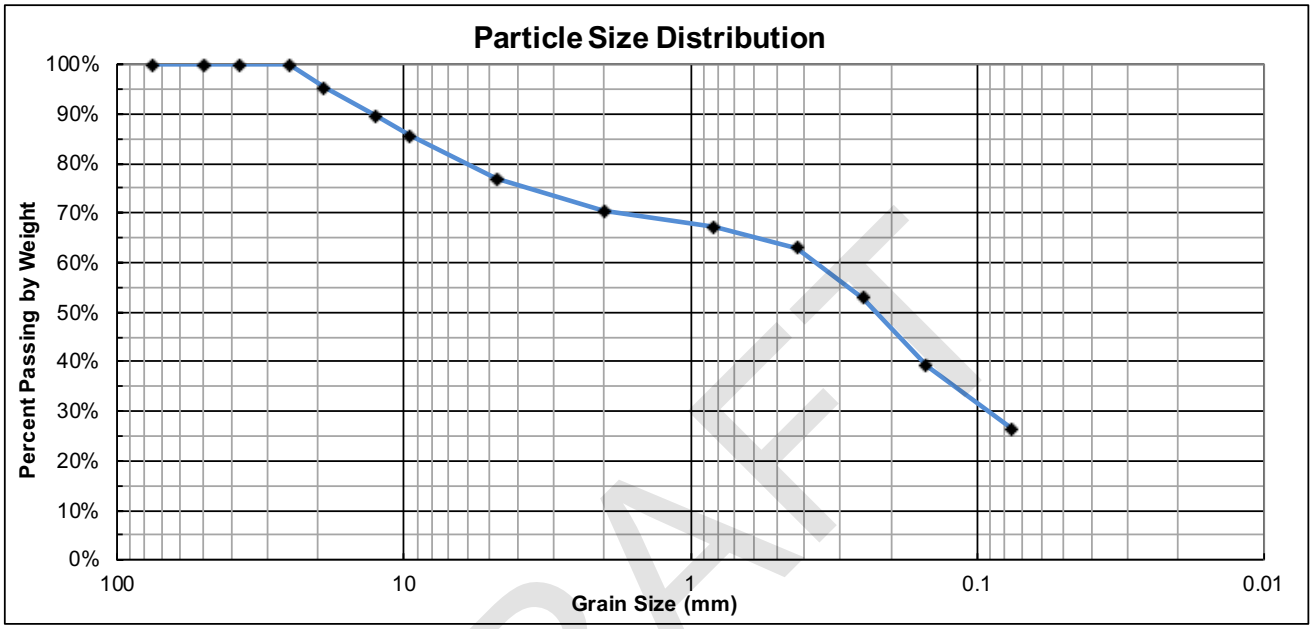
Coefficient of Uniformity	Coefficient of Curvature
Cu = NA	Cc = NA

DRAFT

Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 1/4/21
Technician: MCC
Sample ID: R-20-003-4A
Depth (ft): 11
USCS Classification: SILTY SAND with GRAVEL (SM)

ASTM 6913 - Method A



% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	5	18	7	7	37	
0	**23**		**51**			**26**

		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	0.0	100%
		3/4"	19.0	20.2	95%
	Fine	**1/2"**	12.5	44.8	90%
		3/8"	9.50	61.8	86%
		#4	4.75	99.0	77%
Sand	Coarse	**#10**	2.00	126.5	70%
	Medium	**#20**	0.825	140.5	67%
		#40	0.425	158.0	63%
	Fine	**#60**	0.250	200.9	53%
		#100	0.150	259.9	39%
		#200	0.075	314.6	26%

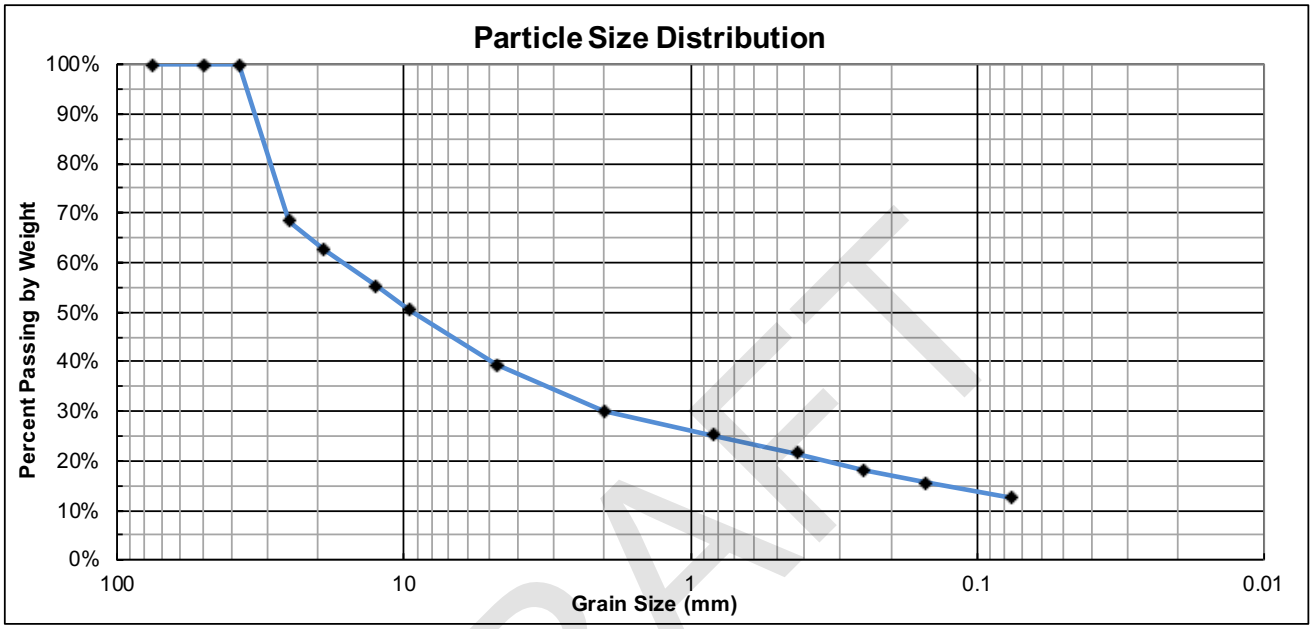
Coefficient of Uniformity	Coefficient of Curvature	50% of Cumulative Mass
Cu = NA	Cc = NA	D_{50} = 0.23

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Crawford & Associates, Inc.
Geotechnical Engineering, Design and Construction Services

Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 1/5/21
Technician: MCC
Sample ID: R-20-003-6A
Depth (ft): 20.5
USCS Classification: CLAYEY GRAVEL with SAND (GC)

ASTM 6913 - Method A



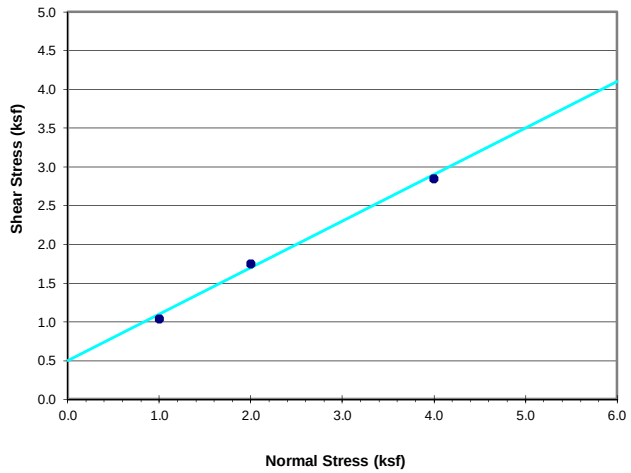
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% Cobble	% Gravel		% Sand			% Fines
	Coarse	Fine	Coarse	Medium	Fine	Silt/Clay
	37	24	9	8	10	
0	**61**		**27**			**12**

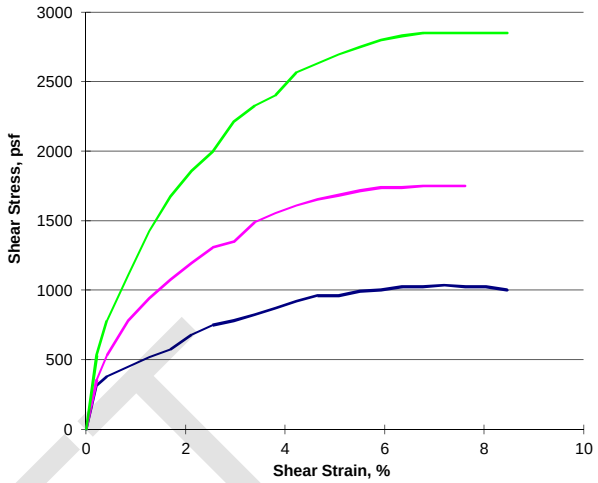
		Sieve #	Opening mm	Cummulative Mass Retained (g)	% Passing %
Cobbles		**3"**	75	0.0	100%
Gravel	Coarse	**2"**	50	0.0	100%
		1-1/2"	37.5	0.0	100%
		1"	25.0	155.2	68%
		3/4"	19.0	183.7	63%
	Fine	**1/2"**	12.5	219.9	55%
		3/8"	9.50	243.7	50%
		#4	4.75	298.1	39%
Sand	Coarse	**#10**	2.00	343.6	30%
	Medium	**#20**	0.825	367.7	25%
		#40	0.425	385.5	22%
	Fine	**#60**	0.250	402.0	18%
		#100	0.150	414.7	16%
		#200	0.075	429.8	12%

Coefficient of Uniformity	Coefficient of Curvature
Cu = NA	Cc = NA

SHEAR STRENGTH



STRESS-STRAIN



Sample Description			
Boring Number	R-19-024		
Sample Depth (feet)	10.5-11		
Material Description	Strong brown Sandy lean CLAY		
Initial Conditions at Start of Test			
Sample ID (psf)	**1000**	**2000**	**4000**
Height (inch)	1.00	1.00	1.00
Diameter (inch)	2.363	2.363	2.363
Moisture Content (%)	16.9	17.8	20.4
Dry Density (pcf)	117.7	112.8	109.2
Estimated Specific Gravity	2.80	2.75	2.75
Saturation (%)	97.7	94.0	98.3
Shear Test Conditions			
Strain Rate (%/min)	0.313	0.317	0.256
Major Principle Stress at Failure (psf)	1034	1749	2851
Strain at Failure (%)	7.19	6.77	6.77
Test Results			
ϕ, degrees	**31.0**		
c, psf	**500**		

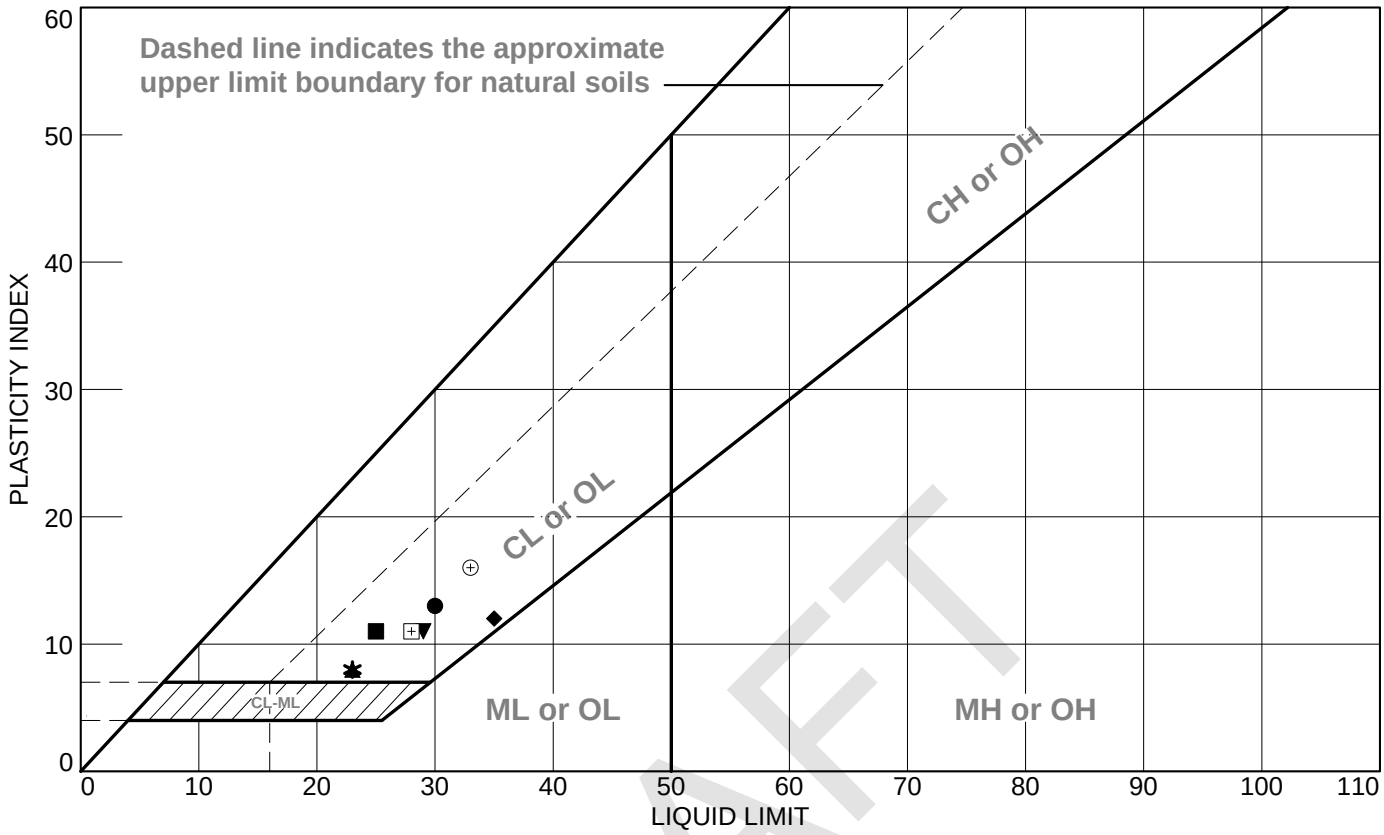
GEOCON CONSULTANTS, INC.
Geocon Consultants, Inc.
3160 Gold Valley Drive, Suite 800
Rancho Cordova, California 95742
Telephone: (916) 852-9118
Fax: (916) 852-9132

Direct Shear Strength Test (ASTM D3080)

Project: Ukiah Recycled Water Pipe
Location: Ukiah, CA
Number: S9763-05-158
Figure:

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LIQUID AND PLASTIC LIMITS TEST REPORT



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SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	USCS
●		R-19-001-2A	7.5-8		17	30	13	
■		R-19-004-Bulk 1	0-5		14	25	11	
▲		A-19-008-1A	5.5-6		15	23	8	
◆		A-19-011-1A	6-6.5		23	35	12	
▼		A-19-013-1A	3.5-4		18	29	11	
✱		A-19-015-2A	6-6.5		15	23	8	
⊕		A-19-018-1A	3.5-4		17	33	16	
⊞		R-19-024-1	10.5-11		17	28	11	

GEOCON CONSULTANTS, INC.

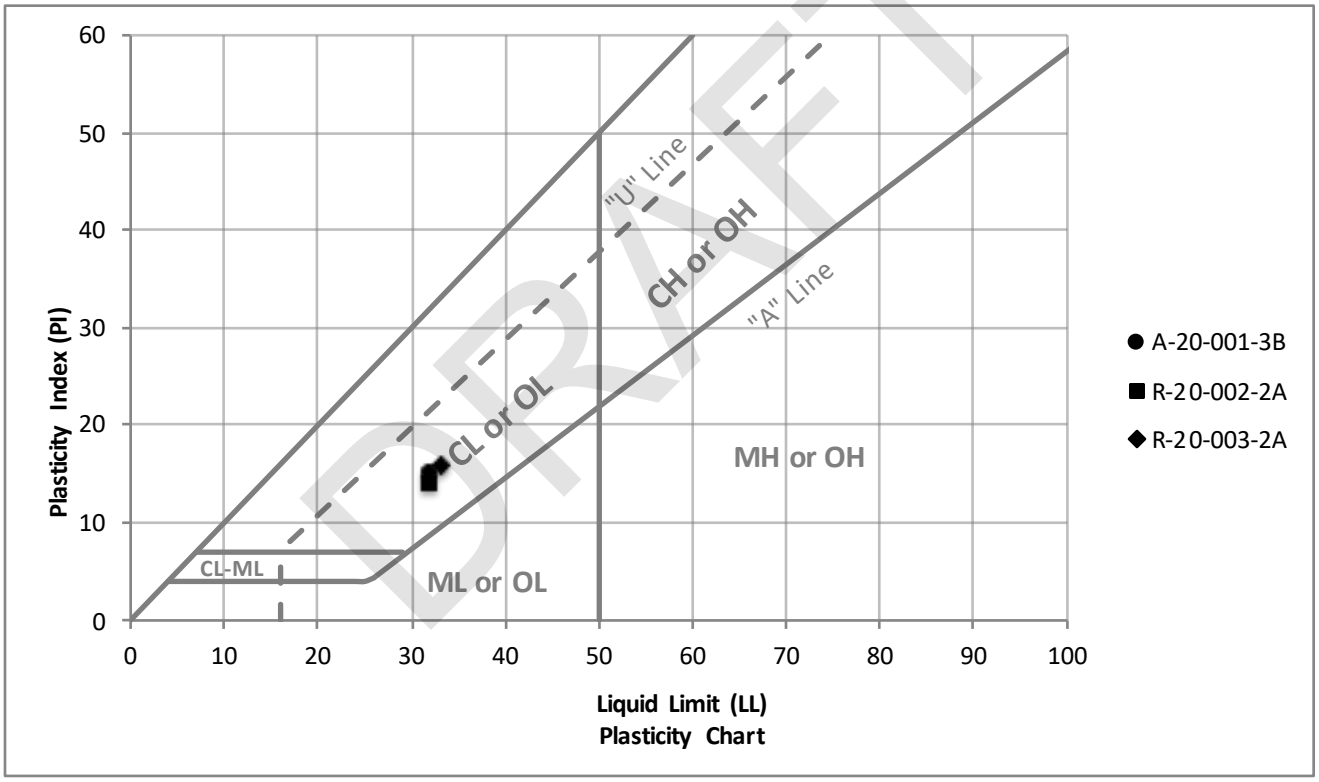
Client: Crawford and Associates
Project: Ukiah Recycled Water Pipeline Ph. 4
Project No.: S9763-05-158 **Figure**

Tested By: MR **Checked By:** MR

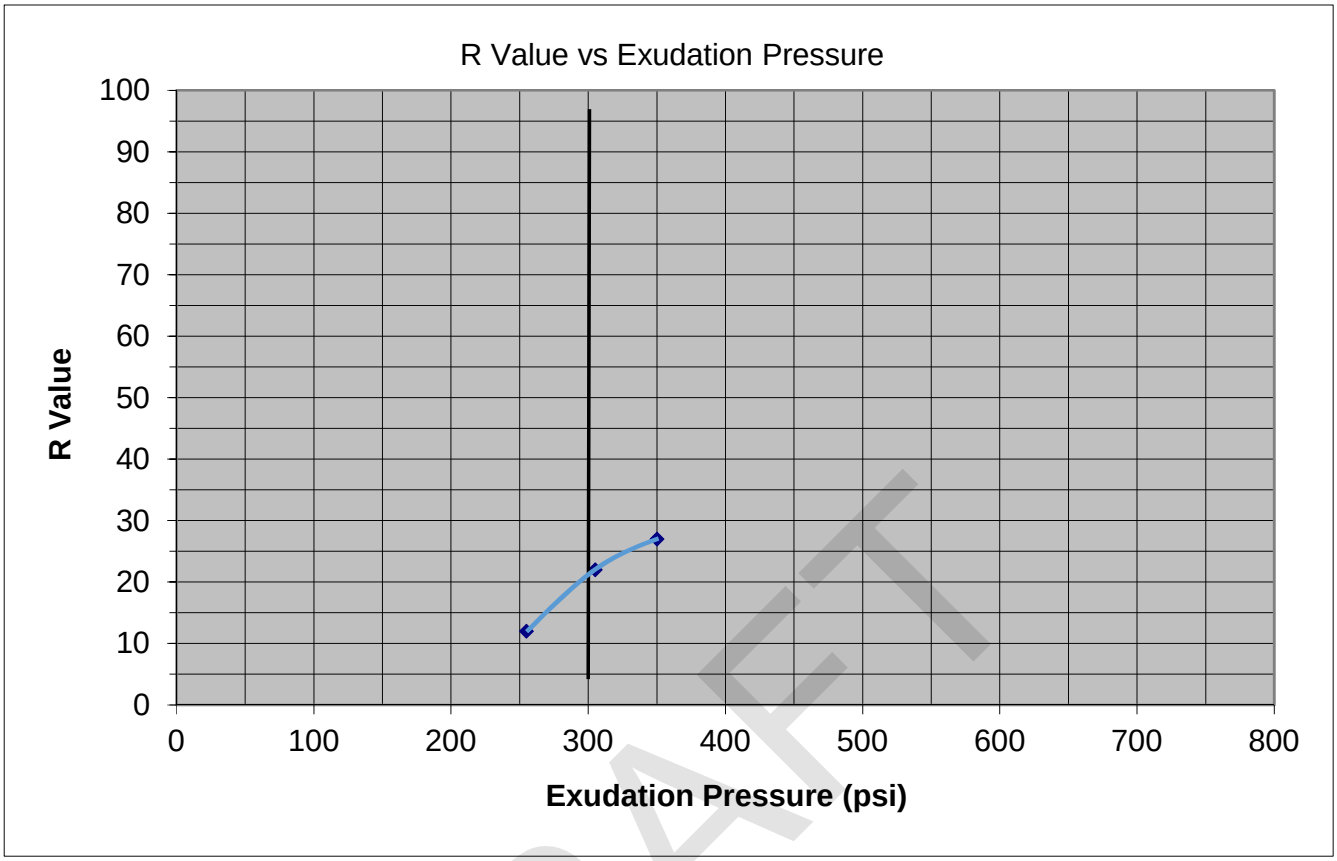
Project Name: Ukiah Recycled Water Pipeline - Phase 4
CAInc File No: 19-503.1
Date: 1/13/21
Technician: MCC/MNA

Plastic Index - ASTM D4318

Sample ID	Depth (ft)	Liquid Limit	Plastic Limit	PI
A-20-001-3B	8.0	32	17	15
R-20-002-2A	5.5	32	18	14
R-20-003-2A	6.0	33	17	16



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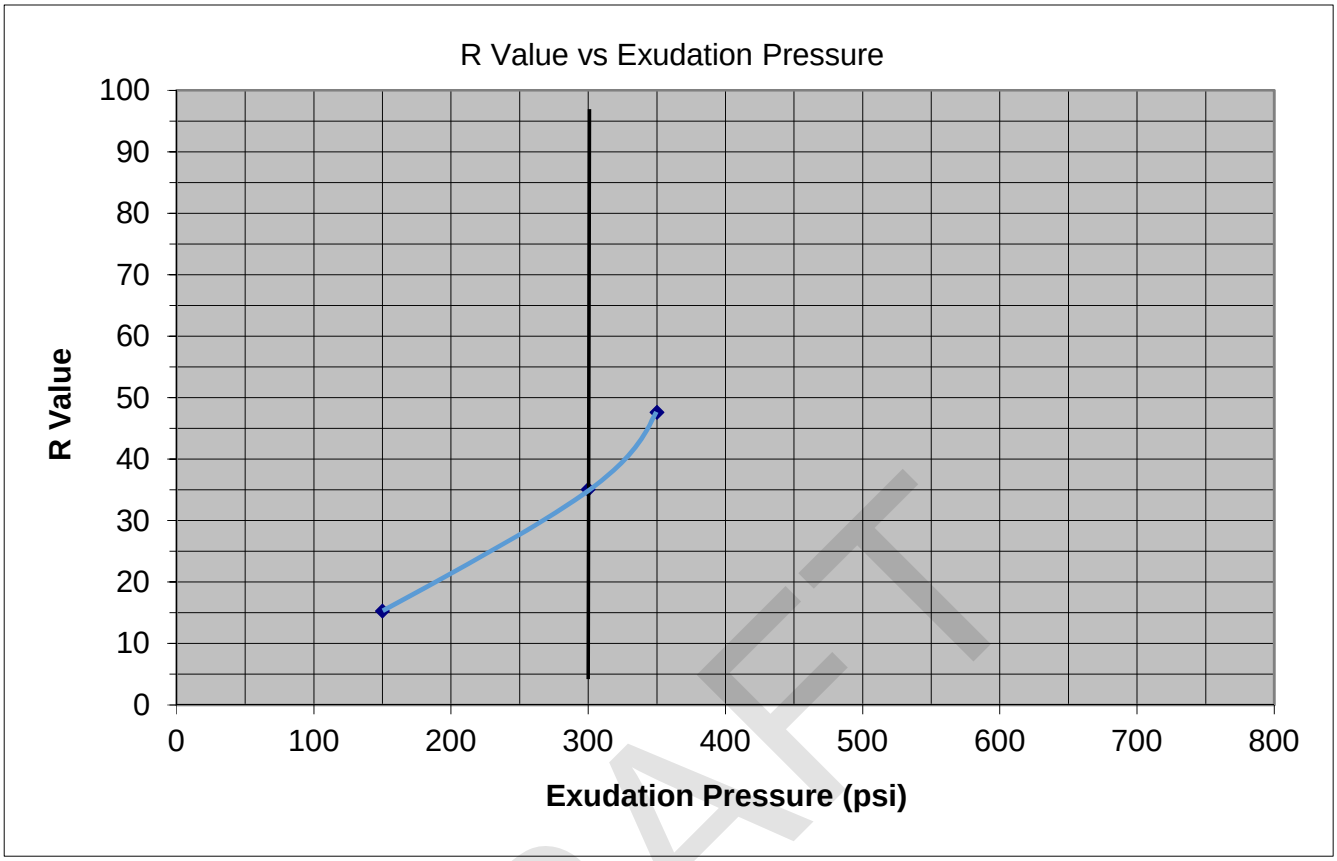
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Sample ID & Description				
	Boring Number	R-19-004-Bulk 1		
	Sample Depth (feet)	0-5		
	Material Description	Very dark gray Sandy Lean CLAY with gravel		
Test Data				
	Specimen	2100	2071	2105
	Exudation Pressure (psi)	350	255	305
	Expansion Dial (.0001")	10	0	0
	Expansion Pressure (psf)	43.3	0.0	0.0
	Resistance 'R' Value	27	12	22
	Moisture at test (%)	8.3	9.2	8.8
	Dry density at test (pcf)	133.3	128.2	132.1
	R Value at 300 psi exudation pressure		**21**	
	R Value by expansion pressure (TI=7.0)		**35**	
	R Value by Equillibrium		**21**	

Geocon Consultants, Inc.
3160 Gold Valley Drive, Suite 800
Rancho Cordova, California 95742
Telephone: (916) 852-9118
Fax: (916) 852-9132

Resistance "R" Value, ASTM D2844, CTM 301

Project: Ukiah Recycled Water Pipeline
Location: Ukiah, CA
Number: S9763-05-158
Figure:



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Sample ID & Description				
Boring Number	A-19-022-Bulk 1			
Sample Depth (feet)	0-5			
Material Description	Browm Sandy Lean CLAY with gravel			
Test Data				
Specimen	2091	2069	2111	
Exudation Pressure (psi)	150	300	350	
Expansion Dial (.0001")	0	0	0	
Expansion Pressure (psf)	0.0	0.0	0.0	
Resistance 'R' Value	15	35	48	
Moisture at test (%)	12.5	11.6	11	
Dry density at test (pcf)	120.3	122.6	122.3	
R Value at 300 psi exudation pressure			**35**	
R Value by expansion pressure (TI=7.0)			**--**	
R Value by Equillibrium			**35**	

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Resistance "R" Value, ASTM D2844, CTM 301

Project: Ukiah Recycled Water Pipeline
Location: Ukiah, CA
Number: S9763-05-158
Figure:

Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 04/24/2019
Date Submitted 04/18/2019

To: Hailey Wagenman
Crawford & Associates, Inc.
1100 Corporate Way STE. 230
Sacramento, CA 95831-6120

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 19-503.1 Site ID : R19-002 2@11FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 79441-165954.

EVALUATION FOR SOIL CORROSION

Soil pH	6.14	
Minimum Resistivity	2.65 ohm-cm (x1000)	
Chloride	1.5 ppm	00.00015 %
Sulfate	5.7 ppm	00.00057 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

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Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
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Date Reported 04/24/2019
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To: Hailey Wagenman
Crawford & Associates, Inc.
1100 Corporate Way STE. 230
Sacramento, CA 95831-6120

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 19-503.1 Site ID : R19-004 BULK@5F.
Thank you for your business.

* For future reference to this analysis please use SUN # 79441-165955.

EVALUATION FOR SOIL CORROSION

Soil pH	6.89	
Minimum Resistivity	3.48 ohm-cm (x1000)	
Chloride	1.4 ppm	00.00014 %
Sulfate	15.0 ppm	00.00150 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

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Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
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Date Reported 04/24/2019
Date Submitted 04/18/2019

To: Hailey Wagenman
Crawford & Associates, Inc.
1100 Corporate Way STE. 230
Sacramento, CA 95831-6120

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 19-503.1 Site ID : A19-008 1@6FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 79441-165956.

EVALUATION FOR SOIL CORROSION

Soil pH	5.71	
Minimum Resistivity	10.99 ohm-cm (x1000)	
Chloride	0.5 ppm	00.00005 %
Sulfate	5.9 ppm	00.00059 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

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11419 Sunrise Gold Circle, #10
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Date Reported 04/24/2019
Date Submitted 04/18/2019

To: Hailey Wagenman
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1100 Corporate Way STE. 230
Sacramento, CA 95831-6120

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 19-503.1 Site ID : A19-018 1@3.5FT.
Thank you for your business.

* For future reference to this analysis please use SUN # 79441-165957.

EVALUATION FOR SOIL CORROSION

Soil pH	4.90	
Minimum Resistivity	2.95 ohm-cm (x1000)	
Chloride	1.7 ppm	00.00017 %
Sulfate	17.6 ppm	00.00176 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

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Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 01/13/2021
Date Submitted 01/06/2021

To: Carmelo Pagan
Crawford & Associates, Inc.
1100 Corporate Way Suite 230
Sacramento, CA 95831

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 19-503.1 UKIAH R.W.P Site ID : A20-001-1A 3-4.
Thank you for your business.

* For future reference to this analysis please use SUN # 83788-174733.

EVALUATION FOR SOIL CORROSION

Soil pH	4.52		
Minimum Resistivity	4.82 ohm-cm (x1000)		
Chloride	4.3 ppm	00.00043	%
Sulfate	1.0 ppm	00.00010	%

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

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Sunland Analytical
11419 Sunrise Gold Circle, #10
Rancho Cordova, CA 95742
(916) 852-8557

Date Reported 01/13/2021
Date Submitted 01/06/2021

To: Carmelo Pagan
Crawford & Associates, Inc.
1100 Corporate Way Suite 230
Sacramento, CA 95831

From: Gene Oliphant, Ph.D. \ Randy Horney
General Manager \ Lab Manager

The reported analysis was requested for the following location:
Location : 19-503.1 UKIAH R.W.P Site ID : R20-003-3A 8.5.
Thank you for your business.

* For future reference to this analysis please use SUN # 83786-174731.

EVALUATION FOR SOIL CORROSION

Soil pH	6.06	
Minimum Resistivity	0.78 ohm-cm (x1000)	
Chloride	120.1 ppm	00.01201 %
Sulfate	169.7 ppm	00.01697 %

METHODS
pH and Min.Resistivity CA DOT Test #643
Sulfate CA DOT Test #417, Chloride CA DOT Test #422m

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APPENDIX IV

Site-Specific Hazard Analysis

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APPENDIX IV
DRAFT SITE-SPECIFIC HAZARD MEMORANDUM CITY OF UKIAH RECYCLED WATER PIPELINE UKIAH, CALIFORNIA

1 INTRODUCTION

Crawford drilled three boring (R-19-009, R-19-017 and R-19-021) in 2019 in the vicinity of the proposed tank and pump station in the Ukiah water treatment plant. Crawford completed a site-specific hazard analysis for compliancy with ASCE 7-16 and 2019 CBC.

2 SITE SPECIFIC ANALYSIS

The following sections describe the site-specific ground motion analysis performed in accordance with ASCE 7-16 (with Supplement 1) and 2019 CBC.

2.1 INITIAL SEISMIC HAZARD ANALYSIS

2.1.1 SEISMIC DESIGN CRITERIA

Seismic design criteria are included in Section 11 of ASCE 7-16 (Sections referenced hereafter refer to ASCE 7-16), including mapped acceleration parameters. These mapped parameters are available online through the SEAOC/OSHPD[1] Seismic Design website, which interpolates values from the ASCE 7-16 maps using the site location.

2.1.2 SITE CLASS AND RISK CATEGORY

The site was classified as Site Class F according to Section 20.3.13 due to the potentially liquefiable soils. The shear wave velocity of 290 meters per second (m/s) in the upper 30 meters or 100 feet (V_{S30}) used for the site was developed from 2019 boring data. Crawford used correlations with SPT blow count N-values corrected for hammer efficiency. The Risk Category for the structure was assumed to be IV.

2.1.3 MAPPED ACCELERATION PARAMETERS

Crawford accessed the SEAOC/OSHPD Seismic Design Map website considering the site location latitude 39.1595°N and longitude 123.1949°W, Site Class F, and Risk Category IV to determine the Mapped Maximum Considered Earthquake (MCE) Spectral Response Short Period (S_S), Mapped MCE Spectral Response at 1 second period (S_1), Long Period (T_L), and mapped risked coefficients (C_{RS} and C_{R1}). The S_S, S_1, T_L, C_{RS}, and C_{R1} are coordinate specific and are taken from ASCE 7-16 figures independently of site class. The mapped acceleration parameters are based on an MCE which is roughly equivalent to an earthquake with a 2% chance of exceedance in 50 years (2,475-year return period). Due to the site class F designation and a S_1, > 0.2, a site-specific analysis is required according to Section 11.4.8 for the acceleration parameters. Table 1 summarizes the mapped acceleration parameters.

[1] https://seismicmaps.org

Table 1: Mapped Acceleration Parameters

Mapped Acceleration Parameter	Value	Source
Mapped MCE_R Spectral Response Short Period (S_S)	2.129	Figure 21-1
Mapped MCE_R Spectral Response at 1 Second Period (S_1)	0.821	Figure 21-2
Long Period (T_L)	8	Figure 21-14
Mapped Risk Coefficient at Short Period (C_{RS})	0.881	Figure 22-17
Mapped Risk Coefficient at 1 Second Period (C_{R1})	0.875	Figure 22-18

2.2 HORIZONTAL GROUND MOTION HAZARD ANALYSIS

A ground motion hazard analysis accounts for the regional tectonic setting, geology, and seismicity of a specific site as well as the expected recurrence of the maximum magnitudes of the earthquakes on known faults and source zones, considering ground motion attenuation and near source effects. The methodology included in ASCE 7-16 was used to determine the site-specific ground motions of the project site, generally consisting of the following steps:

- Determine the probabilistic MCE ground motions
- Determine the deterministic MCE ground motions
- Adjust MCE ground motions to maximum horizontal response
- Adjust probabilistic MCE ground motions to risk-targeted maximum considered earthquake ground motions (MCE_R)
- Compare and scale the site-specific deterministic MCE ground motion with minimum spectral responses to ASCE 7-16 Supplement 1 Section 21.2.2
- Compare the deterministic ground motion to the probabilistic ground motion to determine the site-specific MCE_R ground motion (lower of the two at each period)
- Calculate design spectral response ground motion (2/3 of MCE_R)
- Compare the Section 21.2 design spectral response ground motion to the Section 11.4.6 design spectral response ground motion (cannot be lower than 80% Section 11.4.6 design spectral response ground motion)
- Determine the design spectral response spectrum and design acceleration parameters
- Calculate peak ground acceleration (PGA_M)

2.2.1 GROUND MOTION HAZARD ANALYSIS

Crawford performed a seismic hazard analyses and site response analyses using EZ-FRISK software Version 8.07. Crawford used the following next generation attenuation relationships (NGA) all equally weighted for the nearby strike-slip and reverse faults:

- Boore-et al (2014)
- Campbell and Bozorgnia (2014)
- Chiou and Youngs (2014)

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The following parameters were common to all analyses for each of the attenuation relationships:

- The V_{S30} of the site of 290 m/s
- Depth to soil with a V_S of 1,000 m/s was calculated to be 320 meters based on the methodology proposed by Chiou and Youngs (2008)
- Depth to soil with a V_S of 2,500 m/s was calculated to be 1.7 kilometers based on the methodology proposed by Campbell and Bozorgnia (2008)

2.2.2 PROBABILISTIC MCER GROUND MOTION

Seismic sources within 200 kilometers were used to determine the site-specific ground motions. The NGA analyses considered the following faults in Table 2.

Table 2: Summary of Seismic Sources

Attenuation Relationship Type	Source	Distance (km)	Maximum Magnitude	Mechanism	Dip Angle (degree)	Dips Direction	Site Lies
NGA	California Gridded	0.00	7.0	SS|R	90	--	Above
	Maacama-Garberville	2.49	7.4	Strike Slip	90	--	SW
	Collayomi	34.14	6.7	Strike Slip	90	--	NW
	Bartlett Springs	35.65	7.3	Strike Slip			SW
	Northern San Andreas	44.74	8.1	Strike Slip	90	--	NE
	Hunting Creek-Berryessa	64.72	7.1	Strike Slip	90	--	NW
	Great Valley 3, Mysterious Ridge	68.37	7.1	Reverse	20	SW	W
	Great Valley 2	69.10	6.5	Reverse	15	W	W
	Great Valley 1	71.03	6.8	Reverse	15	W	W
	Hayward-Rogers Creek	73.89	7.3	Strike Slip	90	--	NW
	Mendocino Gridded, Reverse	83.28	7.3	Reverse	90	--	SE
	Mendocino Gridded, Strike Slip	83.28	7.3	Reverse	90	--	SE
	Great Valley 4a, Trout Creek	102.19	6.6	Reverse	20	SW	NW
	Point Reyes	104.39	6.9	Reverse	50	NE	N
	West Napa	109.73	6.7	Strike Slip	90	--	NW
	Great Valley 4b, Gordon Valley	112.91	6.8	Reverse	20	W	NW
	Green Valley Connected	23.40	6.8	Strike Slip	90	--	NW

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Attenuation Relationship Type	Source	Distance (km)	Maximum Magnitude	Mechanism	Dip Angle (degree)	Dips Direction	Site Lies
NGA	Shear 1 Gridded	135.98	7.6	Strike Slip	90	--	SW
	Great Valley 5, Pittsburg Kirby Hills	144.05	6.7	Strike Slip	90	--	NW
	Battle Creek	161.45	6.7	Normal	75	S	SW
	San Gregorio Connected	162.65	7.5	Strike Slip	90	--	N
	Little Salmon (Onshore)	167.10	7.1	Reverse	30	NE	SE
	Little Salmon Connected	167.10	7.5	Reverse	30	NE	SE
	Mount Diablo Thrust	172.91	6.7	Reverse	38	NE	NW
	Calaveras	181.38	7.0	Strike Slip	90	--	NW
	Greenville Connected	184.76	7.0	Strike Slip	90	--	NW
	Greenville Connected U	184.76	7.0	Strike Slip	90	--	NW
	Table Bluff	185.45	7.2	Reverse	45	NE	SE
	McKinleyville	186.43	7.2	Reverse	35	NE	S
	Shear 2 Gridded	186.76	7.6	Strike Slip	90	--	SW
	Mad River	187.02	7.2	Strike Slip	35	NE	S
	Fickle Hill	187.86	7.1	Reverse	35	NE	S
	Trinidad	189.33	7.5	Reverse	35	NE	S
	Shear 3 Gridded	189.74	7.6	Strike Slip	90	--	SW
	Little Salmon (Offshore)	198.92	7.3	Reverse	30	NE	SE

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EZ-FRISK software was used to determine geometric mean spectral response acceleration predicted using NGA from a 5% damped response spectrum with a 2% in 50-year exceedance probability. Crawford scaled the NGA geometric mean spectral response to the maximum rotated spectral using the scale factors in Section 21.1.

A. RISK COEFFICIENTS

Method 1 of Section 21.2 was used to determine the probabilistic MCE_R ground motion

Mapped risk coefficients (C_{RS} and C_{R1}) were used to adjust the response accelerations to a 1% chance of collapse in 50 years per Section 21.2.1.1. The risk coefficients are summarized in Table 1, along with the source figure from ASCE 7-16.

C_{RS} was applied to accelerations at spectral periods less than or equal to 0.2 seconds. C_{R1} was applied accelerations at spectral periods greater than or equal to 1 second. For spectral periods between 0.2 and 1 seconds, the C_R value was linearly interpolated.

B. PROBABILISTIC MCER GROUND MOTION

Figure 1 shows the geometric mean spectral response for the 2% in 50-year event developed using EZ-FRISK for each of the attenuation relationships described above. Also shown is the risk-adjusted response spectrum adjusting the response to a 1% in 50-year probability of collapse, which is equivalent to the site-specific probabilistic ground motion MCE_R.

2.2.3 DETERMINISTIC MCER GROUND MOTION

The deterministic spectral response acceleration is defined as the 84th-percentile 5% damped spectral response in the direction of maximum horizontal response for the characteristic earthquake on all known active faults within the region. EZ-FRISK was used to calculate the deterministic ground motion per Section 21.2.2. The NGA controlled deterministic spectral response was taken as the largest amplitude of ground motion considering all sources using the weighted mean of NGA attenuation relationships stated in Section 2.2.1 of this memorandum. Crawford scaled the deterministic 84th-percentile 5% damped spectral response to the maximum rotated spectral using the scale factors in Section 21.1. The controlling seismic source for the project site is the Maacama-Garberville fault. Figure 2 shows the 84th-percentile 5% damped spectral response for the NGA attenuation relationships.

DETERMINISTIC MCE_R GROUND MOTION SCALING

Per ASCE 7-16 Supplement 1 Section 21.2.2, the maximum deterministic spectral response was compared with the minimum peak acceleration of 1.5Fa with Fa = 1 for Site Class E. Our maximum spectral response was 2.5g, therefore, no scaling of the deterministic curve was required. Figure 3 shows our deterministic ground motions compared to the minimum peak spectral accelerations.

2.2.4 SITE-SPECIFIC SPECTRAL RESPONSE ACCELERATION MCER

The site-specific spectral response acceleration is defined as the lower of the probabilistic and deterministic ground motions in Section 21.2.3. For the project site, the deterministic ground motion was lower for periods (0 to 3 seconds) and the probabilistic ground motion was lower for all periods (4 to 10 seconds). The site-specific spectral response acceleration (MCE_R) is shown on Figure 4.

2.2.5 DESIGN RESPONSE SPECTRUM

The design response spectrum is defined in Section 21.3 as the higher of two values:

- Two-thirds of the site-specific design spectral response acceleration per Section 21.2
- 80% of the design spectral response acceleration per Section 11.4.6 where F_a is calculated in Table 11.4-1 and $F_v = 4$ for $S_1 > 0.2$ for Site Class E

Crawford first calculated the design spectral response acceleration by taking 2/3 of the site-specific response acceleration MCE_R as shown in Figure 5.

Crawford then calculated the design response accelerations per Section 11.4.6 with F_a = 1.0 and F_v = 4 and reduced the spectral accelerations by 80% to adjust for the minimum design spectral accelerations for Site Class E. We reduced the spectral accelerations by 80% again to adjust for the minimum design spectral accelerations for a Site Class F per Section 21.3. We then compared Section 11.4.6 design spectral accelerations for Site Class F with our site-specific design spectral response accelerations (Figure 6). The site-specific design spectral response accelerations controlled at periods below approximately 3.5 seconds and the minimum design spectral accelerations for Site Class F controlled from approximately 3.5 to 10 seconds.

The design response spectrum is shown on Figure 6 and Table 3.

Table 3: Design Response Spectrum

Period, s	Sa, g
0.05	0.78
0.1	1.04
0.2	1.31
0.3	1.51
0.4	1.60
0.5	1.65
0.75	1.52
1.0	1.36
2.0	0.74
3.0	0.49
4.0	0.35
5.0	0.28
6.0	0.23
7.0	0.20
8.0	0.18
10.0	0.11

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2.2.6 DESIGN ACCELERATION PARAMETERS

Design acceleration parameters were calculated in accordance with Section 21.4. The S_{DS} value was taken as 90% the peak spectral acceleration value from periods 0.2 to 5 seconds. The S_{D1} value was taken as the maximum product of $T*S_a$ (period * spectral acceleration) from periods 1 to 5 seconds. Per Section 21.4, the S_{DS} and S_{D1} values cannot be less than 80% of the S_{DS} and S_{D1} calculated from Section 11.4.5. The S_{DS} and S_{D1} values in Section 11.4.5 were calculated from using F_a = 1.0 and F_v = 4.0 for a Site Class E, as given in Section 21.3. The Section 11.4.5

S_{DS} and S_{D1} values were reduced by 80% again to convert to Site Class F values for comparison per Section 21.3.

S_{MS} and S_{M1} were calculated as 1.5 times S_{DS} and S_{D1}, respectively. Per Section 21.4, the S_{MS} and S_{M1} values cannot be less than 80% of the S_{MS} and S_{M1} calculated from Section 11.4.3. The S_{MS} and S_{M1} values in Section 11.4.3 was calculated from using F_a = 1.0 and F_v = 4.0 for a Site Class E, as given in Section 21.3. The Section 11.4.3 S_{MS} and S_{M1} were reduced by 80% again to convert to Site Class F values per Section 21.3.

The design acceleration parameters are summarized in Table 4.

Table 4: Preliminary Horizontal Site-Specific Spectral Accelerations

Design Acceleration Parameter	Value (g)
Design Spectral Acceleration for Short Period (S_{DS})	1.48
Design Spectral Acceleration for 1 Second Period (S_{D1})	1.58
MCE Spectral Response Acceleration for Short Period (S_{MS})	2.22
MCE Spectral Response Acceleration for 1 Second Period (S_{M1})	2.37

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2.2.7 MAXIMUM CONSIDERED EARTHQUAKE MCEG PEAK GROUND ACCELERATION (PGA)

A. PROBABILISTIC MCEG PGA

Per Section 21.5.1, the probabilistic geometric mean PGA shall be taken as geometric mean peak ground acceleration with a 2% probability of exceedance within a 50-year period. The probabilistic MCE_G PGA is 1.14g.

B. DETERMINISTIC MCEG PGA

Per Section 21.5.2, the deterministic geometric mean PGA shall be taken as the largest 84th-percentile geometric mean peak PGA but not lower than 0.5*F_{PGA} where F_{PGA} is determined using ASCE 7-16 Table 11.8-1 and PGA is taken as 0.5g. Table 11.8-1 does not include F_{PGA} values for Site Class F, therefore, the deterministic MCE_G PGA was taken as the 84th percentile geometric mean PGA., therefore, the deterministic MCE_G PGA was taken as 0.90g.

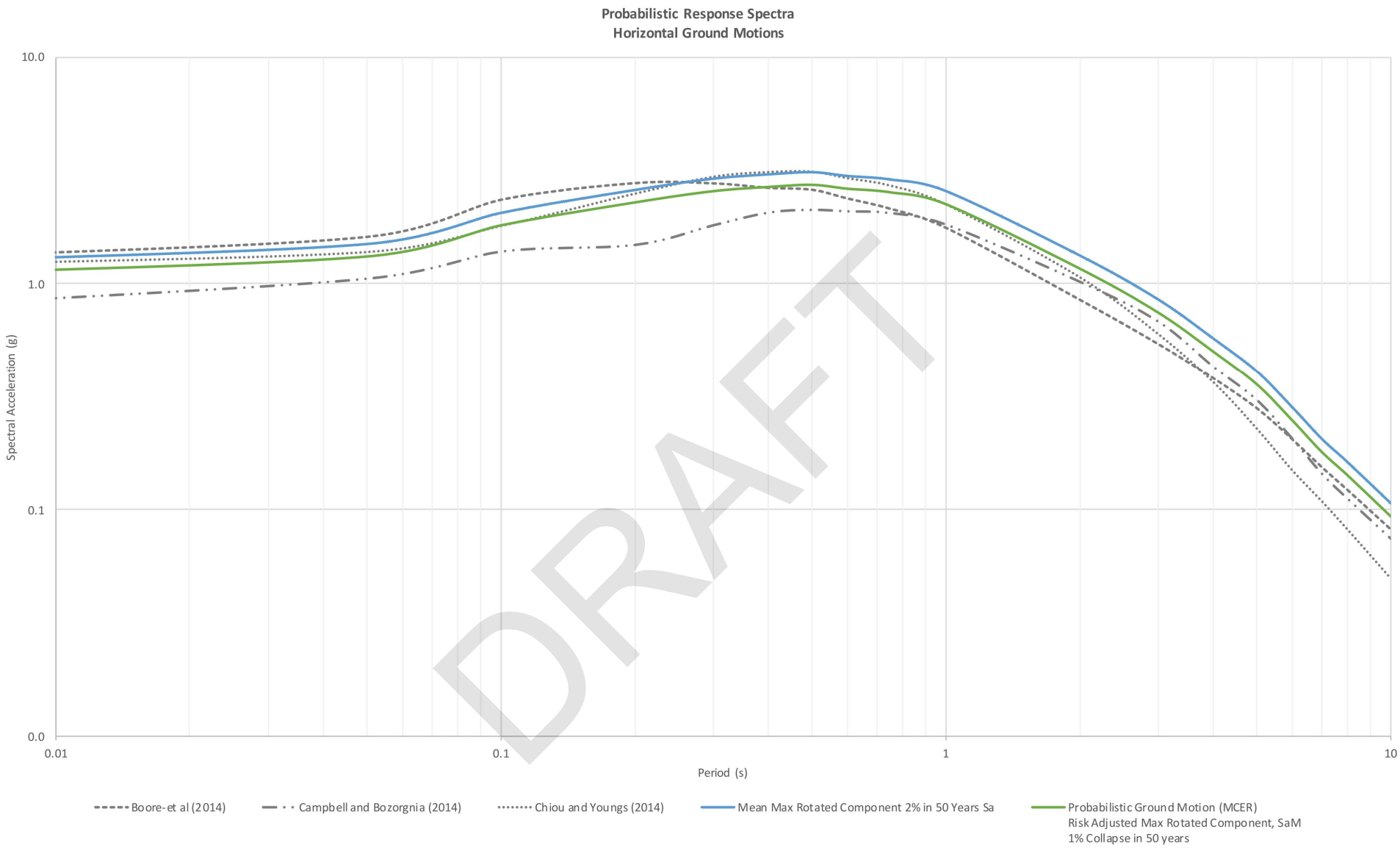
C. SITE-SPECIFIC MCEG PGA

The site-specific MCE_G PGA (PGA_M) taken as the lesser of the probabilistic MCE_G PGA and deterministic MCE_G PGA but not less than 80% of the PGA_M determined from Equation 11.8-1 in ASCE 7-16. Since there are no F_{PGA} values for Site Class F, the site-specific PGA_M was taken as 0.90g.

ATTACHMENTS

Figure 1: Probabilistic Response Spectra
Figure 2: Deterministic Response Spectra
Figure 3: Site-Specific Deterministic MCE_R Spectrum
Figure 4: Risk Targeted Maximum Considered Earthquake (MCE_R)
Figure 5: Risk Targeted MCE_R vs. Design Response Spectrum
Figure 6: Design Response Spectrum

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Notes:

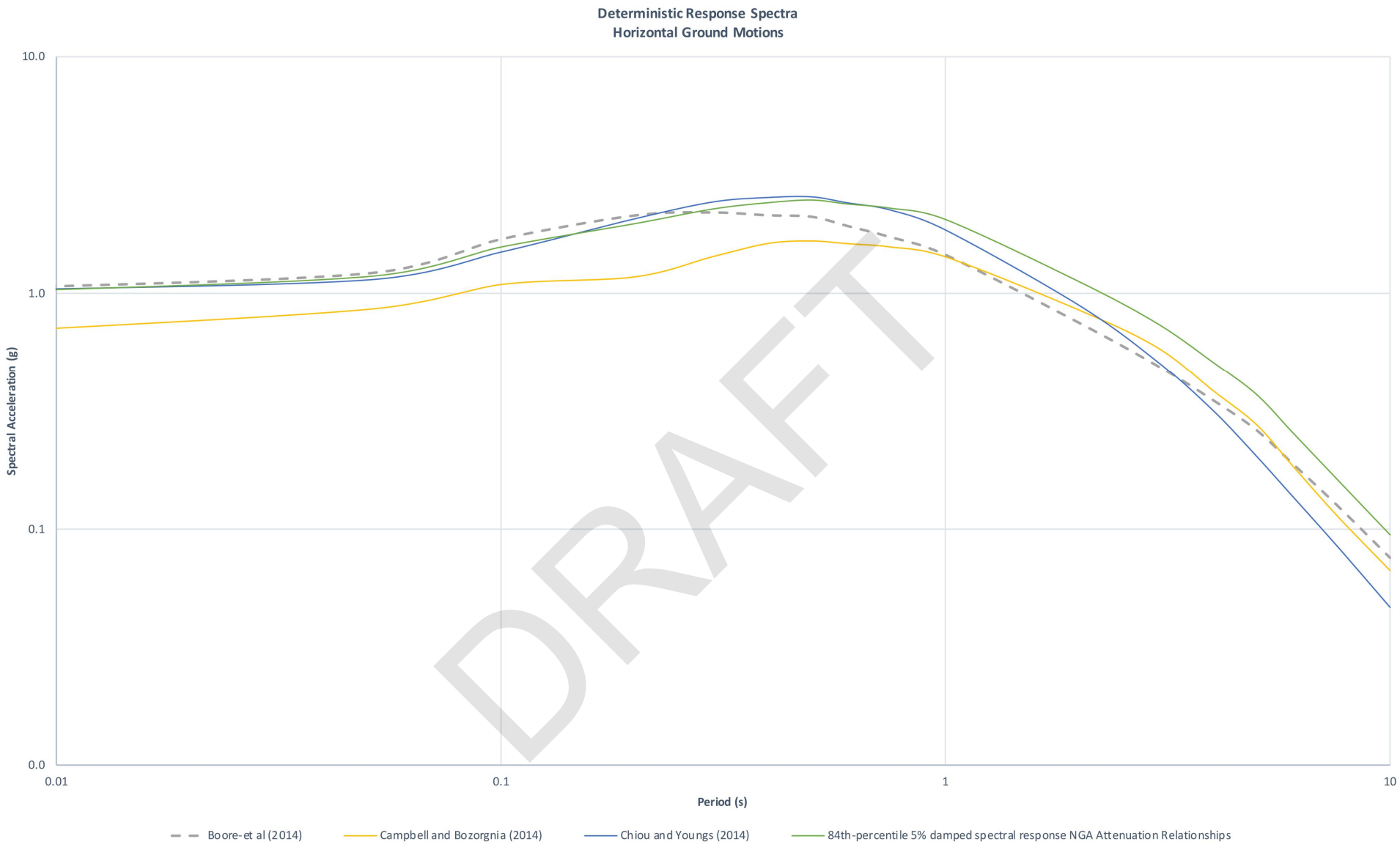
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Sacramento, CA 95831
(916) 455-4225

CITY OF UKIAH RECYCLED WATER PIPELINE

UKIAH, CALIFORNIA

Figure 1
Probabilistic Response Spectra

Proj. No: 19-503.1
Scale: N/A
Date: 07/29/21



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Notes:

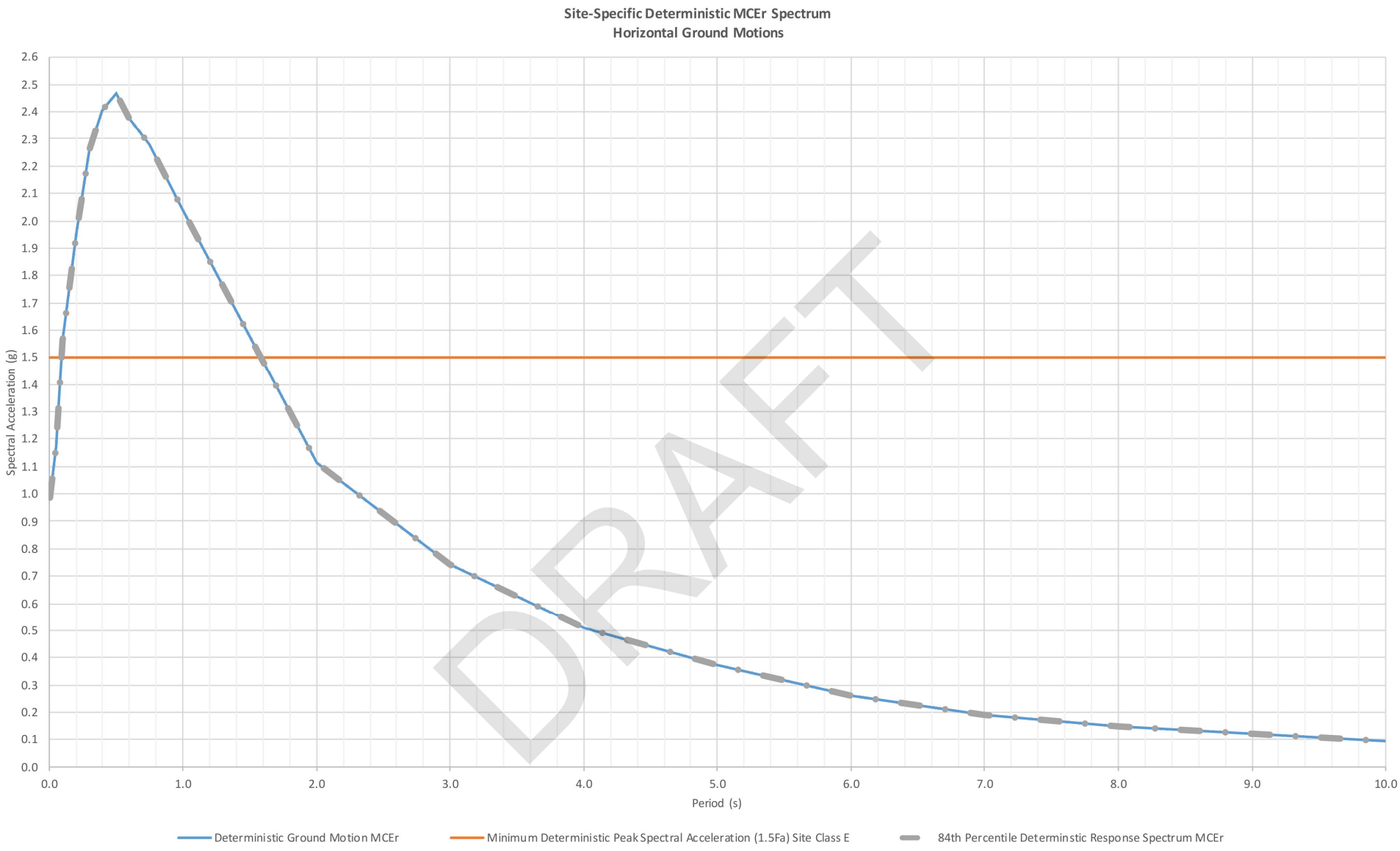
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CITY OF UKIAH RECYCLED WATER PIPELINE

UKIAH, CALIFORNIA

Figure 2
Deterministic Response Spectra

Proj. No:	19-503.1
Scale:	N/A
Date:	07/29/21



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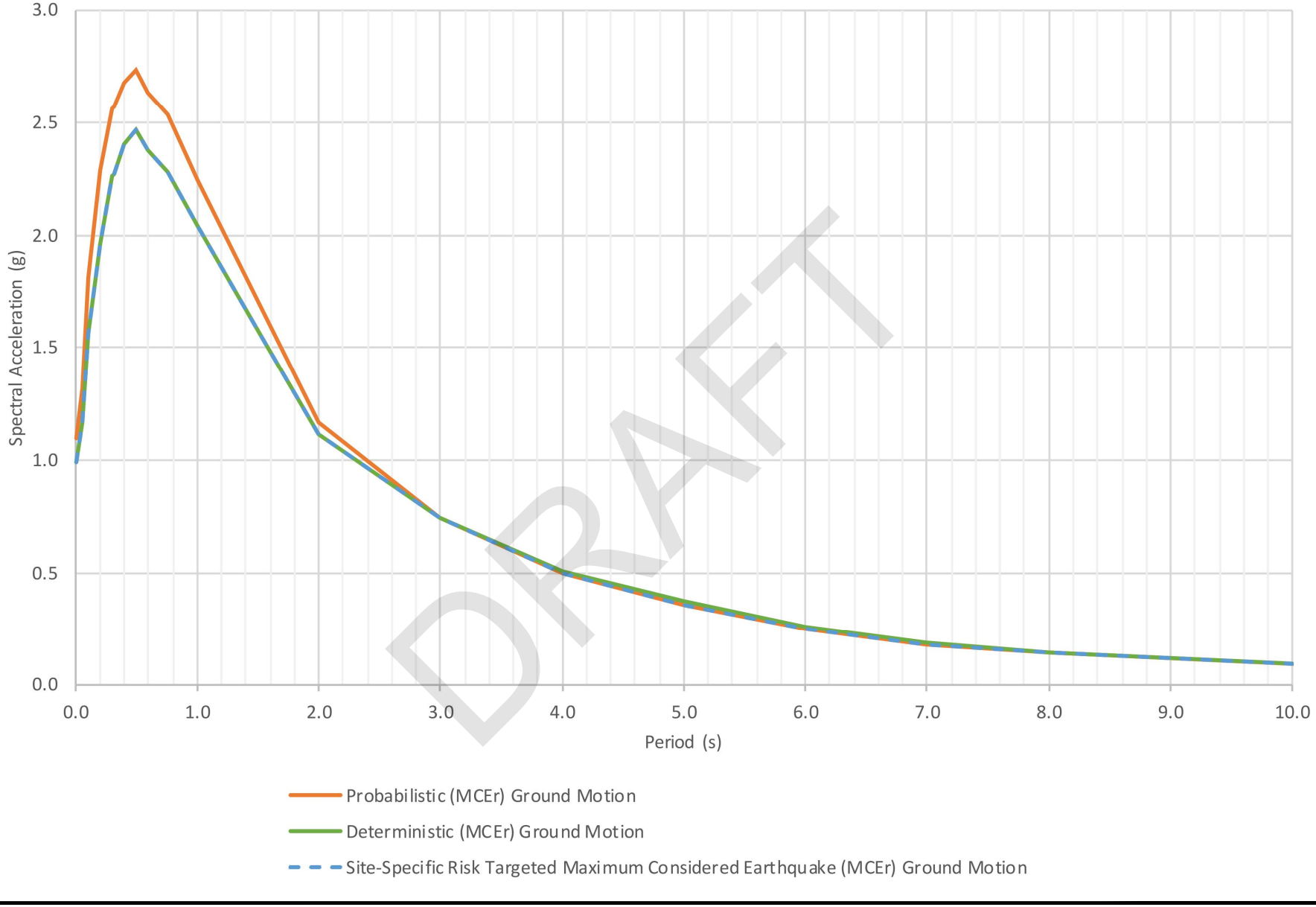
CITY OF UKIAH RECYCLED WATER PIPELINE

UKIAH, CALIFORNIA

Figure 3
Site-Specific Deterministic MCEr Spectrum

Proj. No: 19-503.1
Scale: N/A
Date: 07/29/21

Risk Targeted Maximum Considered Earthquake (MCEr)
Horizontal Ground Motions



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Notes:

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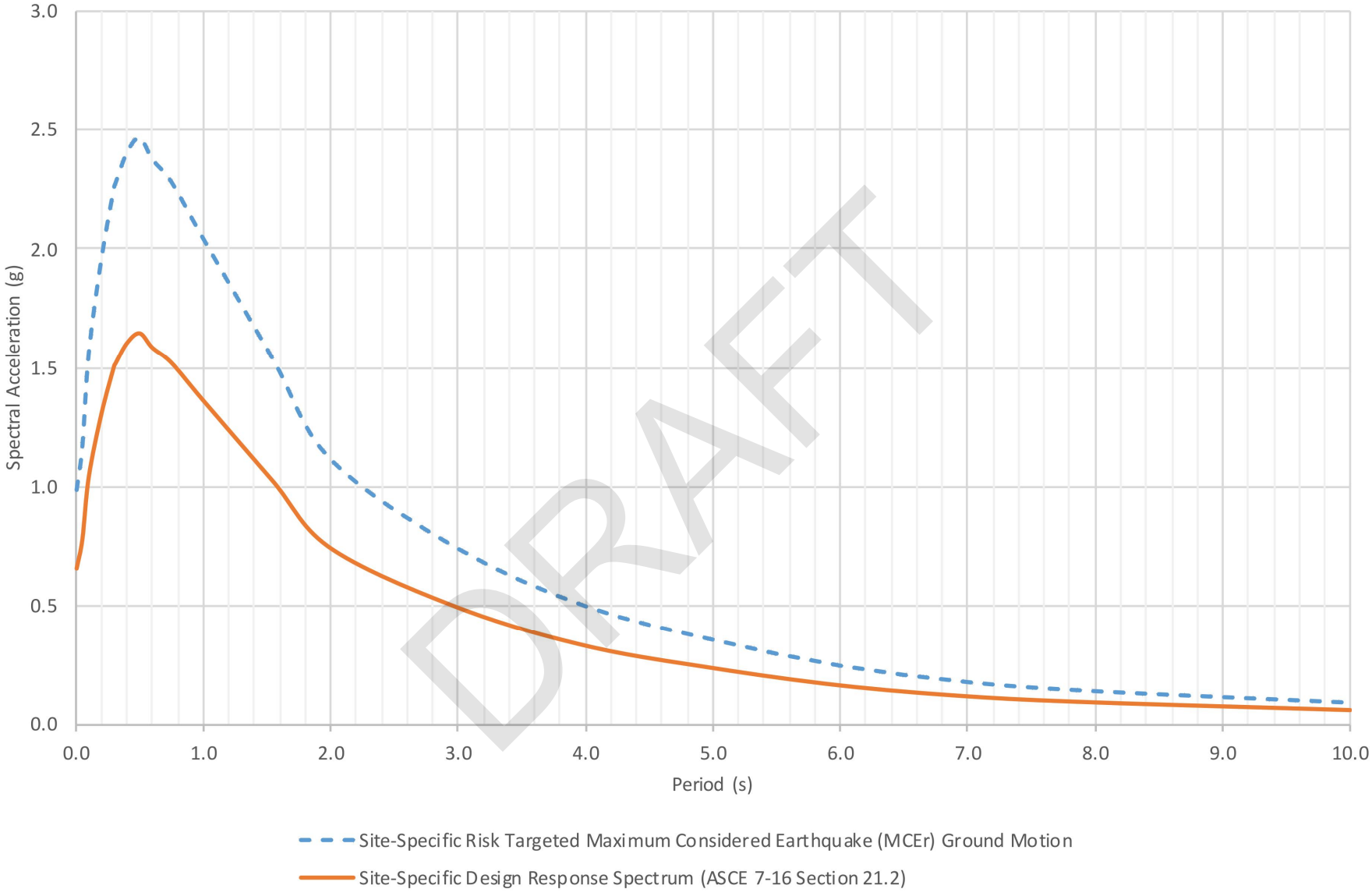
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UKIAH, CALIFORNIA

Figure 4
Risk Targeted Maximum Considered Earthquake (MCEr)

Proj. No: 19-503.1
Scale: N/A
Date: 07/29/21

Site-Specific Risk Targeted Maximum Considered Earthquake (MCEr) vs Site Specific Design Response Spectrum
Horizontal Ground Motions



DRAFT

Notes:
Based on ASCE 7-16 Section 21.2

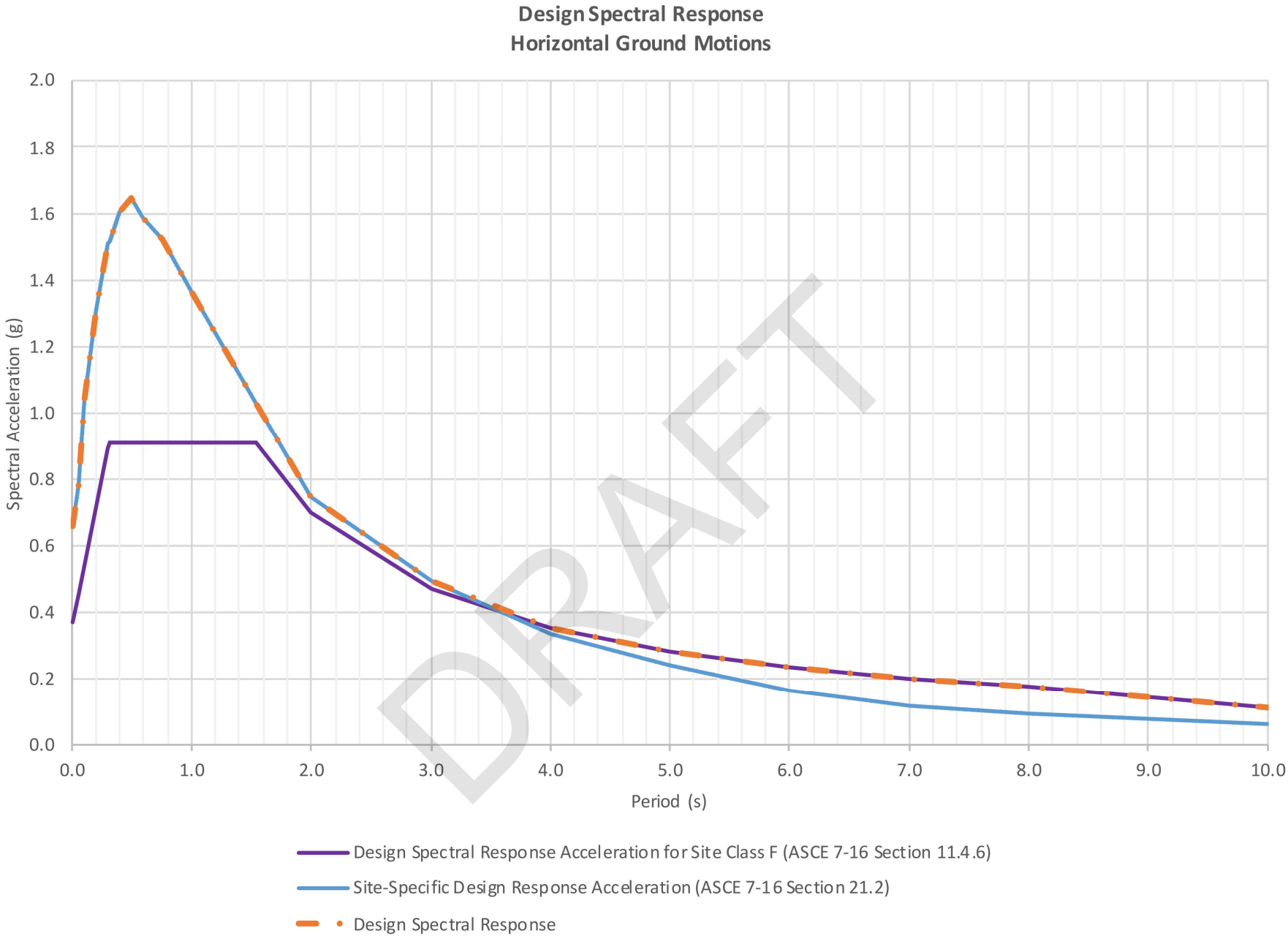
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Sacramento, CA 95831
(916) 455-4225

CITY OF UKIAH RECYCLED WATER PIPELINE

UKIAH, CALIFORNIA

Figure 5
Risk Targeted MCEr vs. Design Response Spectrum

Proj. No: 19-503.1
Scale: N/A
Date: 07/29/21



Notes:

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CITY OF UKIAH RECYCLED WATER PIPELINE

UKIAH, CALIFORNIA

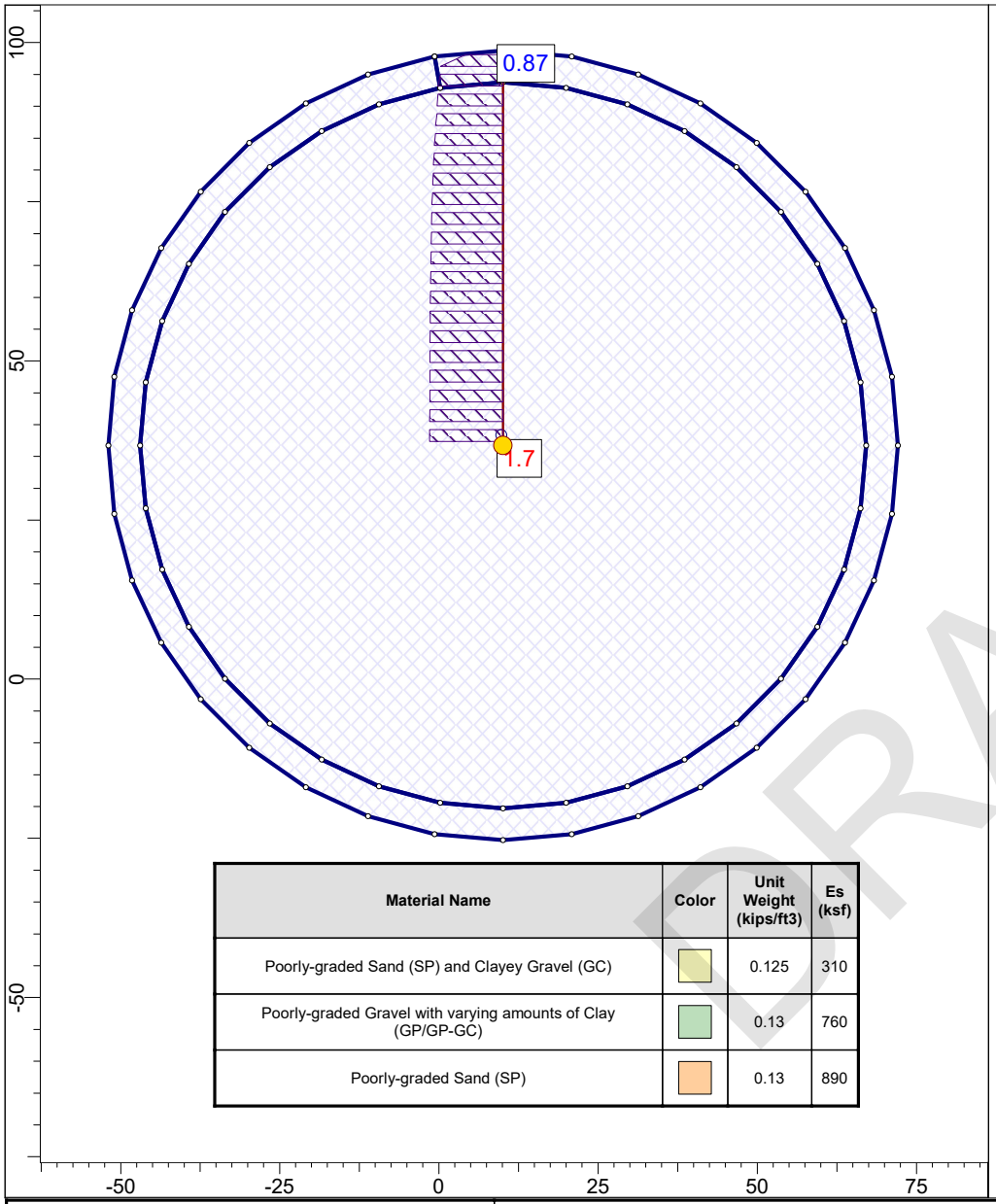
Figure 6
Design Spectral Response

Proj. No: 19-503.1
Scale: N/A
Date: 07/29/21

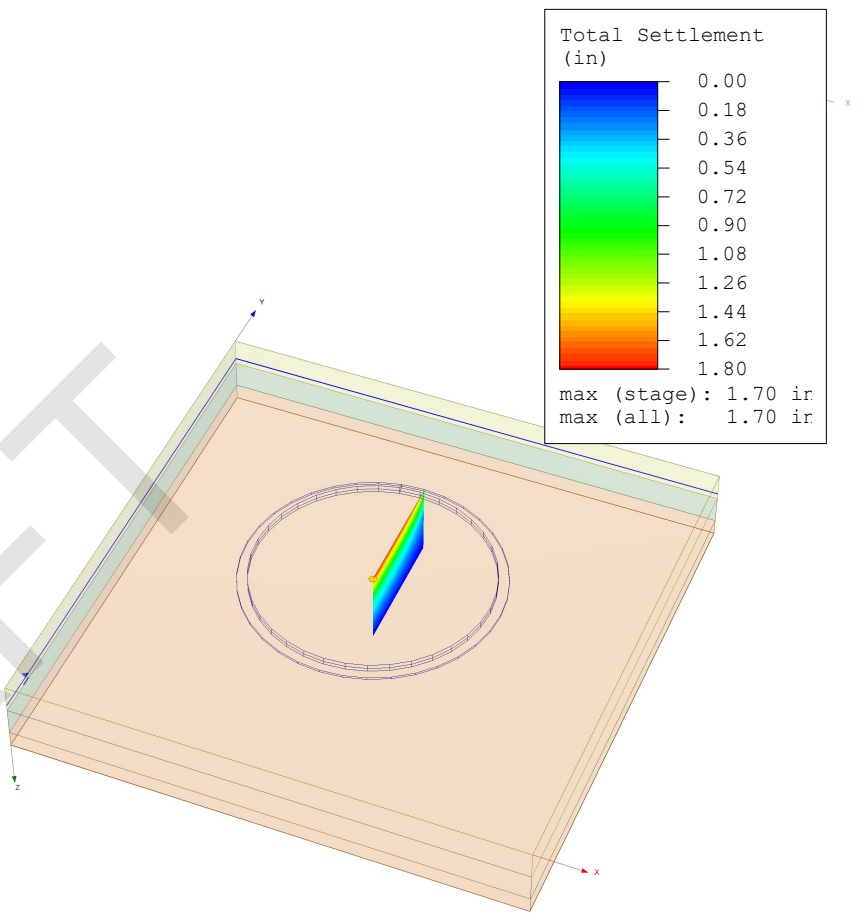
APPENDIX V

Settle 3D Results
CIDH Nominal Resistance Graphs
LPILE Output Graphs

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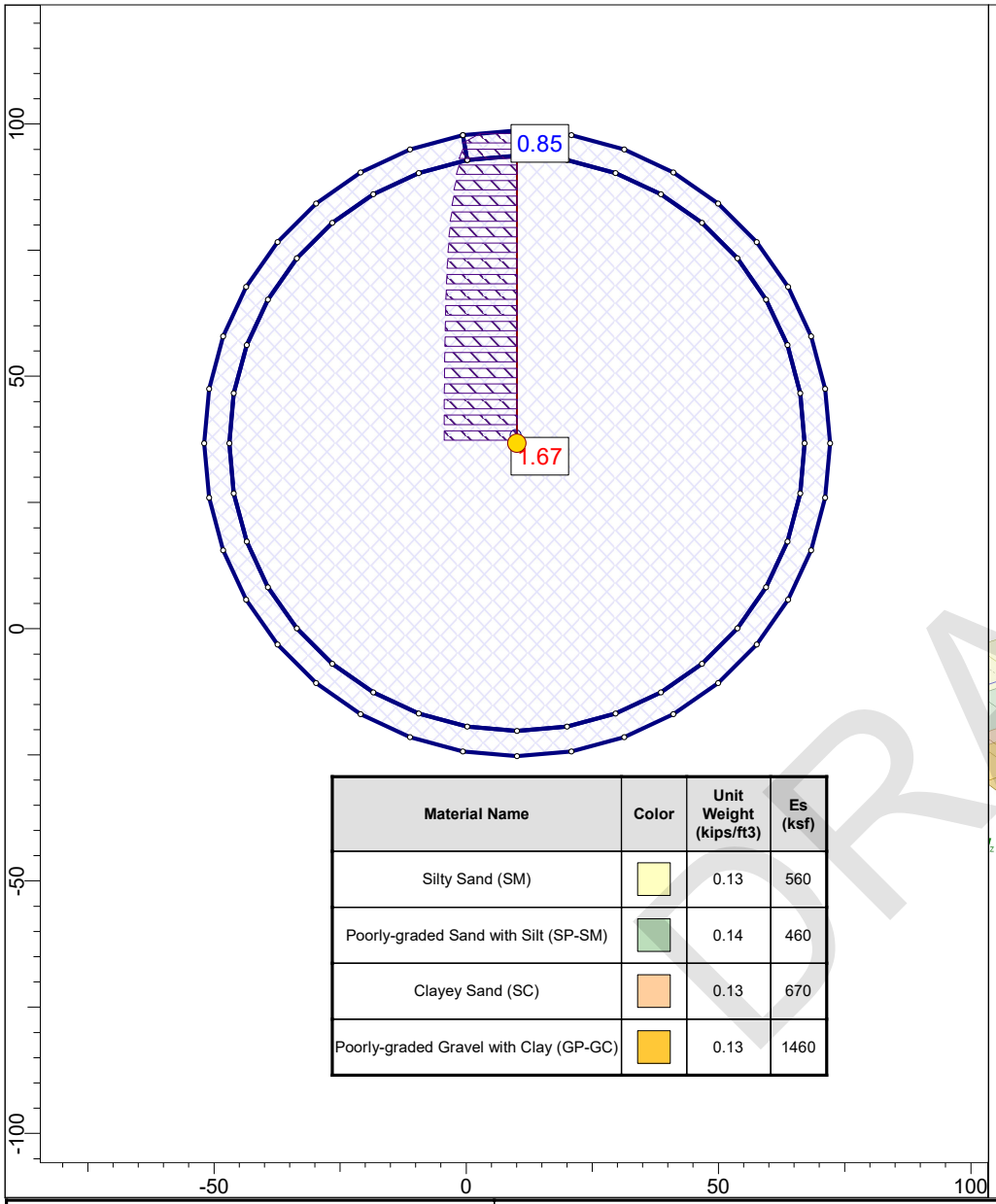
Material Name	Color	Unit Weight (kips/ft3)	Es (ksf)
Poorly-graded Sand (SP) and Clayey Gravel (GC)		0.125	310
Poorly-graded Gravel with varying amounts of Clay (GP/GP-GC)		0.13	760
Poorly-graded Sand (SP)		0.13	890



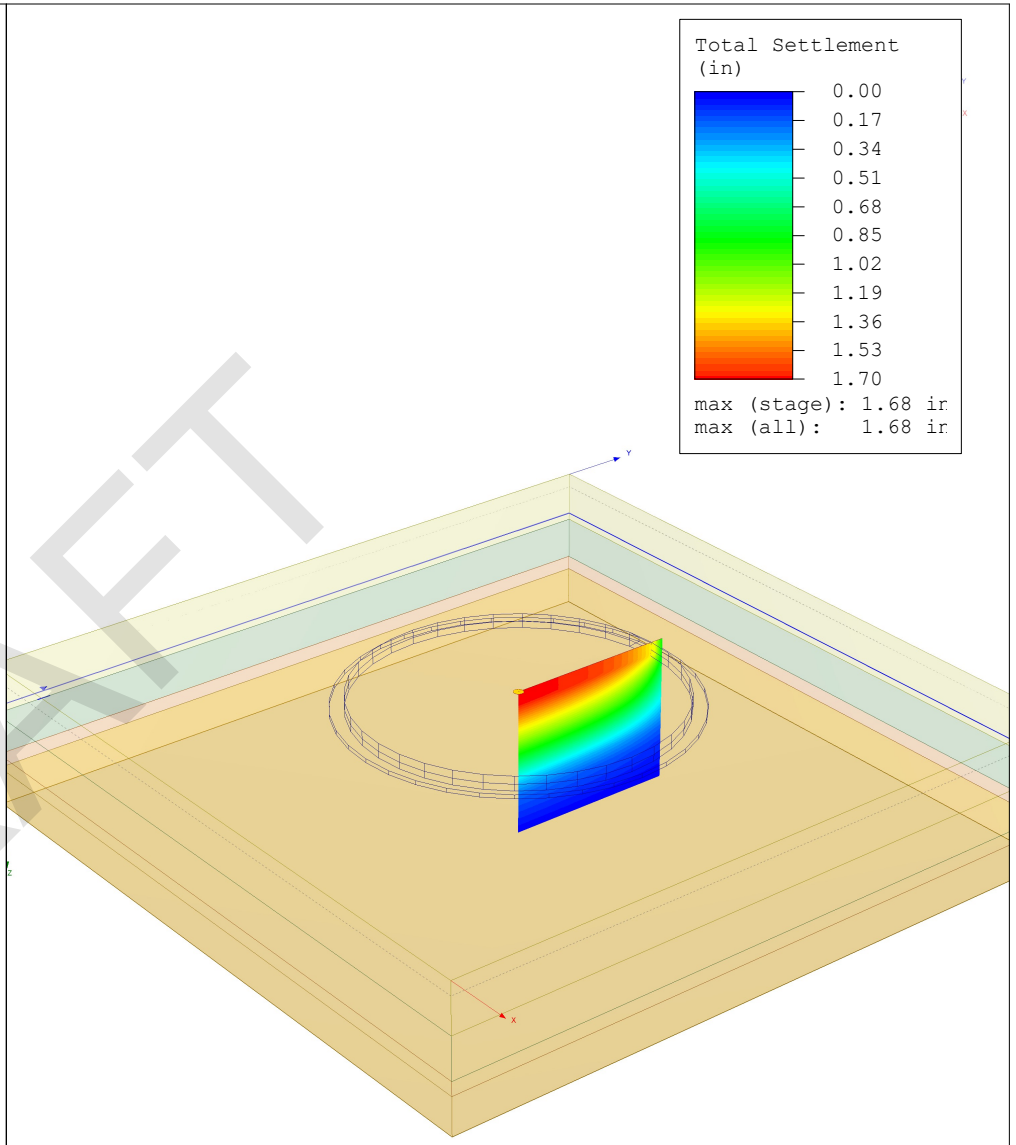
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rocscience	Project	19-503.1: Ukiah Recycled Water Pipeline	
	Analysis Description	120 foot diameter, concrete	
	Drawn By	HFW	Company: Crawford
	Date	8/20/21	File Name: ukiah tank R-19-021.s3z

SETTLE3D 3.020



Material Name	Color	Unit Weight (kips/ft3)	Es (ksf)
Silty Sand (SM)		0.13	560
Poorly-graded Sand with Silt (SP-SM)		0.14	460
Clayey Sand (SC)		0.13	670
Poorly-graded Gravel with Clay (GP-GC)		0.13	1460



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rocscience

SETTLE3D 3.020

Project	19-503.1: Ukiah Recycled Water Pipeline		
Analysis Description	120 foot diameter, concrete		
Drawn By	HFW	Company	Crawford
Date	8/20/21	File Name	ukiah tank R-19-017.s3z

CAST-IN-DRILLED-HOLE (CIDH) PILE NOMINAL RESISTANCE IN SIDE FRICTION

Ukiah Recycled Water Pipeline - Bridge Location

Ukiah, CA

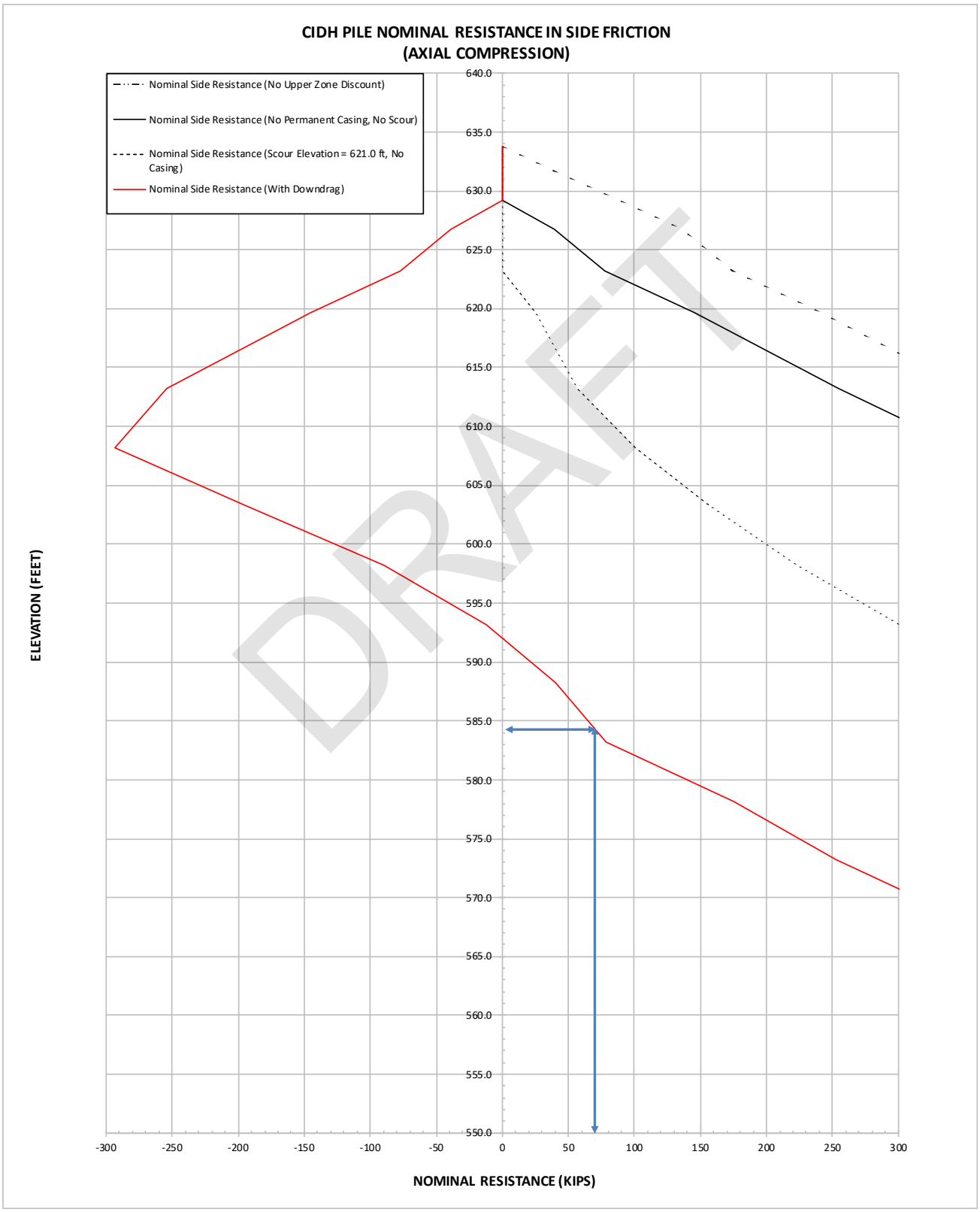
CAInc Project Number: 19-503.1

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Geotechnical Engineering, Design and Construction Services

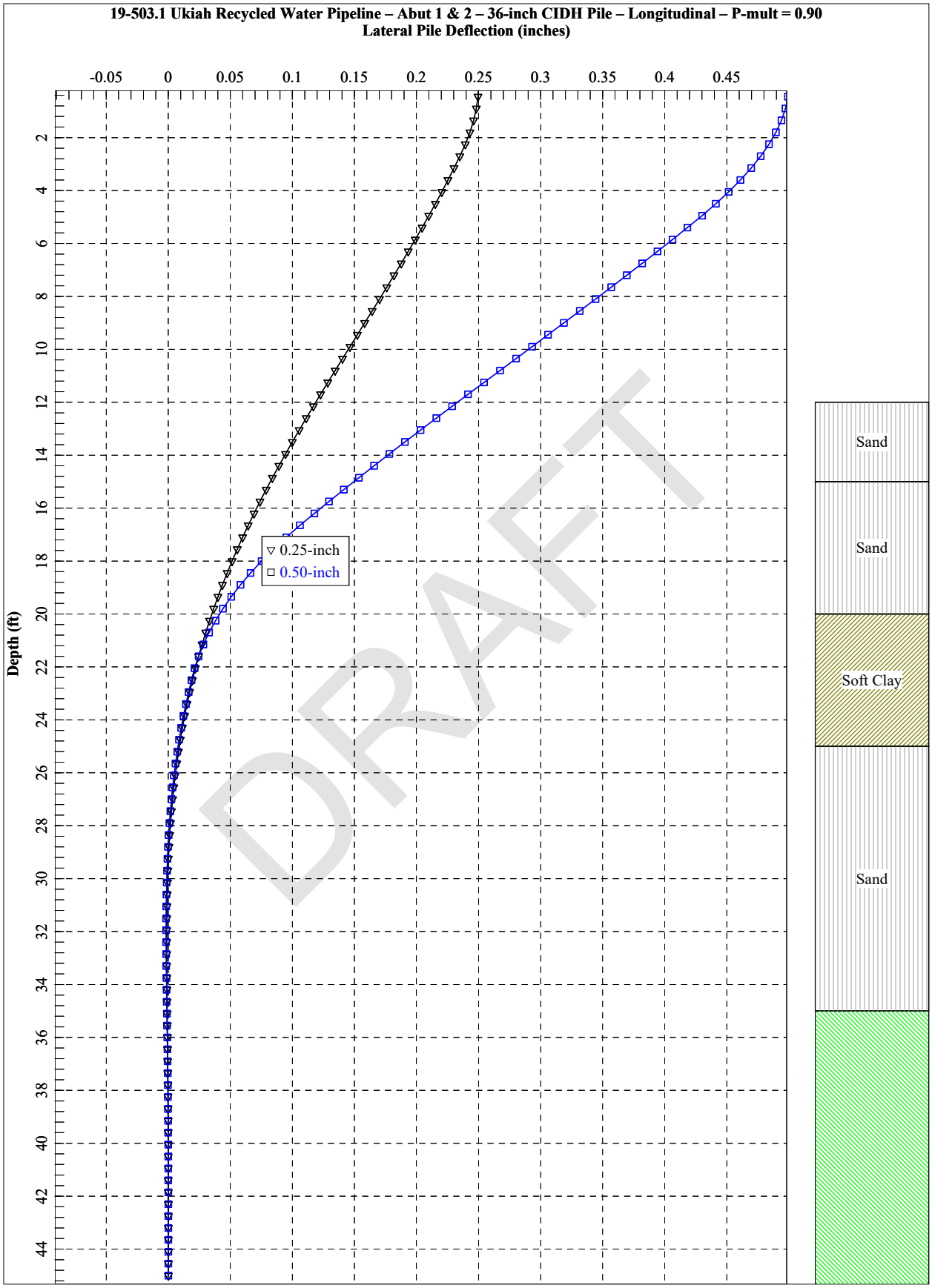
July 30, 2021

Support Location(s): Abutment 1 and 2	**Pile Diameter = 36 inches**	**Pile Cut-Off Elevation = 633.75 feet**
Boring(s): R-20-003	**Socket Diameter = NA**	**Permanent Casing Tip Elevation = NA**

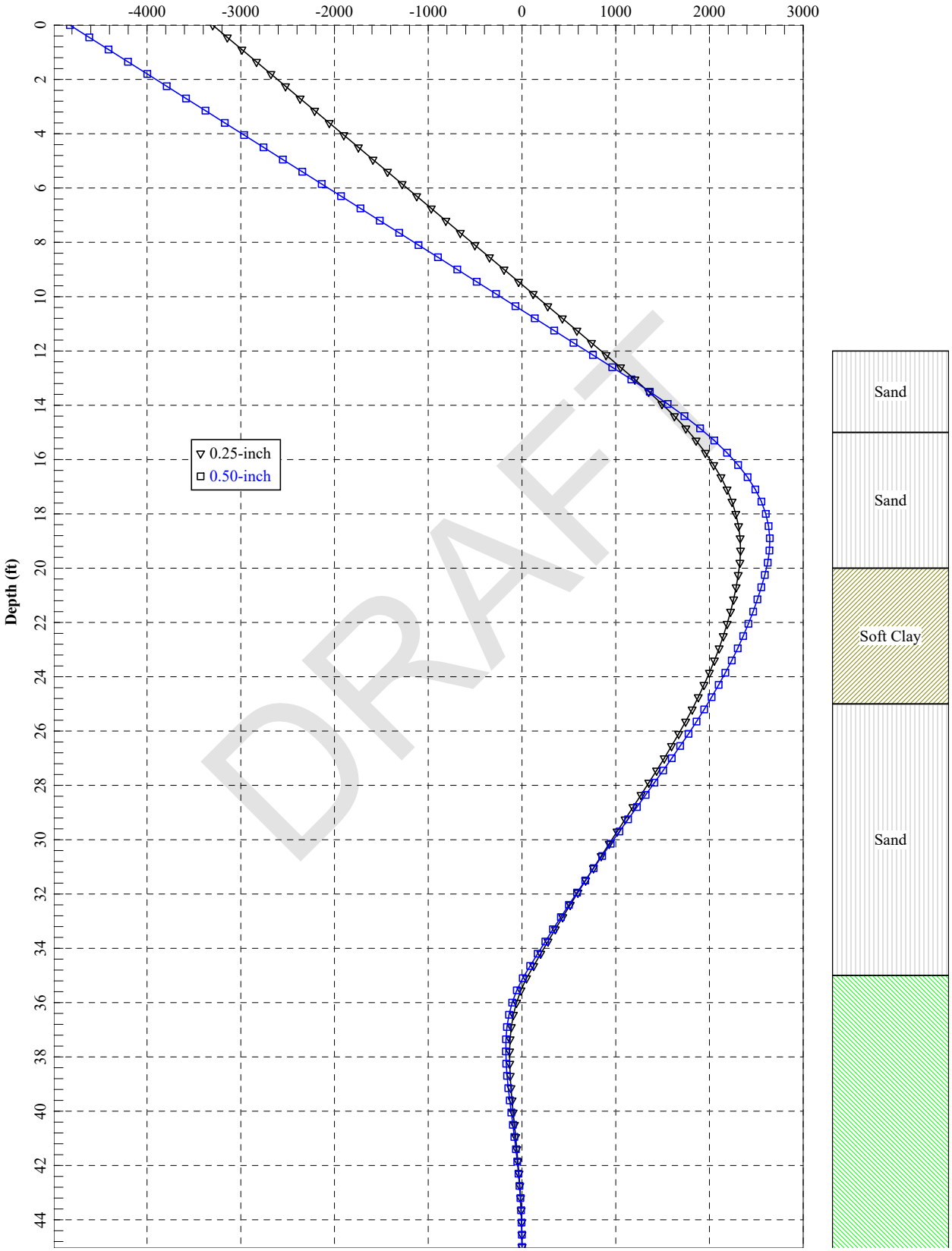
SERVICE LIMIT			STRENGTH LIMIT			EXTREME LIMIT		
REQUIRED NOMINAL RESISTANCE =	NA	kips	REQUIRED NOMINAL RESISTANCE =	70	kips	REQUIRED NOMINAL RESISTANCE =	NA	kips
SCOUR ELEVATION =	620.0	feet	SCOUR ELEVATION =	621.0	feet	SCOUR ELEVATION =	622.0	feet
DESIGN PILE TIP ELEVATION =	NA	feet	DESIGN PILE TIP ELEVATION =	579.0	feet	DESIGN PILE TIP ELEVATION =	NA	feet



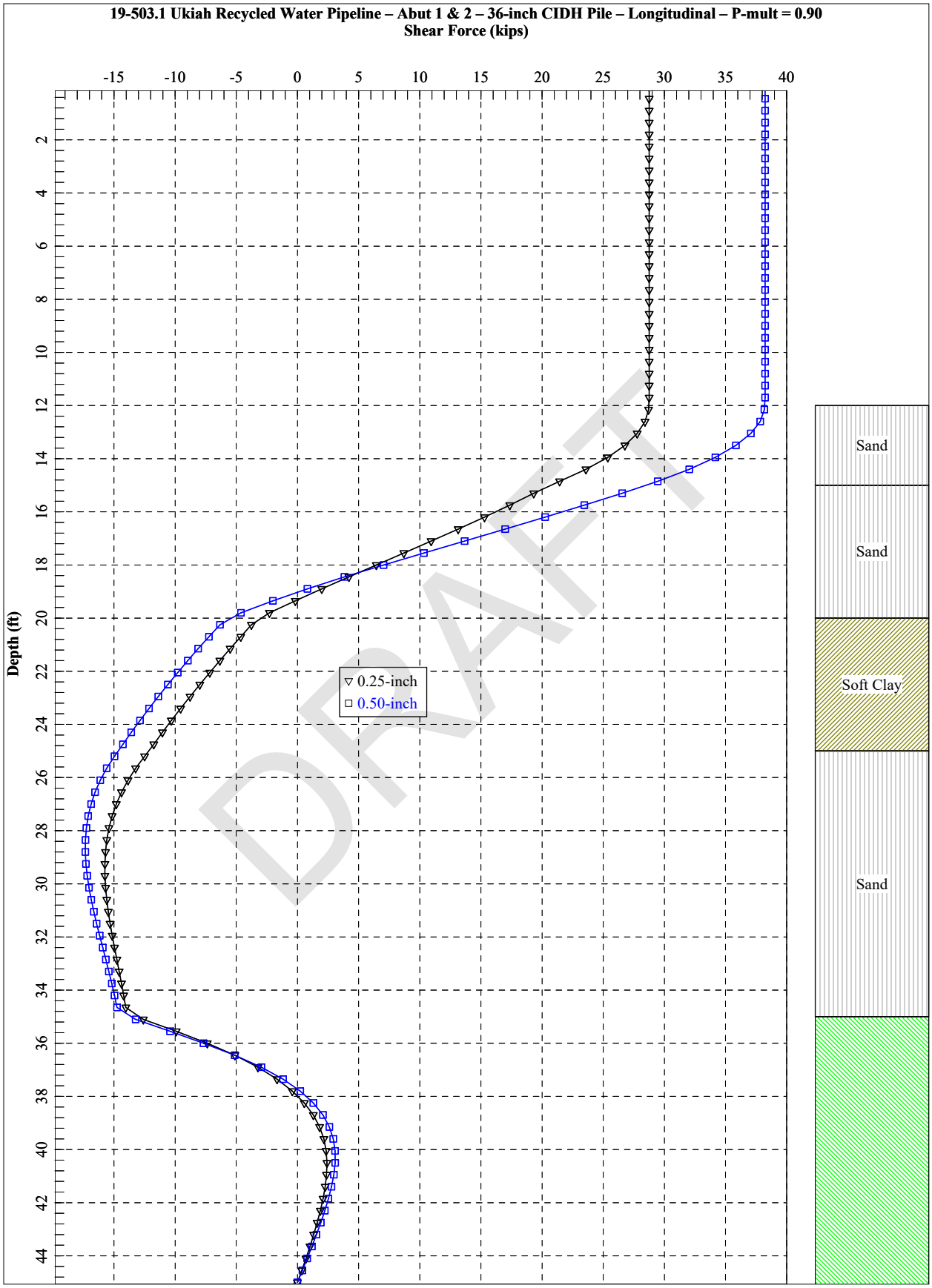
CIDH Pile Nominal Side Resistance calculated consistent with 2017 8th Edition AASHTO LRFD Bridge Design Specifications with California Amendments. **No End Bearing Contribution.**

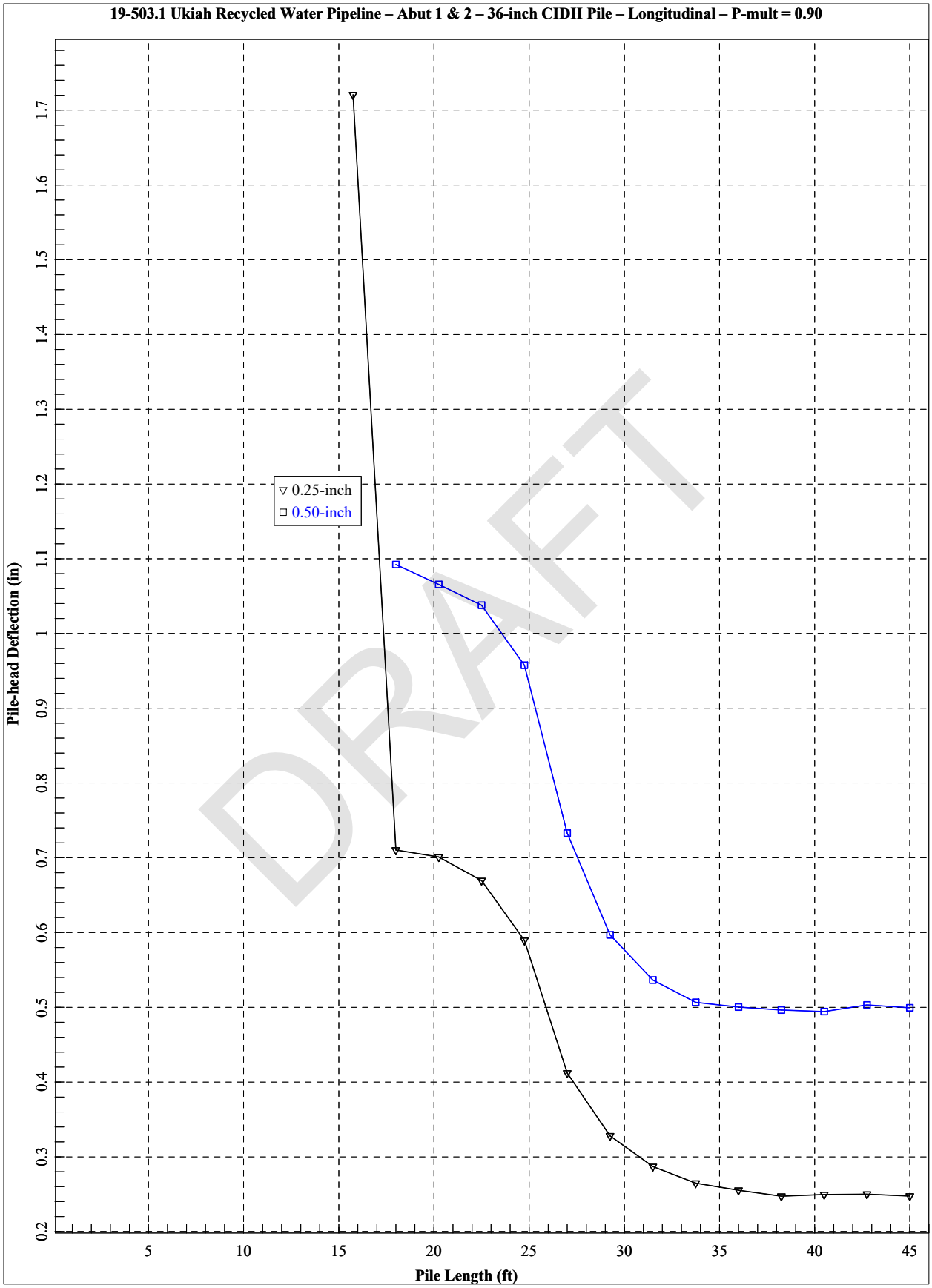

19-503.1 Ukiah Recycled Water Pipeline – Abut 1 & 2 – 36-inch CIDH Pile – Longitudinal – P-mult = 0.90
Lateral Pile Deflection (inches)
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
Depth (ft)
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
0.25-inch
0.50-inch
Sand
Sand
Soft Clay
Sand
DRAFT

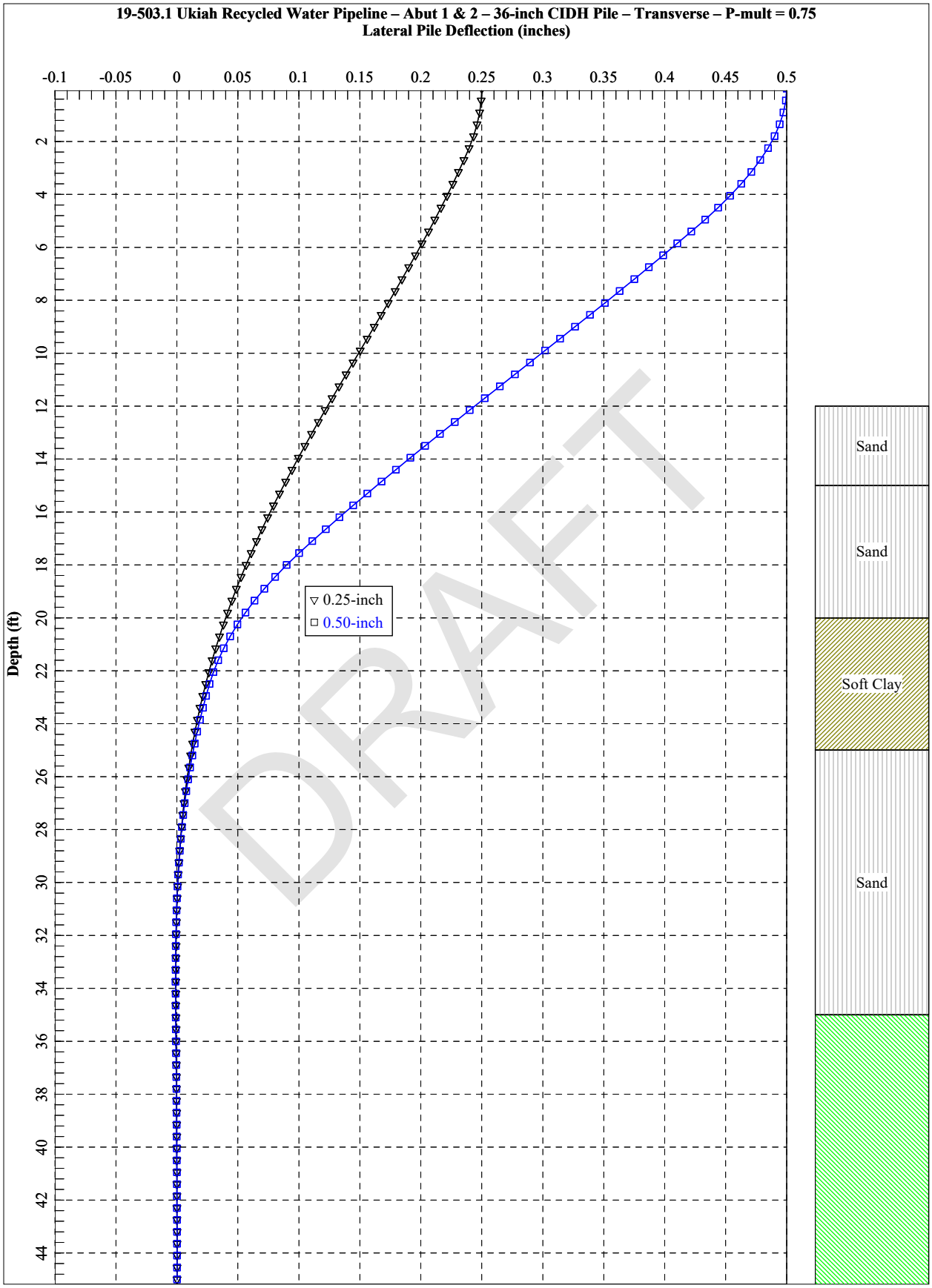
19-503.1 Ukiah Recycled Water Pipeline – Abut 1 & 2 – 36-inch CIDH Pile – Longitudinal – P-mult = 0.90
Bending Moment (in-kips)

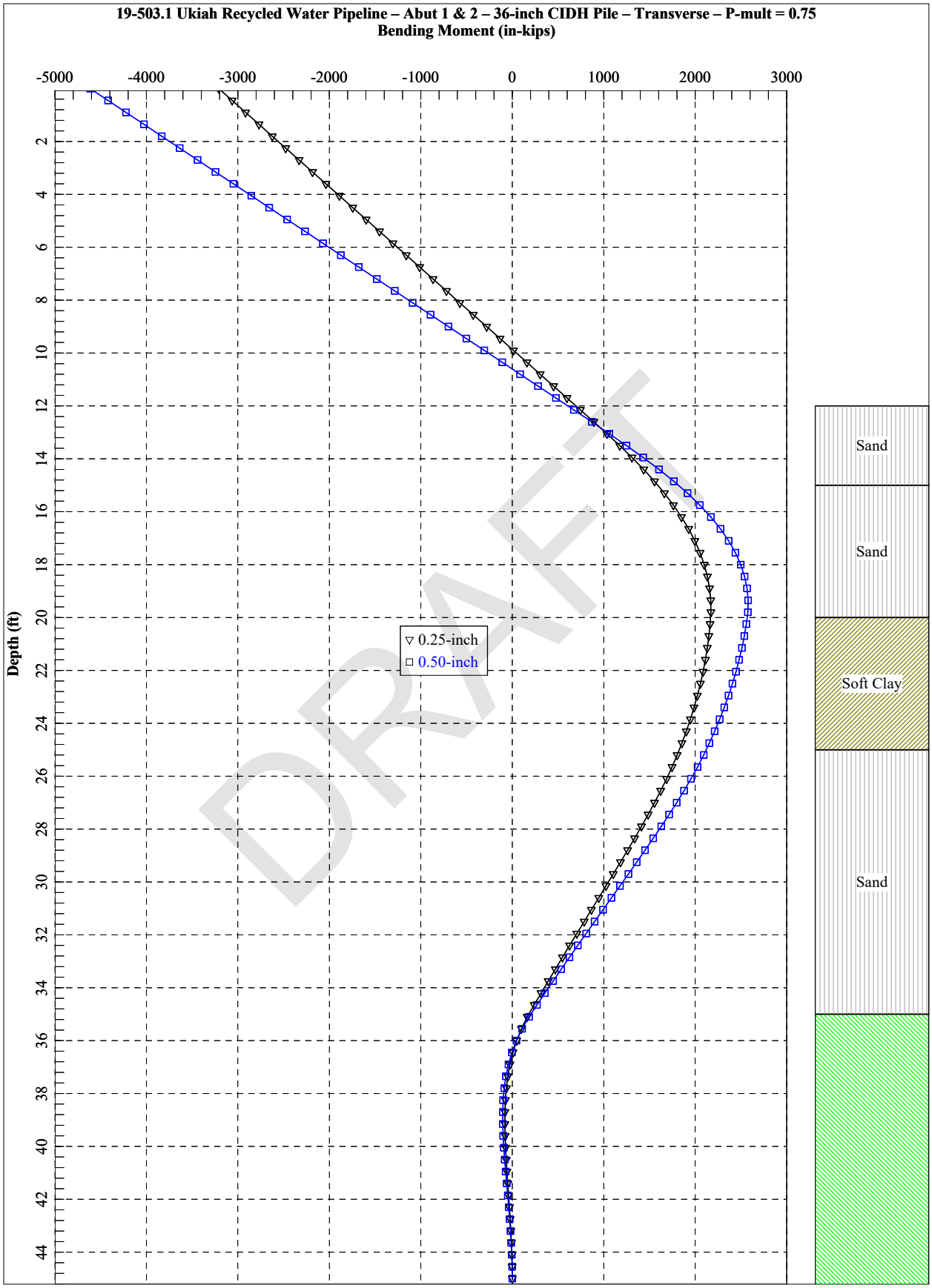


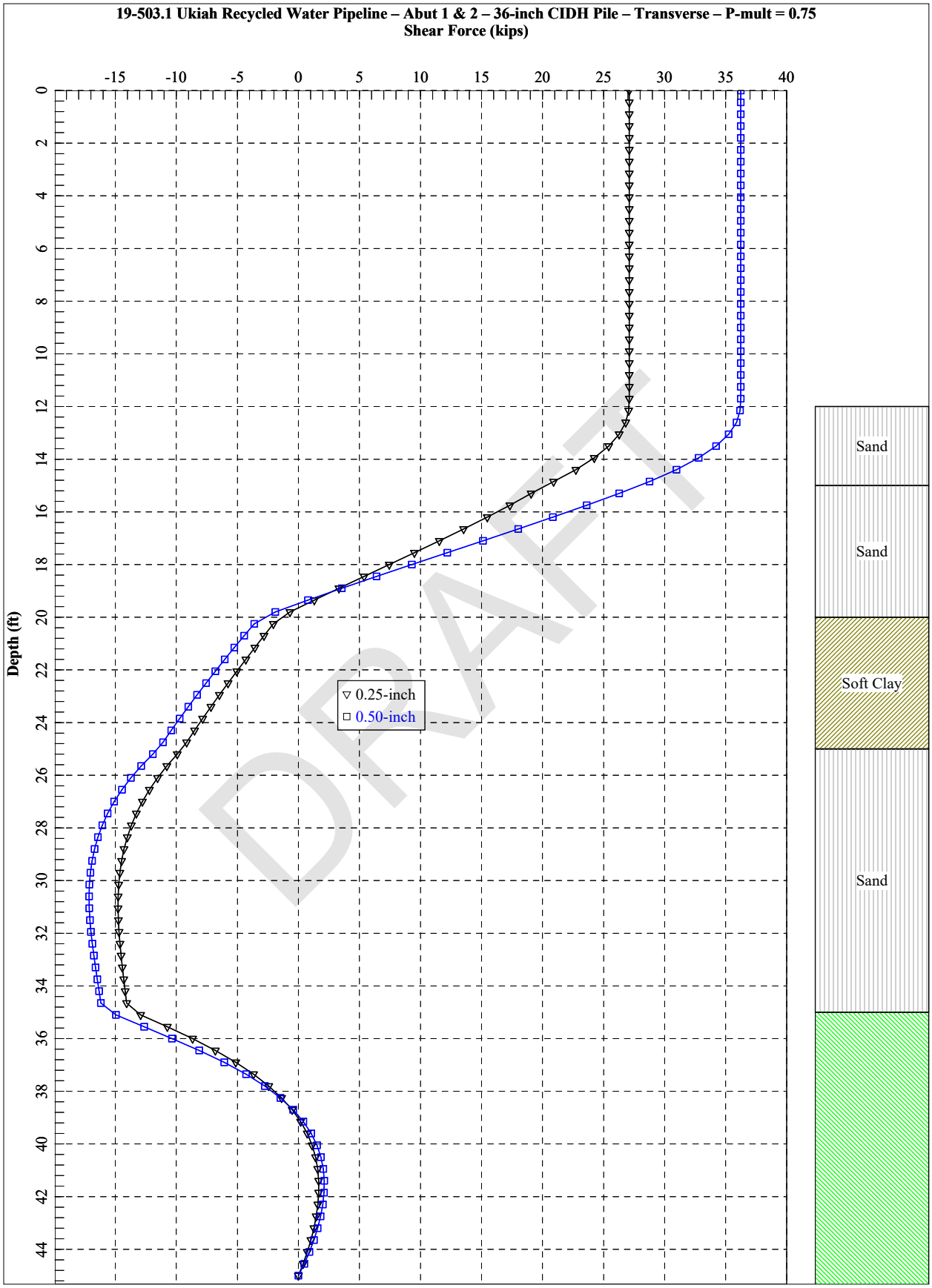
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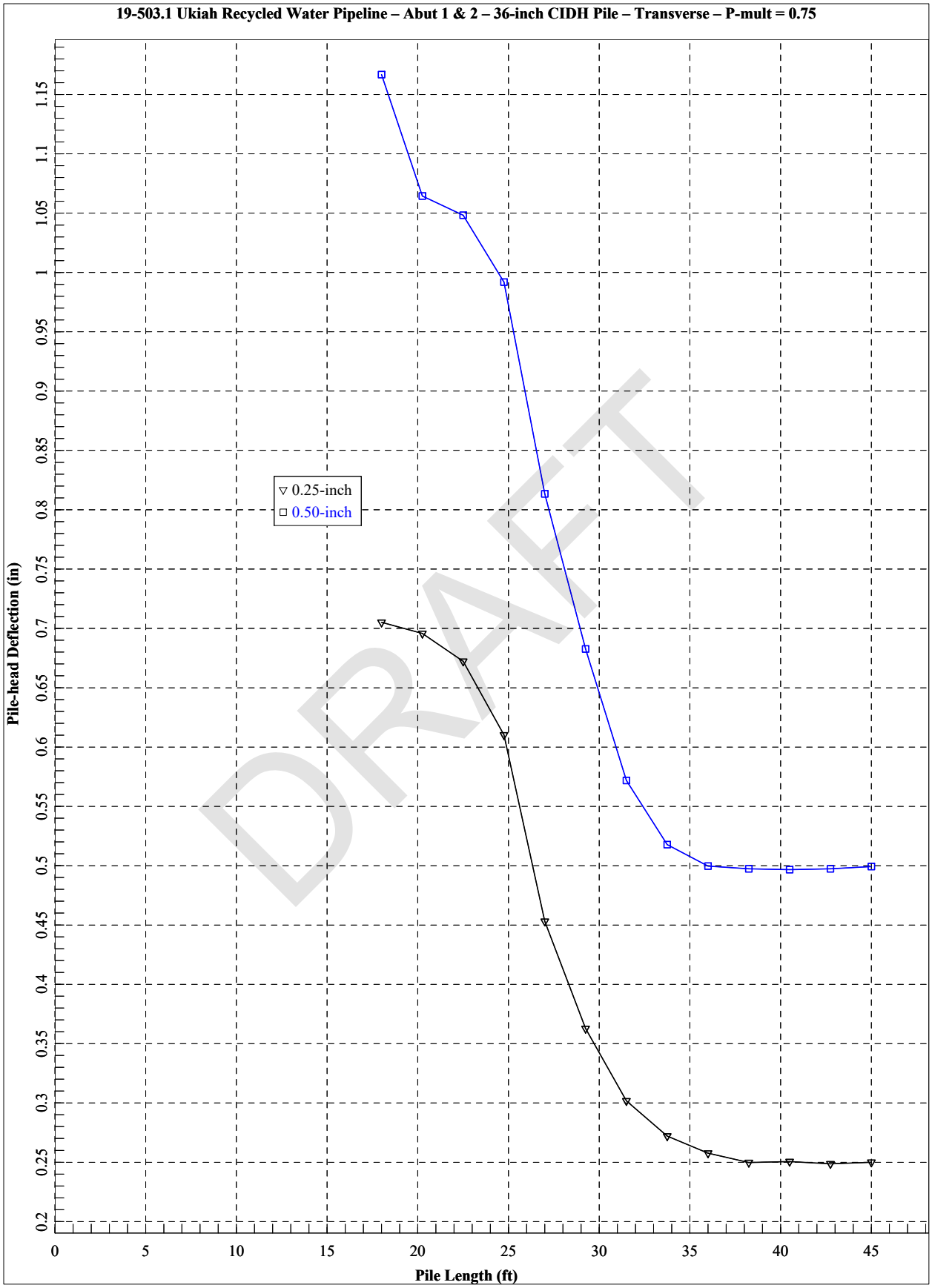

19-503.1 Ukiah Recycled Water Pipeline – Abut 1 & 2 – 36-inch CIDH Pile – Longitudinal – P-mult = 0.90
Shear Force (kips)
-15
-10
-5
0
5
10
15
20
25
30
35
40
Depth (ft)
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
0.25-inch
0.50-inch
Sand
Sand
Soft Clay
Sand
DRAFT

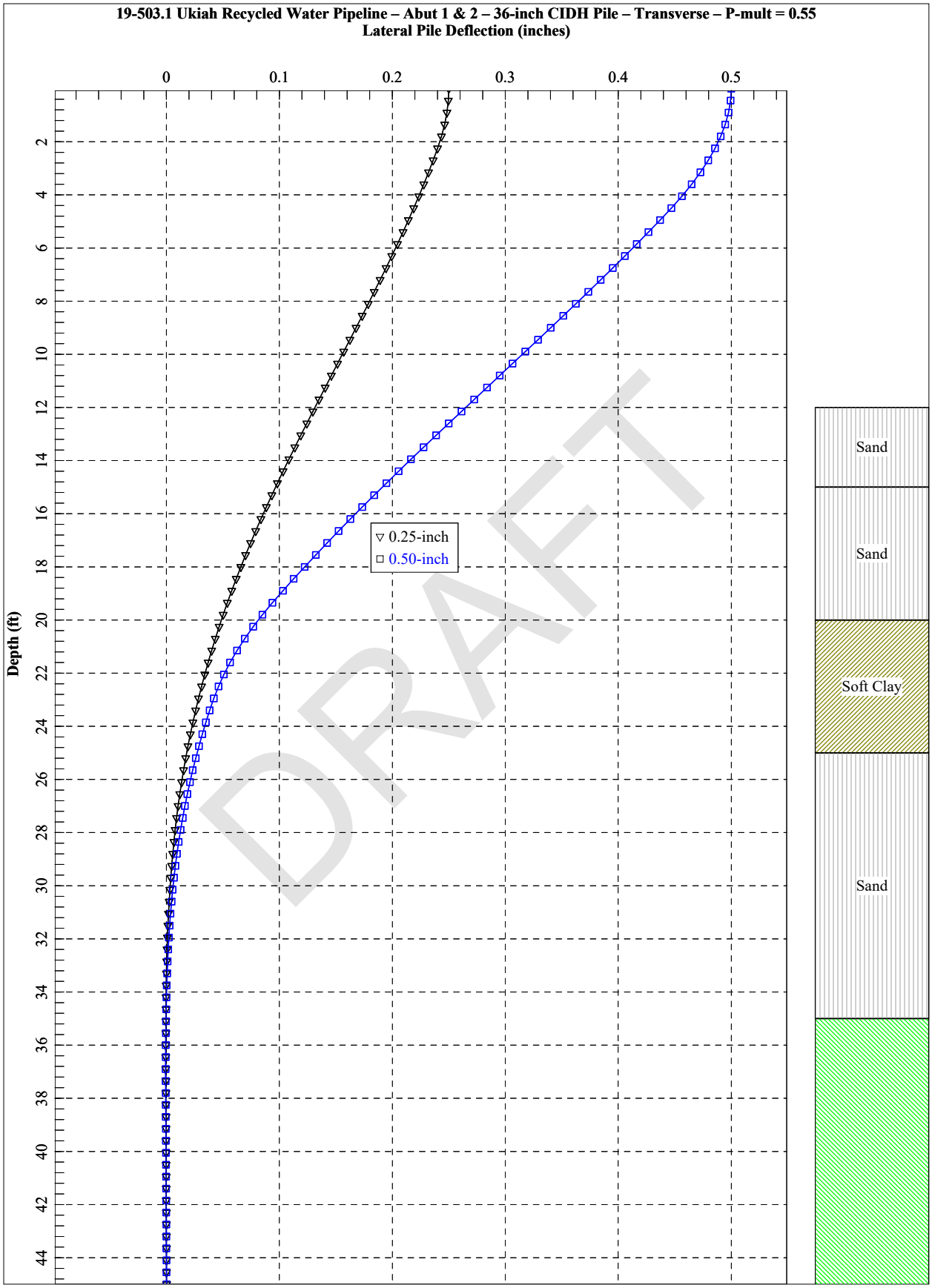

19-503.1 Ukiah Recycled Water Pipeline – Abut 1 & 2 – 36-inch CIDH Pile – Longitudinal – P-mult = 0.90
Pile-head Deflection (in)
Pile Length (ft)
0.25-inch
0.50-inch
DRAFT

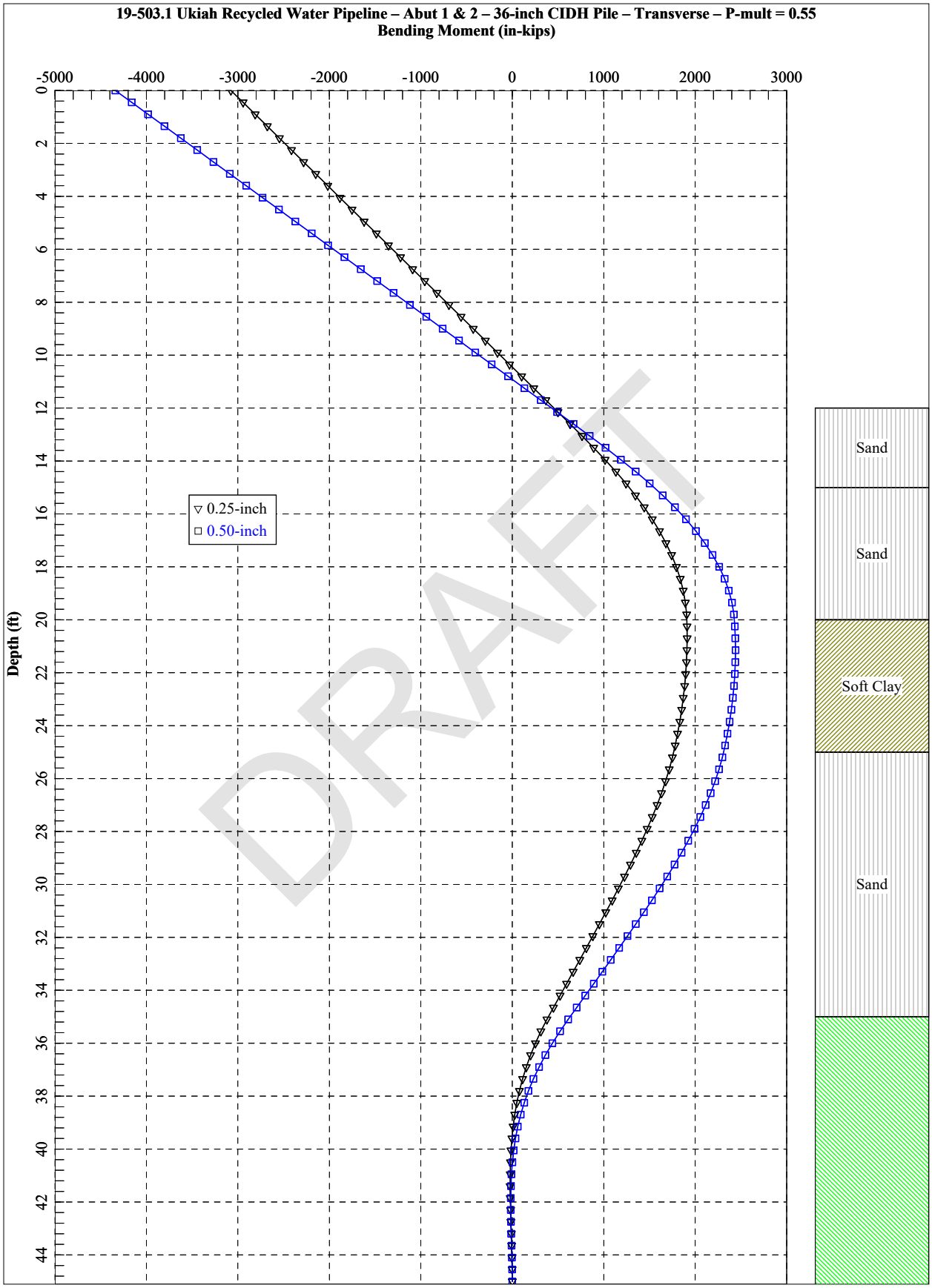

19-503.1 Ukiah Recycled Water Pipeline – Abut 1 & 2 – 36-inch CIDH Pile – Transverse – P-mult = 0.75
Lateral Pile Deflection (inches)
-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Depth (ft)
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
0.25-inch
0.50-inch
Sand
Sand
Soft Clay
Sand
DRAFT

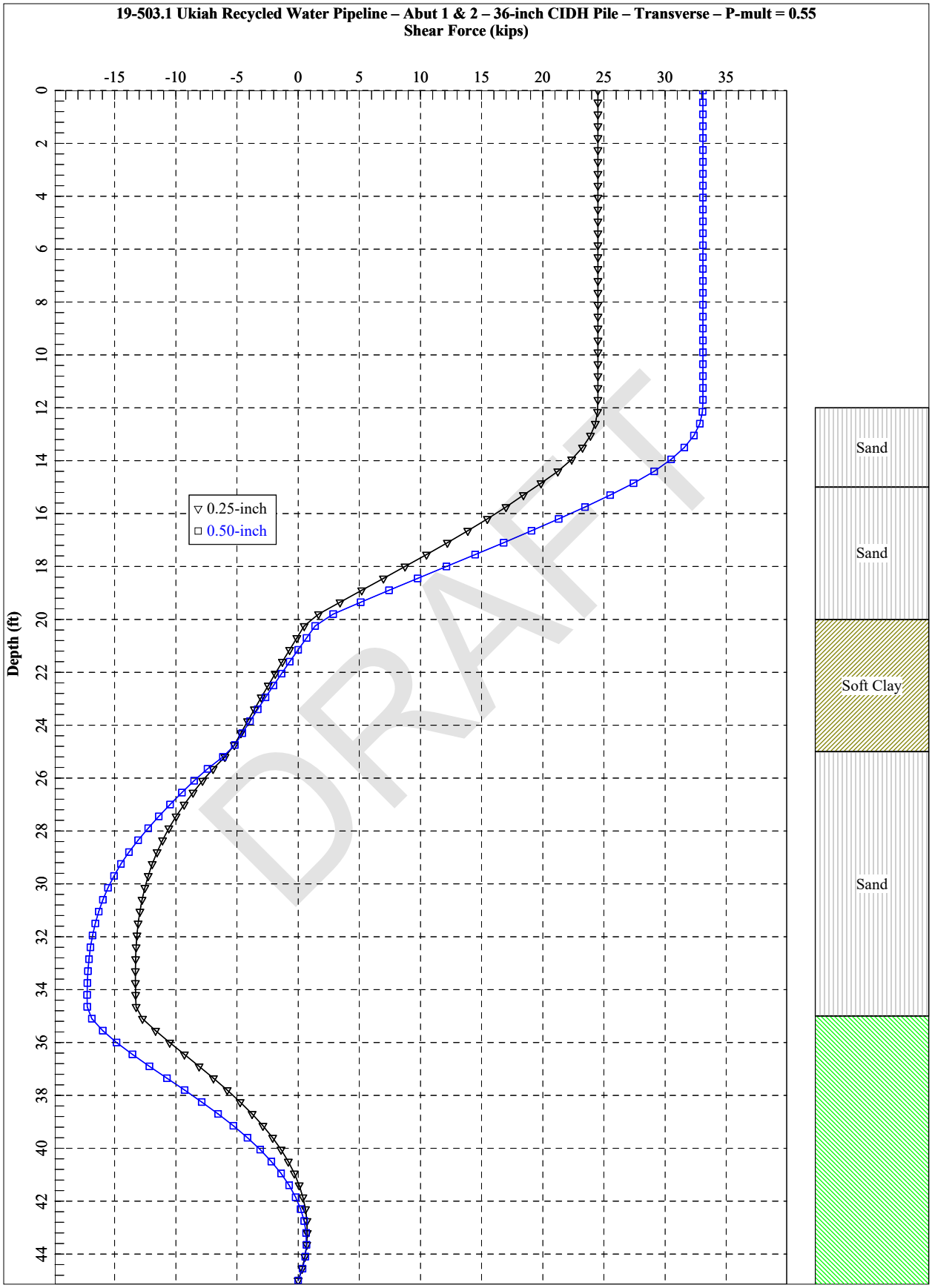

19-503.1 Ukiah Recycled Water Pipeline – Abut 1 & 2 – 36-inch CIDH Pile – Transverse – P-mult = 0.75
Bending Moment (in-kips)
-5000
-4000
-3000
-2000
-1000
0
1000
2000
3000
Depth (ft)
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
0.25-inch
0.50-inch
Sand
Sand
Soft Clay
Sand
DRAFT


19-503.1 Ukiah Recycled Water Pipeline – Abut 1 & 2 – 36-inch CIDH Pile – Transverse – P-mult = 0.75
Shear Force (kips)
-15
-10
-5
0
5
10
15
20
25
30
35
40
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
0.25-inch
0.50-inch
Sand
Sand
Soft Clay
Sand
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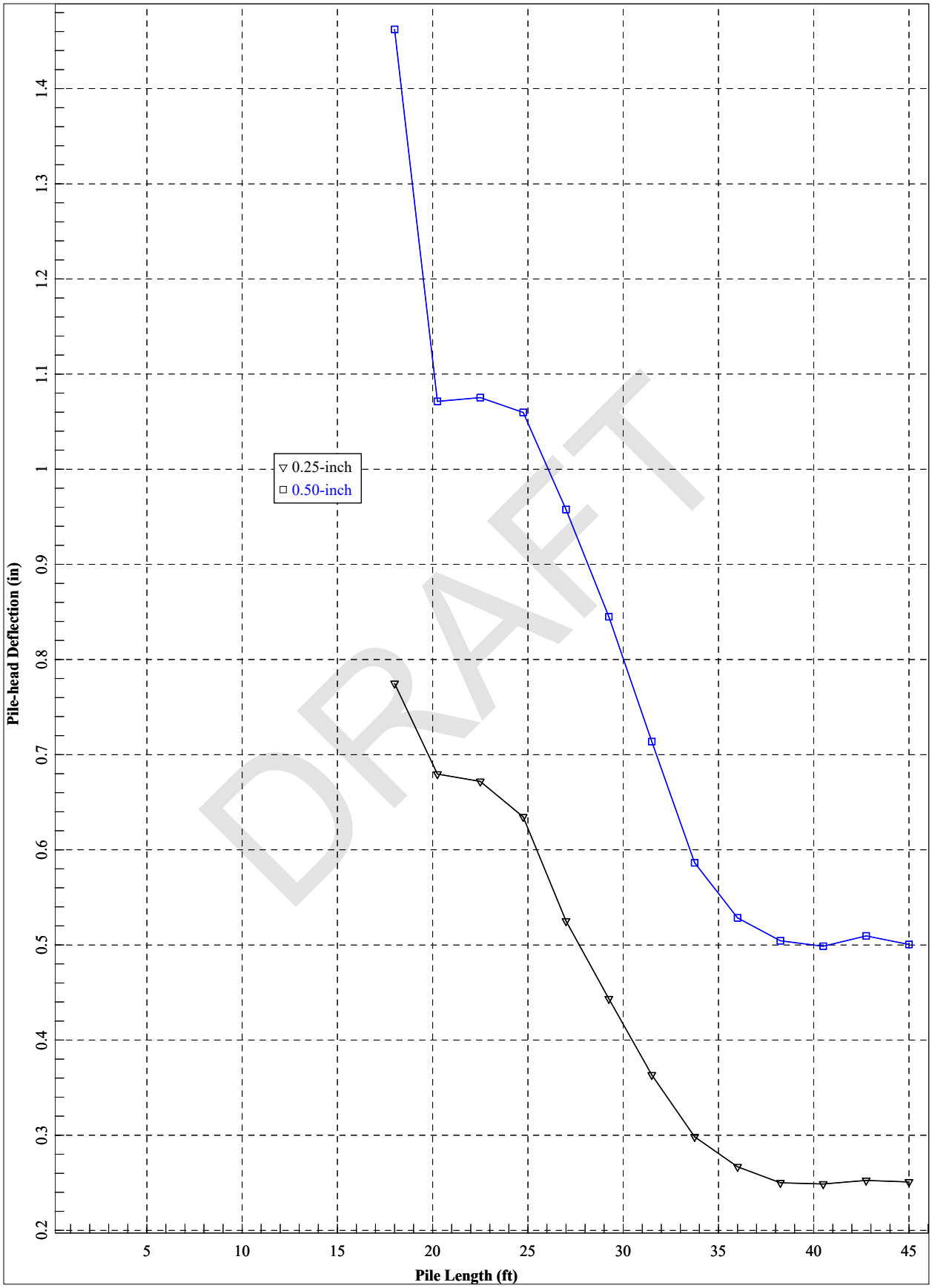

19-503.1 Ukiah Recycled Water Pipeline – Abut 1 & 2 – 36-inch CIDH Pile – Transverse – P-mult = 0.75
Pile-head Deflection (in)
Pile Length (ft)
0.25-inch
0.50-inch
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
1.05
1.1
1.15
0
5
10
15
20
25
30
35
40
45
DRAFT


19-503.1 Ukiah Recycled Water Pipeline – Abut 1 & 2 – 36-inch CIDH Pile – Transverse – P-mult = 0.55
Lateral Pile Deflection (inches)
0
0.1
0.2
0.3
0.4
0.5
Depth (ft)
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
0.25-inch
0.50-inch
Sand
Sand
Soft Clay
Sand
DRAFT


19-503.1 Ukiah Recycled Water Pipeline – Abut 1 & 2 – 36-inch CIDH Pile – Transverse – P-mult = 0.55
Bending Moment (in-kips)
-5000
-4000
-3000
-2000
-1000
0
1000
2000
3000
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
0.25-inch
0.50-inch
Sand
Sand
Soft Clay
Sand
DRAFT


19-503.1 Ukiah Recycled Water Pipeline – Abut 1 & 2 – 36-inch CIDH Pile – Transverse – P-mult = 0.55
Shear Force (kips)
-15
-10
-5
0
5
10
15
20
25
30
35
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
0.25-inch
0.50-inch
Sand
Sand
Soft Clay
Sand
DRAFT

19-503.1 Ukiah Recycled Water Pipeline – Abut 1 & 2 – 36-inch CIDH Pile – Transverse – P-mult = 0.55



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City of Ukiah

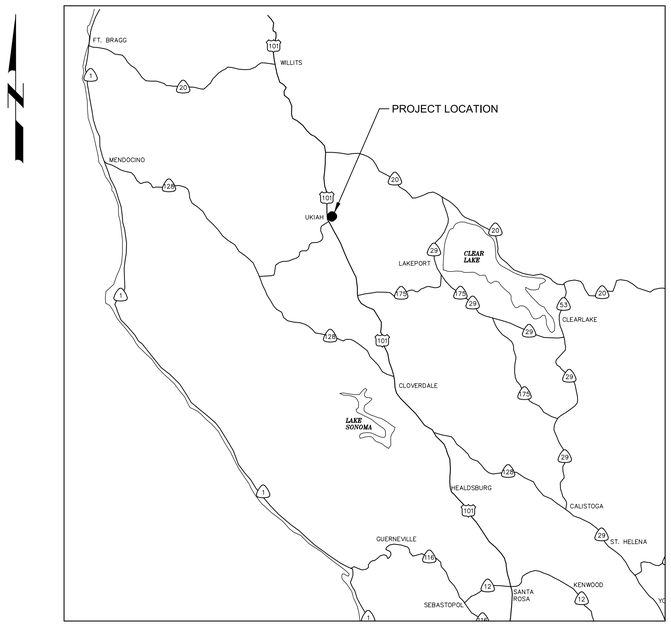
CITY OF UKIAH

RECYCLED WATER PROJECT
PHASE 4 - SPECIFICATION NO. 23-01

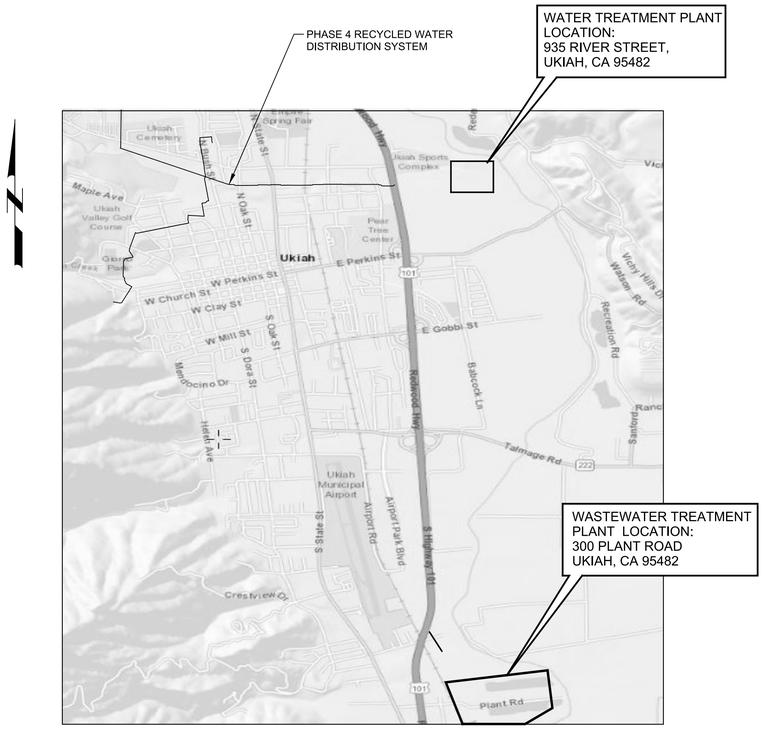
100% SUBMITTAL

JULY 2023

VOLUME 3 OF 3



VICINITY MAP
NO SCALE



LOCATION MAP
NO SCALE

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CONFORMED DOCUMENTS
THESE CONFORMED DOCUMENTS UNIFY ADDENDA ISSUED DURING THE BID PERIOD. IF DISCREPANCIES BETWEEN THE CONFORMED DOCUMENTS AND THE BID DOCUMENTS ARE FOUND, THE BID DOCUMENTS WITH THE ORIGINAL ADDENDA SHALL GOVERN.

**
ORIGINAL
SEALED BY
BRIAN W. AVON
4/10/2023
CA PE NO. 76832
**

JOB NO. 8660F10
DRAWING NO. 00G01
SHEET NO. 1 OF 200

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obonafoux

SHEET NO.	DRAWING NO.				DESCRIPTION
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2	00G02	00	G	02	DRAWING INDEX
3	00G03	00	G	03	GENERAL NOTES, LEGEND, AND SYMBOLS
4	00G04	00	G	04	GENERAL ABBREVIATIONS
5	00G05	00	G	05	KEY MAP AND SURVEY CONTROL
6	00G06	00	G	06	RECYCLED WATER SERVICE SCHEDULE
7	00G07	00	G	07	DESIGN CRITERIA, PIPE SERVICE ABBREVIATIONS AND PROCESS AREA NUMBERS
8	00G08	00	G	08	LIQUIDS PROCESS FLOW DIAGRAM
9	00G09	00	G	09	SITE PLAN
					DEMOLITION
10	00D01	00	D	01	SITE PLAN
11	60D01	60	D	01	DECHLORINATION STRUCTURE PLAN
12	60D02	60	D	02	DECHLORINATION STRUCTURE PHOTOS
13	85D01	85	D	01	AWT CLARIFIER/FILTER PLAN
14	85D02	85	D	02	AWT CLARIFIER/FILTER SECTION AND PHOTOS
15	85D03	85	D	03	AWT CLARIFIER/FILTER PHOTOS
16	87D01	87	D	01	BACKWASH PUMP STATION PLAN AND PHOTOS
17	89D01	89	D	01	CAROUSEL PUMP STATION PLAN
18	89D02	89	D	02	CAROUSEL PUMP STATION PHOTOS
19	91D01	91	D	01	SLUDGE LAGOON PLAN
					CIVIL
20	00C01	00	C	01	GENERAL CIVIL LEGEND, AND SYMBOLS
21	00C02	00	C	02	GENERAL CIVIL NOTES AND SCHEDULES
22	00C03	00	C	03	WWTP SITE PLAN
23	91C01	91	C	01	PAU GRADING PLAN
24	91C02	91	C	02	PAU SECTIONS
25	91C03	91	C	03	PAU DETAILS
26	91C04	91	C	04	PAU DETAILS
27	91C05	91	C	05	PAU SURVEY CONTROL PLAN
28	91C06	91	C	06	PAU PUMP STATION PLAN
29	91C07	91	C	07	PLAN AND PROFILE PAU INLET YARD PIPING
30	91C08	91	C	08	PLAN AND PROFILE PAU OUTLET YARD PIPING
31	99C01	99	C	01	PLAN AND PROFILE - ALIGNMENT A STA A9+40 TO A19+00
32	99C02	99	C	02	PLAN AND PROFILE - ALIGNMENT A STA A19+00 TO A29+00
33	99C03	99	C	03	PLAN AND PROFILE - ALIGNMENT A STA A29+00 TO A39+00
34	99C04	99	C	04	PLAN AND PROFILE - ALIGNMENT A STA A39+00 TO A49+00
35	99C05	99	C	05	PLAN AND PROFILE - ALIGNMENT A STA A49+00 TO A59+00
36	99C06	99	C	06	PLAN AND PROFILE - ALIGNMENT A STA A59+00 TO A69+00
37	99C07	99	C	07	PLAN AND PROFILE - ALIGNMENT A STA A69+00 TO A79+00
38	99C08	99	C	08	PLAN AND PROFILE - ALIGNMENT A STA A79+00 TO A89+00
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40	99C10	99	C	10	PLAN AND PROFILE - ALIGNMENT B STA B9+60 TO B19+00
41	99C11	99	C	11	PLAN AND PROFILE - ALIGNMENT B STA B19+00 TO B24+16.34
42	99C12	99	C	12	PLAN AND PROFILE - ALIGNMENT C STA C10+00 TO C19+00
43	99C13	99	C	13	PLAN AND PROFILE - ALIGNMENT C STA C19+00 TO C29+00
44	99C14	99	C	14	PLAN AND PROFILE - ALIGNMENT C STA C29+00 TO C39+00
45	99C15	99	C	15	PLAN AND PROFILE - ALIGNMENT C STA C39+00 TO C49+00
46	99C16	99	C	16	PLAN AND PROFILE - ALIGNMENT C STA C49+00 TO C59+00
47	99C17	99	C	17	PLAN AND PROFILE - ALIGNMENT C STA C59+00 TO C68+00
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50	99C20	99	C	20	PUMP STATION AND STORAGE GRADING AND DRAINAGE PLAN
51	99C21	99	C	21	PUMP STATION AND STORAGE GRADING DETAILS
52	99C22	99	C	22	SEWER REALIGNMENT
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53	99A01	99	A	01	ELECTRICAL BUILDING CODE ANALYSIS, SCHEDULES, AND EGRESS PLAN
54	99A02	99	A	02	ELECTRICAL BUILDING ROOF ELEVATIONS
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56	85S01	85	S	01	AWT CLARIFIER/FILTER PLAN
57	85S02	85	S	02	AWT CLARIFIER/FILTER SECTIONS AND PHOTO
58	91S01	91	S	01	PAU PUMP STATION PLANS
59	91S02	91	S	02	PAU PUMP STATION SECTIONS AND DETAILS
60	91S03	91	S	03	PAU PUMP STATION INLET STRUCTURE PLAN AND SECTIONS
61	95S01	95	S	01	PAU INLET STRUCTURE PLAN AND SECTION
62	99S01	99	S	01	ELECTRICAL BUILDING FOUNDATION PLAN
63	99S02	99	S	02	ELECTRICAL BUILDING ROOF FRAMING AND ROOF PLANS
64	99S03	99	S	03	ELECTRICAL BUILDING SECTION
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67	99S06	99	S	06	STORAGE TANK ROOF PLAN
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69	99S08	99	S	08	STORAGE TANK SECTION AND DETAILS
70	99S09	99	S	09	BRIDGE PLAN AND SECTION
71	99S10	99	S	10	BRIDGE SECTIONS AND DETAILS
					MECHANICAL
72	00M01	00	M	01	GENERAL MECHANICAL SYMBOLS
73	00M02	00	M	02	GENERAL HVAC NOTES, ABBREVIATIONS, AND SYMBOLS
74	60M01	60	M	01	DECHLORINATION STRUCTURE PLAN AND SECTION
75	85M01	85	M	01	AWT PROCESS FLOW SCHEMATIC
76	85M02	85	M	02	AWT CLARIFIER/FILTER PLAN
77	85M03	85	M	03	AWT CLARIFIER/FILTER SECTIONS
78	85M04	85	M	04	AIR WASH BLOWERS SECTIONS
79	85M05	85	M	05	COAGULANT FEED PUMP AND RAPID MIX PUMP PLAN, SECTION, AND DETAIL
80	87M01	87	M	01	BACKWASH PUMP STATION PLAN AND SECTION
81	89M01	89	M	01	CAROUSEL PUMP STATION PLAN AND SECTIONS
82	91M01	91	M	01	PAU PUMP STATION PLAN AND SECTION
83	99M01	99	M	01	RECYCLED WATER PUMP STATION PLAN, SECTION AND DETAIL
84	99M02	99	M	02	RECYCLED WATER PUMP STATION SECTION
85	99M03	99	M	03	METER AND CONTROL VALVE PLAN AND SECTION
86	99M04	99	M	04	ELECTRICAL BUILDING HVAC FLOOR PLAN AND SCHEDULE

SHEET NO.	DRAWING NO.				DESCRIPTION
					ELECTRICAL
87	00GE01	00	GE	01	LEGEND
88	00GE02	00	GE	02	ABBREVIATIONS
89	01E01	01	E	01	RECYCLED WATER PUMP STATION AND STORAGE SITE PLAN
90	01E02	01	E	02	WWTP AND STORAGE POND PARTIAL SITE PLAN
91	01E03	01	E	03	WWTP AND STORAGE POND DETAILS AND SECTION
92	02E01	02	E	01	DUCT BANK SECTIONS 1
93	02E02	02	E	02	DUCT BANK SECTIONS 2
94	02E03	02	E	03	DUCT BANK SECTIONS 3
95	03E01	03	E	01	WTP MODIFIED OVERALL ONE-LINE DIAGRAM
96	03E02	03	E	02	SWBD-RWPS ELEVATION
97	03E03	03	E	03	SWBD-RWPS ONE-LINE DIAGRAM
98	03E04	03	E	04	WWTP MODIFIED OVERALL ONE-LINE DIAGRAM
99	03E05	03	E	05	CAROUSEL PUMP STATION DEMO ONE-LINE DIAGRAM
100	03E06	03	E	06	SWBD70281 AND SWBD70282 ONE-LINE DIAGRAM
101	03E09	03	E	09	MCC - C DEMO ELEVATION
102	03E10	03	E	10	MCC - C MODIFIED ELEVATION
103	03E11	03	E	11	MCC - C MODIFIED ONE-LINE DIAGRAM 1
104	03E12	03	E	12	MCC - C MODIFIED ONE-LINE DIAGRAM 2
105	03E18	03	E	18	MCC70291 PARTIAL ELEVATION
106	03E19	03	E	19	MCC70291 ONE-LINE DIAGRAM
107	03E20	03	E	20	MCC70292 PARTIAL ELEVATION
108	03E21	03	E	21	MCC70292 ONE-LINE DIAGRAM
109	03E22	03	E	22	MCC70293 PARTIAL ELEVATION
110	03E23	03	E	23	MCC70293 ONE-LINE DIAGRAM
111	04E01	04	E	01	PANELBOARD SCHEDULES 1
112	04E02	04	E	02	PANELBOARD SCHEDULES 2
113	05E01	05	E	01	LUMINAIRE, MANHOLE/HANDHOLE, AND DISCONNECT SCHEDULES
114	05E02	05	E	02	TITLE 24 COMPLIANCE SHEETS 1
115	05E03	05	E	03	TITLE 24 COMPLIANCE SHEETS 2
116	05E04	05	E	04	TITLE 24 COMPLIANCE SHEETS 3
117	12E01	12	E	01	POWER GENERATION BUILDING PARTIAL COMMUNICATION PLAN
118	60E01	60	E	01	DECHLORINATION STRUCTURE POWER, CONTROL, AND LIGHTING PLAN
119	70E01	70	E	01	DAFT EQUIPMENT BUILDING ELECTRICAL ROOM POWER, CONTROL, AND GROUNDING PLAN
120	80E01	80	E	01	STRUCTURE 80 PLAN
121	85E01	85	E	01	AWT BUILDING OVERALL PLAN
122	85E02	85	E	02	AWT BUILDING POWER AND CONTROL PLAN 1
123	85E03	85	E	03	AWT BUILDING POWER AND CONTROL PLAN 2
124	87E01	87	E	01	BACKWASH PUMP STATION POWER AND CONTROL PLAN
125	89E01	89	E	01	CAROUSEL PUMP STATION POWER AND CONTROL PLAN
126	89E02	89	E	02	CAROUSEL PUMP STATION LIGHTING, GROUNDING, AND RECEPTACLE PLAN
127	91E01	91	E	01	PAU PUMP STATION PLANS
128	99E01	99	E	01	EXISTING WATER TREATMENT BUILDING PARTIAL POWER AND CONTROL PLAN
129	99E02	99	E	02	RECYCLED WATER ELECTRICAL BLDG. POWER & CONTROL PLAN
130	99E03	99	E	03	RECYCLED WATER PUMP STATION BLDG. POWER & CONTROL PLAN
131	99E04	99	E	04	RECYCLED WATER STORAGE POWER & CONTROL PLAN
132	99E12	99	E	12	RECYCLED WATER ELECTRICAL BLDG, LIGHTING, GROUNDING, AND RECEPTACLES PLAN
133	99E13	99	E	13	RECYCLED WATER PUMP STATION LIGHTING, GROUNDING, AND RECEPTACLES PLAN
134	99E14	99	E	14	RECYCLED WATER STORAGE LIGHTING, GROUNDING, AND RECEPTACLES PLAN
					INSTRUMENTATION
135	00GN01	00	GN	01	SYMBOLS AND ABBREVIATIONS 1
136	00GN02	00	GN	02	SYMBOLS AND ABBREVIATIONS 2
137	00GN03	00	GN	03	SYMBOLS AND ABBREVIATIONS 3
138	00GN04	00	GN	04	SYMBOLS AND ABBREVIATIONS 4
139	00GN05	00	GN	05	SCHEMATIC SYMBOLS
140	00GN06	00	GN	06	SAMPLE LOOP DRAWING
141	02N01	02	N	01	PCM-99400 ELEVATION LAYOUT
142	02N02	02	N	02	PCM-4 PANEL MODIFICATIONS
143	02N03	02	N	03	PLC-70299 PANEL MODIFICATIONS
144	04N01	04	N	01	RECYCLED WATER PUMP STATION NETWORK BLOCK DIAGRAM
145	04N02	04	N	02	ADVANCED WASTEWATER TREATMENT NETWORK BLOCK DIAGRAM
146	04N03	04	N	03	DAFT BUILDING NETWORK BLOCK DIAGRAM
147	06N01	06	N	01	CONTROL SCHEMATICS 1
148	06N02	06	N	02	CONTROL SCHEMATICS 2
149	06N03	06	N	03	CONTROL SCHEMATICS 3
150	06N04	06	N	04	CONTROL SCHEMATICS 4
151	06N05	06	N	05	CONTROL SCHEMATICS 5
152	06N06	06	N	06	CONTROL SCHEMATICS 6
153	09N01	09	N	01	PCS I/O TABLES
154	60N01	60	N	01	DECHLORINATION STRUCTURE P&ID
155	80N01	80	N	01	STRUCTURE 80 P&ID
156	85N01	85	N	01	AWT CLARIFIER/FILTER 1 P&ID
157	85N02	85	N	02	AWT CLARIFIER/FILTER 2 P&ID
158	85N03	85	N	03	AWT CLARIFIER/FILTER 3 P&ID
159	85N04	85	N	04	AWT CLARIFIER/FILTER 4 P&ID
160	85N05	85	N	05	AIR WASH BLOWERS 1, 2 & 3 P&ID
161	85N06	85	N	06	COAGULANT FEED PUMP P&ID
162	85N07	85	N	07	RAPID MIX PUMP P&ID
163	85N08	85	N	08	EXISTING CHLORINATION FACILITY ANALYZERS P&ID
164	87N01	87	N	01	BACKWASH PUMP STATION CHLORINE ANALYZER P&ID
165	88N01	88	N	01	CHLORINE CONTACT BASIN FLOW METERS P&ID
166	89N01	89	N	01	CAROUSEL PUMP & LEVEL CONTROLS P&ID
167	91N01	91	N	01	PAU PUMP STATION P&ID
168	99N01	99	N	01	RECYCLED WATER PUMP STATION 1 P&ID
169	99N02	99	N	02	RECYCLED WATER PUMP STATION 2 P&ID
170	99N03	99	N	03	RECYCLED WATER PUMP STATION 3 P&ID
171	99N04	99	N	04	RECYCLED WATER PUMP STATION PCM-99400 CABINET P&ID

SHEET NO.	DRAWING NO.				DESCRIPTION
					TYPICAL DETAILS
172	00TA01	00	TA	01	TYPICAL DETAILS - ARCHITECTURAL
173	00TA02	00	TA	02	TYPICAL DETAILS - ARCHITECTURAL
174	00TC01	00	TC	01	TYPICAL DETAILS - CIVIL
175	00TE01	00	TE	01	TYPICAL DETAILS - ELECTRICAL
176	00TE02	00	TE	02	TYPICAL DETAILS - ELECTRICAL
177	00TE03	00	TE	03	TYPICAL DETAILS - ELECTRICAL
178	00TE04	00	TE	04	TYPICAL DETAILS - ELECTRICAL
179	00TE05	00	TE	05	TYPICAL DETAILS - ELECTRICAL
180	00TE06	00	TE	06	TYPICAL DETAILS - ELECTRICAL
181	00TE07	00	TE	07	TYPICAL DETAILS - ELECTRICAL
196	00TE08	00	TE	08	TYPICAL DETAILS - ELECTRICAL
200	00TE09	00	TE	09	TYPICAL DETAILS - ELECTRICAL
184	00TN01	00	TN	01	TYPICAL DETAILS - INSTRUMENTATION
185	00TN02	00	TN	02	TYPICAL DETAILS - INSTRUMENTATION
186	00TP01	00	TP	01	TYPICAL DETAILS - PIPING
187	00TP02	00	TP	02	TYPICAL DETAILS - PIPING
188	00TP03	00	TP	03	TYPICAL DETAILS - PIPING
189	00TP04	00	TP	04	TYPICAL DETAILS - PIPING
190	00TP05	00	TP	05	TYPICAL DETAILS - PIPING
191	00TP06	00	TP	06	TYPICAL DETAILS - PIPING
192	00TP07	00	TP	07	TYPICAL DETAILS - PIPING
193	00TP08	00	TP	08	TYPICAL DETAILS - PIPING
194	00TS01	00	TS	01	TYPICAL DETAILS - STRUCTURAL
195	00TS02	00	TS	02	TYPICAL DETAILS - STRUCTURAL
196	00TS03	00	TS	03	TYPICAL DETAILS - STRUCTURAL
197	00TS04	00	TS	04	TYPICAL DETAILS - STRUCTURAL
198	00TS05	00	TS	05	TYPICAL DETAILS - STRUCTURAL
199	00TS06	00	TS	06	TYPICAL DETAILS - STRUCTURAL
200	00TS07	00	TS	07	TYPICAL DETAILS - STRUCTURAL

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED CA
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
GENERAL
DRAWING INDEX

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00G02
SHEET NO. 2 OF 200

Plot Date: 12-JUL-2023 11:16:07 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: obonafoux

PROJECT NO. 8660F10 FILE NAME: 8660F1000G02.dgn

GENERAL NOTES

1. FOLLOWING NOTES ARE GENERAL AND APPLY TO ALL SHEETS OF THESE CONTRACT DOCUMENTS AS IF THEY WERE WRITTEN IN THEIR ENTIRETY ON EACH SHEET.
2. CONTRACTOR SHALL VERIFY ALL DIMENSIONS BEFORE STARTING WORK AND SHALL IMMEDIATELY NOTIFY THE ENGINEER OF ANY DISCREPANCIES. CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD VERIFYING ALL EXISTING CONDITIONS INCLUDING LOCATION AND DIMENSIONS OF ALL EXISTING CONSTRUCTION AND UTILITIES. CONTRACTOR SHALL NOTIFY ENGINEER IF THERE IS A CONFLICT BETWEEN THE CONTRACT DOCUMENTS AND EXISTING CONSTRUCTION BEFORE PROCEEDING WITH WORK.
3. UNLESS DETAILED, SPECIFIED, OR OTHERWISE INDICATED ON THE DRAWINGS, CONSTRUCTION SHALL BE AS INDICATED IN THE APPLICABLE TYPICAL DETAILS AND GENERAL NOTES. TYPICAL DETAILS SHALL APPLY EVEN THOUGH NOT REFERENCED AT SPECIFIC LOCATIONS ON DRAWINGS.
4. WHERE NO CONSTRUCTION DETAILS ARE SHOWN OR NOTED FOR ANY PART OF WORK. DETAILS SHALL BE IN THE SAME AS FOR OTHER SIMILIAR WORK.
5. CONTRACTOR SHALL COMPLY WITH LOCAL CONSTRUCTION STORM WATER DISCHARGE REGULATIONS AND REQUIREMENTS.
6. PRIOR TO EXCAVATION FOR NEW STRUCTURES, ELECTRICAL CONDUIT, FABRICATION OF NEW PIPING AND/OR OTHER PROPOSED UTILITIES, CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE LOCATION OF ALL EXISTING PIPING AND UTILITIES IN THE CONSTRUCTION AREA. THE CONTRACTOR SHALL TEMPORARILY RELOCATE CONFLICTING EXISTING UTILITIES AT TIE-IN/CONNECTION LOCATIONS AND REINSTALL THEM AS REQUIRED TO ELIMINATE THE CONFLICT AT NO ADDITIONAL COST TO THE OWNER.
7. ALL PIPELINES 12" AND LARGER SHALL HAVE A MINIMUM COVER OF 48" UNLESS THE COVER DEPTH IS SPECIFICALLY INDICATED ON THE DRAWINGS. PIPE SMALLER THAN 12" SHALL HAVE A MINIMUM COVER OF 36" UNLESS NOTED OTHERWISE. PIPES SHALL BE ROUTED AS SHOWN UNLESS MINOR REVISIONS ARE NECESSARY TO MISS EXISTING PIPES, STRUCTURES, ETC. CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING ALL FITTINGS AND ADAPTERS REQUIRED TO MAKE THE ROUTING CHANGES AT NO ADDITIONAL COST TO THE OWNER. CONTRACTOR SHALL INCLUDE COST FOR THIS IN THE BID.
8. EXISTING FACILITY AND UTILITY INFORMATION SHOWN ON THE DRAWINGS WAS OBTAINED FROM AVAILABLE RECORDS OR ELECTRONIC FILES. NEITHER THE OWNER NOR ENGINEER ASSUMES ANY RESPONSIBILITY FOR FACILITIES AND UTILITIES NOT SHOWN OR NOT IN THE LOCATION SHOWN. THE CONTRACTOR SHALL FIELD VERIFY ALL LOCATIONS, SIZES, MATERIAL TYPES, AND ELEVATIONS SHOWN AROUND OR NEAR AREAS OF NEW CONSTRUCTION PRIOR TO START OF CONSTRUCTION.
9. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONARY MEASURES NECESSARY TO PROTECT FROM DAMAGE EXISTING FACILITIES AND UTILITIES SHOWN OR NOT SHOWN THAT ARE TO REMAIN IN PLACE. ALL FACILITIES DAMAGED BY THE CONTRACTOR'S OPERATIONS SHALL BE EXPEDITIOUSLY REPAIRED OR RECONSTRUCTED TO THE ORIGINAL OR BETTER CONDITION AT THE CONTRACTOR'S EXPENSE WITHOUT ADDITIONAL COMPENSATION.
10. CONTRACTOR SHALL MAKE CONNECTIONS TO EXISTING PIPE, EQUIPMENT, ETC. AS REQUIRED AND SHALL PROVIDE ALL FITTINGS, ADAPTERS, AND APPURTENANCES REQUIRED TO MAKE THE CONNECTIONS. PROVIDE ALL SUPPORTS REQUIRED FOR A RIGIDLY SUPPORTED COMPLETE AND WORKING SYSTEM.
11. ADJUST ALL VALVE BOXES, VAULTS, PULL BOXES, AND MANHOLES TO FINISHED GRADE UNLESS OTHERWISE SHOWN OR DIRECTED. MANHOLES IN OPEN FIELDS SHALL BE SET TWELVE INCHES ABOVE FINISHED GRADE AND VAULTS SHALL BE SIX INCHES ABOVE FINISHED GRADE.
12. THE CONTRACTOR SHALL CONTACT THE PROPER UTILITY REPRESENTATIVE AS FOLLOWS FOR QUESTIONS OR COORDINATION OF CONSTRUCTION RELATED TO EXISTING UTILITIES. THE CONTACT INFORMATION IS PROVIDED BELOW:

UTILITY NAME	UTILITY TYPE	CONTACT PERSON	CONTACT NUMBER
CITY OF UKIAH	WATER, SEWER, STORMWATER, ELECTRIC	JASON BENSON	(707) 510-5485
COMCAST	CABLE	STEVE STEVENS	(707) 462-1184
PG&E	GAS, ELECTRIC	DAVE KELLY	(800) 743-5000 ext 00
PACIFIC BELL	TELEPHONE	CONSTRUCTION & ENGINEERING	(510) 645-2929
LEVEL 3 COMMUNICATIONS	FIBER NETWORK		(877) 366-8344 ext 2
ROGINA WATER CO.	WATER	DAN ROGINA	707-462-4443
UKIAH VALLEY SANIT. DIST.	SEWER	FRANK MCMICHAEL	707-462-4429
WILLOW COUNTY WATER DISTRICT	WATER	DAVE REDDING	707-462-2666
MILLVIEW COUNTY WATER DISTRIC	WATER	-	707-462-7229

13. CONTRACTOR SHALL VERIFY THAT PIPING SHOWN TO BE ABANDONED OR AS ABANDONED PREVIOUSLY IS NO LONGER IN SERVICE. LINES IN SERVICE SHALL BE MAINTAINED UNTIL NO LONGER REQUIRED.
14. ALL EXISTING PIPES THAT ARE TO BE ABANDONED IN PLACE OR REMOVED MAY NOT BE SHOWN. WHERE PIPING IS TO BE ABANDONED AND MUST REMAIN IN SERVICE UNTIL COMPLETION OF OTHER PHASES OF WORK, AND IT CONFLICTS WITH NEW PIPING, TEMPORARILY RELOCATE PIPING AS REQUIRED TO MAINTAIN SERVICE.
15. CONTRACTOR SHALL REROUTE THE EXISTING PIPING IF REQUIRED TO MISS THE PROPOSED STRUCTURES. THE EXISTING PIPE SHALL REMAIN IN SERVICE UNTIL NEW PIPING IS READY TO BE PLACED INTO SERVICE. DOWNTIME SHALL BE A MAXIMUM OF 2 HOURS, UNLESS SPECIFIED OR SHOWN OTHERWISE.
16. THE CONTRACTOR SHALL TAKE SPECIAL PRECAUTIONS IN THE VICINITY OF ANY OVERHEAD ELECTRIC LINES. CONTRACTOR SHALL ABIDE BY THE NATIONAL ELECTRIC CODE AND ANY REQUIREMENT BY THE OWNER OF THE ELECTRIC LINES.
17. PROVIDE ALL SHEETING/SHORING REQUIRED TO PROTECT EXISTING STRUCTURES, PIPES AND FACILITIES.
18. CONTRACTOR SHALL VERIFY LOCATION OF ALL ARCHITECTURAL, MECHANICAL, AND ELECTRICAL ITEMS BEFORE PLACING ANY STRUCTURAL STEEL OR CONCRETE. ALSO, STRUCTURAL DIMENSIONS AND OPENINGS CONTROLLED BY ARCHITECTURAL, MECHANICAL, OR ELECTRICAL EQUIPMENT SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION.
19. MECHANICAL AND ELECTRICAL EQUIPMENT SUPPORTS, ANCHORAGES, OPENINGS, RECESSES, AND REVEALS NOT SHOWN ON THE STRUCTURAL DRAWINGS, THAT ARE REQUIRED BY OTHER CONTRACT DRAWINGS, SHALL BE PROVIDED PRIOR TO CASTING CONCRETE.
20. THE CONTRACTOR SHALL POTHOLE EXISTING UTILITIES THAT MAY BE AFFECTED BY CONSTRUCTION UNDER THIS CONTRACT PRIOR TO SUBMITTING PIPE LAY DRAWINGS TO CONSTRUCTION MANAGER WITHIN NINETY (90) DAYS OF NOTICE TO PROCEED BUT NOT LESS THAN THIRTY (30) DAYS PRIOR TO EXCAVATION IN THE VACINITY OF THOSE UTILITIES. UTILITIES TO BE POTHOLED INCLUDE ALL THAT CROSS THE PIPELINE ALIGNMENTS TO CONFIRM CLEARANCE BETWEEN THE EXISTING UTILITY AND THE NEW RECYCLED WATER PIPELINE AND PARALLEL UTILITIES WITHIN TEN (10) FEET OF THE ALIGNMENT CENTERLINES. THE CONTRACTOR SHALL REPORT POTENTIAL UTILITY CONFLICTS TO THE CONSTRUCTION MANAGER IMMEDIATELY AFTER THEY ARE DISCOVERED. NO DELAY CLAIMS WILL BE ACCEPTED IF THE APPARENT CONFLICT IS RESOLVED BY THE CONSTRUCTION MANAGER WITHIN 30 DAYS AFTER IT IS REPORTED. NOT ALL EXISTING ELECTRIC UTILITY POLES AND OVERHEAD WIRES ARE SHOWN ON THE DRAWINGS. THE CONTRACTOR SHALL LOCATE THESE FACILITIES IN THE FIELD AND MAKE PROVISIONS AS NEEDED TO PERFORM CONSTRUCTION WORK WITHOUT DAMAGE TO EXISTING FACILITIES.

GENERAL NOTES CONTINUED

21. THE CONTRACTOR SHALL NOTIFY UNDERGROUND SERVICE ALERT (USA) AT LEAST 48 HOURS IN ADVANCE OF ANY EXCAVATION (1-800-277-2600). THE CONTRACTOR SHALL COMPLY WITH ALL APPLICABLE REGULATIONS PRIOR TO AND DURING EXCAVATIONS.
22. CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD VERIFYING ALL EXISTING CONDITIONS INCLUDING LOCATION AND DIMENSIONS OF ALL EXISTING CONSTRUCTION AND UTILITIES. CONTRACTOR SHALL NOTIFY ENGINEER IF THERE IS A CONFLICT BETWEEN THE CONTRACT DOCUMENTS AND EXISTING CONSTRUCTION BEFORE PROCEEDING WITH WORK.
23. CONTRACTOR SHALL COMPLY WITH TRAFFIC RESTRICTIONS DETAILED IN THE SPECIFICATIONS, INCLUDING SECTION 01140. AT THE CLOSE OF EACH WORKING DAY, EXCAVATIONS MUST BE COVERED WITH STEEL PLATES (NON-SKID SURFACE TYPE) AND TWO WAY TRAFFIC SHALL BE RESUMED. FOR CONSTRUCTION OUTSIDE OF CITY LIMITS, THE CONTRACTOR SHALL SUBMIT A TRAFFIC CONTROL PLAN TO MENDOCINO COUNTY, AND SHALL IMPLEMENT TRAFFIC CONTROL COORDINATED WITH THE TRAFFIC CONTROL PLAN AND IN ACCORDANCE WITH THE SPECIFICATIONS AND THE COUNTY ENCROACHMENT PERMIT REQUIREMENTS.
24. CONTRACTOR SHALL USE CAUTION WHILE WORKING AROUND EXISTING OVERHEAD ELECTRIC UTILITIES AND POLES. ELECTRIC UTILITY POLES SHALL BE SUPPORTED PER UTILITY OWNERS SPECIFICATIONS DURING EXCAVATION.
25. CONTRACTOR SHALL ASSUME THAT EACH PROPERTY HAS AN EXISTING GAS, WATER, SEWER, ELECTRIC, AND CABLE LATERAL WHICH MAY NOT BE SHOWN ON THE PLANS.

SYMBOLS

BRACKET

BREAK LINE

PIPE BREAK PLAN VIEW

PIPE BREAK CROSS SECTION

SCALE 0 50' 100' 200'

PIPE CONTINUATION (SINGLE LINE)

KEY TAG X

KEY NOTE 34

REVISION DELTA 2

EXISTING ELEVATION T.O.W. XXXX.X± (EXIST)

ELEVATION TOC XXXX.XX

NORTH ARROW/PLANT NORTH — 30° NORTH NORTH TRUE PLANT

EQUIPMENT/DEVICE TAG AND NUMBER XXX-XX-XXXX
EQUIPMENT
EX-EQUIP = EXISTING EQUIPMENT
EF-EQUIP = FUTURE EQUIPMENT

PIPE TAG — PIPE SIZE, FLOW STREAM, X" XXX
SIZE FLOW STREAM
EX-SIZE FLOW STREAM = EXISTING
EF-SIZE FLOW STREAM = FUTURE

UNDERGROUND/ OVERHEAD WARNING (STATE/REGION SPECIFIC)

811 Know what's below. Call before you dig.

Avoid overhead power line contact. It's costly.

Call before you OVERHEAD

Replace with Regional Phone Number

DETAIL REFERENCES

PLAN/VIEW TITLE — A PLAN, FILE: FILE, PLAN NOT REFERENCED (VIEW, DESCRIPTION, VIEW DESCRIPTION, AS NECESSARY)

SECTION CUT — C, VIEW; - = SHOWN ON SAME DRAWING; ##X## = SEE INDICATED DRAWING

SECTION OR DETAIL VIEW TITLE W/ REFERENCE — C/1 ##X## SECTION/DETAIL, SCALE: SCALE, FILE: FILE, DRAWING CUT ORIGINATION (ALPHA = SECTION NUMERIC = DETAIL; VIEW DESCRIPTION, AS NECESSARY; DESCRIPTION)

DETAIL OR ENLARGED PLAN CALL OUT — 1 ##X##, ALPHA = ENLARGED PLAN NUMERIC = DETAIL, SEE INDICATED DRAWING

DRAWING REFERENCE — ##X##, AREA DESIGNATOR (WHEN APPLICABLE), DISCIPLINE DESIGNATOR, SHEET NUMBER

TYPICAL DETAIL REFERENCE — ? TYP (TYP), TYPICAL DETAIL #, (TYP) - INDICATES THE TYPICAL DETAIL IS USED IN MULTIPLE LOCATIONS WITHIN THE DRAWING

EXTERIOR ELEVATION VIEWS — A ##X##, SEE INDICATED DRAWING

PHOTO LOCATION — # ##X##, ARROW INDICATES POINT OF VIEW, SEE INDICATED DRAWING

GRID BUBBLE — A 1

TYPICAL DETAIL NUMBER — ? TYP, LINE 3, LINE 1, LINE 2, TYPICAL DETAIL TITLE
MOD: MODIFICATION NOTE; S = STANDARD; J = JOB SPECIFIC; R = REVISED; N = NOTE TO TYPICAL DETAIL USER
SHT # OF #: SHEETS IN DETAIL
VER DATE: DATE CREATED (REVISED)
INDICATES LOCATED ON TYPICAL DETAIL SHEETS

HATCH PATTERNS

AGGREGATE BASE COURSE (ABC)
ALUMINUM
ASPHALT PAVING
BEDROCK
BRICK OR BLOCK
BRONZE, BRASS, OR COPPER
CAST IRON OR FIBERGLASS
CLSM
CONCRETE (ALL CLASSES)
DRAIN ROCK
GRAVEL
GRATING — SPAN
LANDSCAPING
RUBBER
SAND OR GROUT
EXISTING/ UNDISTURBED SOIL
STRUCTURAL FILL OR BACKFILL
STEEL
TREAD PLATE
WOOD

LINE WORK

	NEW	EXISTING
CONSTRUCTION		
FENCE	X	X
GUARDRAIL		
FUTURE CONSTRUCTION		
CENTER LINE		
HIDDEN LINE		
REMOVE AND/OR ABANDON		
GATE		
MATCH LINE	MATCH LINE SEE DWG ##X##	

REV	DATE	BY	DESCRIPTION

CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED MCK
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo®

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

GENERAL

GENERAL NOTES, LEGEND, AND SYMBOLS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00G03
SHEET NO. 3 OF 200

Plot Date: 12-JUL-2023 11:16:02 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: JDiDonato

@	AT (MEASUREMENT)
△	DEFLECTION ANGLE, CENTRAL ANGLE
#	NUMBER (REBAR Ø)

A

AB	ANCHOR BOLT, AGGREGATE BASE
ABC	AGGREGATE BASE COURSE
ABS	ACRYLONITRILE BUTADIENE STYRENE
AC	ASPHALTIC CONCRETE
ACB	AIR CIRCUIT BREAKER
ACI	AMERICAN CONCRETE INSTITUTE
ACP	ASBESTOS CEMENT PIPE
ACU	AIR CONDITIONING UNIT
AD	AREA DRAIN
ADDL	ADDITIONAL
ADJ	ADJACENT, ADJUST, ADJUSTABLE
ADMIN	ADMINISTRATION
ADR	ACCESS DOOR
AED	AREA EQUIPMENT DRAIN
AER	AERAT(ION)(OR)
AFC	AFTERCOOLER
AFF	ABOVE FINISHED FLOOR
AFM	AIR FLOW MONITOR
AHU	AIR HANDLING UNIT
AIC	AIR COMPRESSOR
AIL	AIR INTAKE LOUVER
ALT	ALTERNATE
AL	ALUMINUM
ANCH	ANCHOR
ANV	ANGLE VALVE
APPROX	APPROXIMATE, APPROXIMATELY
ARCH	ARCHITECTURAL
ARV	AIR RELEASE VALVE
ASSY	ASSEMBLY
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS
AV	ACID VENT
AVG	AVERAGE
AVV	AIR AND VACUUM VALVE
AW	ACID WASTE

B

BC	BEGIN CURVE, BRASS CAP, BACK OF CURB, BOLT CIRCLE
BCKR	BACKER BOARD
BCM	BATCHMETER
BD	BOARD
BDD	BACKDRAFT DAMPER
BDR	BASIN DRAIN LINE
BF	BLIND FLANGE
BFG	BELOW FINISHED GRADE
BFP	BELT FILTER PRESS, BACK FLOW PREVENTER
BFV	BUTTERFLY VALVE
BG	BREAK GLASS HAND SWITCH
BKW	BACKWASH
BLDG	BUILDING
BLK	BLOCK
BLKHD	BULKHEAD
BLR	PROCESS BLOWER
BM	BEAM, BENCH MARK
BOA	BEGINNING OF ALIGNMENT
BOC	BACK OF CURB
BOP	BEGINNING OF PIPE
BOTT	BOTTOM
BOTTS	BOTTOM SLUDGE
BPV	BACK PRESSURE VALVE
BRG	BEARING
BSP	BLACK STEEL PIPE
BTU	BRITISH THERMAL UNITS
BTWN	BETWEEN
BV	BALL VALVE
BVC	BEGINNING OF VERTICAL CURVE
BWCCP	BAR-WRAPPED CONCRETE CYLINDER PIPE
BYP	BYPASS

C

C	CLOSE, CONDUIT CHANNEL (STRUCTURAL), CLARIFIER
CA	CONCRETE ANCHOR
CARV	COMBINATION AIR RELEASE VALVE
CATV	CABLE TV
CAUSTIC	CAUSTIC SOLUTION (CONCENTRATED OR DILUTE)
CB	CATCH BASIN
CC	CENTER OF CURVATURE, CENTER TO CENTER, CONCRETE CURB
CCB	CHLORINE CONTACT BASIN
CD	CEILING DIFFUSER, CONDENSATE DRAIN
CDL	CHEMICAL DRAIN LINE
CDT	CONDUIT
CEF	CEILING EXHAUST FAN
CF	CUBIC FEET
CFM	CUBIC FEET PER MINUTE
CFS	CUBIC FEET PER SECOND
CHEMD	CHEMICAL DRAIN
CHF	CHEMICAL FEEDER
CHKD PL	CHECKERED PLATE
CI	CAST IRON
CIP	CAST IRON PIPE
CIPP	CURED IN PLACE PIPE
CIRC	CIRCUMFERENTIAL/CIRCUMFERENCE
CJ	CONSTRUCTION JOINT
CKA	CHECK VALVE, ANGLE
CKB	CHECK VALVE, BALL
CKF	CHECK VALVE, FLAP
CKS	CHECK VALVE, SWING
CL	CENTER LINE
CLK	CHAIN LINK
CLD	CHLORINE LEAK DETECTOR
CLL	CHLORINE LIQUID
CLP	CHLORINE GAS (PRESSURE)
CLR	CLEAR
CLS	CHLORINE SOLUTION
CLSM	CONTROLLED LOW STRENGTH MATERIAL
CLV	CHLORINE GAS (VACUUM)
CM	CONSTRUCTION MANAGER
CML	CEMENT MORTAR LINED
CMLC	CEMENT MORTAR LINED AND COATED
CMLSP	CEMENT MORTAR LINED STEEL PIPE
CMP	CORRUGATED METAL PIPE
CMU	CONCRETE MASONRY UNIT
CNV	CONVEYOR
CO	CLEANOUT
COL(S)	COLUMN(S)
CONC	CONCRETE
CONN	CONNECT, CONNECTION
CONST	CONSTRUCTION
CONT	CONTINUOUS OR CONTINUATION OR (D) (OUS)
COORD	COORDINATE
COUED	CITY OF UKIAH ELECTRICAL DEPARTMENT
CORR	CORRUGATE(D), CORROSION
CP	CONTROL POINT
CPLG	COUPLING
CPT	CARPET
CPVC	CHLORINATED POLYVINYL CHLORIDE
CS	CARBON STEEL, CIRCULATING SLUDGE
CSP	CHEMICAL SUMP PUMP, CORRUGATED STEEL PIPE
CT	CURRENT TRANSFORMER, CERAMIC TILE
CTJ	CONTROL JOINT
CTL	CONTROL
CTR	CENTER, CENTERED
CTSK	COUNTERSUNK
CU	CUBIC
CULV	CULVERT
CUP	COPPER PIPE
CV	CHECK VALVE
CW	COLD WATER
CWV	COMBINATION WASTE AND VENT
CY	CUBIC YARD

D

D	DEPTH, DIGITAL OR DISCRETE, DRAIN
D/W	DRIVEWAY
DBL	DOUBLE
DDR	DESICCANT DRYER
DEG or °	DEGREE
DEMO	DEMOLISH, DEMOLITION
DET	DETAIL
DFL	DECANT/FILTRATE
DG	DOOR GRILLE
DI	DROP INLET
DIA or Ø	DIAMETER
DIAG	DIAGONAL
DIF	DIFFUSER
DIFF	DIFFERENCE
DIG	DIGESTER
DIM	DIMENSION
DIP	DUCTILE IRON PIPE
DISCH	DISCHARGE
DIW	DEIONIZED WATER
DL	DEAD LOAD, DRAIN LINE
DLV	DOOR LOUVER
DMJT	DISMANTLING JOINT
DMP	DAMPER
DMS	DIAPHRAGM SEAL
DN	DOWN
do	DITTO
DO	DOOR OPENING
DP	DEEP (OR DEPTH)
DPV	DIAPHRAGM VALVE
DR	DOOR, DRAIN, DRIVE
DRT	DRIP TRAP
DRV	DRAIN VALVE
DS	DIGESTED SLUDGE, DOWN SPOUT
DSW	DISTILLED WATER, DOOR SWITCH
DUC	DUST COLLECTOR
DUH	DUCT HEATER UNIT
DW	DISTILLED WATER
D/W	DRIVEWAY APRON
DWD	DEWATERING DRAIN
DWG(S)	DRAWING(S)
DWL(S)	DOWEL(S)

E

E	EAST
EA	EACH
EC	END OF CURVE
ECC RED	ECCENTRIC REDUCER
ECU	EVAPORATOR COOLING UNIT
ED	EQUIPMENT DRAIN
EF	EXHAUST FAN, EACH FACE
EFF	EFFLUENT
EG	EXHAUST GRILLE, EXISTING GROUND
EIFS	EXTERIOR INSULATION AND FINISH SYSTEM
EJ	EXPANSION JOINT
EJR	INJECTOR/EDUCTOR
EL	ELEVATION
ELEC	ELECTRICAL
ELL	ELBOW
EMBED	EMBEDMENT
EMH	ELECTRICAL MANHOLE
EOA	END OF ALIGNMENT
EOP	EDGE OF PAVEMENT
EP	EDGE OF PAVING
EPS	EXPANDED POLYSTYRENE
EPV	ECCENTRIC PLUG VALVE
EQ	EQUAL
EQUIP	EQUIPMENT
ER	EXHAUST REGISTER
ES	EACH SIDE
ESEW	EMERGENCY SHOWER AND EYE WASH
ESS	EMERGENCY HAND SWITCH
ET	ELECTRICALLY HEAT TRACED
EUG	ELECTRICAL UNDERGROUND
EUH	ELECTRIC UNIT HEATER
EVC	ELECTRIC UNIT HEATER, END OF VERTICAL CURVE
EVR	EVAPORATOR
EW	EACH WAY
EWC	ELECTRIC WATER COOLER
EWEF	EACH WAY EACH FACE
EWH	ELECTRIC WATER HEATER, EXHAUST
EX	EXISTING
EXIST	EXISTING
EXP	EXPANSION, EXPANSION TANK
EXPO	EXPOSED
EXT	EXTERIOR

F

FACT	FACTORY
FAD	FOUL AIR DUCT
FB	FLAT BAR
FBW	FILTER BACKWASH
FC	FACE OF CURB, FLEXIBLE COUPLING
FCA	FLANGE COUPLING ADAPTER
FCO	FLOOR CLEANOUT
FCU	FAN COIL UNIT
FD	FIRE DAMPER, FLOOR DRAIN, FOUND
FDC	FIRE DEPARTMENT CONNECTION
FDL	FLOOR DRAIN LINE
FDR	FEEDER
FEFF	FINAL EFFLUENT
FG	FLAP GATE
FH	FIRE HYDRANT
FILT	FILTRATE
FIN	FINISH, FINAL
FIN FL	FINISHED FLOOR
FIN GR	FINISHED GRADE
FL	FLOOR, FLOW LINE
FLA	FOUL AIR
FLD	FILTER DRAIN
FLE	FILTER EFFLUENT
FLEX	FLEXIBLE
FLG	FLANGE, OR FLANGED
FLGA	FLANGE ADAPTER
FLR	FILTER
FM	FORCE MAIN
FMSS	FORCE MAIN SANITARY SEWER
FND	FOUNDATION
FO	FUEL OIL, FIBER OPTIC OR CATV
FOB	FLAT ON BOTTOM
FOC	FACE OF CURB
FOT	FLAT ON TOP
FPM	FEET PER MINUTE
FPP	FLEXIBLE PLASTIC PIPE
FRP	FIBERGLASS REINFORCED PLASTIC
FRPP	FIBERGLASS REINFORCED PLASTIC PIPE
FRS	FROTH SPRAY
FS	FAR SIDE, FIRE SERVICES
FSP	FABRICATED STEEL PIPE
FSTN	FASTEN(ED)
FT or '	FOOT, FEET
FTG	FOOTING
FUP	FUEL DISPENSER
FV	FLAP VALVE
FW	FLUSHING WATER, FINISHED WATER
FX	FIRE EXTINGUISHER
FXC	FIRE EXTINGUISHER CABINET
FXE	FIRE EXTINGUISHER - ELECTRICAL

G

G	GAS, GROUND, GUTTER
GA	GAUGE or GAGE
GAL	GALLONS
GALV	GALVANIZE(D)
GAV	GRAVITY VENTILATOR
GB	GRADE BREAK
GBT	GRAVITY BELT THICKENER
GC	GROOVED COUPLING
GEL	GRAVITY EXHAUST LOUVER
GEN	GENERAL, GENERATOR
GL	GLASS
GLV	GLOBE VALVE
GM	GAS METER
GND	GROUND
GPD	GALLONS PER DAY
GPM	GALLONS PER MINUTE
GR	GRADE
GRTG	GRATING
GRV	GRAVITY VENTILATOR
GSP	GALVANIZED STEEL PIPE
GV	GATE VALVE
GYP	GYPSUM

H

H	EXPLOSION-PROOF, HIGH, HORIZONTAL
H1E	HOOK ONE END
H2E	HOOK TWO ENDS
HAS	HEADED ANCHOR STUD
HB	HOSE BIBB
HDG	HOT DIPPED GALVANIZED
HDPE	HIGH DENSITY POLYETHYLENE
HDW	HARDWARE
HDWL	HEADWALL
HEF	HOOD EXHAUST FAN
HGT	HEIGHT
HORIZ	HORIZONTAL
HP	HEAT PUMP, HORSEPOWER, HIGH PRESSURE, HIGH POINT
HPA	HIGH PRESSURE AIR
HPT	HIGH POINT
HPU	HEAT PUMP UNIT AIR
HR	HANDRAIL, HOSE REEL, HOUR
HSF	HOOD SUPPLY FAN
HSS	HOLLOW STRUCTURAL SECTION (STEEL)
HTX	HEAT EXCHANGER
HV	HOSE VALVE
HW	HOT WATER, HEADWALL
HWL	HIGH WATER LEVEL, HEADWALL
HWR	HOT WATER RETURN
HWS	HOT WATER SUPPLY
HWY	HIGHWAY
HxW	HEIGHT BY WIDTH
HYD	HYDRANT

I

I	INTERSECTION OF ANGLE
IA	INSTRUMENT AIR
ID	INSIDE DIAMETER, INSIDE DIMENSION, IDENTIFICATION
I.F.	INSIDE FACE
IN or "	INCHES
INCL	INCLUDE, INCLUDING
INF	INFLUENT
INJ	INJECTOR
INSTR	INSTRUMENTATION
INSUL	INSULAT(E)(ED)(ING)(ION)
INT	INTERIOR
INV	INVERT
IP	IRON PIPE
IRR	IRRIGATION
ISR	INTRINSICALLY SAFE RELAY

J

JNCT	JUNCTION
JST	JOIST
JT	JOINT

K

KGV	KNIFE GATE VALVE

L

L	ANGLE (STRUCTURAL), LENGTH, LOUVER
LAB	LABORATORY
LAT	LATERAL
LAV	LAVATORY
LB(S)	POUND(S)
LDF	LIQUID DIESEL FUEL
LDFR	LIQUID DIESEL FUEL RETURN
LF	LINEAL FEET
LG	LONG
LH	LEFT HAND
LHR	LEFT HAND REVERSE
LHRA	LEFT HAND REVERSE ACTIVE
LHRB	LEFT HAND REVERSE BEVEL
LL	LIVE LOAD
LLH	LONG LEG HORIZONTAL
LLV	LONG LEG VERTICAL
LONG	LONGITUDINAL
LP	LOW PRESSURE
LPA	LOW PRESSURE AIR
LPG	LIQUIFIED PROPANE GAS
LPT	LOW POINT
LR	LONG RADIUS
LS	LAB SINK
LT	LEFT
LWL	LOW WATER LEVEL

M

M	MOTOR
MAINT	MAINTENANCE
MAN	MANUAL
MASY	MASONRY
MATL	MATERIAL
MAU	MAKE-UP AIR UNIT
MAX	MAXIMUM
MB	MACHINE BOLT
MC	MECHANICAL COUPLING
MCJ	MASONRY CONTROL JOINT
MD	MOTORIZED DAMPER
MECH	MECHANICAL
MET	METAL
MFR	MANUFACTURER
MG/L	MILLIGRAMS PER LITER
MGD	MILLION GALLONS PER DAY
MH	MANHOLE
MIN	MINIMUM
MISC	MISCELLANEOUS
MIX	MIXER
MJ	MECHANICAL JOINT
MK	MARK
ML	MIXED LIQUOR
MO	MASONRY OPENING
MOD	MODIFIED
MOIST	MOISTURE
MON	MONUMENT
MOS	MOISTURE SEPARATOR
MPM	METERING PUMP
MS	MOP SINK
MTD	MOUNTED

N

N	NORTH, NEUTRAL
NA	NOT APPLICABLE
NC	NORMALLY CLOSED
NEV	VALVE, NEEDLE
NG	NATURAL GRADE, NATURAL OR LP GAS
NIC	NOT IN CONTRACT
NO., #	NUMBER
NOM	NOMINAL
NPT	NATIONAL PIPE THREAD
NPW	NON-POTABLE WATER
NS	NEAR SIDE
NTS	NOT TO SCALE
NW	NORTHWEST
NWPRR	NORTHWESTERN PACIFIC RAILROAD

O

O	OPEN
OBD	OPPOSED BLADE DAMPER
OC	ON CENTER
OD	OUTSIDE DIAMETER, OUTSIDE DIMENSION
OED	OPEN EQUIPMENT DRAIN
O.F.	OUTSIDE FACE
OFL	OVERFLOW
OHE	OVERHEAD ELECTRIC
OHU	OVERHEAD UTILITIES
OHW	OVERHEAD WIRE
OPNG	OPENING
OPP	OPPOSITE
OPP HND	OPPOSITE HAND
OTF	OUTFALL
OZ	OUNCE

P

P	POLE
PAU	PRODUCTION AUGMENTATION UNIT
PBL	POLYMER BLENDER
PC	POINT OF CURVATURE
PCC	PLANT CONTROL CENTER, POINT OF COMPOUND CURVE
PCCP	PRESTRESSED CONCRETE CYLINDER PIPE
PCP	PROGRESSIVE CAVITY PUMP
PD	POSITIVE DISPLACEMENT, PLANT DRAIN
PD, PLD	PULSATION DAMPENER
PDP	POSITIVE DISPLACEMENT PUMP
PE	PLAIN END
PERP	PERPENDICULAR
PG	PRESSURE GAUGE
PH	PHASE, PHYSICALLY HANDICAPPED, POT HOLE, POINT OF INTERSECTION
PIV	POST INDICATOR VALVE
PL	PLATE, PROPERTY LINE
PLAS	PLASTIC
PLCS	PLACES
PLS	POLYMER SOLUTION
PLWD	PLYWOOD
PMP	PUMP
PNL(S)	PANEL(S)
POL	POLYMER
POLY	POLYETHYLENE
POS	POSITION
POW	POTABLE WATER
PP	POWER POLE
PPMV	PARTS PER MILLION (VOLUME)
PRC	POINT OF REVERSE CURVATURE
PREFAB	PREFABRICATED
PRG	PRESSURE REGULATOR
PRI	PRIMARY
PROJ	PROJECTION
PROP	PROPERTY
PRR	PRESSURE OR VACUUM RELIEF VALVE
PRV	PRESSURE REDUCING VALVE, PRESSURE REGULATION VALVE, PRESSURE RELIEF VALVE
PS	PUMP STATION, PIPE SUPPORT
PSF	POUNDS PER SQUARE FOOT
PSG	PRESSURE GAUGE
PSI	POUNDS PER SQUARE INCH
PSIG	POUNDS PER SQUARE INCH GAUGE
PT	POINT, POINT OF TANGENCY
PV	PLUG VALVE
PVC	POINT OF VERTICAL CURVATURE, POLYVINYL CHLORIDE
PVDF	POLYVINYLIDENE FLUORIDE
PVI	POINT OF VERTICAL INTERSECTION
PVMT	PAVEMENT
PVT	POINT OF VERTICAL TANGENCY
PLW	PLANT WATER

Q

QTY	QUANTITY

R

R/W	RIGHT OF WAY
RAD	RADIUS, RADIAL
RAS	RETURN ACTIVATED SLUDGE
RCCP	REINFORCED CONCRETE CYLINDER PIPE
RCP	REINFORCED CONCRETE PIPE
RCW	RECLAIMED WATER
RD	ROOF DRAIN
RDL	ROOF DRAIN LINE
RDOF	ROOF DRAIN OVERFLOW
RECIRC	RECIRCULATING
RED	REDUCER, ROOF EQUIPMENT DRAIN
REF	REFERENCE
REG	REGULATOR, REGULATING
REINF	REINFORCE(D)(ING)(MENT)
REJ	RUBBER EXPANSION JOINT
REQD	REQUIRED
RER	REACTOR
RES	RESERVOIR
REV	REVISION, REVERSE
RF	RETURN FAN
RG	RETURN GRILLE RUBBER GASKET
RH	RIGHT HAND
RHR	RIGHT HAND REVERSE
RHRA	RIGHT HAND REVERSE ACTIVE
RHRB	RIGHT HAND REVERSE BEVEL
RLS	REGISTERED LAND SURVEYOR
RM	ROOM
RO	ROUGH OPENING
ROT	ROTAMETER
RP	RADIUS POINT
RPM	REVOLUTIONS PER MINUTE
RPMP	REINFORCED PLASTIC MORTAR PIPE
RR	RETURN REGISTER, RAILROAD
RSR	RISER
RT	RIGHT
RTF	ROTARY FEEDER
RTU	ROOF TOP UNIT
RUD	RUPTURE DISK
RW	RECLAIMED WATER, REUSE WATER, RECYCLED WATER
RWR	RECLAIMED WATER RETURN
RWW	RAW WASTEWATER

S

S/W	SIDEWALK
S	SOUTH, SWITCH, SLOPE
SA	SAMPLE
SC	SECONDARY CLARIFIER
SCB	SCRUBBER
SCD	SMOKE CONTROL DAMPER
SCFM	STANDARD CUBIC FEET PER MINUTE
SCH	SCHEDULE
SCO	SURFACE CLEANOUT
SCR	BAR SCREEN
SCR	SILICON CONTROL RECTIFIER
SD	SMOKE DETECTOR, SPLITTER DAMPER, STORM DRAIN
SDDI	STORM DRAIN DROP INLET
SDMH	STORM DRAIN MANHOLE
SDVLT	STORM DRAIN VAULT
SDL	SUMP DISCHARGE DRAIN LINE
SDO	SLUDGE DRAWOFF
SE	SECONDARY EFFLUENT
SEC	SECONDARY, SECOND
SECT	SECTION
SED	SEDIMENTATION
SEP	SEPTAGE
SF	SUPPLY FAN
SFW	SOFTENED WATER
SG	SUPPLY GRILLE
SGS	STORE FRONT GLAZING SYSTEM
SHD	SHOWER DRAIN
SHDR	SOLIDS HANDLING-RECYCLE
SHLD	SHOULDER
SHR	SHOWER
SHT	SHEET
SIM	SIMILAR
SK	SKIMMINGS
SL	SLOPE, SLUDGE
SLC	SLUDGE COLLECTOR DRIVE
SLG	SLIDE GATE
SLV	SLEEVE VALVE
SMP	SAMPLER, SUMP PUMP
SN	SUPERNATANT OR SUBNATANT
SO_2	SULFUR DIOXIDE
SOL	SOLUTION
SP	STATIC PRESSURE, SET POINT
SPD	SUMP PUMP DRAIN
SPDT	SINGLE POLE DOUBLE THROW
SPEC(S)	SPECIFICATION(S)
SPL	SPLITTER BOX
SPR	SPARE
SPS	SAMPLE SINK
SPW	SAMPLE WATER
SQ	SQUARE
SQ FT	SQUARE FEET
SQ IN(S)	SQUARE INCH(ES)
SR	SHORT RADIUS, SUPPLY REGISTER
SRF	STATE REVOLVING FUND
SRL	SCRUBBER RECIRCULATION LIQUID (CAUSTIC)
SS	SANITARY SEWER, SELECTOR SWITCH
SSCO	SANITARY SEWER CLEANOUT
SSK	SERVICE SINK
SSL	SECONDARY SLUDGE
SSMH	SANITARY SEWER MANHOLE
SST	STAINLESS STEEL
ST	SLUDGE TRANSFER, STREET
STA	STATION
STB	STABILIZER
STD(S)	STANDARDS(S)
STIFF	STIFFENER
STIR	STIRRUPS
STL	STEEL
STM	STEAM
STP	STEEL PIPE
STR	STRAINER
STRUCT	STRUCTURAL
SUG	SLUICE GATE
SUPT	PIPE SUPPORT, SUPPORT
SV	SERVICE VALVE, SHUTOFF VALVE, SOLENOID VALVE
SW	SANITARY WASTE, SOUTHWEST
SWR	SEAL WATER
SYM	SYMMETRICAL
SYN	SYNTHETIC

T

T	TANGENT LENGTH, THERMOSTAT, TIMER
T&B	TOP AND BOTTOM
TAS	THREADED ANCHOR STUD
TB	THRUST BLOCK
TBM	TEMPORARY BENCHMARK
TC	TOP OF CURB
TCV	TEMPERATURE CONTROL VALVE
TDH	TOTAL DYNAMIC HEAD
TDR	TIME DELAY RELAY, TOWEL DISPENSER/RECEPTACLE
TEL	TELEPHONE
TH	TEST HOLE
THK	THICKENER, THICKNESS, THICK
TKS	THICKENED SLUDGE
TLV	TELESCOPING VALVE
TMH	TELEPHONE MANHOLE
TMP	TEMPERATURE
TNK	TANK
T.O.	TOP OF
TOC	TOP OF CONCRETE
TOG	TOP OF GRATING
TOM	TOP OF MASONRY
TOP	TOP OF PIPE
TS	TRAFFIC SIGNAL
TOS	TOP OF STEEL
T.O.W.	TOP OF WALL
TR	TRIAD (THREE CONDUCTOR SHIELDED CABLE), TIMING RELAY
TRD	TREAD
TS	THICKENER SUPERNATANT OR SUBNATANT
TSD	THICKENED SLUDGE DECANT
TSPL	TURBIDIMETER SAMPLE
TSTAT	THERMOSTAT
TTB	TELEPHONE TERMINAL BOARD
TUR	TURBINE
TV	TURNING VANES
TWV	THREE-WAY VALVE
TYP	TYPICAL

U

UC	UNDERCUT
UG	UNDERGROUND
UGE	UNDERGROUND ELECTRIC
UGG	UNDERGROUND G
UGPB	UNDERGROUND POWER BOX
UGTEL	UNDERGROUND TELEPHONE
UNKN	UNKNOWN
UHMWPE	ULTRA HIGH MOLECULAR WEIGHT POLYETHYLENE
UHMW	ULTRA HIGH MOLECULAR WEIGHT
UNO	UNLESS NOTED OTHERWISE
US	UTILITY SINK

V

V	VALVE
VAR	VARIES
VB	VALVE BOX
VC	VERTICAL CURVE
VCP	VITRIFIED CLAY PIPE
VEC	VINYL ESTER COATING
VERT	VERTICAL
VFR	VOLUMETRIC FEEDER
VG	VACUUM GAUGE, VALLEY GUTTER
VLT	VAULT
VOL	VOLUME
VPI	VERTICAL POINT OF INTERSECTION
VRV	VACUUM REGULATING VALVE
VTR	VENT THROUGH ROOF

W

W	WEST, WIDTH
W/	WITH
W/O	WITHOUT
WAS	WASTE ACTIVATED SLUDGE
WV	WATER VALVE
WCO	WALL CLEANOUT
WEF	WALL EXHAUST FAN
WF	WALL FITTING, WASH FOUNTAIN
WH	WATER HEATER
WI	WEIGHT INDICATOR
WL	WALL LOUVER, WATER LEVEL
WM	WATER METER
WOD	WASTE OIL DRAIN
WP	WEATHERPROOF, WATERPROOF
WPT	WORKING POINT
WRG	WEIR GATE
WRS	WATER SOFTENER
WS	WATER SURFACE
WSTP	WATERSTOP
WT	WALK THROUGH, WEIGHT
WTF	WATER TREATMENT FACILITY
WTP	WATER TREATMENT PLANT
WTR	WATER
WV	WATER CONTROL VALVE
WW	WASTEWATER
WWF	WELDED WIRE FABRIC
WWTF	WASTEWATER TREATMENT FACILITY
WWTP	WASTEWATER TREATMENT PLANT

Y

Y	WYE
YCO	YARD CLEANOUT
YH	YARD HYDRANT

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED MCK
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

CITY OF UKIAH

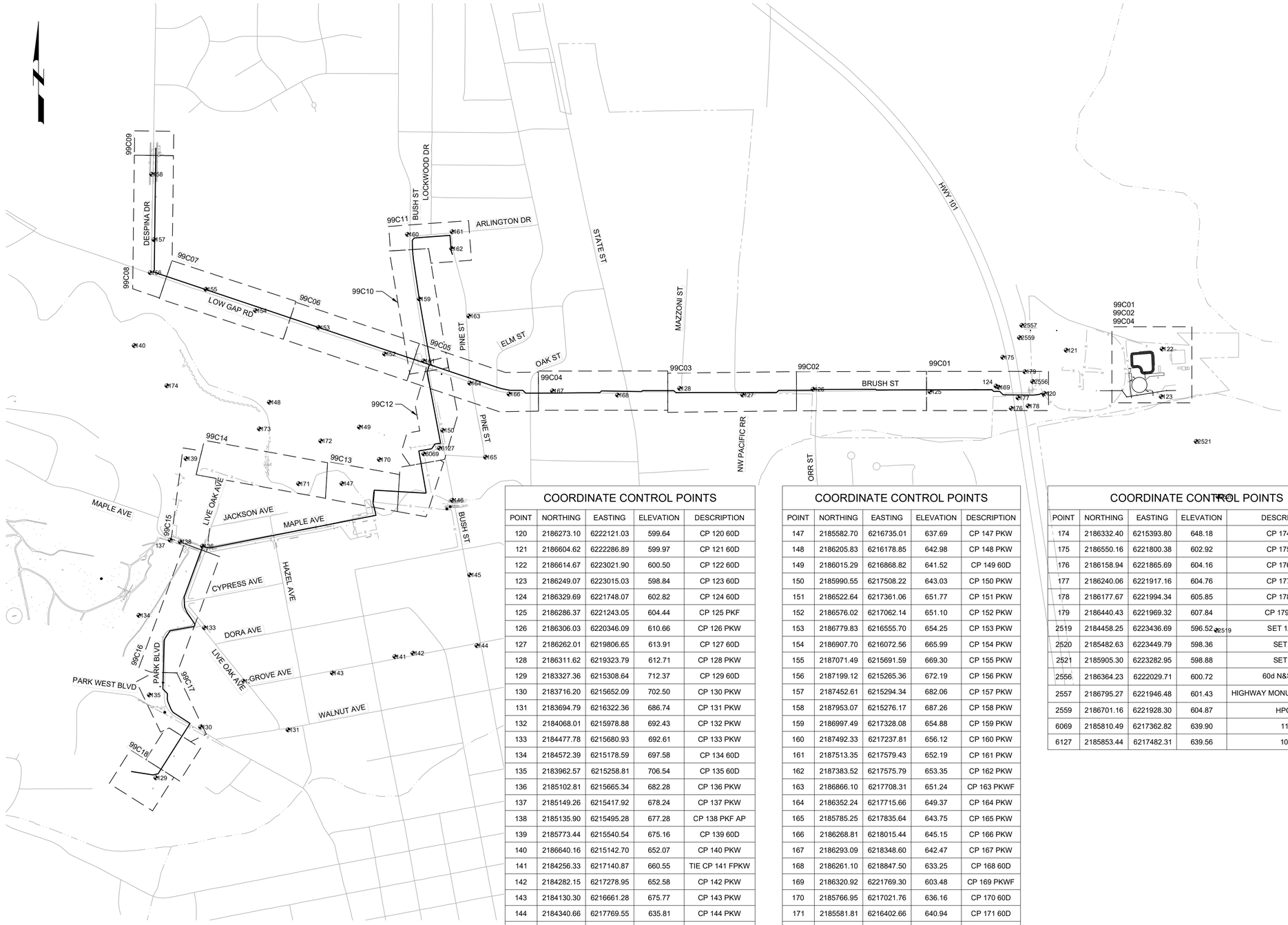
RECYCLED WATER PROJECT - PHASE 4

GENERAL

GENERAL ABBREVIATIONS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00G04
SHEET NO. 4 OF 200



BENCHMARK INFORMATION

HPGN- D CA 01 CG
THE STATION IS LOCATED ON U.S. HIGHWAY 101, ABOUT 9 MI (14.5 KM) NORTH OF HOPLAND AND ABOUT 4 MI (6.4 KM) SOUTH OF UKIAH. TO REACH THE STATION FROM THE COUNTY COURTHOUSE AT THE CORNER OF NORTH STATE STREET AND PERKINS STREET IN UKIAH, GO EAST ON PERKINS STREET FOR 0.52 MI (0.84 KM) TO THE SOUTHBOUND ENTRANCE TO HIGHWAY 101. GO SOUTH ON THE ON RAMP AND ALONG HIGHWAY 101 FOR 3.74 MI (6.02 KM) TO THE COX-SCHRADER ROAD EXIT TO THE RIGHT. PROCEED ALONG THE OFF RAMP FOR 0.14 MI (0.23 KM) TO THE SOUTH SIDE
OF ROBINSON OVERCROSSING(BRIDGE NO. 10-86) AND THE STATION ON THE LEFT AT POST MILE 20.70. THE STATION IS A SURVEY DISK ENCASED IN PVC PIPE WITH ACCESS COVER SET IN CONCRETE FLUSH WITH THE GROUND, 43 FT (13.1 M) SOUTHWEST OF THE WEST END OF THE SOUTH RAIL OF THE OVERCROSSING, 40 FT (12.2 M) SOUTH OF THE EXTENDED CENTERLINE OF THE BRIDGE, 15 FT (4.6 M) EAST OF THE CENTERLINE OF THE RAMP, 12.6 FT (3.8 M) SOUTH OF A FREEWAY ENTRANCE SIGN, 3.7 FT (1.1 M) EAST OF THE BACK OF THE EAST RAMP CURB AND 3.0 FT (0.9 M) NORTHEAST OF A WITNESS

HPGN- UKIAH AIRPORT RESET
THE STATION IS LOCATED AT THE NORTH END OF UKIAH MUNI AIRPORT NEAR THE RUNWAY END OF 15. THE STATION IS 141.8 FT (43.2 M) EAST OF THE AIRPORT PERIMETER FENCE, 93.8 FT (28.6 M) NORTHWEST OF RM NO 3, 88.6 FT (27.0 M) WEST OF THE WESTERLY EDGE OF THE TAXIWAY, 2.0 FT (0.6 M) EAST OF A 4 INCH X 4 INCH WOODEN WITNESS POST, AND 2.9 FT (0.9 M) WEST OF A 4 INCH X 4 INCH WOODEN WITNESS POST. THE STATION IS USCGS TRIANGULATION DISK SET IN THE TOP OF A SQUARE 10 INCH CONCRETE MONUMENT SET FLUSH WITH THE GROUND AND STAMPED UKIAH AIRPORT 1949 1963.

NOTES:

1. BEARINGS AND DISTANCES ARE IN GRID.
2. HORIZONTAL DATUM-BETWEEN FOUND HPGN POINTS DESIGNATED AS UKIAH AIRPORT RESET AND HPGN D CA 01 CG. USE COMBINED SCALE FACTOR 0.99988998 WITH EPOCH DATE 2007.00. USE RECIPROCAL 1.000110032 TO ACHIEVE GROUND DISTANCES.
3. VERTICAL DATUM BASED ON NGS BENCH MARK DESIGNATES AS UKIAH RESET NAVD 1988=622.50.

COORDINATE CONTROL POINTS

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
120	2186273.10	6222121.03	599.64	CP 120 60D
121	2186604.62	6222286.89	599.97	CP 121 60D
122	2186614.67	6223021.90	600.50	CP 122 60D
123	2186249.07	6223015.03	598.84	CP 123 60D
124	2186329.69	6221748.07	602.82	CP 124 60D
125	2186286.37	6221243.05	604.44	CP 125 PKF
126	2186306.03	6220346.09	610.66	CP 126 PKW
127	2186262.01	6219806.65	613.91	CP 127 60D
128	2186311.62	6219323.79	612.71	CP 128 PKW
129	2183327.36	6215308.64	712.37	CP 129 60D
130	2183716.20	6215652.09	702.50	CP 130 PKW
131	2183694.79	6216322.36	686.74	CP 131 PKW
132	2184068.01	6215978.88	692.43	CP 132 PKW
133	2184477.78	6215680.93	692.61	CP 133 PKW
134	2184572.39	6215178.59	697.58	CP 134 60D
135	2183962.57	6215258.81	706.54	CP 135 60D
136	2185102.81	6215665.34	682.28	CP 136 PKW
137	2185149.26	6215417.92	678.24	CP 137 PKW
138	2185135.90	6215495.28	677.28	CP 138 PKF AP
139	2185773.44	6215540.54	675.16	CP 139 60D
140	2186640.16	6215142.70	652.07	CP 140 PKW
141	2184256.33	6217140.87	660.55	TIE CP 141 FPKW
142	2184282.15	6217278.95	652.58	CP 142 PKW
143	2184130.30	6216661.28	675.77	CP 143 PKW
144	2184340.66	6217769.55	635.81	CP 144 PKW
145	2184883.23	6217714.30	630.93	CP 145 PKW
146	2185455.14	6217581.19	633.86	CP 146 PKW

COORDINATE CONTROL POINTS

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
147	2185582.70	6216735.01	637.69	CP 147 PKW
148	2186205.83	6216178.85	642.98	CP 148 PKW
149	2186015.29	6216868.82	641.52	CP 149 60D
150	2185990.55	6217508.22	643.03	CP 150 PKW
151	2186522.64	6217361.06	651.77	CP 151 PKW
152	2186576.02	6217062.14	651.10	CP 152 PKW
153	2186779.83	6216555.70	654.25	CP 153 PKW
154	2186907.70	6216072.56	665.99	CP 154 PKW
155	2187071.49	6215691.59	669.30	CP 155 PKW
156	2187199.12	6215265.36	672.19	CP 156 PKW
157	2187452.61	6215294.34	682.06	CP 157 PKW
158	2187953.07	6215276.17	687.26	CP 158 PKW
159	2186997.49	6217328.08	654.88	CP 159 PKW
160	2187492.33	6217237.81	656.12	CP 160 PKW
161	2187513.35	6217579.43	652.19	CP 161 PKW
162	2187383.52	6217575.79	653.35	CP 162 PKW
163	2186866.10	6217708.31	651.24	CP 163 PKWF
164	2186352.24	6217715.66	649.37	CP 164 PKW
165	2185785.25	6217835.64	643.75	CP 165 PKW
166	2186268.81	6218015.44	645.15	CP 166 PKW
167	2186293.09	6218348.60	642.47	CP 167 PKW
168	2186261.10	6218847.50	633.25	CP 168 60D
169	2186320.92	6221769.30	603.48	CP 169 PKWF
170	2185766.95	6217021.76	636.16	CP 170 60D
171	2185581.81	6216402.66	640.94	CP 171 60D
172	2185909.00	6216572.62	638.64	CP 172 60D
173	2186001.86	6216102.39	642.29	CP 173 60D

COORDINATE CONTROL POINTS

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
174	2186332.40	6215393.80	648.18	CP 174 60D
175	2186550.16	6221800.38	602.92	CP 175 60D
176	2186158.94	6221865.69	604.16	CP 176 60D
177	2186240.06	6221917.16	604.76	CP 177 60D
178	2186177.67	6221994.34	605.85	CP 178 60D
179	2186440.43	6221969.32	607.84	CP 179 PKW
2519	2184458.25	6223436.69	596.52	SET 1/2" IP
2520	2185482.63	6223449.79	598.36	SET 1/2
2521	2185905.30	6223282.95	598.88	SET 1/2
2556	2186364.23	6222029.71	600.72	60d N&S_SET
2557	2186795.27	6221946.48	601.43	HIGHWAY MONUMENT_FOUND
2559	2186701.16	6221928.30	604.87	HPGN
6069	2185810.49	6217362.82	639.90	111
6127	2185853.44	6217482.31	639.56	109

0 200' 400' 800'
SCALE: 1" = 400'

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED RAF
DRAWN BWH
CHECKED JM
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
GENERAL
KEY MAP AND SURVEY CONTROL

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00G05
SHEET NO. 5 OF 200

Plot Date: 7/12/2023 11:16:12 AM
LAST SAVED BY: JDiDonato

METER ID	SERVICE LINE SIZE (INCHES)	METER SIZE (INCHES)	CUSTOMER	APN	STATION	METER BOX 1		METER BOX 2		METER BOX 3	
						TYP. SIZE	LID LABEL	TYP. SIZE	LID LABEL	TYP. SIZE	LID LABEL
401	2.0	2	Vinewood Park	145001	B24+13	B2346	METER	B1234	PRV & Check	-	N/A
402	2.0	2	Frank Zeek Elementary School	143026, 102066	B19+70	B2346	METER	B1234	PRV & Check	-	N/A
403	3.0	2	Russian River Cemetery	102050, 102049	A70+68	B2346	METER	B1234	PRV & Check	-	N/A
404	8.0	4	Russian River Cemetery	102063	A87+86	B1017	STRAINER	B1017	METER	B1234	PRV / Check
405	8.0	4	Ukiah High School	102061, 102060, 102074	A89+50	B1017	STRAINER	B1017	METER	B1234	PRV / Check
406	3.0	2	Pomolita Middle School	108111	C16+50	B2346	METER	B1234	PRV & Check	-	N/A
407	3.0	3	Pomolita Middle School	105011, 108105	C24+80	B1017	STRAINER	B1017	METER	B1234	PRV / Check
408	6.0	3	City Golf Course (B9)	102078	C39+30	B1017	STRAINER	B1017	METER	B1234	PRV / Check
409	6.0	3	City Golf Course (B9)	102078	C46+35	B1017	STRAINER	B1017	METER	B1234	PRV / Check
410	6.0	4	City Golf Course (F9)	103001, 109001	C57+00	B1017	STRAINER	B1017	METER	B1234	PRV / Check
411	3.0	3	Todd Grove Park	109002, 114101	C57+30	B1017	STRAINER	B1017	METER	B1234	PRV / Check
412	3.0	2	Anton Stadium (City Park)	113028, 116005, 117101	C68+68	B2346	METER	B1234	PRV & Check	-	N/A
413	1.5	1.5	Anton Stadium (City Park)	116005	C70+40	B2346	METER	B1234	PRV & Check	-	N/A

Plot Date: 12-JUL-2023 11:15:39 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: obonafaux

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CA
DRAWN CE
CHECKED JM
DATE JULY 2023

**
ORIGINAL
SEALED BY
BRIAN W. AVON
4/10/2023
CA PE NO. 76832
**

carollo®

City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
GENERAL
RECYCLED WATER SERVICE SCHEDULE

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00G06
SHEET NO. 6 OF 200

PROJECT NO. 8660F10
FILE NAME: 8660F1000G06.dgn

DESIGN CRITERIA

	UNITS	VALUE
RECYCLED WATER PUMP STATION		
QUANTITY	EA	4
DUTY	-	3 DUTY + 1 STANDBY
TYPE OF PUMPS	-	SPLIT CASE CENTRIFUGAL
CAPACITY, EA	GPM	1,000
TOTAL DYNAMIC HEAD	FT	240
DRIVER TYPE	-	VFD
MOTOR HORSEPOWER, EA	HP	100
RECYCLED WATER STORAGE TANK		
TOTAL CAPACITY	MG	1.5
DIAMETER	FT	120
FLOOR ELEVATION	FT	595.08
TOP OPERATIONAL WATER LEVEL	FT	620.00
OVERFLOW LEVEL	FT	620.00
RECYCLED WATER PIPELINES		
RESIDUAL PRESSURE AT SERVICE	PSI	50
WASTEWATER TREATMENT PLANT FLOW CONDITIONS		
AVERAGE DRY WEATHER (ADWF)	MGD	3.01
PEAK WEEK DRY WEATHER (PWDWF)	MGD	3.40
AVERAGE WET WEATHER (AWWF)	MGD	6.89
PEAK WEEK WET WEATHER (PWWWF)	MGD	15.8
PEAK HOUR WET WEATHER (PHWWF)	MGD	24.5
COAGULANT FEED SYSTEM		
COAGULANT	-	FERRIC CHLORIDE
CONCENTRATION	% BY WT	40
PUMP TYPE	-	DIAPHRAGM
QUANTITY (EXISTING/NEW)	EA	2 / 1
CAPACITY, EA	GPH	34.2 (E) / 20.4 (E) / 20.4 (N)
MINIMUM DOSAGE	mg/L	20
MAXIMUM DOSAGE	mg/L	50
MOTOR HORSEPOWER, EA	HP	0.5 (E) / 0.5 (E) / 0.5 (N)
ADVANCED WATER TREATMENT (AWT) CLARIFIER/FILTER SYSTEM		
AWT CLARIFIER/FILTER UNITS		
QUANTITY (EXISTING)	EA	4
MINIMUM CAPACITY, EA	MGD	1.2
MAXIMUM CAPACITY, EA	MGD	2
LENGTH	FT	40
WIDTH	FT	12
HEIGHT	FT	10
CLARIFIER		
MINIMUM LOADING, EA	GPM/SF	6
MAXIMUM LOADING, EA	GPM/SF	10
MEDIA DEPTH	IN	48
MEDIA EFFECTIVE SIZE	MM	1.5-3
AVERAGE RUN TIME	HRS	4
FILTER		
MINIMUM LOADING, EA	GPM/SF	3
MAXIMUM LOADING, EA	GPM/SF	5
MEDIA DEPTH	IN	30
BACKWASH	GPM/SF	15
AIR WASH BLOWERS		
TYPE	-	POSITIVE DISPLACEMENT
QUANTITY (NEW)	EA	3
CAPACITY, EA	SCFM	447
MOTOR HORSEPOWER, EA	HP	20
PRODUCTION AUGMENTATION UNIT (PAU)		
QUANTITY	EA	1
CAPACITY, EA	MG	5
CAROUSEL PUMP STATION		
PUMP TYPE	-	VERTICAL TURBINE
QUANTITY (EXISTING/NEW)	EA	2 / 1
CAPACITY, EA	GPM	4000
MOTOR HORSEPOWER, EA	HP	40
PAU PUMP STATION		
PUMP TYPE	-	VERTICAL TURBINE
QUANTITY (NEW)	EA	1
CAPACITY, EA	GPM	1750
MOTOR HORSEPOWER, EA	HP	20

PIPE SERVICE ABBREVIATIONS

PROCESS STREAMS	
1W	POTABLE WATER
2W	NON-POTABLE CITY WATER
3W	NO. 3 SPRAY WATER
AA	AERATION AIR/AIR WASH
BA	BACKWASH AIR
BW	BACKWASH WATER
CCI	CHLORINE LIQUID
COAG	COAGULANT
CLS	CHLORINE SOLUTION
CS	CIRCULATING SLUDGE
CSO	CAUSTIC SODA
D	DRAIN
DS	DIGESTED SLUDGE
DW	DOMESTIC CITY WATER
F	FLOAT
FC	FERRIC CHLORIDE
FE	FINAL EFFLUENT
FM	FORCE MAIN
FW	FILTERED WATER
HOCL	SODIUM HYPOCHLORITE
IA	INSTRUMENT AIR
LSG	LOW PRESSURE SLUDGE GAS
OF	OVERFLOW
PE	PRIMARY EFFLUENT
POLY	POLYMER
RCW	RECLAIMED WATER
RW	RECYCLED WATER
SA	SERVICE AIR
SBIS	SODIUM BISULFITE
SAM	SAMPLE
SE	SECONDARY EFFLUENT
SH	SODIUM HYDROXIDE
SL	SLUDGE
STD	STORM DRAIN
SW	SURFACE WASH
TD	TANK DRAIN
THS	THICKENED SLUDGE
V	VENT
W	WATER
WW	WASH WATER

PROCESS AREA NUMBERS

AREA	DESCRIPTION
00	GENERAL
00	TYPICAL DETAILS
00	SYMBOLS AND ABBREVIATIONS
01	SITE PLAN
02	ELECTRICAL DUCTBANK SECTIONS
02	I&C CONTROL PANELS & NETWORK RACKS
03	ELECTRICAL ONE-LINE DIAGRAMS
03	I&C SCADA BLOCK DIAGRAMS
04	ELECTRICAL SCHEDULES
04	I&C BLOCK DIAGRAMS
05	ELECTRICAL MISC. SCHEDULES
05	I&C FIBER PINOUTS
05	TITLE 24 COMPLIANCE SHEETS
06	I&C CONTROL SCHEMATICS
09	I&C TABLES
60	DECHLORINATION STRUCTURE
75	DIGESTER
80	FILTER FEED PUMP STATION
85	ADVANCED WASTEWATER TREATMENT (AWT)
85	AWT CLARIFIER/FILTER UNITS
87	BACKWASH PUMP STATION
89	CAROUSEL PUMP STATION
91	PAU PUMP STATION
91	PLAN AND PROFILE FOR PAU PIPING
99	METER AND CONTROL VALVE
99	ELECTRICAL BUILDING
99	PLAN AND PROFILE ALIGNMENTS A, B, C
99	RECYCLED WATER PUMP STATION
99	RECYCLED WATER DISTRIBUTION TANK

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED EY
DRAWN JBB
CHECKED JD
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

GENERAL

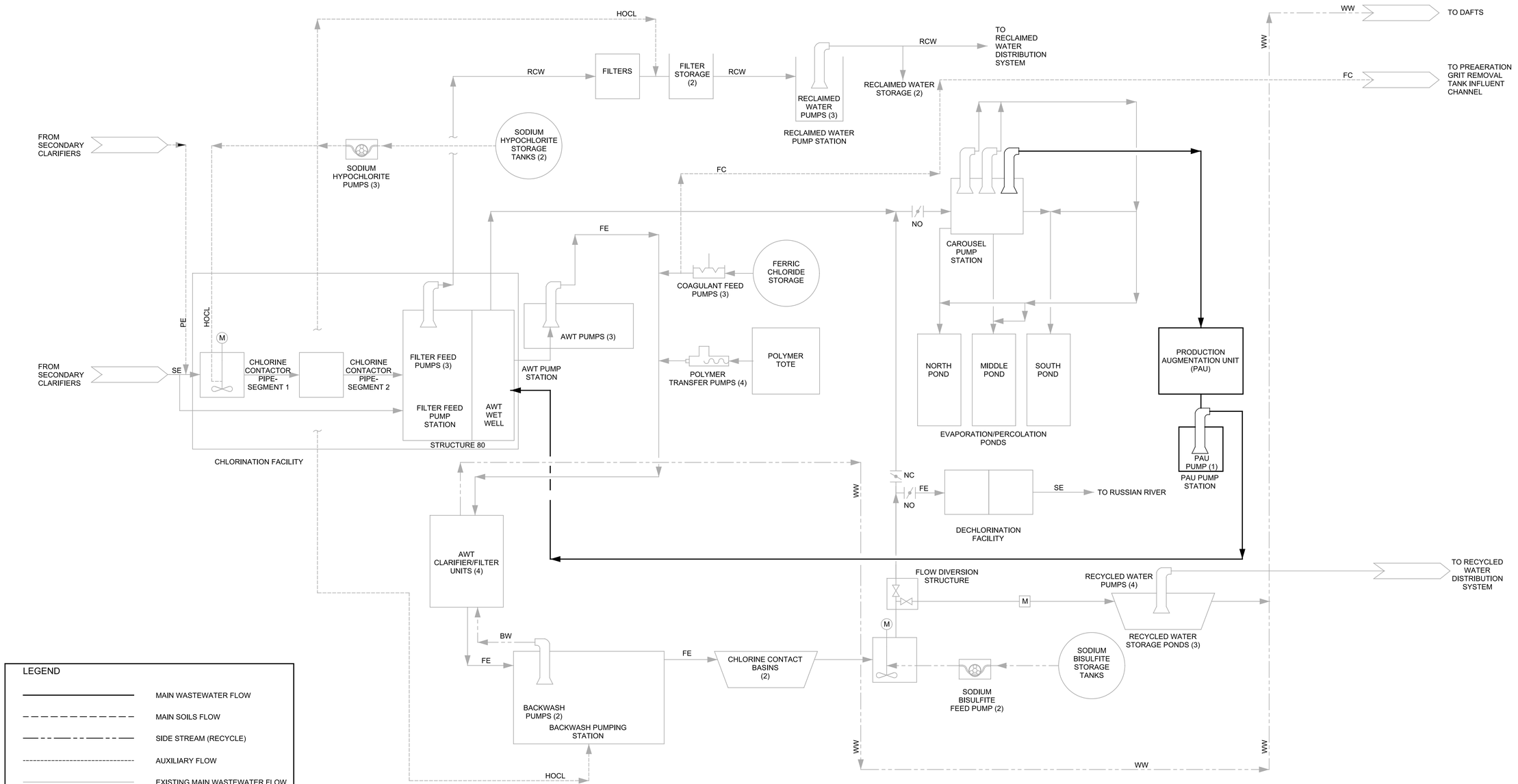
DESIGN CRITERIA, PIPE SERVICE ABBREVIATIONS AND PROCESS AREA NUMBERS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00G07
SHEET NO. 7 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1000G07.dgn

Plot Date: 12-JUL-2023 11:15:33 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: eparker



LEGEND

- MAIN WASTEWATER FLOW
- MAIN SOILS FLOW
- SIDE STREAM (RECYCLE)
- AUXILIARY FLOW
- EXISTING MAIN WASTEWATER FLOW
- EXISTING MAIN SOILS FLOW
- EXISTING SIDE STREAM (RECYCLE)
- EXISTING AUXILIARY FLOW

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED EY
DRAWN JBB
CHECKED JD
DATE JULY 2023

** ORIGINAL SEALED BY MATTHEW C. KALLEVANT 4/7/2023 CA PE NO. 84405 **

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

GENERAL

LIQUIDS PROCESS FLOW DIAGRAM

VERIFY SCALES
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0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00G08
SHEET NO. 8 OF 200

Plot Date: 12-JUL-2023 11:15:56 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: tumadhay
PROJECT NO. 8660F10
FILE NAME: 8660F1000G08.dgn



PLAN

FILE: 8660F10C04

GENERAL NOTES:

1. SEE ELECTRICAL DRAWINGS FOR ELECTRICAL ROUTING AND DETAILS.

KEY NOTES:

1. PAU INLET.
2. TRUCK FILL HYDRANT (PHASE 3) TO BE REMOVED AND REPLACED DURING POND CONSTRUCTION.
3. PAU PUMP STATION INLET.

LEGEND:

PROJECT STAGING AREA

VEHICLE AND PEDESTRIAN ACCESS (NOT AVAILABLE TO CONTRACTOR)

STRUCTURES:

- (A) PRODUCTION AUGMENTATION UNIT (PAU)
- (B) CAROUSEL PUMP STATION
- (C) DECHLORINATION STRUCTURE
- (D) CHLORINE CONTACT BASINS
- (E) DISSOLVED AIR FLOTATION THICKENERS
- (F) DAFT EQUIPMENT BUILDING
- (G) DISINFECTION CHEMICAL STORAGE FACILITIES
- (H) AWT FACILITY
- (I) CHLORINATION FACILITY
- (J) SLUDGE DRYING BED
- (K) DIGESTER
- (L) SLUDGE DEWATERING FACILITY
- (M) STORM DRAIN PUMP STATION
- (N) BACKWASH PUMP STATION
- (O) PRIMARY CLARIFIERS
- (P) MAINTENANCE BUILDING
- (Q) MECHANICAL EQUIPMENT BUILDING
- (R) SOLIDS CONTACT TANKS
- (S) TRICKLING FILTER
- (T) SECONDARY CLARIFIERS
- (U) WASHWATER RECOVERY POND
- (V) POWER GENERATION BUILDING
- (W) RECYCLED WATER STORAGE PONDS
- (X) PERCOLATION PONDS
- (Y) AWT PUMP STATION
- (Z) RECLAIMED WATER FILTERS
- (AA) TRICKLING FILTER PUMP STATION
- (AB) PRE-AERATION GRIT REMOVAL TANK & EQUIPMENT
- (AC) AERATION BLOWER BUILDING
- (AD) PAU PUMP STATIONS

811 Know what's **below.** **Call** before you dig.

SCALE

0 30' 60' 120'

SCALE: 1" = 60'

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED EYY
DRAWN AL/ART
CHECKED JD
DATE JULY 2023

** ORIGINAL SEALED BY MATTHEW C. KALLEVANT 4/7/2023 CA PE NO. 84405 **

carollo

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

GENERAL

SITE PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00G09
SHEET NO. 9 OF 200

Plot Date: 7/12/2023 11:16:11 AM
FILE NAME: 8660F1000G09.dwg
PROJECT NO. 8660F10
LAST SAVED BY: kjackson

Plot Date: 12-JUL-2023 11:35:02 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: eparker

EXISTING STRUCTURES:

- (A) SLUDGE LAGOONS
- (B) CAROUSEL PUMP STATION
- (C) DECHLORINATION STRUCTURE
- (D) CHLORINE CONTACT BASINS
- (E) DISSOLVED AIR FLOTATION THICKENERS
- (F) DAFT EQUIPMENT BUILDING
- (G) DISINFECTION CHEMICAL STORAGE FACILITIES
- (H) AWT FACILITY
- (I) CHLORINATION FACILITY
- (J) SLUDGE DRYING BED
- (K) DIGESTER
- (L) SLUDGE DEWATERING FACILITY
- (M) STORM DRAIN PUMP STATION
- (N) BACKWASH PUMP STATION
- (O) PRIMARY CLARIFIERS
- (P) MAINTENANCE BUILDING
- (Q) MECHANICAL EQUIPMENT BUILDING
- (R) SOLIDS CONTACT TANKS
- (S) TRICKLING FILTER
- (T) SECONDARY CLARIFIER
- (U) WASHWATER RECOVERY POND
- (V) POWER GENERATION BUILDING
- (W) RECYCLED WATER STORAGE PONDS
- (X) PERCOLATION PONDS
- (Y) AWT PUMP STATION



A PLAN
SCALE: NO SCALE
FILE: 8660F1000D01A

GENERAL NOTES:

1. THE DEMOLITION DRAWINGS HEREIN ARE PROVIDED TO THE CONTRACTOR FOR REFERENCE IN DETERMINING THE SCOPE OF DEMOLITION REQUIRED. THE CONTRACTOR SHALL MAKE SUCH FIELD INVESTIGATIONS AS NECESSARY TO SATISFY THEMSELVES AS TO THE FIELD CONDITIONS. THE USE OF THESE DRAWINGS SHALL BE AT THE CONTRACTOR'S DISCRETION. THE CONTRACTOR IS CAUTIONED TO REVIEW EXISTING REFERENCE DRAWINGS AVAILABLE FROM THE CITY.
2. THE DEMOLITION DRAWINGS HEREIN HAVE BEEN PRODUCED BY SCANNING DESIGN DRAWINGS OF THE EXISTING ELEMENT(S) TO BE DEMOLISHED. WHERE POSSIBLE, A FIELD VERIFICATION WAS PERFORMED AND MAJOR DEVIATIONS HAVE BEEN NOTED. CONTRACTOR SHALL FIELD VERIFY SITE CONDITIONS TO SATISFY THEMSELVES PER NOTE 1. ORIGINAL DRAWINGS ARE AVAILABLE FROM OWNER FOR CONTRACTOR'S REFERENCE.
3. NOT ALL DEMOLITION WORK REQUIRED ON THIS PROJECT IS SHOWN ON THE DEMOLITION DRAWINGS. SEE OTHER CONTRACT DRAWINGS FOR ADDITIONAL DEMOLITION WORK REQUIRED. SEE YARD PIPING DRAWINGS FOR ADDITIONAL BELOW GRADE PIPING DEMOLITION.
4. COORDINATE DEMOLITION WORK WITH ALL APPLICABLE REQUIREMENTS OF THE CONTRACT DOCUMENTS.
5. SALVAGE EQUIPMENT PER SPECIFICATION SECTION 01738.
6. REFER TO SPECIFICATION SECTION 01140 FOR WORK RESTRICTIONS PRIOR TO DEMOLITION.
7. EXISTING CONDITIONS:
   a. FIELD VERIFY ALL EXISTING DIMENSIONS, ELEVATIONS, AND CONDITIONS RELATED TO WORK PRIOR TO DEMOLITION, SHOP DRAWING PREPARATION, AND FABRICATION.
   b. NOTIFY ENGINEER IMMEDIATELY IF CONDITIONS NOT COVERED BY THESE DRAWINGS ARE EXPOSED DURING CONSTRUCTION INCLUDING BUT NOT LIMITED TO:
      I. SIZES OR DIMENSIONS DIFFERING FROM THE CONTRACT DOCUMENTS.
      II. DAMAGE OR DETERIORATION TO MATERIALS AND COMPONENTS.
      III. CONDITIONS OR DETAILS DIFFERENT FROM THOSE SHOWN ON THE DRAWINGS.
8. RESTORE TO ITS PRECONSTRUCTION CONDITION ANY EXISTING CONSTRUCTION THAT IS DAMAGED AS A RESULT OF DEMOLITION.
9. SITE DEMOLITION WILL IMPACT EXISTING DRAINAGE PATTERNS. MAINTAIN SITE DRAINAGE PATTERNS DURING CONSTRUCTION. REROUTE EARTHEN SWALES AND PROVIDE TEMPORARY FACILITIES AS NECESSARY.
10. UNLESS OTHERWISE INDICATED, WHERE EQUIPMENT, BRACKETS, PIPE SUPPORTS, BASE PLATES, CLAMPS, ETC ARE REMOVED, FASTENER SHALL BE CUT OFF 1-INCH BELOW SURFACE. PATCH HOLE WITH NON-SHRINK GROUT.
11. WHERE ANY EQUIPMENT OR PIPING IS CALLED OUT TO BE DEMOLISHED OR REMOVED, THE ASSOCIATED SUPPORTS FOR THAT EQUIPMENT OR PIPE SHALL ALSO REMOVED.
12. DISCONNECT AND DEMOLISH POWER AND CONTROL WIRING BETWEEN THE DEMOLISHED EQUIPMENT AND ITS ASSOCIATED MCC OR CONTROL PANEL.
13. PROTECT EXISTING RECEPTACLES AND LIGHT SWITCHES. PROTECT EXISTING CONDUITS TO SWITCHES, LIGHTS, AND RECEPTACLES.
14. REMOVE CABLES FROM ABANDONED IN-SLAB OR BURIED CONDUITS. GRIND ABANDONED CONDUITS DOWN AND FILL CONDUIT PENETRATION WITH DRY-PACK MORTAR PER SPECIFICATION SECTION 03600. PLACE DRY-PACK MORTAR IN HOLES IN LAYERS WITH THICKNESS NOT EXCEEDING TIE HOLE DIAMETER AND HEAVILY COMPACT EACH LAYER.
15. FOR EQUIPMENT BEING DEMOLISHED OR HAVING ITS ELECTRICAL AND CONTROL CONDUITS AND WIRES BEING REPLACED, DEMOLISH ALL ASSOCIATED CONDUITS AND WIRE BETWEEN EQUIPMENT AND ITS ASSOCIATED MCC OR CONTROL PANEL UNLESS OTHERWISE NOTED.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED EYY
DRAWN BAC
CHECKED JD
DATE JULY 2023

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City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
DEMOLITION
SITE PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

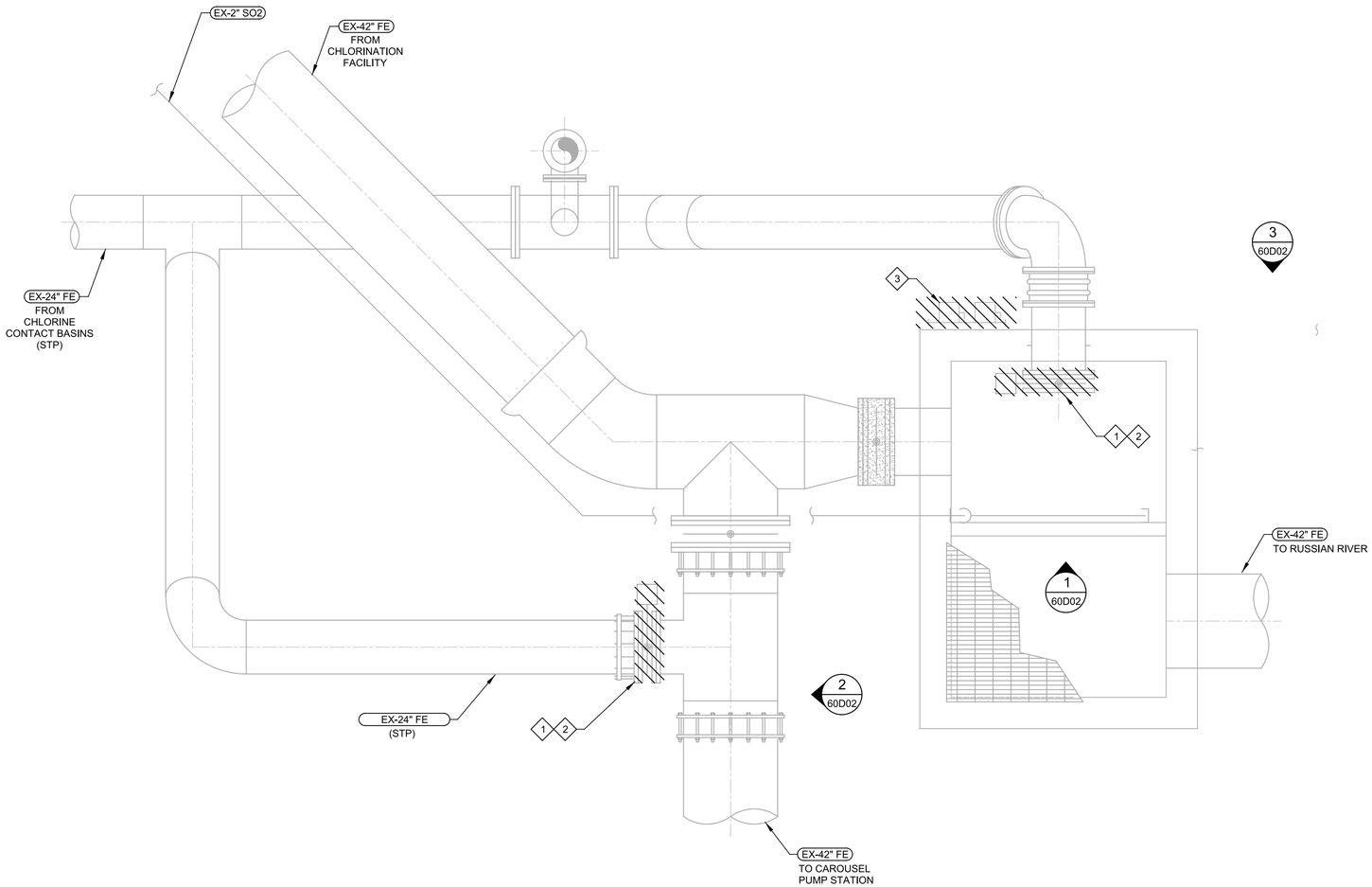
JOB NO. 8660F.10
DRAWING NO. 00D01
SHEET NO. 10 OF 200

GENERAL NOTES:

1. REFER TO GENERAL NOTES ON 00D01.

KEY NOTES:

1. DEMOLISH VALVE. CRITICAL DIMENSION: CONTRACTOR TO FIELD VERIFY SIZE AND MATERIAL OF PIPE AND NOTIFY ENGINEER OF ANY DEVIATIONS PRIOR TO INSTALLING NEW VALVE.
2. VALVE IS 20± FEET DEEP.
3. DEMOLISH EXISTING DISCONNECTS, EXPOSED CONDUITS, AND EQUIPMENT STANDS ASSOCIATED WITH DISCONNECT SWITCHES. CAP EXISTING UNDERGROUND CONDUITS AND LABEL THEM AS SPARE.



A PLAN
SCALE: 3/8" = 1'-0"
FILE: 8660F1060M9101

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

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DATE JULY 2023

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SEALED BY
MATTHEW C. KALLEVANT
4/7/2023
CA PE NO. 84405
**

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CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
DEMOLITION
DECHLORINATION STRUCTURE
PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

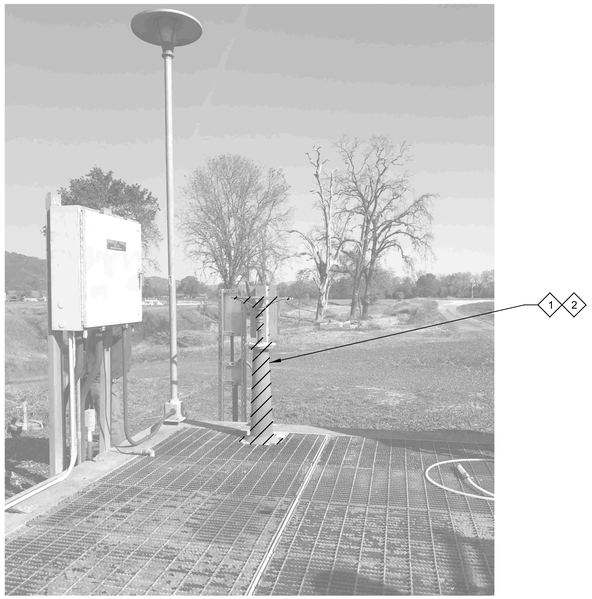
JOB NO. 8660F.10
DRAWING NO. 60D01
SHEET NO. 11 OF 200

GENERAL NOTES:

1. REFER TO GENERAL NOTES ON 00D01.

KEY NOTES:

1. DEMOLISH VALVE.
2. VALVE IS 20± FEET DEEP.
3. DEMOLISH CHLORINE ANALYZER 4.



1 PHOTO
60D01 SCALE: NO SCALE
FILE: 8660F1060D002A



3 PHOTO
60D01 SCALE: NO SCALE
FILE: 8660F1060D002C



2 PHOTO
60D01 SCALE: NO SCALE
FILE: 8660F1060D002B

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

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CHECKED JD
DATE JULY 2023

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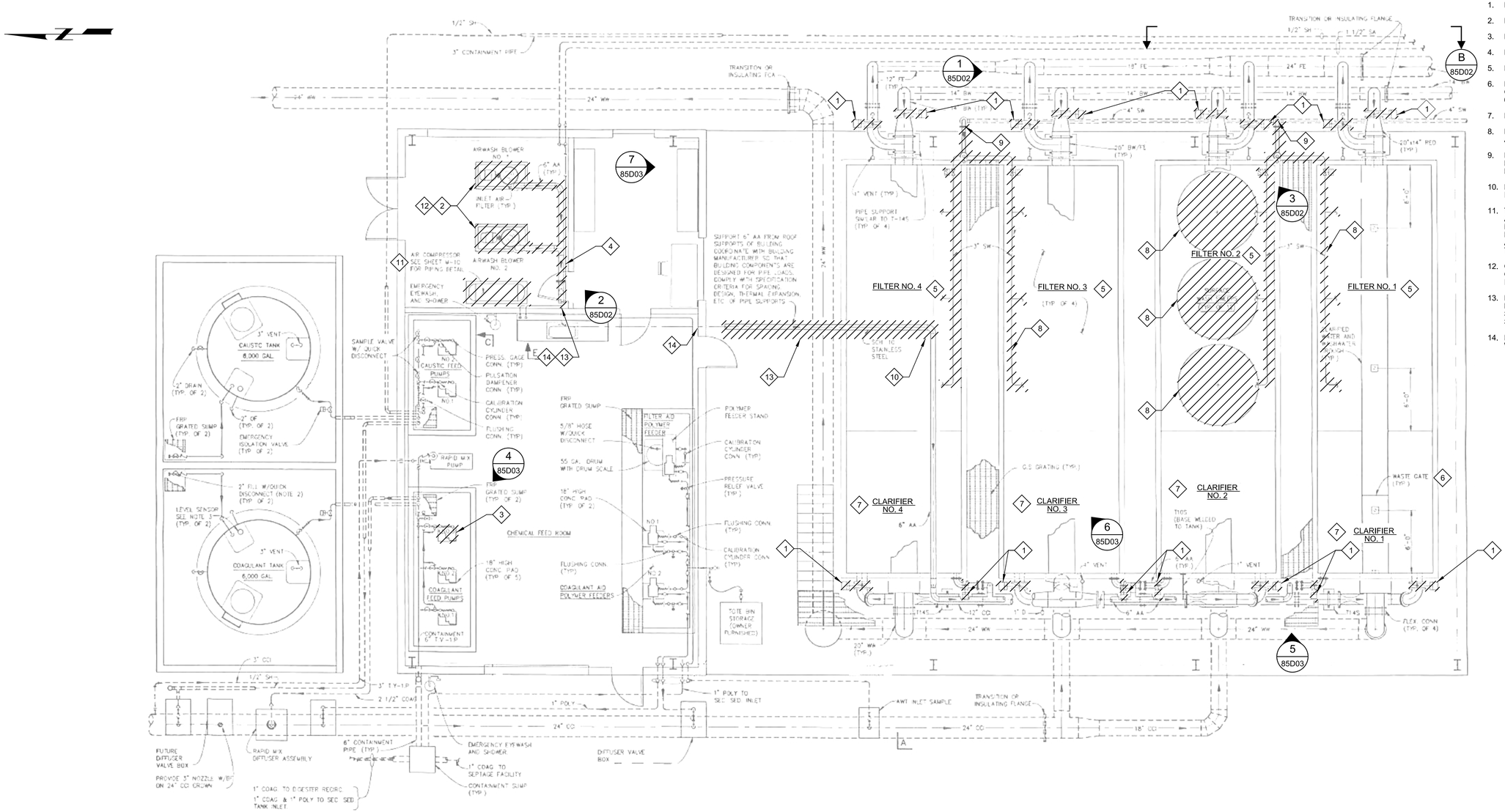
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
DEMOLITION
DECHLORINATION STRUCTURE PHOTOS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 60D02
SHEET NO. 12 OF 200

Plot Date: 12-JUL-2023 11:35:38 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: tumadhay



A PLAN

SCALE: 3/16"=1'-0"
FILE: 8660F085D01.jpg

GENERAL NOTES:

1. REFER TO GENERAL NOTES ON 00D01.

KEY NOTES:

1. DEMOLISH VALVES.
2. DEMOLISH AIR BLOWER.
3. DEMOLISH PRIMARY COAGULANT FEED PUMP.
4. DEMOLISH AIR PIPING AND SUPPORTS.
5. REMOVE FILTER MEDIA AND FILTER GRAVEL SUPPORT.
6. DEMOLISH EXISTING PNEUMATIC WASTE GATE ACTUATOR ON EACH AWT CLARIFIER/FILTER UNIT. REFER TO PHOTO 6/85D03. OTHER WASTE GATES NOT SHOWN FOR CLARITY.
7. REMOVE ADSORPTION CLARIFIER MEDIA.
8. DEMOLISH THE SURFACE WASH SWEEPS (TYPICAL OF 12) AND ASSOCIATED PIPING AND SUPPORTS.
9. EXISTING 4" SW PIPE TO BE ABANDONED N PLACE. CUT PIPE FLUSH WITH EXISTING GRADE AND PROVIDE PERMANENT BLIND FLANGE.
10. REPLACE EXISTING 6-INCH ELBOW WITH A TEE AS INDICATED ON 85M02.
11. TEMPORARILY RELOCATE AIR COMPRESSOR AND ASSOCIATED PIPING TO FACILITATE INSTALLATION OF NEW BLOWERS PER 85M02. AIR COMPRESSOR SHALL REMAIN IN SERVICE UNTIL THE PNEUMATIC WASTE GATE ACTUATORS HAVE BEEN REPLACED FOR ALL FOUR OF THE AWT CLARIFIER/FILTER UNITS.
12. CONTRACTOR SHALL STORE ONE EXISTING BLOWER ONSITE UNTIL ALL THE NEW BLOWERS HAVE BEEN INSTALLED AND ARE FULLY OPERABLE.
13. DEMOLISH 6-INCH AIR PIPING AFTER ALL EXISTING BLOWERS HAVE BEEN DEMOLISHED. REFER TO SPECIFICATION SECTION 01140 FOR POSSIBLE WORK SEQUENCING AND 85M02.
14. RESTORE EXISTING PENETRATION TO MATCH EXISTING WALL.

REV	DATE	BY	DESCRIPTION

CONFORMED DOCUMENTS

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DRAWN BAC
CHECKED JD
DATE JULY 2023

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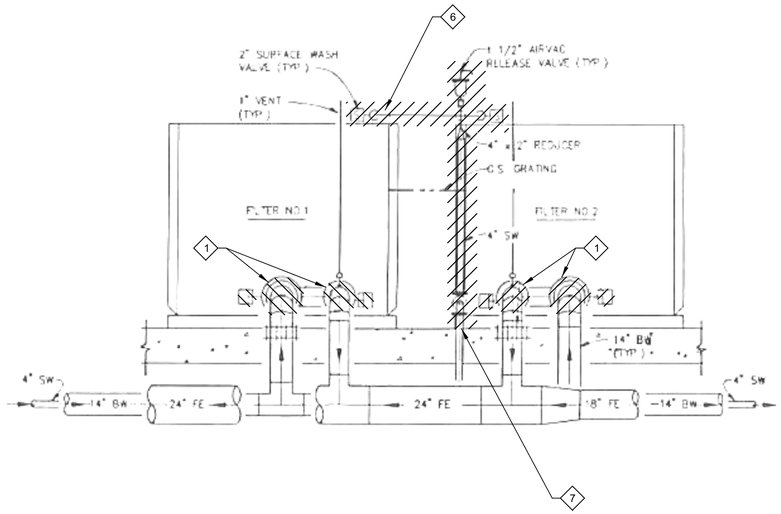
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City of Ukiah

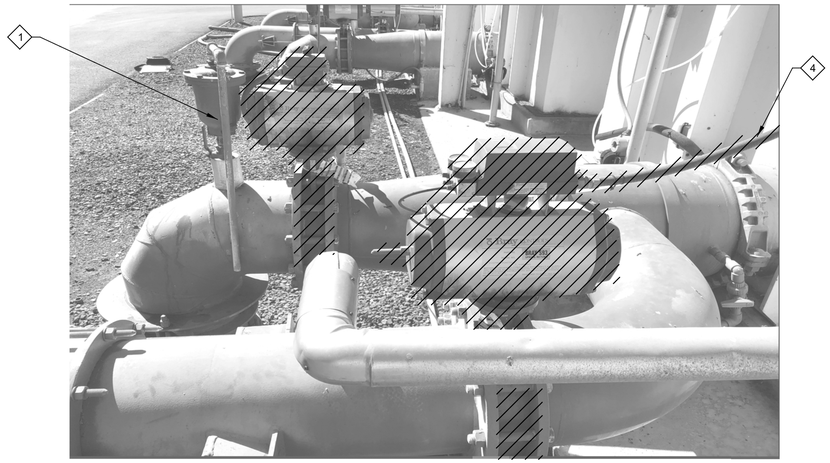
CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
DEMOLITION
AWT CLARIFIER/FILTER PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 85D01
SHEET NO. 13 OF 200



B SECTION
85D01 SCALE: NO SCALE
FILE: 8660F1085D02A



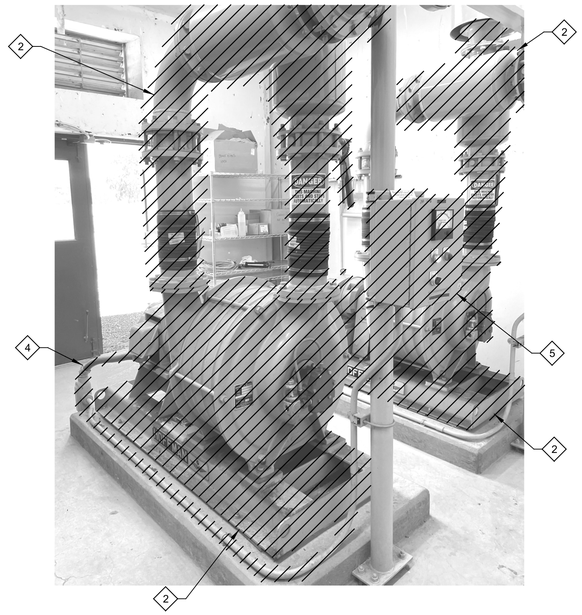
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85D01 SCALE: NO SCALE
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GENERAL NOTES:

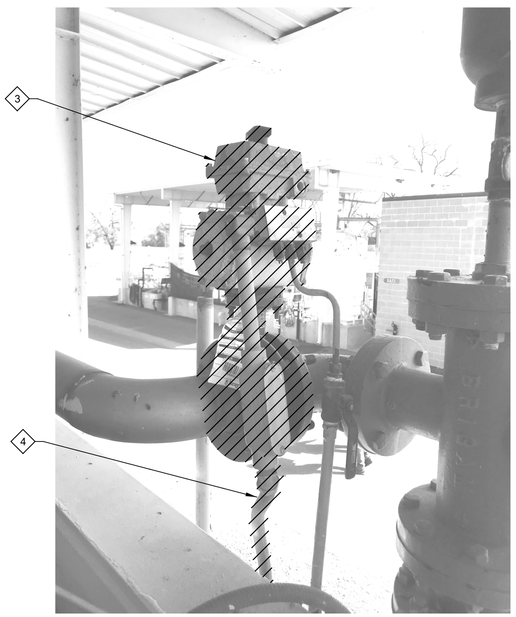
1. REFER TO GENERAL NOTES ON 00D01.

KEY NOTES:

1. DEMOLISH VALVE. TYPICAL OF EIGHT VALVES FOR THE FILTERS.
2. DEMOLISH AIR BLOWER AND ASSOCIATED PIPING AND SUPPORTS.
3. DEMOLISH SOLENOID VALVE. TYPICAL OF FOUR SOLENOID VALVES FOR FILTERS.
4. DEMOLISH EXISTING EXPOSED CONDUITS AND ALL CONDUCTORS ASSOCIATED WITH DEMO EQUIPMENT FROM POWER AND CONTROL SOURCE TO EQUIPMENT LOCATION. THIS IS TYPICAL FOR TWO AIR BLOWER, EIGHT FILTER VALVES, AND FOUR AIR SCOUR VALVES, AND FOUR SOLENOID VALVES.
5. DEMOLISH EXISTING LOCAL CONTROL PANEL FOR TWO AIR BLOWERS.
6. DEMOLISH SURFACE WASH SYSTEM EQUIPMENT AND ASSOCIATED PIPING AND SUPPORTS.
7. EXISTING 4" SW PIPE TO BE ABANDONED IN PLACE. CUT PIPE FLUSH WITH EXISTING GRADE AND PROVIDE PERMANENT BLIND FLANGE.



2 PHOTO
85D01 SCALE: NO SCALE
FILE: 8660F1085D02C



3 PHOTO
85D01 SCALE: NO SCALE
FILE: 8660F1085D02D

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

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DATE JULY 2023

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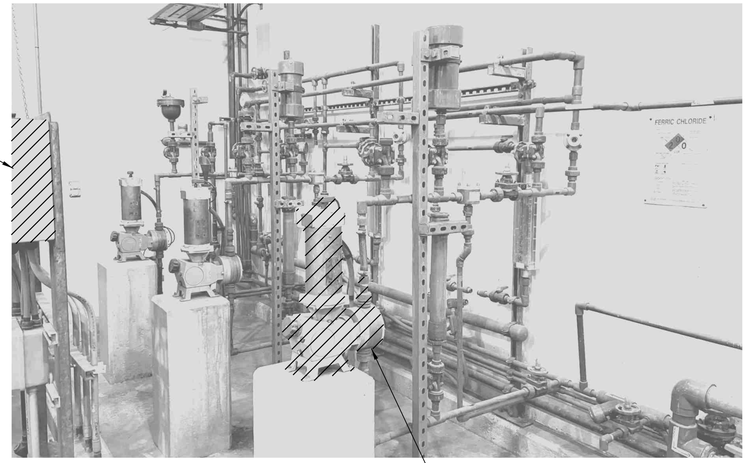
CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
DEMOLITION
AWT CLARIFIER/FILTER SECTION AND PHOTOS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

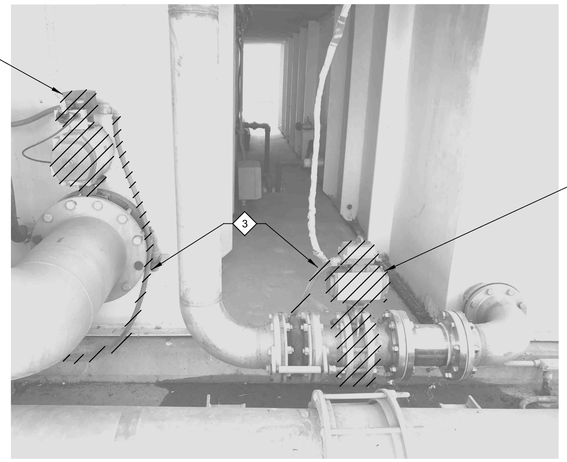
JOB NO. 8660F.10
DRAWING NO. 85D02
SHEET NO. 14 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1085D002.dgn

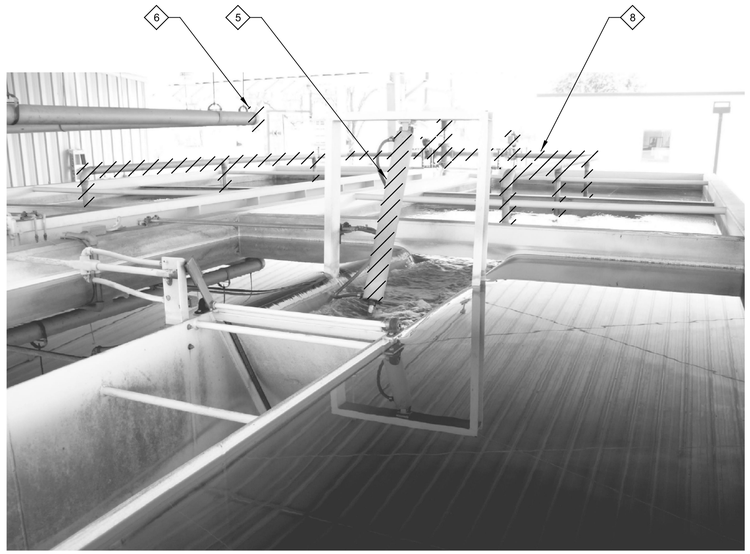
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ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: tumadhay



4 PHOTO
85D01 SCALE: NO SCALE
FILE: 8660F1085D03-4



5 PHOTO
85D01 SCALE: NO SCALE
FILE: 8660F1085D03-5



6 PHOTO
85D01 SCALE: NO SCALE
FILE: 8660F1085D03C



EXISTING PLC-3 PANEL ELEVATION EXTERIOR

7 PHOTO
85D01 SCALE: NO SCALE
FILE: 8660F1085D03D

GENERAL NOTES:

1. REFER TO GENERAL NOTES ON 00D01

KEY NOTES:

1. DEMOLISH VALVE. TYPICAL OF EIGHT VALVES FOR THE CLARIFIERS.
2. DEMOLISH COAGULANT FEED PUMP. PROTECT EXISTING POWER AND CONTROL CONDUCTORS IN PLACE.
3. DEMOLISH EXISTING EXPOSED CONDUITS AND ALL CONDUCTORS ASSOCIATED WITH DEMO EQUIPMENT FROM POWER AND CONTROL SOURCE TO EQUIPMENT LOCATION. THIS IS TYPICAL FOR CLARIFIERS.
4. DEMOLISH COAGULANT FEED PUMP CONTROLLER UNIT. PROTECT EXISTING CONDUCTORS AND CONDUITS IN PLACE FOR NEW CONTROLLER INSTALLATION.
5. DEMOLISH EXISTING PNEUMATIC RAM OF WASTE GATES. REFER TO SPECIFICATION SECTION 11802. TYPICAL OF AWT CLARIFIER/FILTER UNITS.
6. DEMOLISH PORTION OF AIR WASH LINE.
7. DEMOLISH THE EXISTING PLC-3 PANEL. SALVAGE AND TURN OVER ALL COMPONENTS TO THE OWNER. EXISTING PLC-3 PANEL SHALL BE REPLACED WITH VCP-3 AS SPECIFIED IN SPECIFICATION SECTION 11802 AND CONTRACT DRAWINGS.
8. DEMOLISH PIPING AND SUPPORTS ASSOCIATED WITH THE SURFACE WASH SWEEPS.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED EYY
DRAWN BAC
CHECKED JD
DATE JULY 2023

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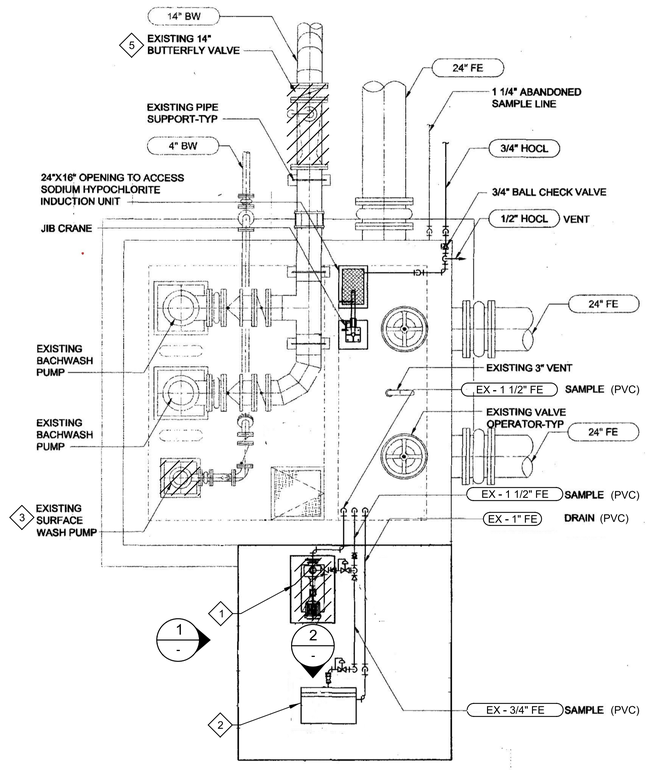
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CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
DEMOLITION
AWT CLARIFIER/FILTER PHOTOS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

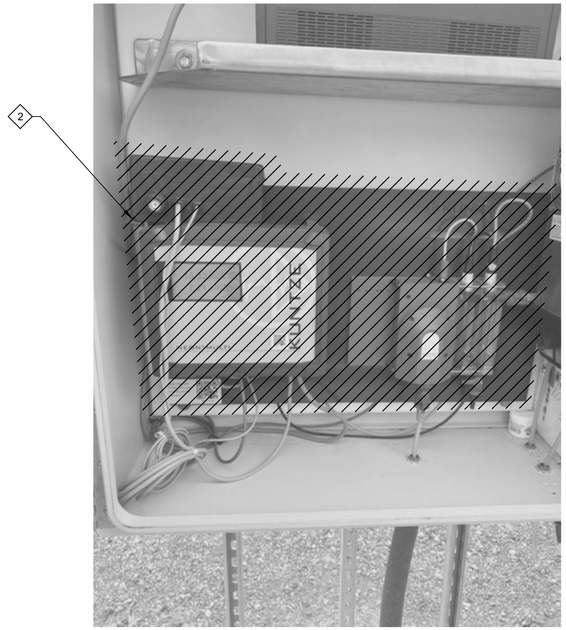
JOB NO. 8660F.10
DRAWING NO. 85D03
SHEET NO. 15 OF 200



A PLAN
SCALE: NO SCALE
FILE: 8660F1087D01A



1 - PHOTO
SCALE: NO SCALE
FILE: 8660F1087D01B



2 - PHOTO
SCALE: NO SCALE
FILE: 8660F1087D01C

GENERAL NOTES:

1. REFER TO GENERAL NOTES ON 00D01.

KEY NOTES:

1. DEMOLISH SAMPLE PUMP 3.
2. DEMOLISH CHLORINE ANALYZER 3. PROTECT THE EXISTING ENCLOSURE IN PLACE.
3. DEMOLISH EXISTING SURFACE WASH PUMP.
4. PROTECT SIGNAL AND POWER CONDUCTORS AND CONDUITS IN PLACE FOR NEW ANALYZER INSTALLATION.
5. REMOVE, PROTECT, AND REINSTALL BUTTERFLY VALVE AS SHOWN ON 87M01.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

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CHECKED JD
DATE JULY 2023

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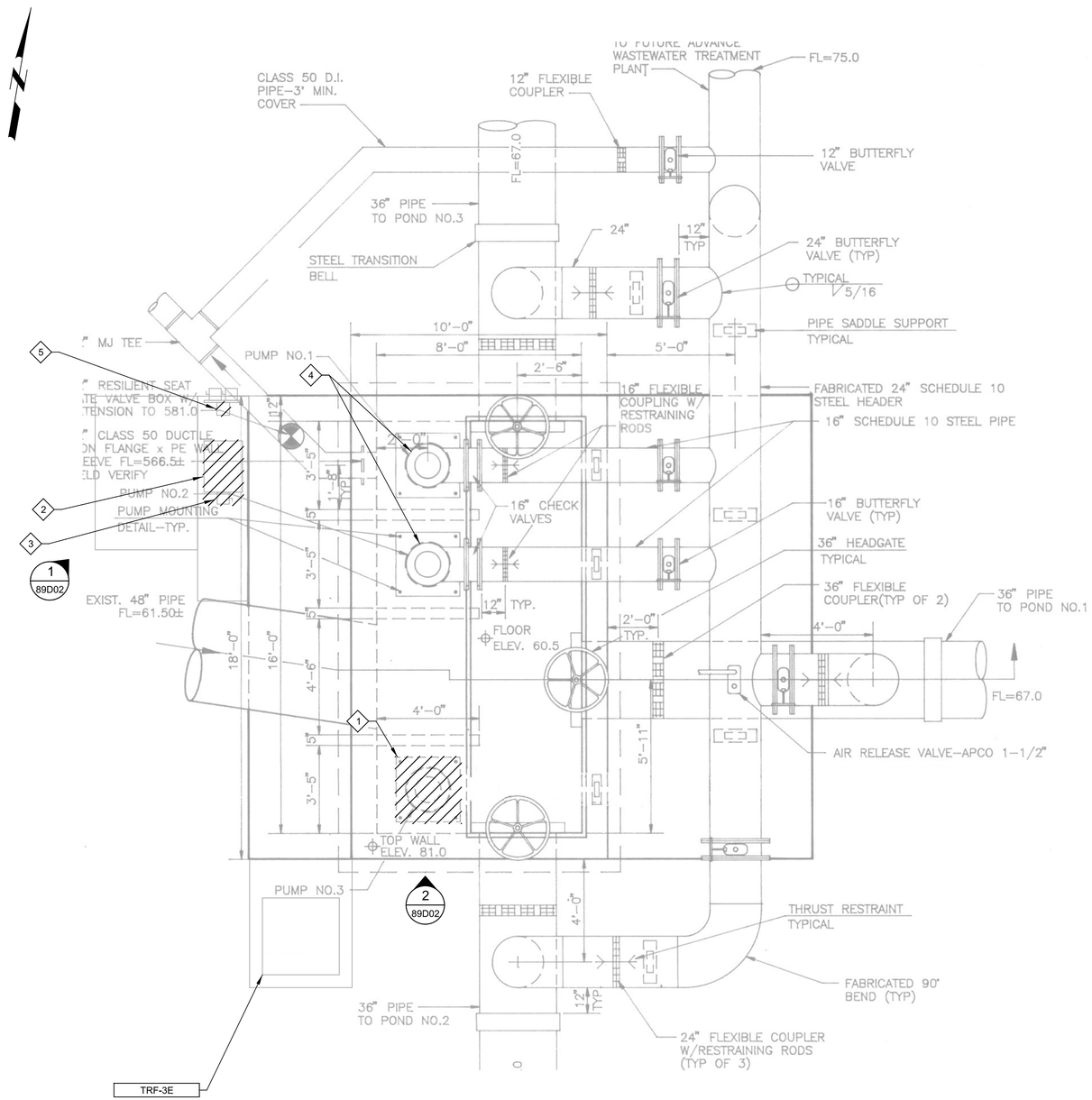
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
DEMOLITION
BACKWASH PUMP STATION PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 87D01
SHEET NO. 16 OF 200

Plot Date: 12-JUL-2023 11:34:32 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: eparker



A PLAN
SCALE: NO SCALE
FILE: 8660F002D01.jpg

GENERAL NOTES:

1. REFER TO GENERAL NOTES ON 00D01.

KEY NOTES:

1. DEMOLISH EFFLUENT PUMP.
2. DEMOLISH MOTOR CONTROL CABINET. REFER TO ELECTRICAL DRAWINGS FOR SPECIFIC REQUIREMENTS.
3. DEMOLISH MAIN DISCONNECT SWITCH 200 A, 3-POLE. REFER TO ELECTRICAL DRAWINGS FOR SPECIFIC REQUIREMENTS.
4. REMOVE EXISTING MOTOR OF EFFLUENT PUMP.
5. DEMOLISH 1 KVA, 480 V TRANSFORMER. REFER TO ELECTRICAL DRAWINGS FOR SPECIFIC REQUIREMENTS.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED EB
DRAWN BAC
CHECKED JD
DATE JULY 2023

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CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
DEMOLITION
CAROUSEL PUMP STATION
PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 89D01
SHEET NO. 17 OF 200

Plot Date: 12-JUL-2023 11:35:20 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: eparker



1 PHOTO
89D01
SCALE: NO SCALE
FILE: 8660F1002D01-3.JPG



2 PHOTO
89D01
SCALE: NO SCALE
FILE: 8660F1002D01-1.JPG

GENERAL NOTES:

1. REFER TO GENERAL NOTES ON 00D01.
2. REFER TO CAROUSEL PUMP STATION DEMO ONE-LINE DIAGRAM FOR MORE ELECTRICAL DEMOLITION INFORMATION.

KEY NOTES:

1. DEMOLISH EFFLUENT PUMP.
2. DEMOLISH EXISTING EXPOSED CONDUITS AND ALL CONDUCTORS ASSOCIATED WITH DEMO EQUIPMENT FROM POWER AND CONTROL SOURCE TO EQUIPMENT LOCATION.
3. DEMOLISH EXISTING MOTOR OF EFFLUENT PUMPS. PROTECT PUMP IN PLACE FOR NEW MOTOR INSTALLATION.
4. DEMOLISH MOTOR CONTROL CABINET.
5. DEMOLISH 1 KVA, 480 V TRANSFORMER.
6. DEMOLISH MAIN DISCONNECT SWITCH 200 A, 3-POLE.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED EB
DRAWN BAC
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DATE JULY 2023

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CA PE NO. 84405
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CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
DEMOLITION
CAROUSEL PUMP STATION
PHOTOS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 89D02
SHEET NO. 18 OF 200

PROJECT NO. 8660F10
FILE NAME: 8660F1089D002.dgn

Plot Date: 12-JUL-2023 11:34:50 AM
User: svcPW
DesignScript: Carollo_Std_Pen_v0905.pen
PlotScale: 1:1
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: obonafoux

GENERAL NOTES:

1. REFER TO GENERAL NOTES ON 00D01.

KEY NOTES:

1. DEMOLISH CENTER BERM.
2. REMOVED EXISTING SLUDGE PIPING.
3. REGRADE EXISTING POND AREA PER DRAWING 91C01.



A PLAN
SCALE: NO SCALE
FILE: 8660F1000D01.jpg

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CA
DRAWN BAC
CHECKED JM
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

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CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
DEMOLITION
SLUDGE LAGOON PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 91D01
SHEET NO. 19 OF 200

Plot Date: 10/5/2022 11:08:46 AM

DETAIL REFERENCES

PLAN/TITLE — VIEW; DESCRIPTION; VIEW TITLE; A PLAN; SCALE: SCALE; FILE: FILE; PLAN NOT REFERENCED

SECTION CUT — A; VIEW; ##X##; - = SHOWN ON SAME DRAWING; ##X## = SEE INDICATED DRAWING

SECTION OR DETAIL — ALPHA = SECTION; NUMERIC = DETAIL; DESCRIPTION; VIEW TITLE; C/1; ##X##; ELEVATION; SCALE: SCALE; FILE: FILE

TITLE W/ REFERENCE — DRAWING CUT ORIGINATION

DETAIL CALL-OUT (ENLARGED) — 1; VIEW; ##X##; SEE INDICATED DRAWING

DRAWING REFERENCE — ##X##; AREA DESIGNATOR (WHEN APPLICABLE); DISCIPLINE DESIGNATOR; CONSECUTIVE SHEET NUMBER

TYPICAL DETAIL REFERENCE — TYPICAL DETAIL #; ?; TYP

EXTERIOR ELEVATION VIEWS — A; ##X##

PHOTO LOCATION — #; -; ARROW INDICATES POINT OF VIEW

GRID BUBBLE

TYPICAL DETAIL # — ?; TYP; TYPICAL DETAIL TITLE; LINE 3; LINE 1; LINE 2; S; MODIFICATION NOTE; S = STANDARD; J = JOB SPECIFIC; R = REVISED; N = NOTE TO TYPICAL DETAIL USER; SHT X OF X; SHEETS IN DETAIL; XX/XX/20XX; DATE CREATED (REVISED)

LINE WORK

NEW STRUCTURES OR EDGE OF PAVEMENT
EXISTING STRUCTURES (SCREENED)
NEW PIPING (TRIPLE LINES)
NEW PIPING (SINGLE LINE)
EXISTING PIPING (TRIPLE LINES) (SCREENED)
EXISTING PIPING (SINGLE LINE)(SCREENED)
HIDDEN LINE OR TRAIL EDGE
CENTER, MONUMENT, OR SURVEY LINE
GUARDRAIL
EXISTING CONTOURS (SCREENED) — 310
NEW CONTOURS — 310
NEW FENCE — X
EXISTING FENCE (SCREENED) — X
REMOVE OR ABANDONED (CROSS HATCHING: FENCE SHOWN AS EXAMPLE)
POWER POLE & LINE — OHE; PP; OHE
CABLE TV (UNDERGROUND) — CTV
FIBER OPTIC — FO
FUEL — F
NATURAL GAS — G
UNDERGROUND ELECTRIC — UGE
SANITARY SEWER — SS
FORCEMAIN SANITARY SEWER — FM
STORM DRAIN — SD
TELEPHONE — TEL
WATER — W
PROPERTY LINE OR RIGHT OF WAY
SLOPE
NEW ROAD
EXISTING ROAD (SCREENED)
FUTURE ROAD, WATER EDGE OR RIDGE
CURB & GUTTER
CURB
SWALE
FLOWLINE
SHORING
RAILROAD TRACKS
LIMITS OF CONSTRUCTION — LOC
SILT FENCE — SF
EASEMENT
EXISTING EASEMENT
CITY LIMITS
EXISTING GRADE (PROFILE)
PROPOSED GRADE (PROFILE)
MATCH LINE — MATCH LINE STA XXX SEE DWG XXX

COORDINATES / ELEVATION

COORDINATES — XX; N=1600000 E=1000000; N=XXXXXX.XX; E=XXXXXX.XX
CONTROL POINT — XX
SPOT ELEVATION — XX.XX; ANY SPECIFIC DESIGNATIONS NOTED WILL NEED TO REFER TO ABBREVIATIONS
EXISTING SPOT ELEVATION — X 1325.00
SLOPE CALLOUT — 2:1; 2; 1; 2.0%; S=0.0020

ROADWAY / PIPE CURVES

ROADWAY / PIPE CURVE

(SEE TABLE ON EACH PAVING AND GRADING OR CIVIL PIPING DWG WITH ROADWAY / PIPE CURVES.)

LENGTH; CURVE NUMBER; PC; CXX; CLOCKWISE; ANGLE; RADIUS; PT; RADIUS POINT; EDGE OF PVMT OR OUTSIDE FACE OF CURB

HATCH PATTERNS

AGGREGATE BASE COURSE (ABC)
ASPHALT PAVING
OR
(WITH AERIAL)
BEDROCK
CLSM
CONCRETE (ALL CLASSES)
DRAIN ROCK
GRAVEL
GRATING; SPAN
LANDSCAPING
RIPRAP
EXISTING/ UNDISTURBED SOIL
STRUCTURAL FILL OR BACKFILL
STEEL
STAGING AREA
TREAD PLATE

SYMBOLS

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	EXISTING CONTROL POINT	CTV	CABLE TV	CO	CLEANOUT
	EXISTING MONUMENT		POWER TOWER		AIR RELEASE VALVE
XX	CONTROL POINT		GATE		BLOW OFF VALVE
B-XX	SOIL BORING LOCATIONS		GUARD POST		HOSE BIBB / YARD HYDRANT
PH	POTHOLE		HEADWALL		SERVICE CONNECTION
PHX	POTHOLE NUMBER		ROCK WALL		BURIED VALVE
	FLOW/SLOPE DIRECTION		SHRUB/HEDGE		FLANGE
	MANHOLE (PLAN)		TREE		BALL VALVE
	MANHOLE (PROFILE)		SIGN/SIGN POST		BUTTERFLY VALVE
			LIGHT		CHECK VALVE
	CATCH BASIN		UTILITY POLE		GATE VALVE
E	ELECTRICAL MANHOLE AND PULL BOX		UTILITY POLE GUY WIRE		PLUG VALVE
M	METER BOX	PP	POWER POLE		PIPE CAP OR CONNECTION
P	PULL BOX		FIRE HYDRANT		REDUCER
T	TELEPHONE PEDESTAL				

NOTE: ALL SYMBOLS SHOWN AS NEW. EXISTING SYMBOLS ARE SCREENED.

BRACKET
BREAK LINE
PIPE BREAK PLAN VIEW
PIPE BREAK CROSS SECTION
SCALE — 0; 10'; 20'; 40'; SCALE: 1" = 20'
PIPE CONTINUATION (SINGLE LINE)
KEY NOTE — 34

REVISION DELTA — 2
EXISTING ELEVATION — EX TOW XXXX.X±
ELEVATION — TOC XXXX.XX
EQUIPMENT/DEVICE KEY TAG — 1
EQUIPMENT/DEVICE NUMBER — XXX-XX-XXX
PIPE TAG — *PIPE SIZE; FLOW STREAM; "X" XXX; FUTURE PIPING (WHERE APPLICABLE); FUTURE
* FOR EXISTING PIPING SHOW AS EX *SIZE FLOW STREAM*

UNDERGROUND/ OVERHEAD WARNING (STATE/REGION SPECIFIC) — 811; Know what's below. Call before you dig.; usanorth811.org

Avoid overhead power line contact. It's costly.
Call before you
OVERHEAD
Replace with Regional Phone Number

NORTH ARROW/ PLANT NORTH — 30.0°; NORTH; NORTH; TRUE; PLANT

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN JRD
CHECKED JM
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
CIVIL
GENERAL CIVIL LEGEND AND SYMBOLS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00C01
SHEET NO. 20 OF 200

LAST SAVED BY: gdavis

NOTES

GENERAL NOTES:

1. FOLLOWING NOTES ARE GENERAL AND APPLY TO ALL SHEETS OF THESE CONTRACT DOCUMENTS AS IF THEY WERE WRITTEN IN THEIR ENTIRETY ON EACH SHEET.
2. CONTRACTOR SHALL VERIFY ALL DIMENSIONS BEFORE STARTING WORK AND SHALL IMMEDIATELY NOTIFY THE ENGINEER OF ANY DISCREPANCIES. CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD VERIFYING ALL EXISTING CONDITIONS INCLUDING LOCATION AND DIMENSIONS OF ALL EXISTING CONSTRUCTION AND UTILITIES. CONTRACTOR SHALL NOTIFY ENGINEER IF THERE IS A CONFLICT BETWEEN THE CONTRACT DOCUMENTS AND EXISTING CONSTRUCTION BEFORE PROCEEDING WITH WORK.
3. UNLESS DETAILED, SPECIFIED, OR OTHERWISE INDICATED ON THE DRAWINGS, CONSTRUCTION SHALL BE AS INDICATED IN THE APPLICABLE TYPICAL DETAILS AND GENERAL NOTES. TYPICAL DETAILS SHALL APPLY EVEN THOUGH NOT REFERENCED AT SPECIFIC LOCATIONS ON DRAWINGS.
4. WHERE NO CONSTRUCTION DETAILS ARE SHOWN OR NOTED FOR ANY PART OF WORK. DETAILS SHALL BE IN THE SAME AS FOR OTHER SIMILAR WORK.
5. CONTRACTOR SHALL COMPLY WITH LOCAL CONSTRUCTION STORM WATER DISCHARGE REGULATIONS AND REQUIREMENTS.
6. PRIOR TO EXCAVATION FOR NEW STRUCTURES, ELECTRICAL CONDUIT, FABRICATION OF NEW PIPING AND/OR OTHER PROPOSED UTILITIES, CONTRACTOR SHALL BE RESPONSIBLE FOR VERIFYING THE LOCATION OF ALL EXISTING PIPING AND UTILITIES IN THE CONSTRUCTION AREA. THE CONTRACTOR SHALL TEMPORARILY RELOCATE CONFLICTING EXISTING UTILITIES AT TIE-IN/CONNECTION LOCATIONS AND REINSTALL THEM AS REQUIRED TO ELIMINATE THE CONFLICT AT NO ADDITIONAL COST TO THE OWNER.
7. ALL PIPELINES 12" AND LARGER SHALL HAVE A MINIMUM COVER OF 36" UNLESS THE COVER DEPTH IS SPECIFICALLY INDICATED ON THE DRAWINGS. PIPE SMALLER THAN 12" SHALL HAVE A MINIMUM COVER OF 30" UNLESS NOTED OTHERWISE. PIPES SHALL BE ROUTED AS SHOWN UNLESS MINOR REVISIONS ARE NECESSARY TO MISS EXISTING PIPES, STRUCTURES, ETC. CONTRACTOR SHALL BE RESPONSIBLE FOR FURNISHING ALL FITTINGS AND ADAPTERS REQUIRED TO MAKE THE ROUTING CHANGES AT NO ADDITIONAL COST TO THE OWNER. CONTRACTOR SHALL INCLUDE COST FOR THIS IN THE BID.
8. EXISTING FACILITY AND UTILITY INFORMATION SHOWN ON THE DRAWINGS WAS OBTAINED FROM AVAILABLE RECORDS OR ELECTRONIC FILES. NEITHER THE OWNER NOR ENGINEER ASSUMES ANY RESPONSIBILITY FOR FACILITIES AND UTILITIES NOT SHOWN OR NOT IN THE LOCATION SHOWN. THE CONTRACTOR SHALL FIELD VERIFY ALL LOCATIONS, SIZES, MATERIAL TYPES, AND ELEVATIONS SHOWN AROUND OR NEAR AREAS OF NEW CONSTRUCTION PRIOR TO START OF CONSTRUCTION.
9. THE CONTRACTOR SHALL TAKE ALL PRECAUTIONARY MEASURES NECESSARY TO PROTECT FROM DAMAGE EXISTING FACILITIES AND UTILITIES SHOWN OR NOT SHOWN THAT ARE TO REMAIN IN PLACE. ALL FACILITIES DAMAGED BY THE CONTRACTOR'S OPERATIONS SHALL BE EXPEDITIOUSLY REPAIRED OR RECONSTRUCTED TO THE ORIGINAL OR BETTER CONDITION AT THE CONTRACTOR'S EXPENSE WITHOUT ADDITIONAL COMPENSATION.
10. CONTRACTOR SHALL MAKE CONNECTIONS TO EXISTING PIPE, EQUIPMENT, ETC. AS REQUIRED AND SHALL PROVIDE ALL FITTINGS, ADAPTERS, AND APPURTENANCES REQUIRED TO MAKE THE CONNECTIONS. PROVIDE ALL SUPPORTS REQUIRED FOR A RIGIDLY SUPPORTED COMPLETE AND WORKING SYSTEM.
11. ADJUST ALL VALVE BOXES, VAULTS, PULL BOXES, AND MANHOLES TO FINISHED GRADE UNLESS OTHERWISE SHOWN OR DIRECTED. MANHOLES IN OPEN FIELDS SHALL BE SET TWELVE INCHES ABOVE FINISHED GRADE AND VAULTS SHALL BE SIX INCHES ABOVE FINISHED GRADE.
12. THE CONTRACTOR SHALL CONTACT THE PROPER UTILITY REPRESENTATIVE AS FOLLOWS FOR QUESTIONS OR COORDINATION OF CONSTRUCTION RELATED TO EXISTING UTILITIES.

    SEE SCHEDULE ON SHEET 00G03
13. CONTRACTOR SHALL VERIFY THAT PIPING SHOWN TO BE ABANDONED OR AS ABANDONED PREVIOUSLY IS NO LONGER IN SERVICE. LINES IN SERVICE SHALL BE MAINTAINED UNTIL NO LONGER REQUIRED BY THE PLANT.
14. ALL EXISTING PIPES THAT ARE TO BE ABANDONED IN PLACE OR REMOVED MAY NOT BE SHOWN. WHERE PIPING IS TO BE ABANDONED AND MUST REMAIN IN SERVICE UNTIL COMPLETION OF OTHER PHASES OF WORK, AND IT CONFLICTS WITH NEW PIPING, TEMPORARILY RELOCATE PIPING AS REQUIRED TO MAINTAIN SERVICE BY THE PLANT.
15. CONTRACTOR SHALL REROUTE THE EXISTING PIPING IF REQUIRED TO MISS THE PROPOSED STRUCTURES. THE EXISTING PIPE SHALL REMAIN IN SERVICE UNTIL NEW PIPING IS READY TO BE PLACED INTO SERVICE. DOWNTIME SHALL BE A MAXIMUM OF 2 HOURS, UNLESS SPECIFIED OR SHOWN OTHERWISE.
16. ALL SIDEWALKS TO BE 3'-0" WIDE UNLESS SHOWN OTHERWISE.
17. THE CONTRACTOR SHALL TAKE SPECIAL PRECAUTIONS IN THE VICINITY OF ANY OVERHEAD ELECTRIC LINES. CONTRACTOR SHALL ABIDE BY THE NATIONAL ELECTRIC CODE AND ANY REQUIREMENT BY THE OWNER OF THE ELECTRIC LINES.
18. PROVIDE ALL SHEETING/SHORING REQUIRED TO PROTECT EXISTING STRUCTURES, PIPES AND FACILITIES.
19. CONTRACTOR SHALL VERIFY LOCATION OF ALL ARCHITECTURAL, MECHANICAL, AND ELECTRICAL ITEMS BEFORE PLACING ANY STRUCTURAL STEEL OR CONCRETE. ALSO, STRUCTURAL DIMENSIONS AND OPENINGS CONTROLLED BY ARCHITECTURAL, MECHANICAL, OR ELECTRICAL EQUIPMENT SHALL BE VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION.
20. MECHANICAL AND ELECTRICAL EQUIPMENT SUPPORTS, ANCHORAGES, OPENINGS, RECESSES, AND REVEALS NOT SHOWN ON THE STRUCTURAL DRAWINGS, THAT ARE REQUIRED BY OTHER CONTRACT DRAWINGS, SHALL BE PROVIDED PRIOR TO CASTING CONCRETE.

GENERAL PIPELINE NOTES:

1. DIMENSIONS TO STRUCTURES, REFERENCED PIPING, PAVING, AND OTHER IMPROVEMENTS IS APPROXIMATE. THE CONTRACTOR SHALL FIELD VERIFY ALL DIMENSIONS AND CONDITIONS 14 DAYS IN ADVANCE OF THE CONSTRUCTION PROGRESS. THE CONTRACTOR SHALL REPORT ANY DISCREPANCIES TO THE ENGINEER.
2. CONTRACTOR SHALL MAINTAIN A MINIMUM CLEARANCE OF 10 FEET HORIZONTAL AND 3 FEET VERTICAL BETWEEN THE SEWER LINES AND EXISTING WATER LINES.
3. REFER TO THE GEOTECHNICAL REPORT LOCATED IN THE APPENDIX OF THE SPECIFICATIONS FOR ADDITIONAL INFORMATION ON THE GEOTECHNICAL CONDITIONS AND BORING INFORMATION.
4. IN ALL LOCATIONS WHERE TRENCH PLATE IS USED FOR VEHICULAR OR PEDESTRIAN TRAFFIC, THE CONTRACTOR SHALL APPLY SKID RESISTANT COATING ON THE TRENCH PLATES AND COLD MIX ASPHALT CONCRETE AT THE EDGES. THE TRENCH PLATES SHALL BE NOTCHED INTO THE ASPHALT, CONCRETE, OR TRAVELED SURFACE TO PREVENT SLIPPAGE AND ROCKING UNDER TRAFFIC.
5. THE CONTRACTOR SHALL MAINTAIN ACCESS TO ALL PROPERTIES ADJACENT TO THE WORK, THROUGHOUT THE CONSTRUCTION PERIOD.
6. ALL OPEN TRENCHES, WORK AREAS AND SHAFTS SHALL HAVE A SHORING SYSTEM IN ACCORDANCE WITH OSHA, STATE AND LOCAL REQUIREMENTS.
7. THE CONTRACTOR SHALL COMPLY WITH ALL FEDERAL, STATE, COUNTY, AND LOCAL LAWS AND ORDINANCES RELATING TO THE SAFETY AND CHARACTER OF WORK, EQUIPMENT AND PERSONNEL. THIS INCLUDES BUT IS NOT LIMITED TO SHEETING, SHORING, BRACING, VENTILATION, CONFORMANCE WITH TRAFFIC CONTROL AND MAINTENANCE OF BARRICADES AND WARNING DEVICES.
8. LAYOUT DRAWINGS ARE REQUIRED FOR PIPING INSTALLED.
9. ALL ROAD DITCHES, FENCE LINES, PASTURES AND SIMILAR AREAS SHALL BE RESTORED PER SPECIFICATION 02952.
10. ALL CROPPED AREAS DISTURBED SHALL HAVE THE TOPSOIL REPLACED AND THE ENTIRE AREA DISTURBED SHALL BE RIPPED 2 FT DEEP PER THE LAND OWNERS REQUIREMENTS.
11. CONTRACTOR SHALL TAKE ALL PRACTICAL PRECAUTIONS TO MINIMIZE DISTURBANCES TO STREAMS, VEGETATION, TREES AND CROP LANDS. WHEREVER PRACTICAL LEAVE EXISTING TREES AND VEGETATED AREAS UNDISTURBED.

UTILITY NOTES:

1. EXISTING UTILITIES IN THE PROJECT MAY BE IN A FRAGILE CONDITION. THE CONTRACTOR SHALL EXERCISE NECESSARY CAUTION WHEN WORKING NEAR EXISTING UTILITIES.
2. PLAN LOCATIONS AND ELEVATIONS OF EXISTING UTILITIES ARE BASED ON RECORD DRAWINGS, POTHOLING AND SURVEY INFORMATION AND ARE CONSIDERED APPROXIMATE ONLY. WHERE NO ELEVATIONS ARE SHOWN, NO INFORMATION WAS AVAILABLE DURING THE DESIGN PERIOD.
3. SOME UTILITY SERVICES MAY NOT BE SHOWN ON THESE DRAWINGS. THE CONTRACTOR SHALL TAKE NECESSARY MEASURES TO LOCATE AND PROTECT SERVICE DURING CONSTRUCTION.
4. CONTRACTOR SHALL CALL THE "LOCAL UTILITY LOCATOR" AT 1-800-277-2600 PRIOR TO ANY EXCAVATION ACTIVITIES.
5. THE LOCATION, SIZE, AND MATERIALS OF EXISTING UNDERGROUND UTILITIES SHOWN ON THESE DRAWINGS ARE APPROXIMATE AND IS SHOWN FOR BIDDING PURPOSES. THE CONTRACTOR SHALL BE RESPONSIBLE TO CONTACT THE UTILITY OWNERS SO THAT THOSE UTILITIES MAY MARK THE LOCATION OF THEIR UTILITIES PRIOR TO ANY EXCAVATION ACTIVITIES. THE CONTRACTOR SHALL BE RESPONSIBLE TO LOCATE AND PROTECT EXISTING UTILITIES.

EARTHWORK NOTES:

1. CLEAR THE CONSTRUCTION AREA OF NATURAL OBSTRUCTIONS EXISTING FOUNDATIONS, BUILDINGS, FENCES, LUMBER, WALLS, STUMPS, BRUSH, WEEDS, RUBBISH, TREES, BOULDERS, AND ANY OTHER ITEMS WHICH INTERFERES WITH CONSTRUCTION OPERATIONS OR ARE DESIGNATED FOR REMOVAL.
2. GRUB OUT AND DISPOSE OF TREE TRUNKS AND ROOT MATERIAL BELOW THE GROUND SURFACE REMAINING AFTER CLEARING.
3. DISPOSE OF THE UNACCEPTABLE BACKFILL MATERIAL FROM THE CLEARING AND GRUBBING OPERATIONS AT NO ADDITIONAL COST TO THE OWNER.
4. STRIP AND STOCKPILE THE TOPSOIL. THE DEPTH OF STRIPPING SHALL BE ESTIMATED TO BE 12-INCHES BUT WILL BE DETERMINED IN THE FIELD AS SOIL CONDITIONS DICTATE.
5. REPLACE STOCKPILED SOIL AND RESTORE SITE AS SPECIFIED.
6. ROCK AND AGGREGATE STORAGE AREAS SHALL BE RESTORED BY EXCAVATING ANY SOILS CONTAINING ROCK OR AGGREGATE AND BACKFILLING WITH TOPSOIL. SOIL REMOVED MAY BE USED FOR TRENCH BACKFILL ABOVE THE PIPE ZONE AND 3 FEET BELOW FINISHED GRADE.

SCHEDULES

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN JDM
CHECKED BWA
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

City of Ukiah

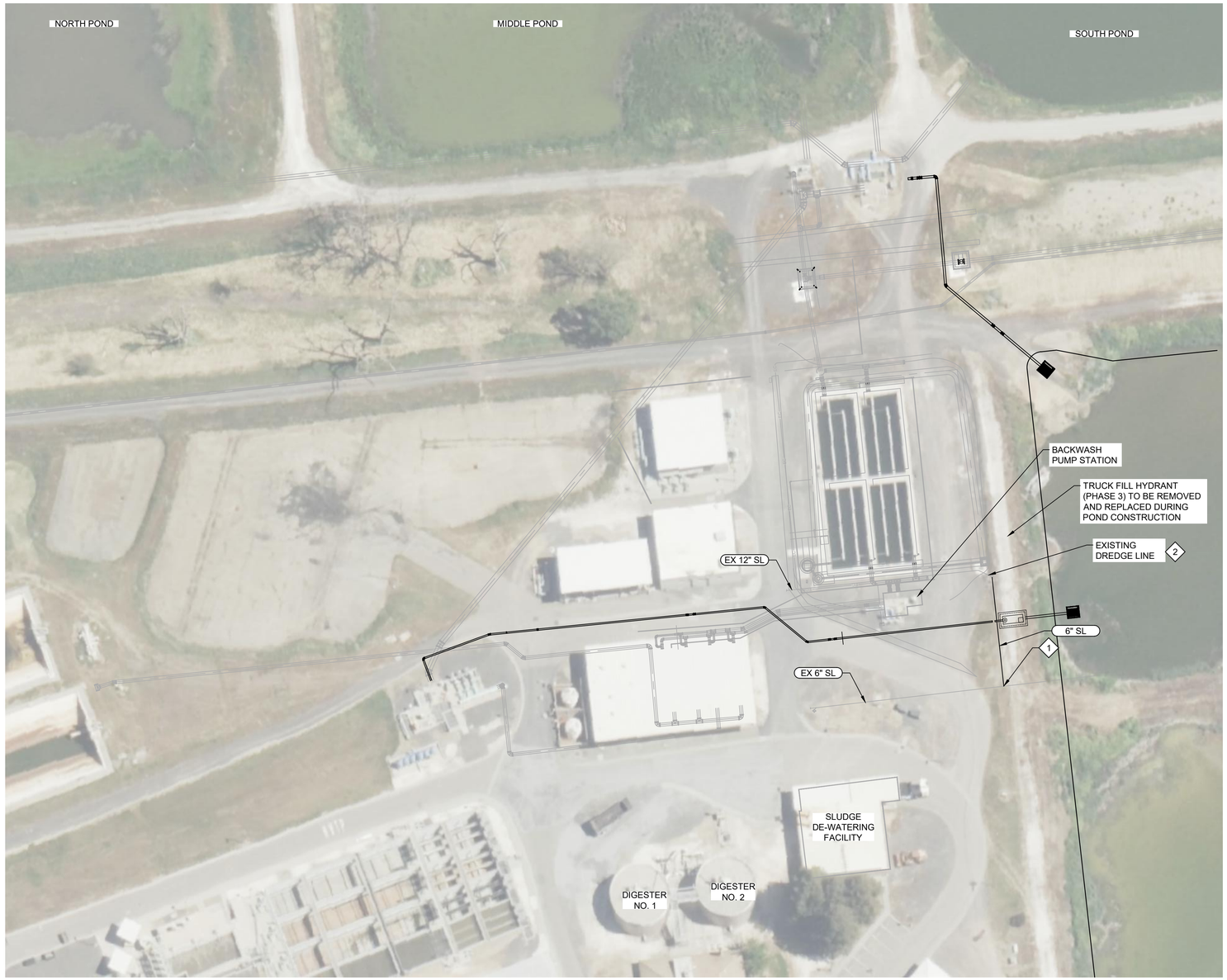
CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
CIVIL
GENERAL CIVIL NOTES AND SCHEDULES

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00C02
SHEET NO. 21 OF 200

Plot Date: 10/5/2022 11:07:47 AM
LAST SAVED BY: JDiDonato

PROJECT NO. 8660F10 FILE NAME: 8660F1000C02.dwg



PLAN

FILE: 8660F10C04

GENERAL NOTES:

1. THE LOCATIONS OF UTILITIES SHOWN ARE APPROXIMATE. CONTRACTOR IS RESPONSIBLE FOR FIELD VERIFICATION OF ALL RELEVANT EXISTING UTILITIES.

KEY NOTES:

1. PRIOR TO INSTALLING THE NEW 6" SLUDGE PIPE, CONTRACTOR SHALL FIELD VERIFY THE LOCATION, CONDITION, MATERIAL, OUTSIDE DIAMETER OF THE EXISTING 6" SLUDGE LINE (APPROXIMATELY 4 FEET BELOW GRADE), AND NOTIFY THE ENGINEER. USE FITTINGS/COUPLINGS AS REQUIRED.
2. PRIOR TO INSTALLING THE NEW 6" SLUDGE PIPE, CONTRACTOR SHALL FIELD VERIFY THE LOCATION, CONDITION, MATERIAL, OUTSIDE DIAMETER OF THE EXISTING 12" SLUDGE LINE (APPROXIMATELY 4 FEET BELOW GRADE), AND NOTIFY THE ENGINEER. USE FITTINGS/COUPLINGS AS REQUIRED.

811 Know what's below. Call before you dig.

SCALE

0 20' 40' 80'

SCALE: 1" = 40'

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN JRD
CHECKED JM
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

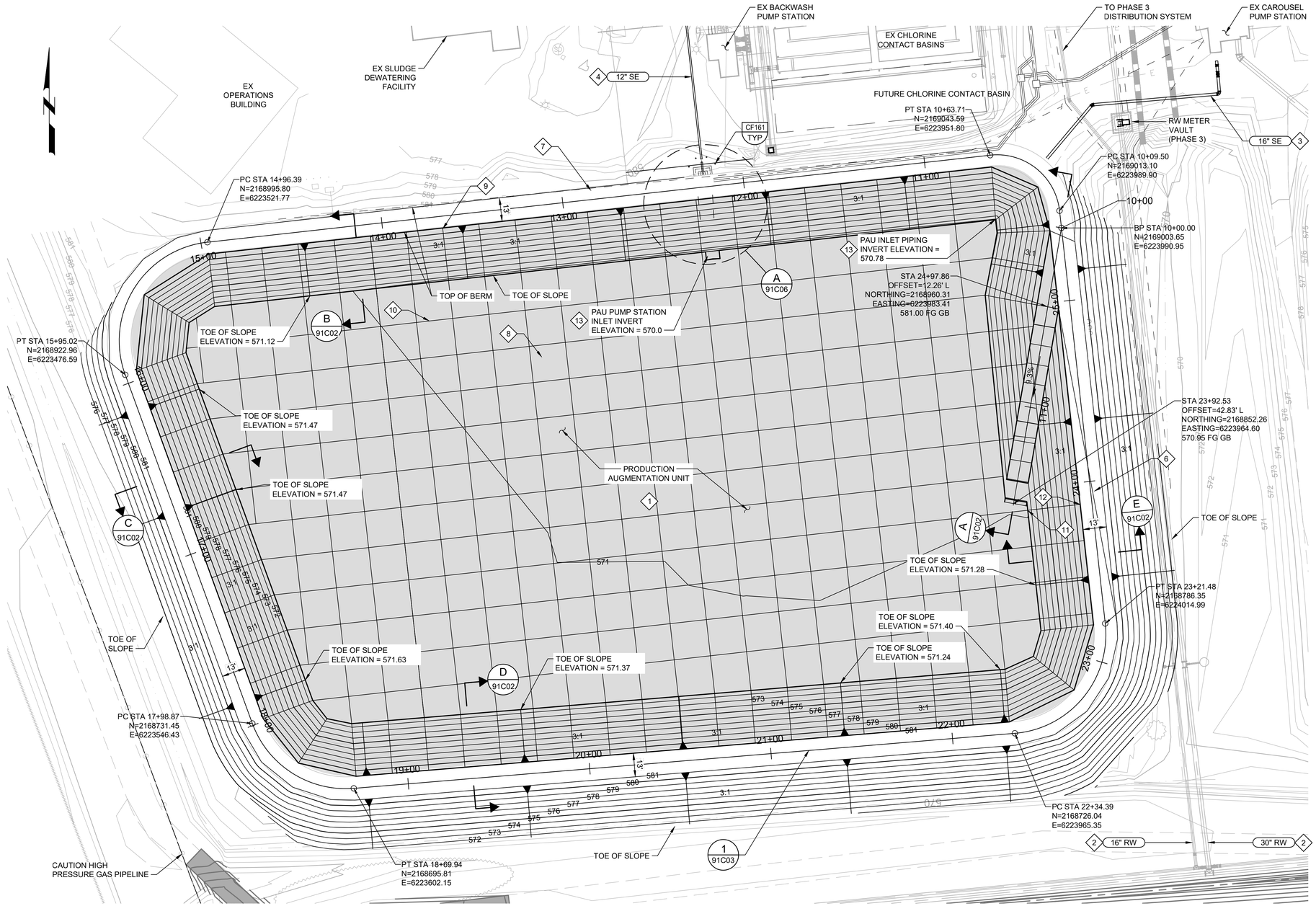
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
CIVIL
WWTP SITE PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00C03
SHEET NO. 22 OF 200

Plot Date: 7/12/2023 11:48:27 AM
FILE NAME: 8660F1000C03.dwg
PROJECT NO. 8660F10
LAST SAVED BY: JDiDonato



PLAN

FILE: 8660F10C04

CUT: 31974 CUBIC YARDS
FILL: 2747 CUBIC YARDS

GENERAL NOTES:

1. CONTRACTOR TO VERIFY THE HORIZONTAL AND VERTICAL LOCATIONS OF ALL EXISTING UTILITIES PRIOR TO THE START OF CONSTRUCTION AND NOTIFY THE ENGINEER OF ANY DISCREPANCIES OR CONFLICTS.
2. CLEAR, GRUB, AND STRIP CONSTRUCTION AREAS PRIOR TO EARTHWORK ACTIVITIES PER SPECIFICATION SECTION 02200.
3. REFER TO SPECIFICATION SECTION 02300 AND 02301 FOR EARTHWORK AND BACKFILL REQUIREMENTS.
4. THE CONTRACTOR SHALL REMOVE ALL EXISTING SLUDGE MATERIAL. THE SLUDGE MATERIALS SHALL BE REMOVED TO AN APPROXIMATE ELEVATION OF 567 FEET.

KEY NOTES:

1. FINISHED GRADE OF THE BOTTOM OF THE PAU SHALL BE SLOPED FROM THE TOE OF THE SLOPE TO THE PUMP STATION INLET.
2. RECYCLED WATER INFRASTRUCTURE SHALL REMAIN IN SERVICE DURING CONSTRUCTION. PROTECT IN PLACE.
3. REFER TO SHEET 91C07 FOR PAU INLET PIPING ALIGNMENT AND PROFILE.
4. REFER TO SHEET 91C08 FOR PAU OUTLET PIPING ALIGNMENT AND PROFILE.
5. REFER TO SHEET 91S04 FOR PAU INLET STRUCTURE.
6. ACCESS ROAD ON TOP OF BERM SHALL CONSIST OF 6-INCHES AB OVER GEOTEXTILE FABRIC WITH 1-FOOT SUBGRADE AT 95% RC UNLESS OTHERWISE NOTED. ACCESS ROAD TO BE SEALED IN ACCORDANCE WITH SPECIFICATION SECTION 02747.
7. THE CONTRACTOR SHALL DECOMMISSION THE EXISTING BURIED ELECTRIC UTILITY BEFORE PAU CONSTRUCTION. REFER TO SPECIFICATION SECTION 01140 FOR WORK RESTRICTIONS. THE CONTRACTOR SHALL REESTABLISH THE BURIED ELECTRIC UTILITY AS SHOWN ON THE ELECTRIC SITE PLAN. REFER TO DWG 01E02.
8. 8" THICK SLAB ON GRADE WITH #5@12" O.C. EACH WAY. REFER TO DETAIL 5/91C04.
9. 8" THICK SLOPED SLAB ON GRADE (WALL) WITH #5@12" O.C. EACH WAY. REFER TO DETAIL 5/91C04 AND DETAIL 7/91C04.
10. CONSTRUCTION JOINTS IN SLAB ON GRADE SPACED AT MAXIMUM 20'-0" O.C. IN EACH DIRECTION. THE JOINTS SHALL AS PER TYPICAL DETAIL S110 WITH WATER STOP AND EXTEND THROUGH THE SLOPED SLAB ON GRADE (WALL).
11. EXPANSION JOINT PER DETAIL 6 /91C04 TYPICAL ALL AROUND THE BASIN.
12. TOP OF THE BERM CONCRETE LINER DETAIL PER DETAIL 7/91C04 TYPICAL ALL AROUND THE BASIN.
13. ADJUST CONSTRUCTION JOINT LOCATION TO ACCOMMODATE INLET STRUCTURES.

LEGEND:

CONCRETE BASIN DESIGN PER 91C03

Know what's **below.**
Call before you dig.

SCALE

0 15' 30' 60'

SCALE: 1" = 30'

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN OV
CHECKED BWA
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

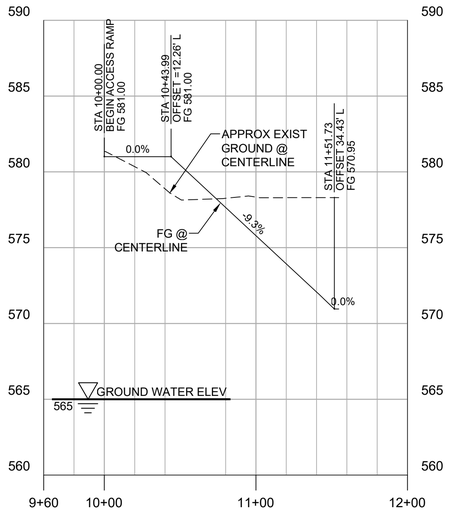
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
CIVIL
PAU GRADING PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

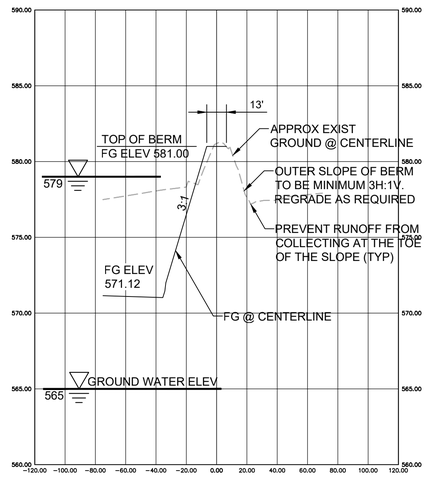
JOB NO. 8660F.10
DRAWING NO. 91C01
SHEET NO. 23 OF 200

Plot Date: 7/12/2023 11:48:50 AM
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PROJECT NO. 8660F10
LAST SAVED BY: atucker



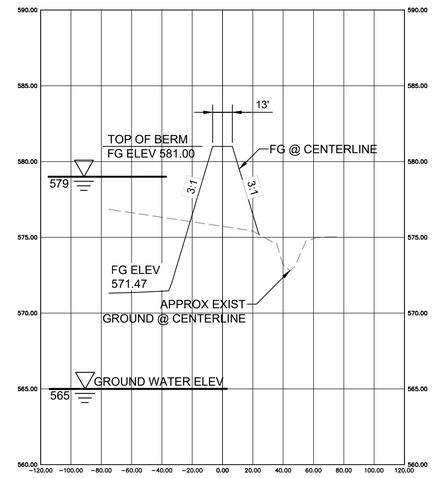
POND ACESS RAMP

A SECTION
91C01
FILE: POND AWT STORAGE.dwg



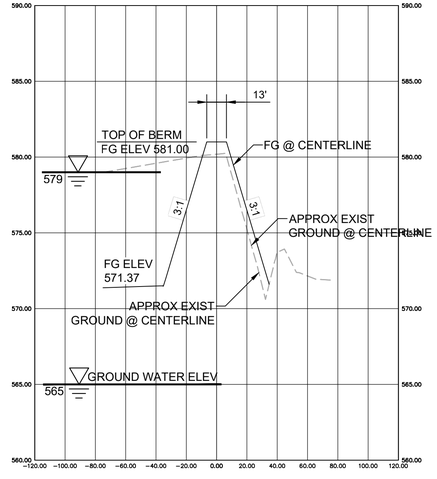
BERM SECTION STA 14+25

B SECTION
91C01
SCALE: AS NOTED
FILE: POND AWT STORAGE.dwg



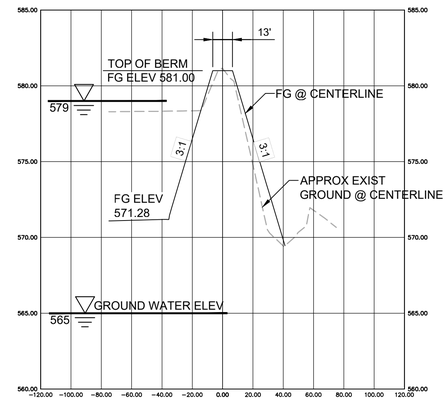
BERM SECTION STA 16+50

C SECTION
91C01
SCALE: AS NOTED
FILE: POND AWT STORAGE.dwg



BERM SECTION STA 19+50

D SECTION
91C01
SCALE: AS NOTED
FILE: POND AWT STORAGE.dwg



BERM SECTION ST 23+60

E SECTION
91C01
SCALE: AS NOTED
FILE: POND AWT STORAGE.dwg

GENERAL NOTES:

1. CONTRACTOR TO VERIFY THE HORIZONTAL AND VERTICAL LOCATIONS OF ALL EXISTING UTILITIES PRIOR TO THE START OF CONSTRUCTION AND NOTIFY THE ENGINEER OF ANY DISCREPANCIES OR CONFLICTS.
2. PAU TO BE CONSTRUCTED PER SPECIFICATION SECTIONS 02300 AND 02301.
3. CLEAR, GRUB, AND STRIP CONSTRUCTION AREAS PRIOR TO EARTHWORK ACTIVITIES PER SPECIFICATION SECTION 02200.
4. ACCESS ROAD ON TOP OF BERM SHALL CONSIST OF 6-INCH AB OVER GEOTEXTILE FABRIC WITH 1-FOOT SUBGRADE AT 95% RC UNLESS OTHERWISE NOTED. ACCESS ROAD TO BE SEALED IN ACCORDANCE WITH SPECIFICATION SECTION 02747.
5. UNPAVED AREAS OUTSIDE OF CONCRETE BASIN OR ACCESS ROAD SHALL BE GRADED TO MEET EXISTING GRADE, COMPACTED, AND RESEEDED PER SPECIFICATION SECTION 02939.
6. THE CROSS-SECTIONS ON THIS SHEET ONLY DEPICT EXISTING AND FINAL ELEVATIONS. REFER TO DRAWING 91C03 FOR CONCRETE BASIN DETAILS AND SUB-GRADE PREPARATION REQUIREMENTS.

811
Know what's **below.**
Call before you dig.

SCALE

0 25' 50' 100'
SCALE: 1" = 50' (HORIZ)

0 5' 10' 20'
SCALE: 1" = 10' (VERT)

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN JRD
CHECKED JM
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

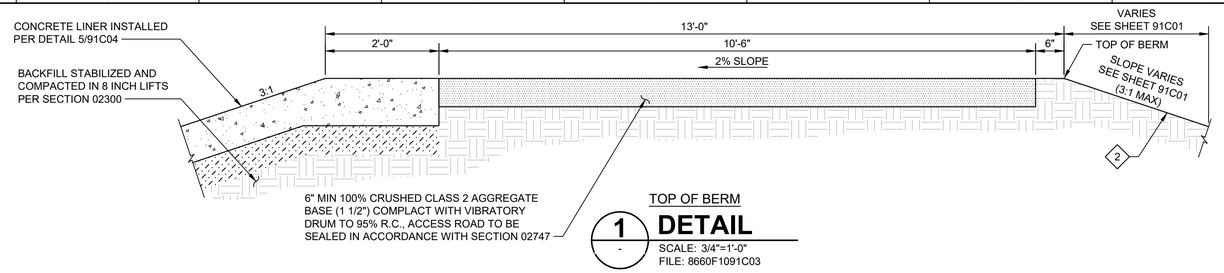
carollo

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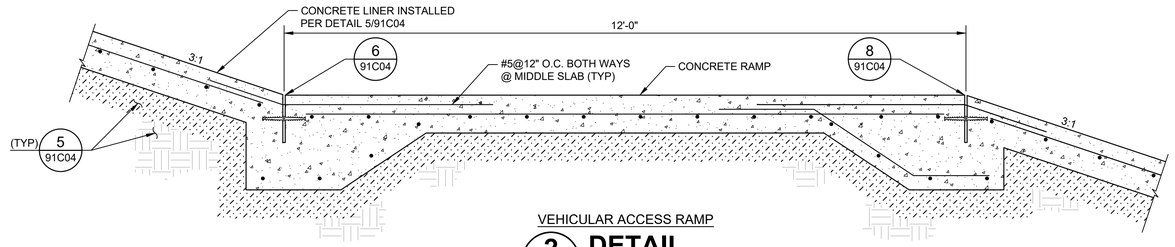
CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
CIVIL
PAU
PROFILE AND SECTIONS

VERIFY SCALES
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0 1"
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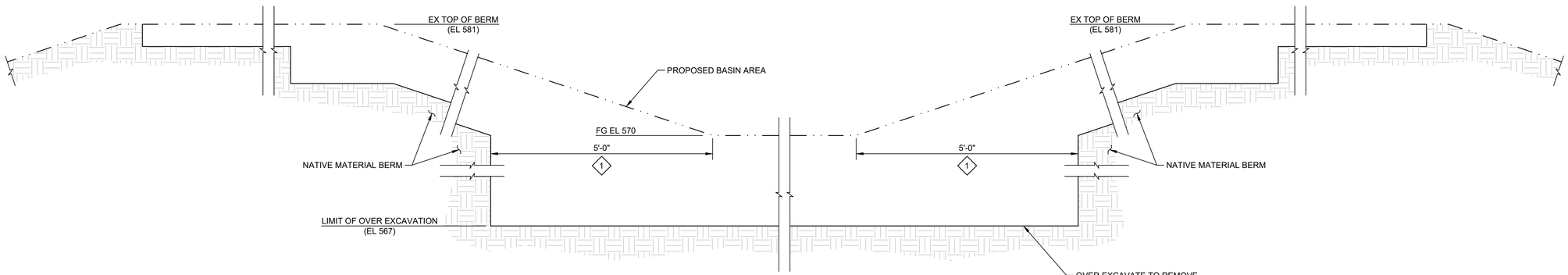
JOB NO. 8660F.10
DRAWING NO. 91C02
SHEET NO. 24 OF 200



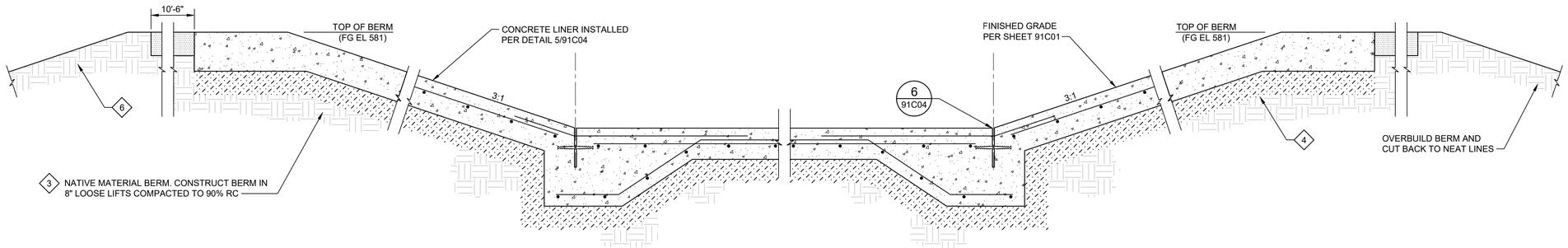
TOP OF BERM
1 DETAIL
SCALE: 3/4"=1'-0"
FILE: 8660F1091C03



VEHICULAR ACCESS RAMP
2 DETAIL
SCALE: 3/4"=1'-0"
FILE: 8660F1091C03



EXCAVATION SECTION
3 DETAIL
SCALE: 3/4"=1'-0"
FILE: 8660F1091C03



CONCRETE BASIN SECTION
4 DETAIL
SCALE: 3/4"=1'-0"
FILE: 8660F1091C03

GENERAL NOTES:

1. ACCESS ROAD ON TOP OF BERM SHALL CONSIST OF 6 INCH AB OVER GEOTEXTILE FABRIC WITH 1 FT SUBGRADE AT 95% RC UNLESS OTHERWISE NOTED. ACCESS ROAD TO BE SEALED IN ACCORDANCE WITH SPECIFICATION SECTION 02747. ALL UNPAVED AREAS WITHIN THE PROJECT SITE SHALL BE COMPACTED AND RESEEDED PER SPECIFICATIONS UNLESS OTHERWISE NOTED.
2. UNPAVED AREAS OUTSIDE OF CONCRETE BASIN OR ACCESS ROAD SHALL BE GRADED TO MEET EXISTING GRADE, COMPACTED, AND RESEEDED PER SPECIFICATION SECTION 02939.
3. CLEAR, GRUB, AND STRIP CONSTRUCTION AREAS PRIOR TO EARTHWORK ACTIVITIES PER SPECIFICATION SECTION 02200.

KEY NOTES:

1. EXTEND OVER EXCAVATION 5 FT LATERALLLY BEYOND THE EDGE OF THE BASIN BOTTOM.
2. SLOPE OUTSIDE OF BERM TO MEET EXISTING GRADE.
3. NATIVE MATERIAL, MINUS ORGANICS, DEBRIS, AND OTHER DELETERIOUS MATERIALS ARE SUITABLE FOR ENGINEERED FILL IF NOT EXCEEDING A MAXIMUM PARTICLE SIZE OF 4 INCHES. EXCAVATED MATERIALS UNSUITABLE FOR USE AS STRUCTURAL FILL CAN BE PLACED OUTSIDE OF THE STRUCTURE LIMITS, OR DISPOSED OFF-SITE.
4. BENCH FILL INTO THE EXISTING EMBANKMENT AT A MINIMUM OF 1'H:1'V OF FILL PLACED, OR AS NECESSARY TO REMOVE LOOSE MATERIAL AND PROVIDE PROPER COMPACTION ALONG THE ZONE OF TRANSITION.
5. IF IMPORTED SOIL IS REQUIRED FOR CONSTRUCTION DUE TO EXISTING BACKFILL MATERIAL BEING UNSUITABLE, THE GEOTECHNICAL ENGINEER MUST REVIEW AND APPROVE SOILS FOR USE PRIOR TO TRANSPORT TO THE SITE.
6. BERM TO BE CONSTRUCTED IN ACCORDANCE WITH SPECIFICATION SECTIONS 02300 AND 02301.

LEGEND:

- ACCESS ROAD FILL
- AGGREGATE BASE
- CONCRETE
- EXISTING BACKFILL

811
Know what's **below.**
Call before you dig.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN JRD
CHECKED JM
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

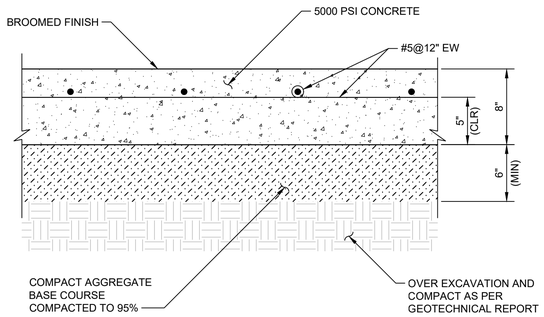
carollo

City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
CIVIL
PAU DETAILS 1

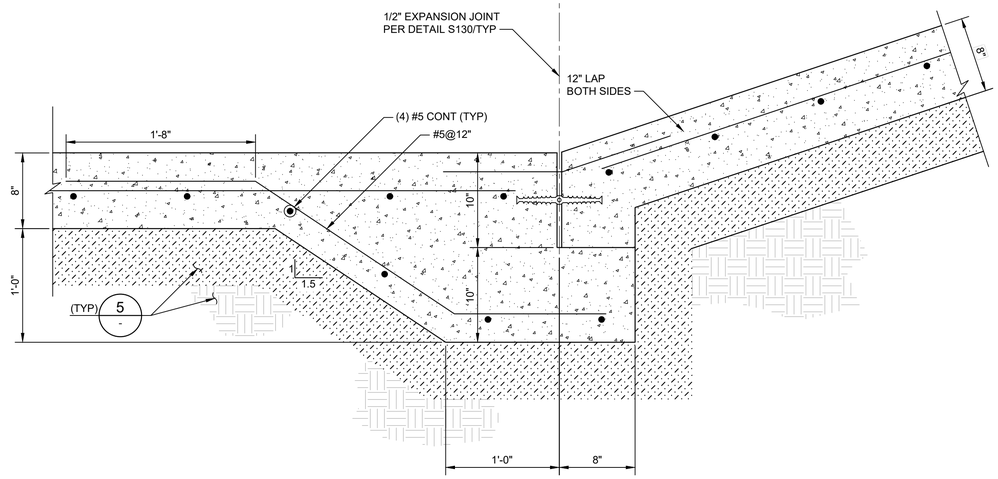
VERIFY SCALES
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JOB NO. 8660F.10
DRAWING NO. 91C03
SHEET NO. 25 OF 200

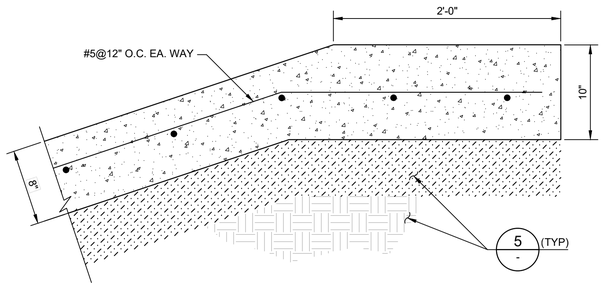


CONCRETE PAVEMENT

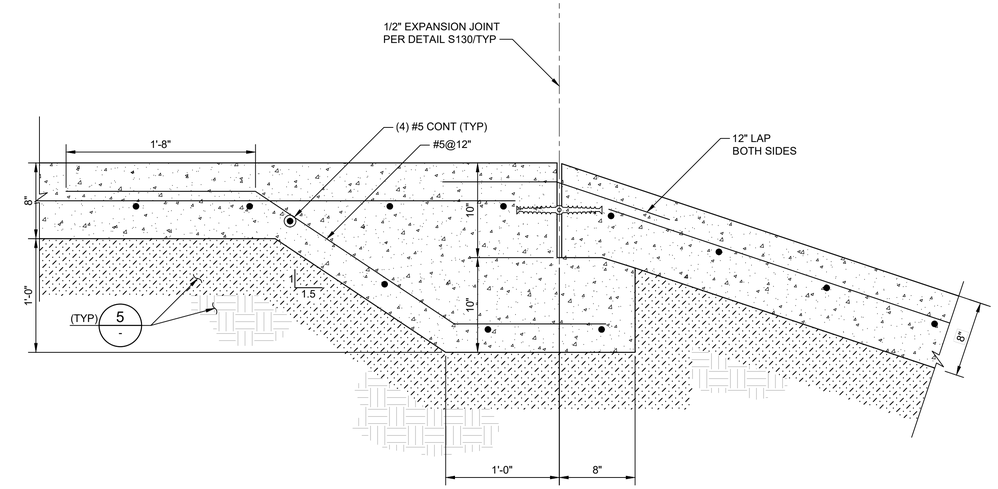
5 DETAIL
91C03 SCALE: 1 1/2"=1'-0"
FILE: 8660F1091C04



6 DETAIL
91C03 SCALE: 1 1/2"=1'-0"
FILE: 8660F1091C04



7 DETAIL
91C03 SCALE: 1 1/2"=1'-0"
FILE: 8660F1091C04



8 DETAIL
91C03 SCALE: 1 1/2"=1'-0"
FILE: 8660F1091C04

GENERAL NOTES:

1. ACCESS ROAD ON TOP OF BERM SHALL CONSIST OF 6 INCH AB OVER GEOTEXTILE FABRIC WITH 1 FT SUBGRADE AT 95% RC UNLESS OTHERWISE NOTED. ACCESS ROAD TO BE SEALED IN ACCORDANCE WITH SPECIFICATION SECTION 02747. ALL UNPAVED AREAS WITHIN THE PROJECT SITE SHALL BE COMPACTED AND RESEEDED PER SPECIFICATIONS UNLESS OTHERWISE NOTED.
2. UNPAVED AREAS OUTSIDE OF CONCRETE BASIN OR ACCESS ROAD SHALL BE GRADED TO MEET EXISTING GRADE, COMPACTED, AND RESEEDED PER SPECIFICATION SECTION 02939.
3. CLEAR, GRUB, AND STRIP CONSTRUCTION AREAS PRIOR TO EARTHWORK ACTIVITIES PER SPECIFICATION SECTION 02200.

LEGEND:

AGGREGATE BASE

CONCRETE

EXISTING BACKFILL

811 Know what's **below.** **Call** before you dig.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN JRD
CHECKED JM
DATE JULY 2023

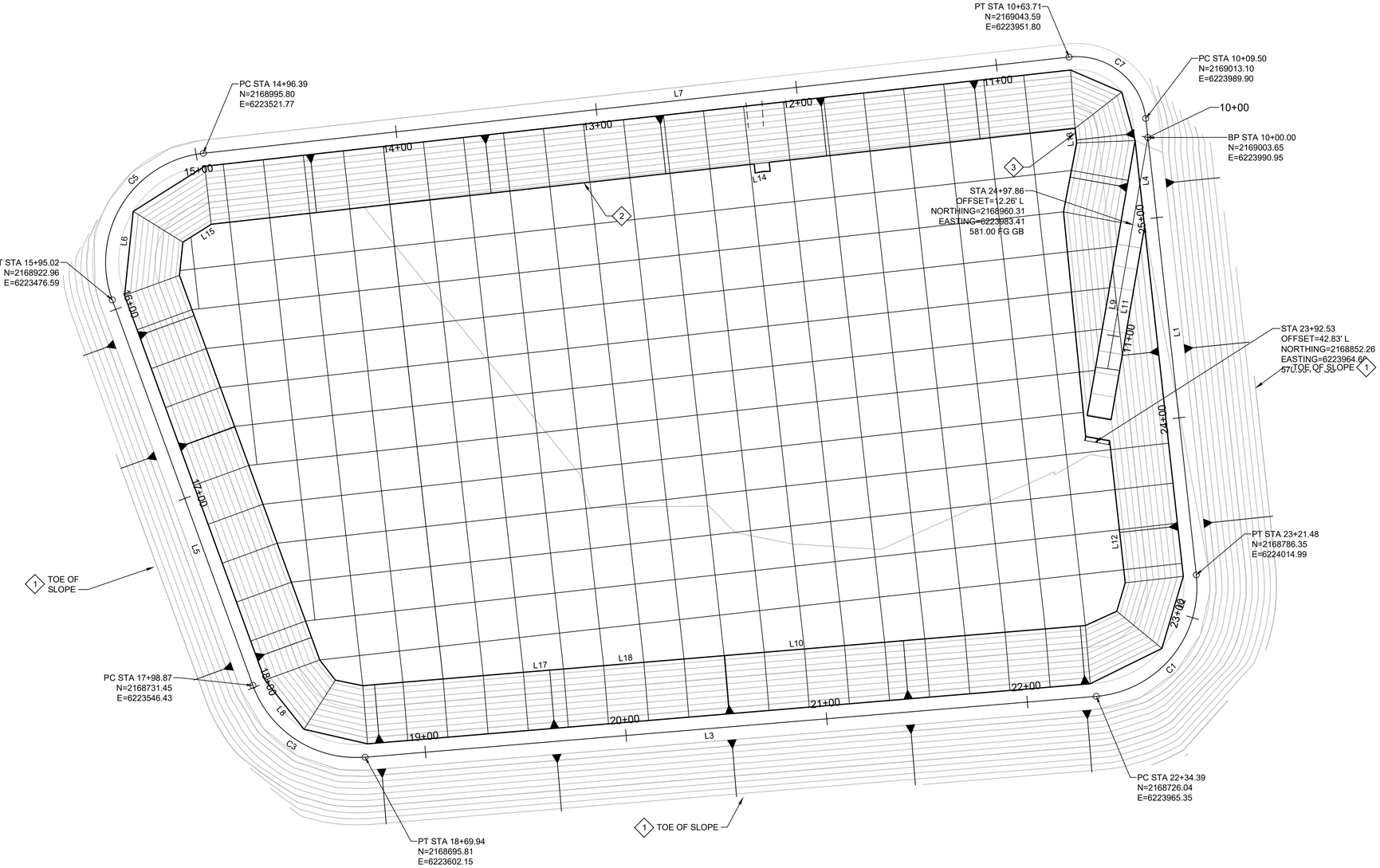
** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
CIVIL
PAU DETAILS 2

VERIFY SCALES
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JOB NO. 8660F.10
DRAWING NO. 91C04
SHEET NO. 26 OF 200

LAST SAVED BY: alucker



PLAN

FILE: 8660F10C04

Curve Table

Curve #	Length	Radius	Delta
C1	97.48	61.00	91.56
C3	79.55	61.00	74.72
C5	40.20	61.00	37.76
C7	64.42	41.00	90.03

Line Table

Line #	Length	Direction
L1	210.34	N6° 18' 52.04"W
L2	37.34	S16° 34' 28.96"W
L3	364.45	N85° 14' 31.97"E
L4	43.05	S6° 18' 52.04"E
L5	203.84	S20° 02' 13.69"E
L6	41.97	N5° 53' 12.34"E
L7	134.27	S83° 39' 30.43"W
L8	31.23	N38° 25' 10.85"W
L9	96.77	S9° 52' 16.31"W
L10	39.31	N85° 14' 31.97"E
L11	96.77	N9° 52' 16.31"E
L12	25.16	N6° 17' 51.03"W
L13	5.85	N6° 18' 52.04"W
L14	3.52	S78° 13' 05.23"W
L15	16.59	S57° 44' 59.02"W
L17	14.93	N85° 14' 31.97"E
L18	87.28	N85° 14' 31.97"E

GENERAL NOTES:

1. REFER TO 91C01 FOR PAU GRADING PLAN.
2. THE PLAN DEPICTS FINISHED GRADE AND DIMENSIONS. REFER TO 91C04 FOR CONCRETE BASIN AND SUBGRADE DESIGN DETAILS.

KEY NOTES:

1. LIMIT OF GRADING SHOWN. THE BERM OUTSIDE OF THE ACCESS ROAD SHOULD BE SLOPED AT 1V:3H TO MEET THE EXISTING GRADE. REFER TO DRAWING 91C04 FOR TYPICAL BERM DETAILS.
2. REFER TO DRAWING 91C06 FOR PUMP STATION AND INLET LOCATIONS.
3. REFER TO DRAWING 91C07 FOR PUMP STATION AND INLET LOCATIONS.

811 Know what's **below.** **Call** before you dig.

SCALE

0 15' 30' 60'

SCALE: 1" = 30'

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN JRD
CHECKED JM
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

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City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

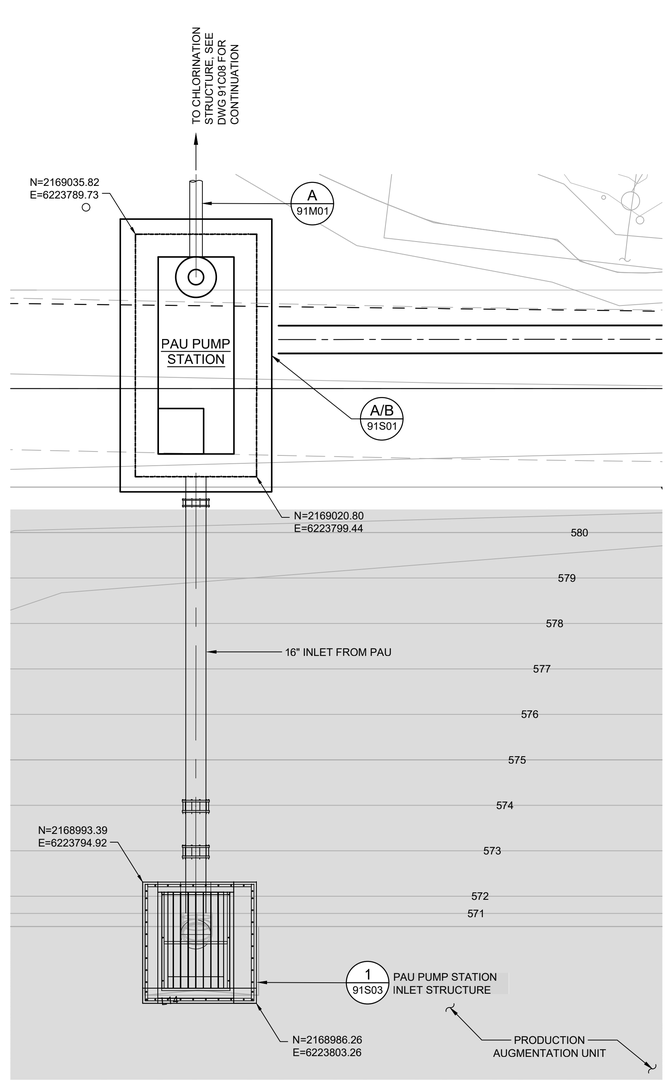
CIVIL

PAU SURVEY CONTROL PLAN

VERIFY SCALES
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0 1"
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JOB NO. 8660F.10
DRAWING NO. 91C05
SHEET NO. 27 OF 200

Plot Date: 7/12/2023 11:49:02 AM
FILE NAME: 8660F1091C05.dwg
PROJECT NO. 8660F10
LAST SAVED BY: atucker



SITE

A PLAN

SCALE: 1" = 5'
FILE: 8660F1073C0801

GENERAL NOTES:

1. REFER TO DRAWING 91S01 FOR PUMP STATION DIMENSIONS.

LEGEND:

CONCRETE BASIN DESIGN PER 91C03

Know what's **below.**
Call before you dig.

SCALE

0 2.5' 5' 10'
SCALE: 1" = 5'

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN JRD
CHECKED BWA
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

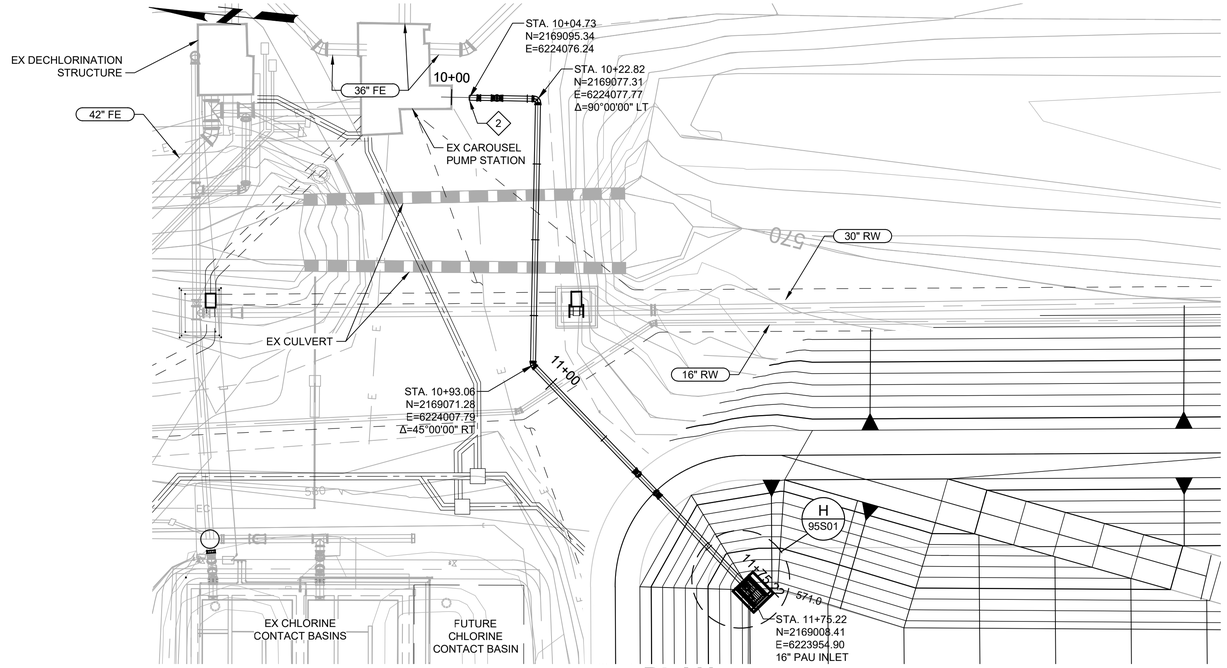
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
CIVIL
PAU PUMP STATION PLAN

VERIFY SCALES
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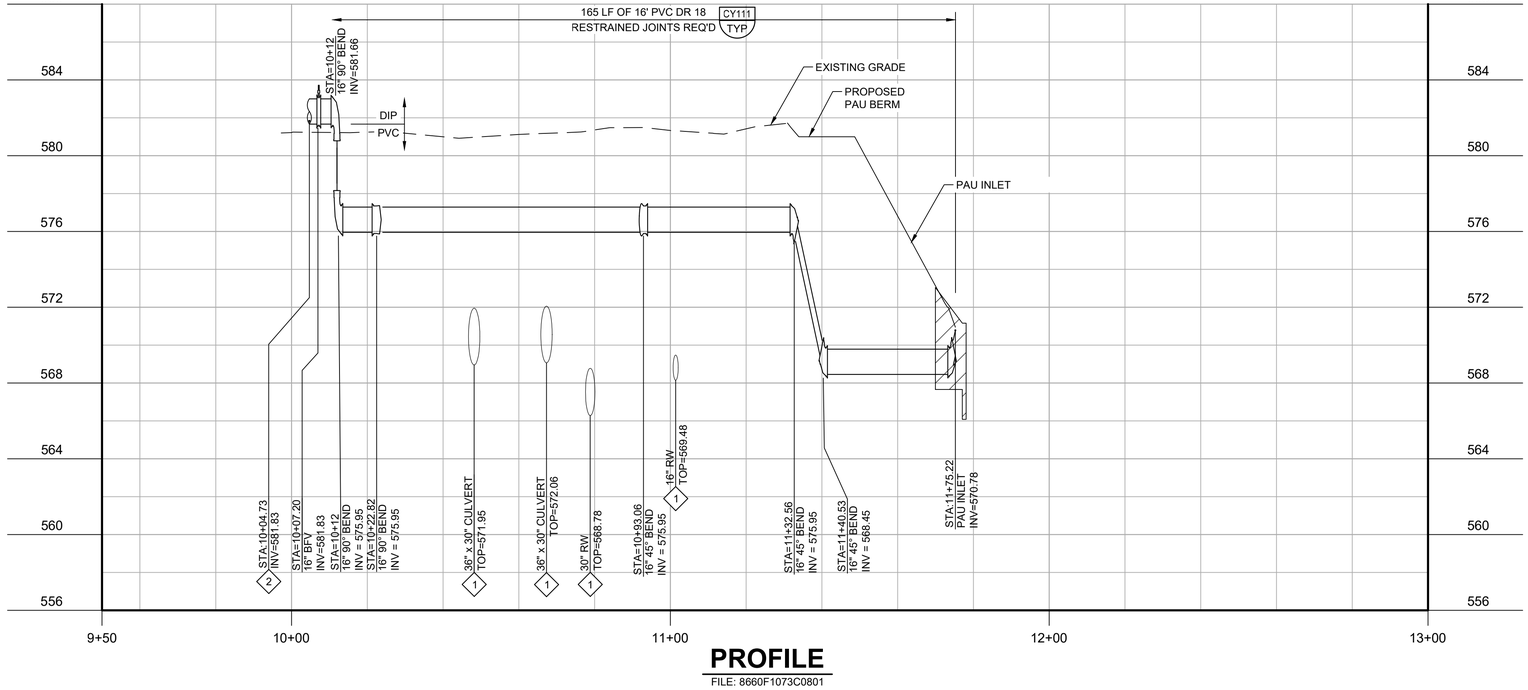
JOB NO. 8660F.10
DRAWING NO. 91C06
SHEET NO. 28 OF 200

Plot Date: 7/12/2023 11:49:31 AM
FILE NAME: 8660F1091C06.dwg
PROJECT NO. 8660F10
LAST SAVED BY: atucker



PLAN

FILE: 8660F1073C0801



PROFILE

FILE: 8660F1073C0801

GENERAL NOTES:

1. CONTRACTOR TO VERIFY ALL CROSSINGS PRIOR TO CONSTRUCTION.

KEY NOTES:

1. CROSSING DEPTH UNKNOWN. CONTRACTOR TO VERIFY PRIOR TO EXCAVATION.
2. REFER TO DRAWING 89M01 FOR CONTINUATION AND CONNECTION TO PUMP STATION.

811 Know what's **below.** **Call** before you dig.

SCALE

0 10' 20' 40'
SCALE: 1" = 20' (HORIZ)

0 5' 10' 20'
SCALE: 1" = 10' (VERT)

REV	DATE	BY	DESCRIPTION

CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN JRD
CHECKED JM
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

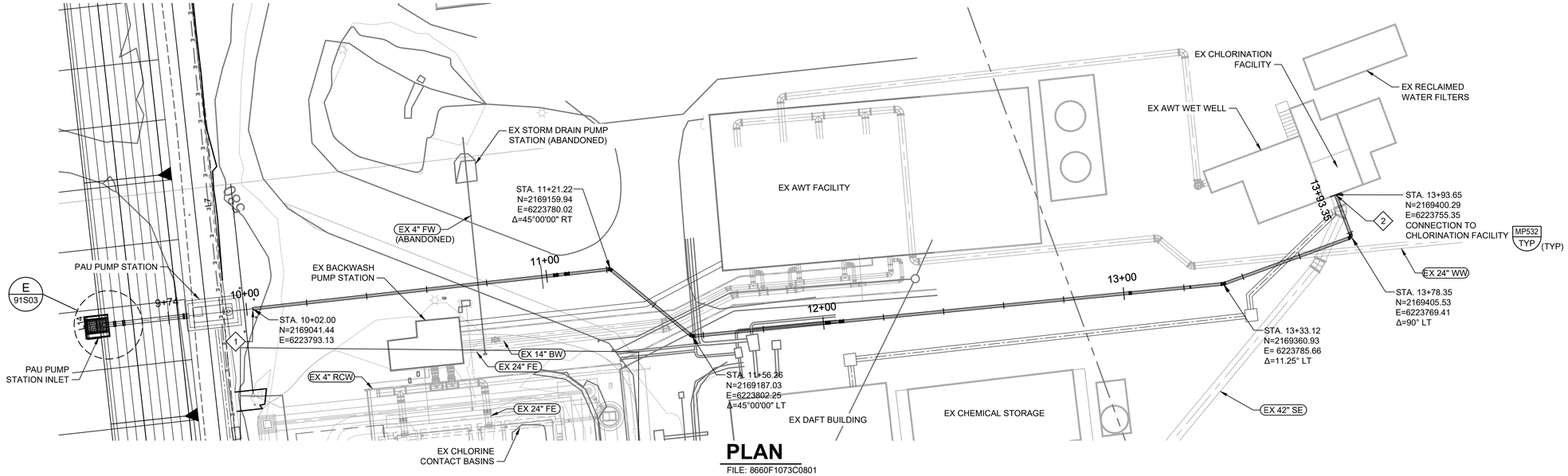
CIVIL

PLAN AND PROFILE
PAU INLET YARD PIPING

VERIFY SCALES
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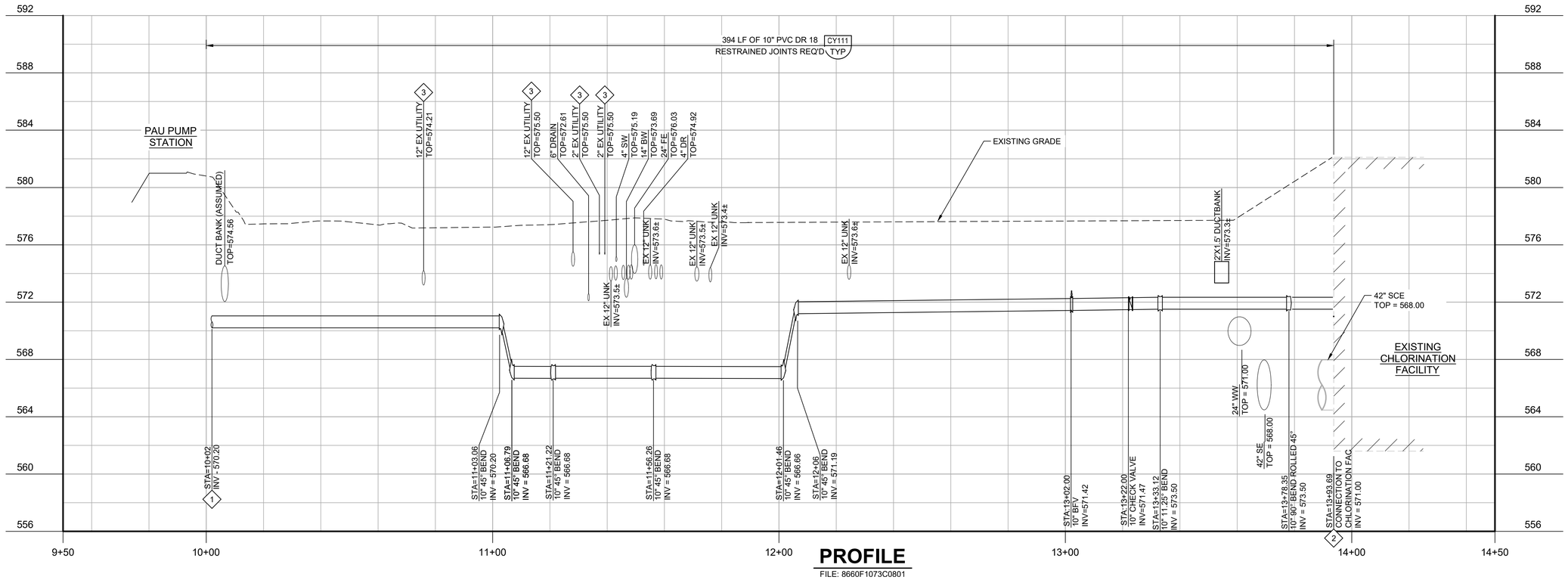
JOB NO. 8660F.10
DRAWING NO. 91C07
SHEET NO. 29 OF 200

Plot Date: 7/12/2023 11:50:00 AM
FILE NAME: 8660F1091C07.dwg
PROJECT NO. 8660F10
LAST SAVED BY: JDiDonato



PLAN

FILE: 8660F1073C0801



PROFILE

FILE: 8660F1073C0801

GENERAL NOTES:

1. CONTRACTOR TO VERIFY ALL UTILITY OR PIPE CROSSINGS PRIOR TO CONSTRUCTION.

KEY NOTES:

1. REFER TO DRAWING 91M01 FOR CONTINUATION AND CONNECTION TO PUMP STATION.
2. SEE DETAIL P300/TYP FOR CONNECTION TO EXISTING WET WELL. CONTRACTOR TO VERIFY CONNECTION POINT AND SUPPORT ADJACENT YARD PIPING WHILE EXCAVATING. CONNECTION LOCATION SHOULD NOT INTERFERE WITH EXISTING EFFLUENT FLOW TRANSMITTER.
3. CROSSING DEPTH UNKNOWN. CONTRACTOR TO VERIFY PRIOR TO EXCAVATION.

811 Know what's **below.** **Call** before you dig.

SCALE

0 10' 20' 40'
SCALE: 1" = 20' (HORIZ)

0 2' 4' 8'
SCALE: 1" = 4' (VERT)

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN JDM
CHECKED JM
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

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City of Ukiah

CITY OF UKIAH

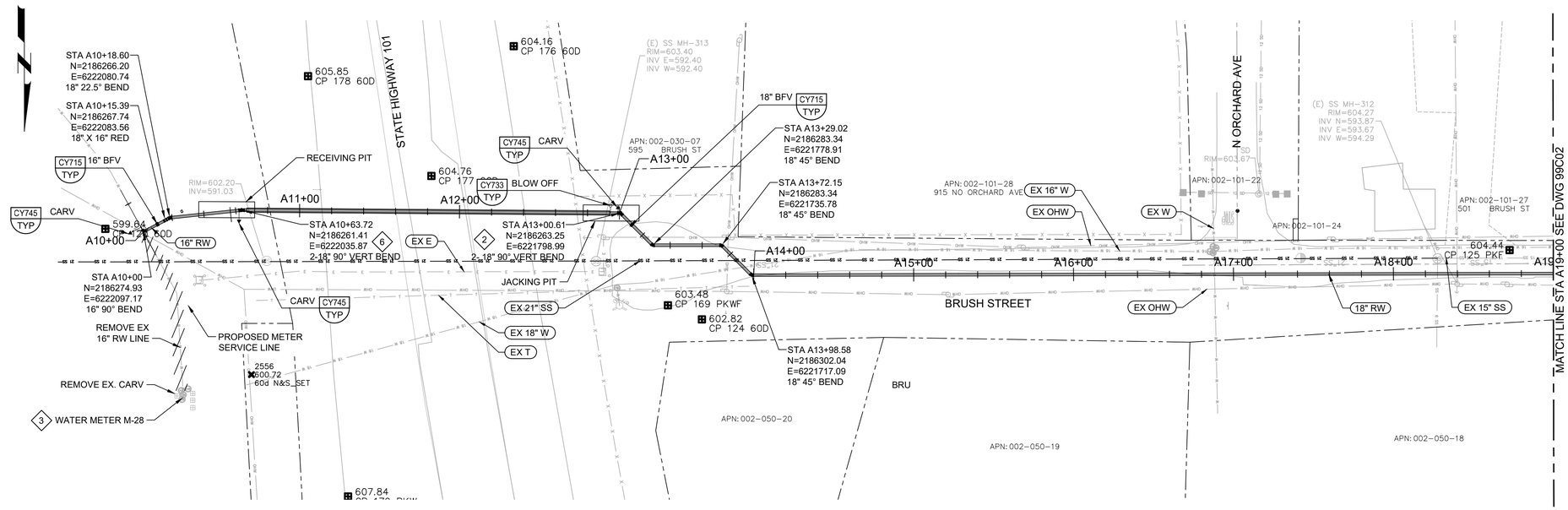
RECYCLED WATER PROJECT - PHASE 4

CIVIL

PLAN AND PROFILE
PAU OUTLET YARD PIPING

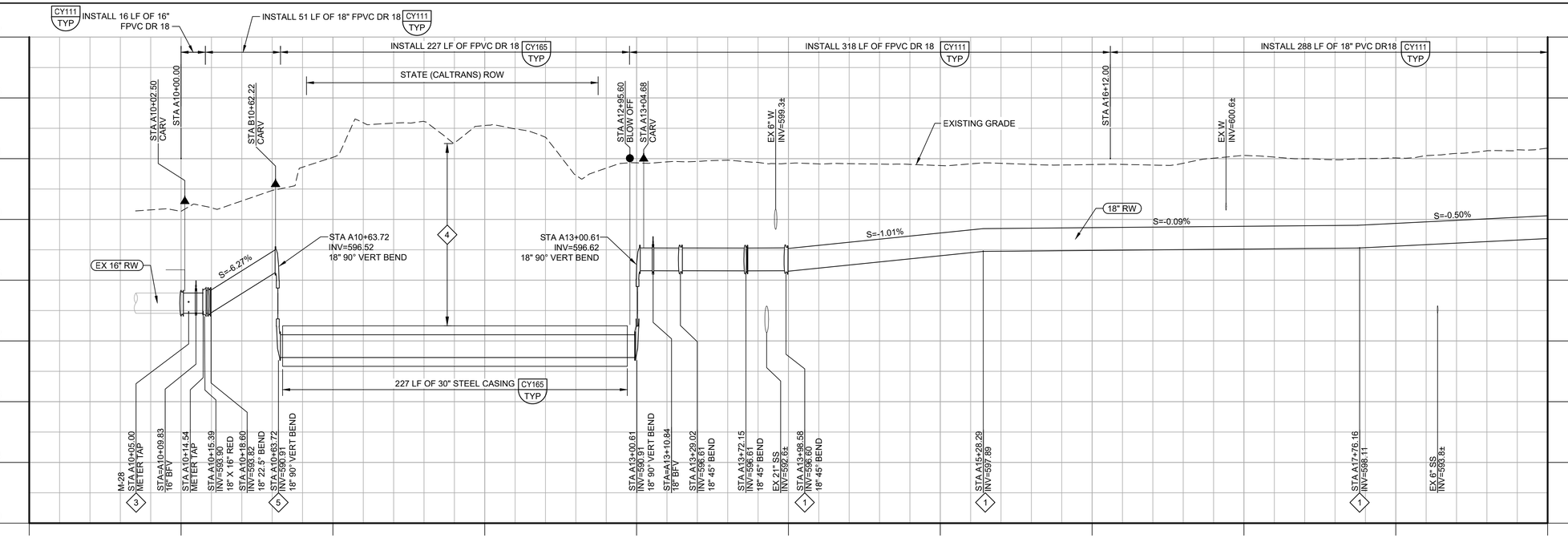
VERIFY SCALES
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JOB NO. 8660F.10
DRAWING NO. 91C08
SHEET NO. 30 OF 200



PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

GENERAL NOTES:

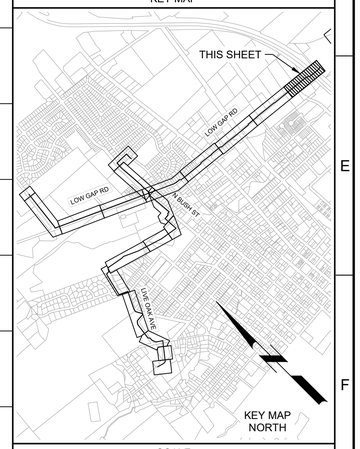
1. SEE RECYCLED WATER PROJECT PHASE 1 TO 3 PLANS FOR EXISTING RW PIPE ALIGNMENT.
2. CONTRACTOR TO DETERMINE FINAL LAUNCHING AND RECEIVING PIT SIZE.
3. CONTRACTOR TO VERIFY ALL UTILITY CROSSINGS PRIOR TO CONSTRUCTION.
4. CONTRACTOR TO ASSUME THAT ANY VERTICAL BENDS SHOWN ON THE PLANS ARE ROTATED FROM THE CORRESPONDING HORIZONTAL BENDS UNLESS NOTED OTHERWISE.

KEY NOTES:

1. VERTICAL BEND ACHIEVED BY PULLING JOINTS IN PIPE. MAXIMUM ALLOWED DEFLECTION IS HALF OF THE MANUFACTURER'S SPECIFIED DEFLECTION CONTRACTOR MAY DEFLECT MORE THAN ONE JOINT TO ACHIEVE TOTAL DEFLECTION.
2. HORIZONTAL ALIGNMENT CHANGE ACHIEVED BY ROTATING VERTICAL 90 DEGREE BEND 45 DEGREES
3. EXISTING WATER METER INSTALLED AS PART OF PHASE 3 SCOPE, SHALL BE REUSED AND REINSTALLED DURING PHASE 4 CONSTRUCTION.
4. MAINTAIN MINIMUM 12 FT CLEARANCE BETWEEN GRADE AND TOP OF CASING.
5. VERTICAL BEND ACHIEVED BY ROLLING HORIZONTAL BEND 8.7 DEGREES.
6. HORIZONTAL ALIGNMENT CHANGE ACHIEVED BY ROTATING VERTICAL 90 DEGREE BEND 6.5 DEGREES.

811 Know what's **below.** **Call** before you dig.

KEY MAP



SCALE

0 20' 40' 80'
SCALE: 1" = 40' (HORIZ)

0 2' 4' 8'
SCALE: 1" = 4' (VERT)

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN BH
CHECKED JM
DATE JULY 2023

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City of Ukiah

CITY OF UKIAH

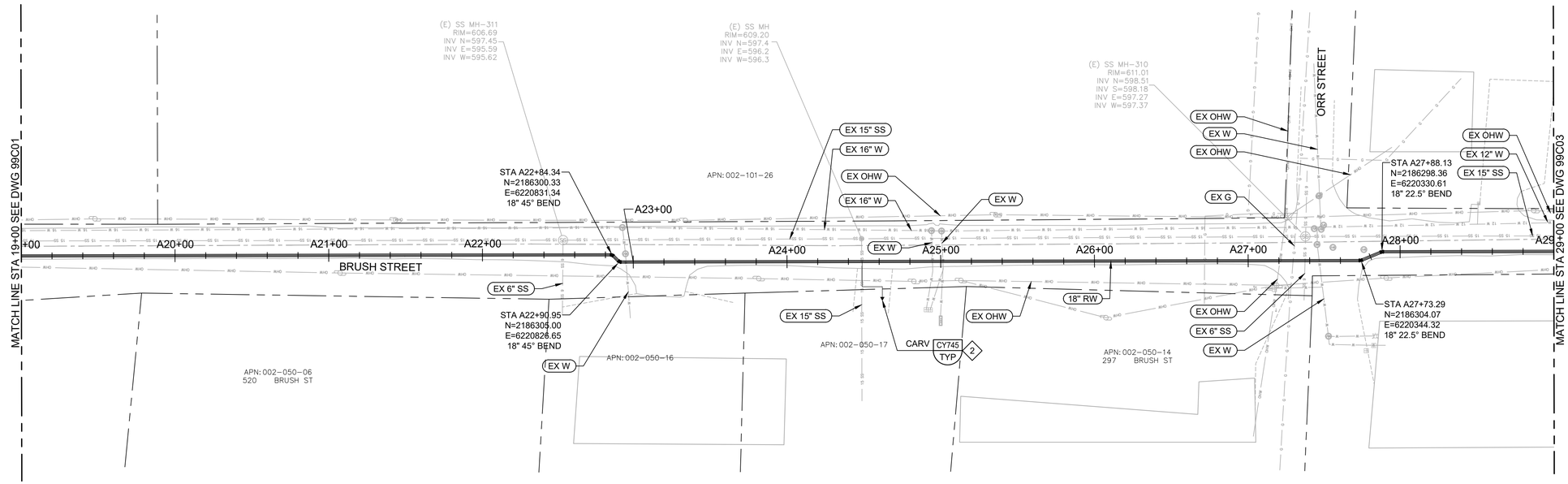
RECYCLED WATER PROJECT - PHASE 4

CIVIL

PLAN AND PROFILE ALIGNMENT A STA A09+40 TO A19+00

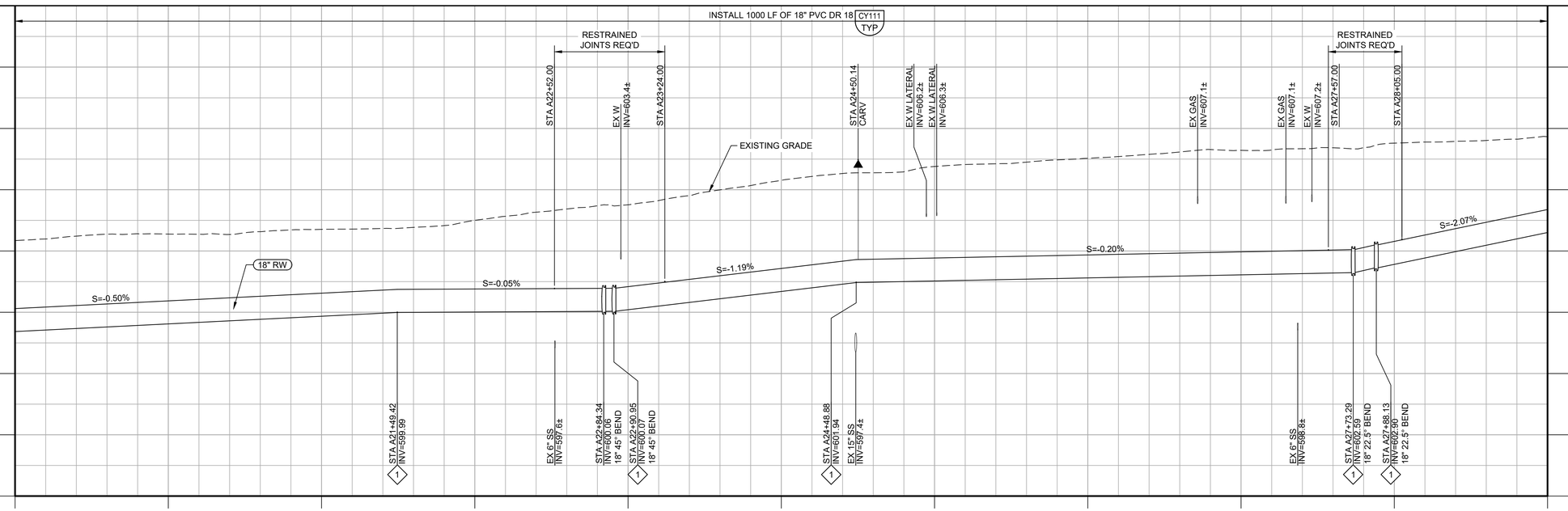
VERIFY SCALES
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JOB NO. 8660F.10
DRAWING NO. 99C01
SHEET NO. 31 OF 200



PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

GENERAL NOTES:

1. THE CONTRACTOR SHALL ASSUME THAT ANY VERTICAL BENDS SHOWN ARE ROTATED FROM CORRESPONDING HORIZONTAL BENDS UNLESS NOTED OTHERWISE.
2. CONTRACTOR TO VERIFY ALL UTILITY CROSSINGS PRIOR TO CONSTRUCTION.

KEY NOTES:

1. VERTICAL BEND ACHIEVED BY PULLING JOINTS IN PIPE. MAXIMUM ALLOWED DEFLECTION IS HALF OF THE MANUFACTURER'S SPECIFIED DEFLECTION CONTRACTOR MAY DEFLECT MORE THAN ONE JOINT TO ACHIEVE TOTAL DEFLECTION.
2. LOCATE ARV MINIMUM 15 FEET FROM SANITARY SEWER.

811 Know what's **below.** **Call** before you dig.

KEY MAP



SCALE

0 20' 40' 80'
SCALE: 1" = 40' (HORIZ)

0 2' 4' 8'
SCALE: 1" = 4' (VERT)

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN BH
CHECKED BWA
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

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City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

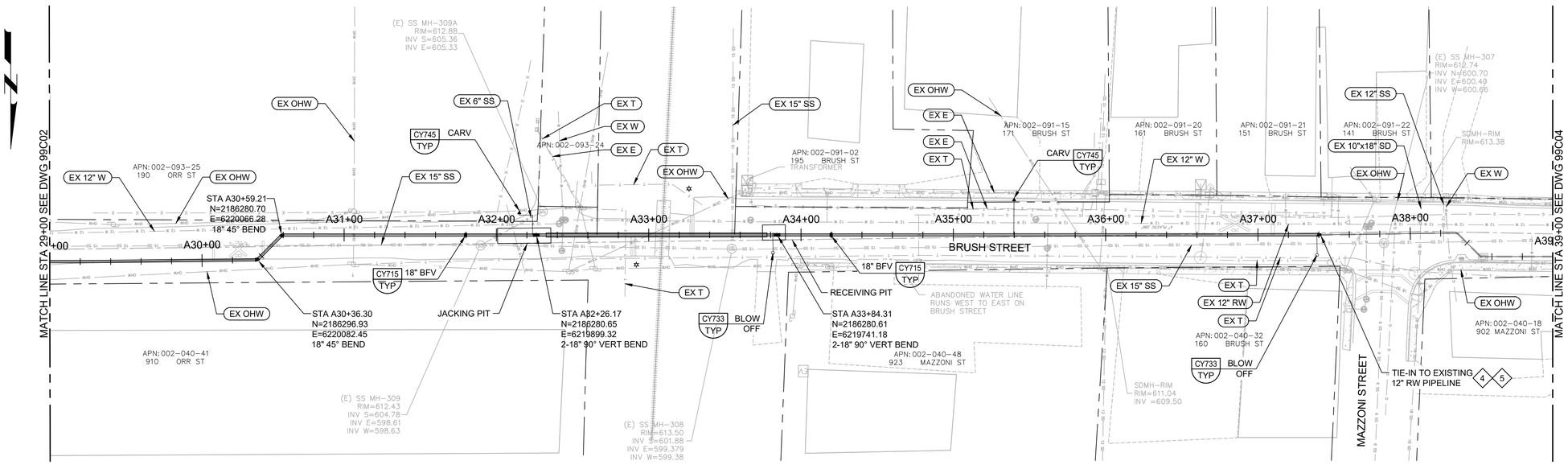
CIVIL

PLAN AND PROFILE ALIGNMENT A
STA A19+00 TO STA A29+00

VERIFY SCALES
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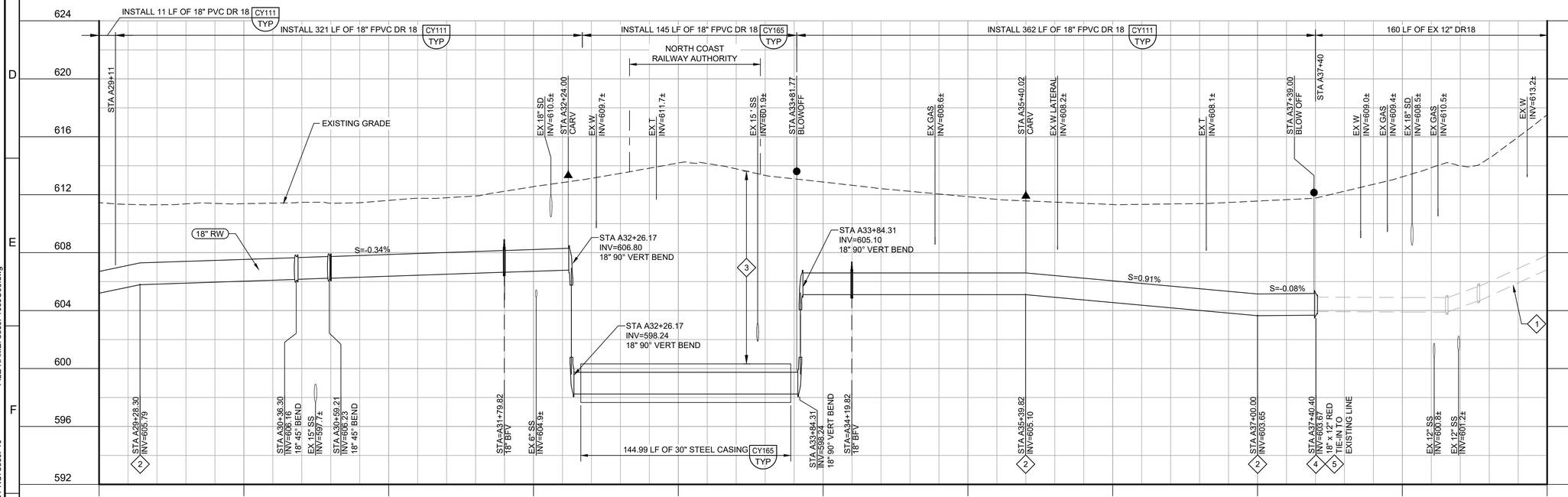
JOB NO. 8660F.10
DRAWING NO. 99C02
SHEET NO. 32 OF 200

Plot Date: 7/12/2023 11:47:26 AM
FILE NAME: 8660F1099C02.dwg
PROJECT NO. 8660F10
LAST SAVED BY: JDiDonato



PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

GENERAL NOTES:

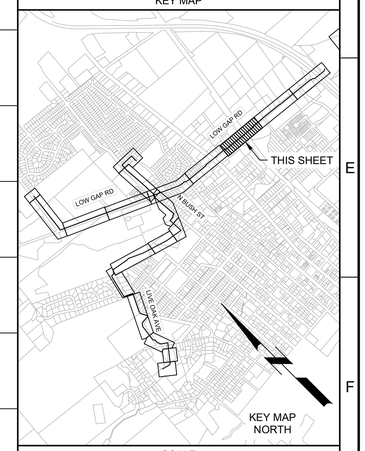
1. CONTRACTOR TO DETERMINE FINAL JACKING AND RECEIVING PIT SIZE.
2. CONTRACTOR TO VERIFY ALL UTILITY CROSSINGS PRIOR TO CONSTRUCTION.
3. THE CONTRACTOR SHALL ASSUME THAT ANY VERTICAL BENDS SHOWN ARE ROTATED FROM CORRESPONDING HORIZONTAL BENDS UNLESS NOTED OTHERWISE.

KEY NOTES:

1. SEE CITY AS BUILTS FOR EXISTING 12" RW ALIGNMENT INFORMATION. CONTRACTOR SHALL CONFIRM EXISTING JOINT RESTRAINT PRIOR TO OPEN CUT EXCAVATION. IF JOINT RESTRAINT IS NOT PRESENT, CONTRACTOR SHALL INSTALL JOINT RESTRAINTS OF SUFFICIENT LENGTH.
2. VERTICAL BEND ACHIEVED BY PULLING JOINT IN PIPE. MAXIMUM ALLOWED DEFLECTION IS HALF OF THE MANUFACTURER'S SPECIFIED DEFLECTION. CONTRACTOR MAY DEFLECT MORE THAN ONE JOINT TO ACHIEVE TOTAL DEFLECTION.
3. MAINTAIN MINIMUM 12 FT CLEARANCE BETWEEN GRADE AND TOP OF CASING.
4. CONTRACTOR TO VERIFY EXACT TIE-IN LOCATION TO EXISTING 12 INCH RW LINE PRIOR TO CONSTRUCTION.
5. REMOVE EXISTING CAP.

811 Know what's **below.** **Call** before you dig.

KEY MAP



SCALE

0 20' 40' 80'
SCALE: 1" = 40' (HORIZ)

0 2' 4' 8'
SCALE: 1" = 4' (VERT)

CONFORMED DOCUMENTS

REV	DATE	BY	DESCRIPTION

DESIGNED CDA
DRAWN BH
CHECKED JM
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

City of Ukiah

CITY OF UKIAH

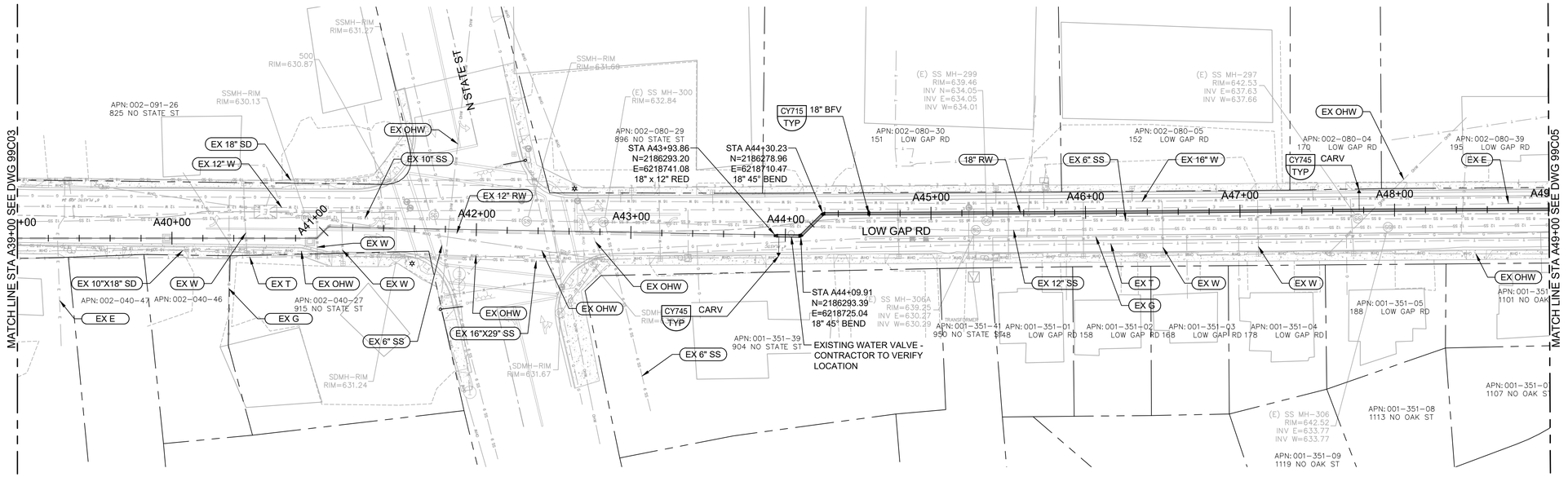
RECYCLED WATER PROJECT - PHASE 4

CIVIL

PLAN AND PROFILE ALIGNMENT A
STA A29+00 TO STA A39+00

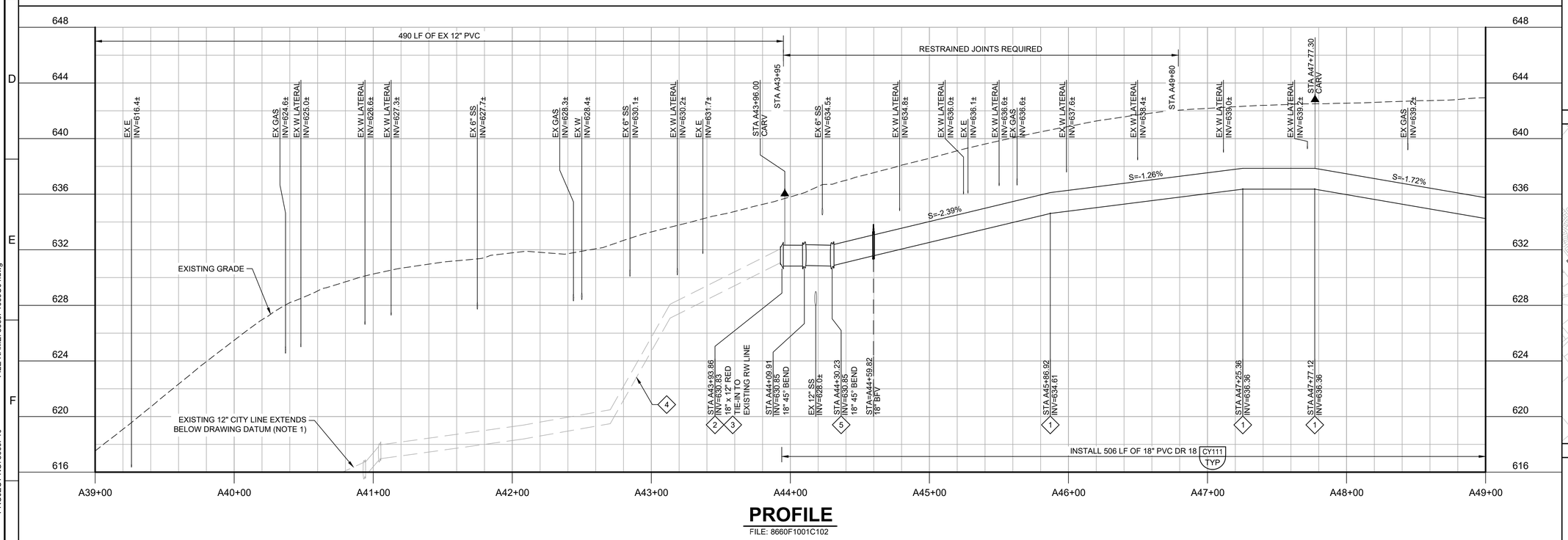
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99C03
SHEET NO. 33 OF 200



PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

GENERAL NOTES:

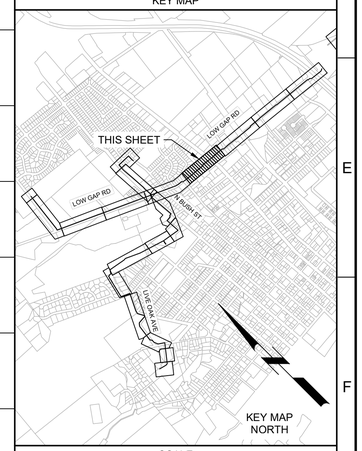
1. SEE CITY AS BUILTS FOR EXISTING 12 INCH RW ALIGNMENT AND PIPE INFORMATION.
2. CONTRACTOR TO VERIFY ALL UTILITY CROSSINGS PRIOR TO CONSTRUCTION.
3. THE CONTRACTOR SHALL ASSUME THAT ANY VERTICAL BENDS SHOWN ARE ROTATED FROM CORRESPONDING HORIZONTAL BENDS UNLESS NOTED OTHERWISE.

KEY NOTES:

1. VERTICAL BEND ACHIEVED BY PULLING JOINT IN PIPE. MAXIMUM ALLOWED DEFLECTION IS HALF OF THE MANUFACTURER'S SPECIFIED DEFLECTION. CONTRACTOR MAY DEFLECT MORE THAN ONE JOINT TO ACHIEVE TOTAL DEFLECTION.
2. CONTRACTOR TO VERIFY EXACT TIE-IN LOCATION TO EXISTING 12 INCH RW LINE PRIOR TO CONSTRUCTION. CONTRACTOR SHALL CONFIRM EXISTING JOINT RESTRAINT PRIOR TO OPEN CUT EXCAVATION. IF JOINT RESTRAINT IS NOT PRESENT, CONTRACTOR SHALL INSTALL JOINT RESTRAINTS OF SUFFICIENT LENGTH.
3. REMOVE EXISTING CAP.
4. SEE CITY AS BUILTS FOR EXISTING 12" RW ALIGNMENT AND PIPE INFORMATION.
5. VERTICAL BEND ACHIEVED BY ROLLING HORIZONTAL BEND.

811 Know what's below. Call before you dig.

KEY MAP



SCALE

0 20' 40' 80'
SCALE: 1" = 40' (HORIZ)

0 2' 4' 8'
SCALE: 1" = 4' (VERT)

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN BH
CHECKED JM
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

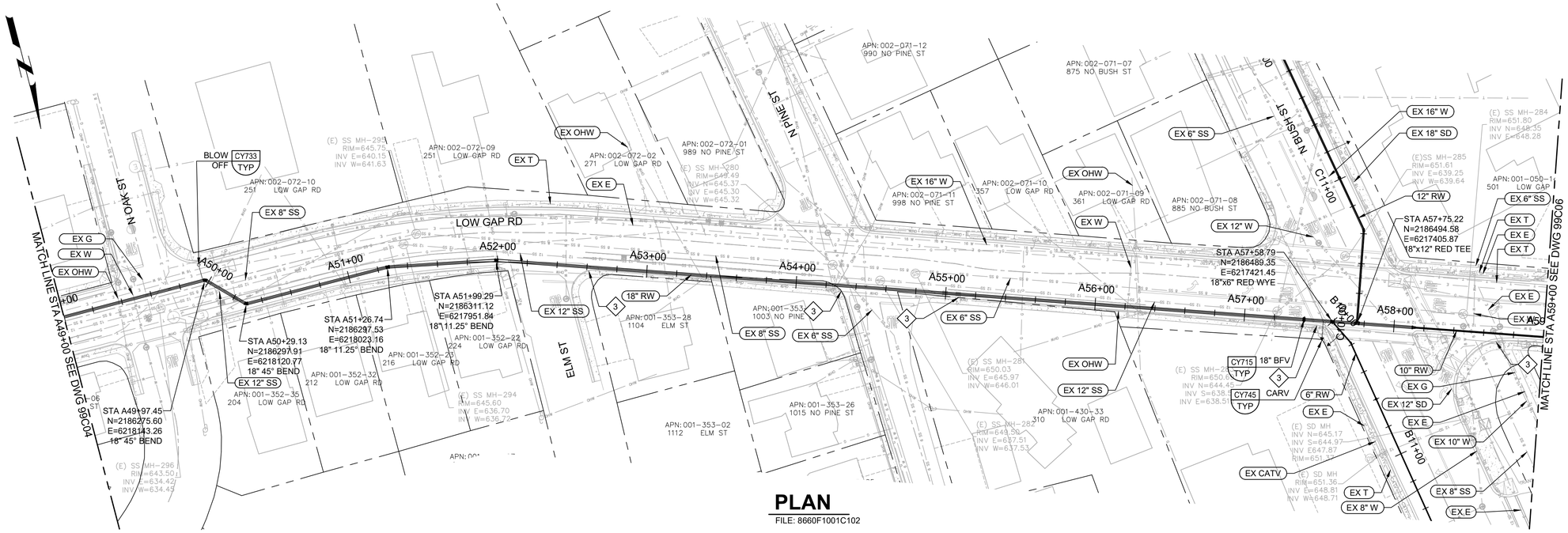
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
CIVIL
PLAN AND PROFILE ALIGNMENT A STA A39+00 TO STA A49+00

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

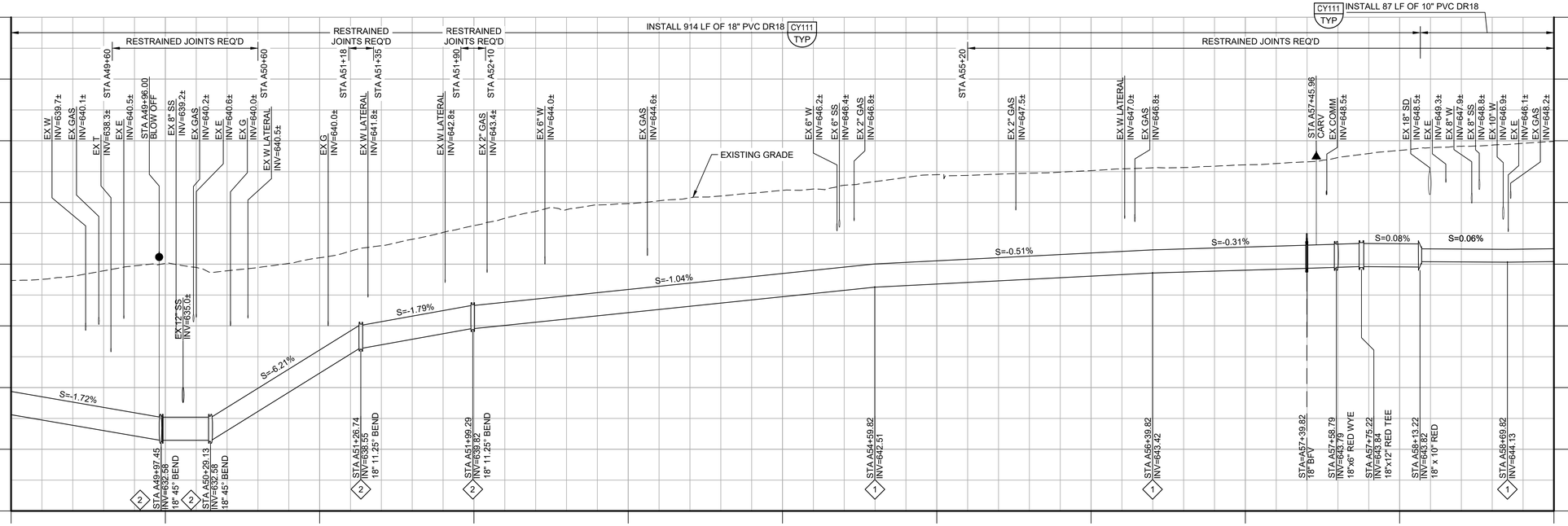
JOB NO. 8660F.10
DRAWING NO. 99C04
SHEET NO. 34 OF 200

Plot Date: 7/12/2023 11:48:00 AM



PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

GENERAL NOTES:

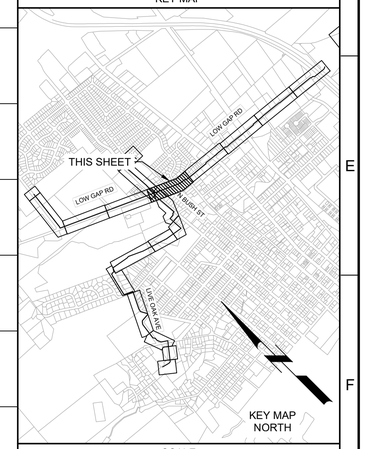
1. CONTRACTOR TO VERIFY ALL UTILITY CROSSINGS PRIOR TO CONSTRUCTION.
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3. CONTRACTOR TO REPLACE ALL ROAD STRIPING DAMAGED BY PIPELINE REPLACEMENT PER SECTION 02762. CONTRACTOR SHALL REPLACE ENTIRETY OF DAMAGED STRIPING.

KEY NOTES:

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2. VERTICAL BEND ACHIEVED BY ROLLING HORIZONTAL BEND.
3. CONTRACTOR SHALL REPLACE ANY CURB AND GUTTER THAT IS DAMAGED AS A RESULT OF PIPELINE INSTALLATION. REPLACE PER CITY OF UKIAH STANDARD SPECIFICATIONS AND SECTION 02772.
4. CONTRACTOR SHALL PROTECT EXISTING SSMH DURING PIPELINE INSTALLATION. REPLACE IF DAMAGED. ADJUST PIPELINE ALIGNMENT AS REQUIRED.
5. CONTRACTOR SHALL PROTECT EXISTING VALVE DURING PIPELINE INSTALLATION. REPLACE IF DAMAGED. ADJUST PIPELINE ALIGNMENT AS REQUIRED.

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KEY MAP



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SCALE: 1" = 4' (VERT)

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN BH
CHECKED BWA
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

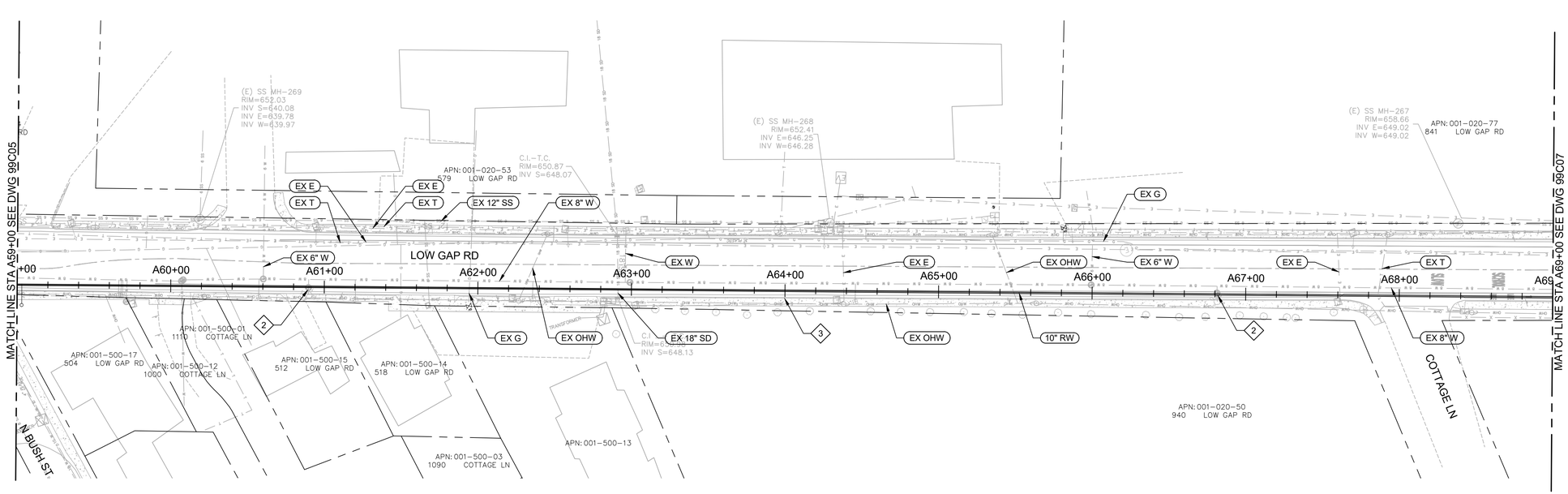
CIVIL

PLAN AND PROFILE ALIGNMENT A STA A49+00 TO STA A59+00

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

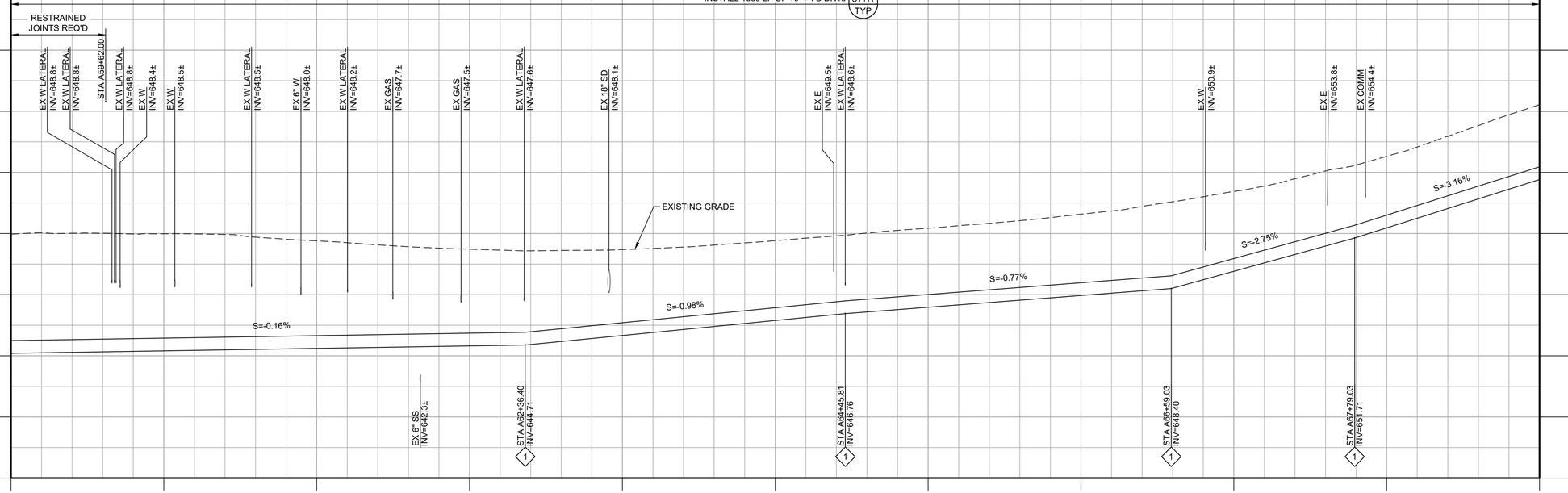
JOB NO. 8660F.10
DRAWING NO. 99C05
SHEET NO. 35 OF 200

FILE NAME: 8660F1099C05.dwg
PROJECT NO. 8660F10
LAST SAVED BY: JDiDonato



PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

GENERAL NOTES:

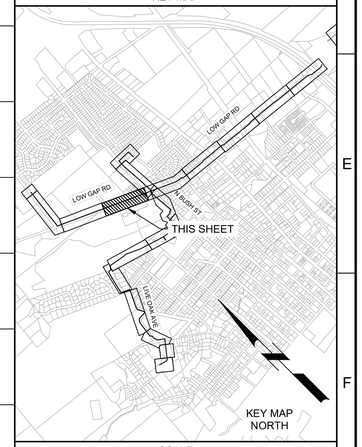
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3. CONTRACTOR TO REPLACE ALL ROAD STRIPING DAMAGED BY PIPELINE REPLACEMENT PER SECTION 02762. CONTRACTOR SHALL REPLACE ENTIRETY OF DAMAGED STRIPING.

KEY NOTES:

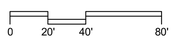
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2. CONTRACTOR SHALL PROTECT EXISTING VALVE DURING PIPELINE INSTALLATION. REPLACE IF DAMAGED. ADJUST PIPELINE ALIGNMENT AS REQUIRED.
3. CONTRACTOR SHALL REPLACE ANY CURB AND GUTTER THAT IS DAMAGED AS A RESULT OF PIPELINE INSTALLATION. REPLACE PER CITY OF UKIAH STANDARD SPECIFICATIONS AND SECTION 02772.

811 Know what's **below.** **Call** before you dig.

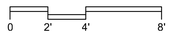
KEY MAP



SCALE



SCALE: 1" = 40' (HORIZ)



SCALE: 1" = 4' (VERT)

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN BH
CHECKED JM
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

City of Ukiah

CITY OF UKIAH

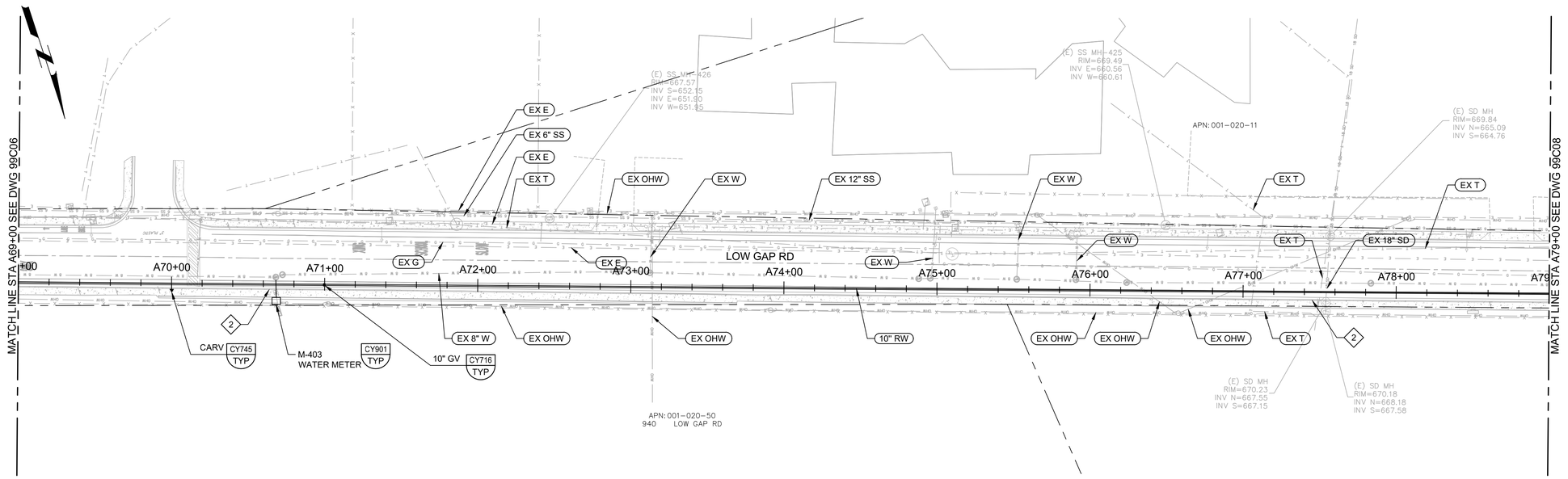
RECYCLED WATER PROJECT - PHASE 4

CIVIL

PLAN AND PROFILE ALIGNMENT A
STA A59+00 TO STA A69+00

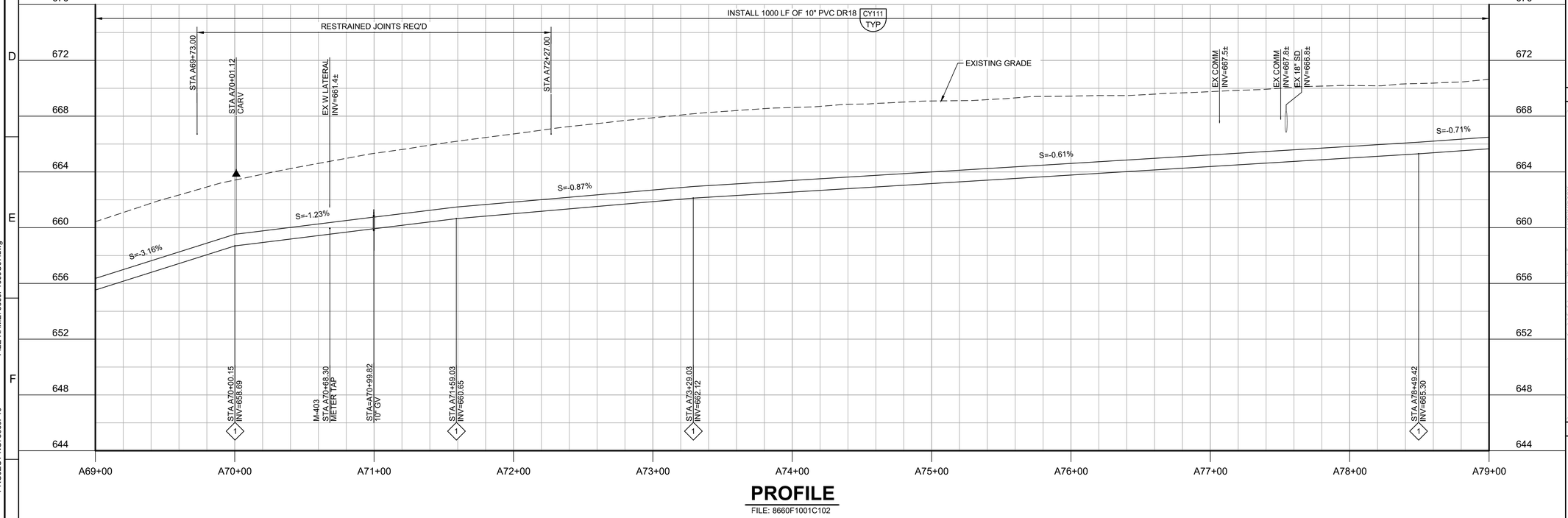
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99C06
SHEET NO. 36 OF 200



PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

GENERAL NOTES:

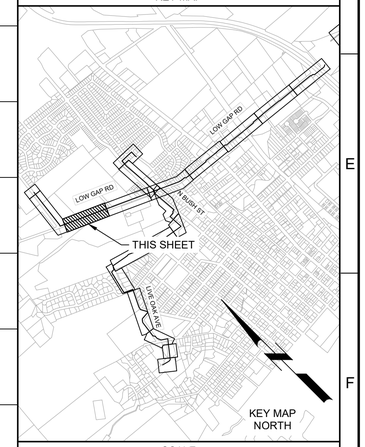
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KEY MAP



SCALE

0 20' 40' 80'
SCALE: 1" = 40' (HORIZ)

0 2' 4' 8'
SCALE: 1" = 4' (VERT)

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN BH
CHECKED JM
DATE JULY 2023

**
ORIGINAL
SEALED BY
BRIAN W. AVON
4/10/2023
CA PE NO. 76832
**

carollo

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

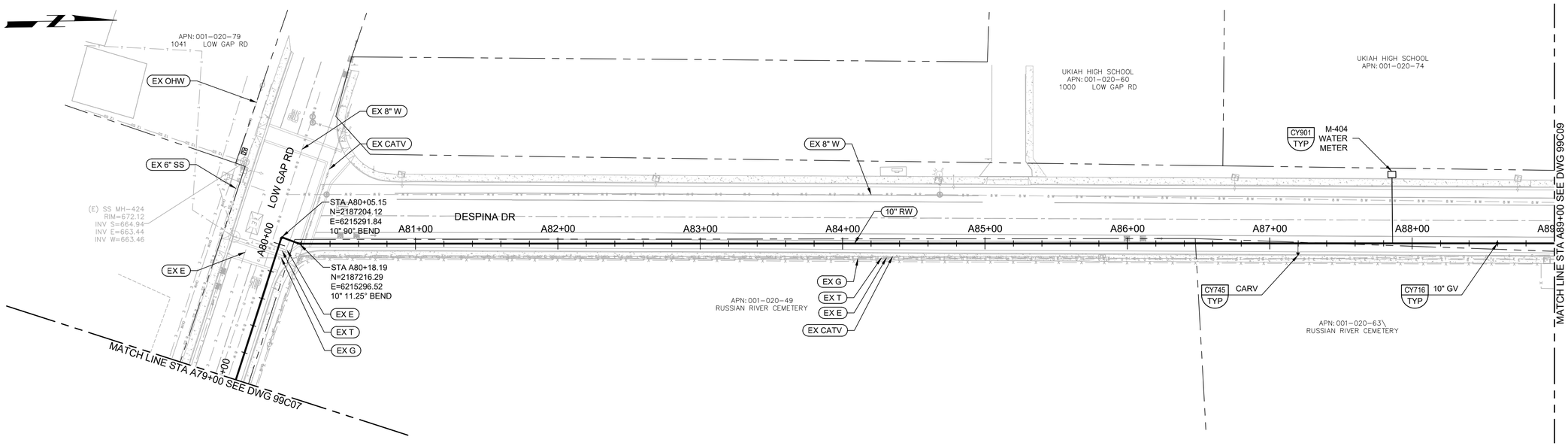
CIVIL

PLAN AND PROFILE ALIGNMENT A
STA A69+00 TO STA A79+00

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

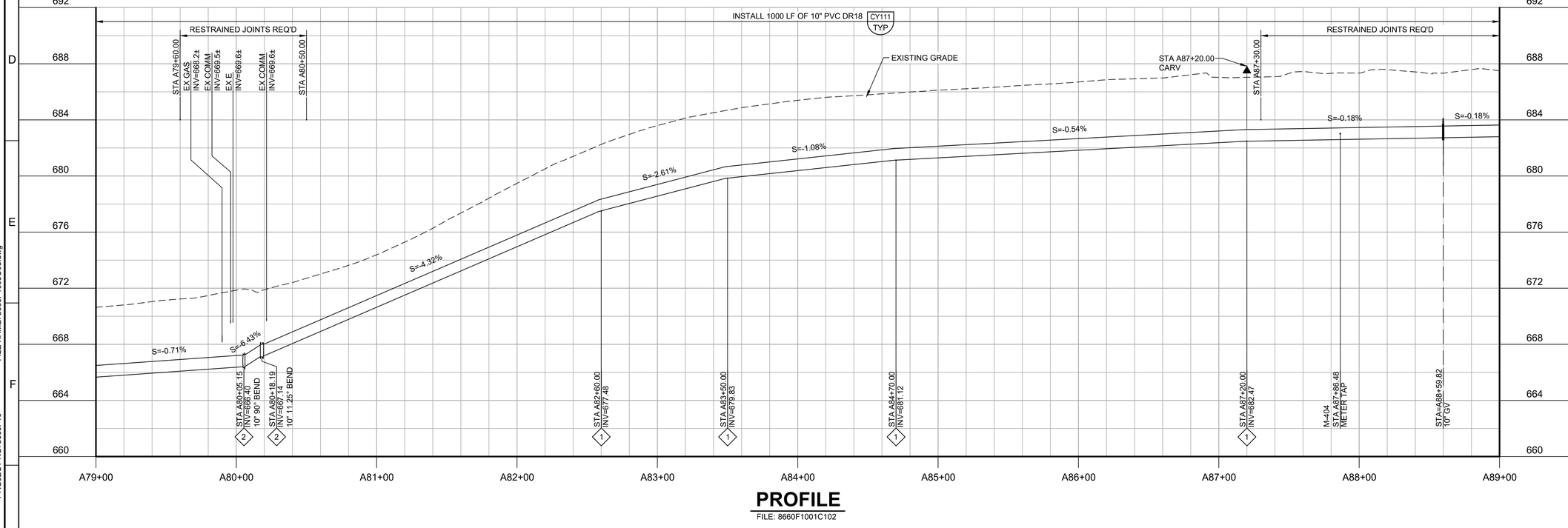
JOB NO. 8660F.10
DRAWING NO. 99C07
SHEET NO. 37 OF 200

FILE NAME: 8660F1099C07.dwg
PROJECT NO. 8660F10
LAST SAVED BY: JDiDonato



PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

GENERAL NOTES:

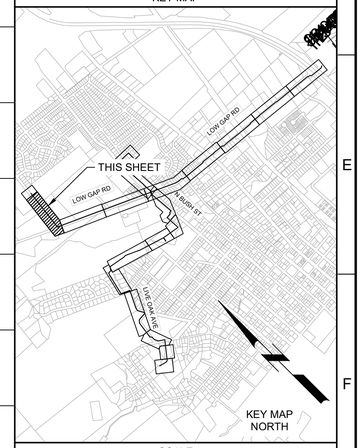
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KEY NOTES:

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2. VERTICAL BEND ACHIEVED BY ROLLING HORIZONTAL BEND.

811 Know what's below. Call before you dig.

KEY MAP



SCALE

0 20' 40' 80'
SCALE: 1" = 40' (HORIZ)

0 2' 4' 8'
SCALE: 1" = 4' (VERT)

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN BH
CHECKED BWA
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

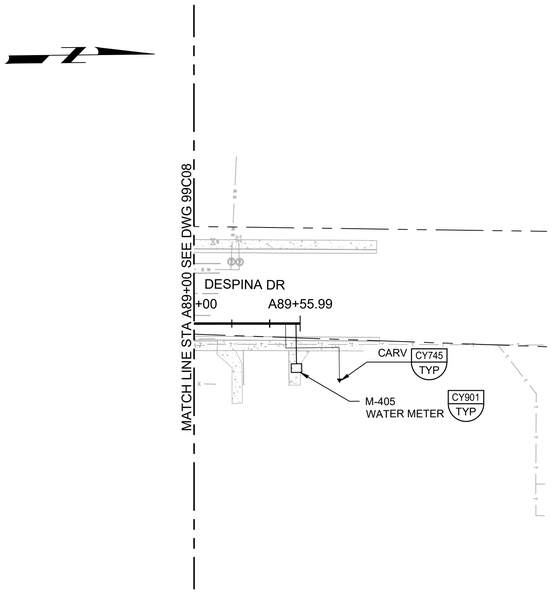
CIVIL

PLAN AND PROFILE ALIGNMENT A
STA A79+00 TO STA A89+00

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

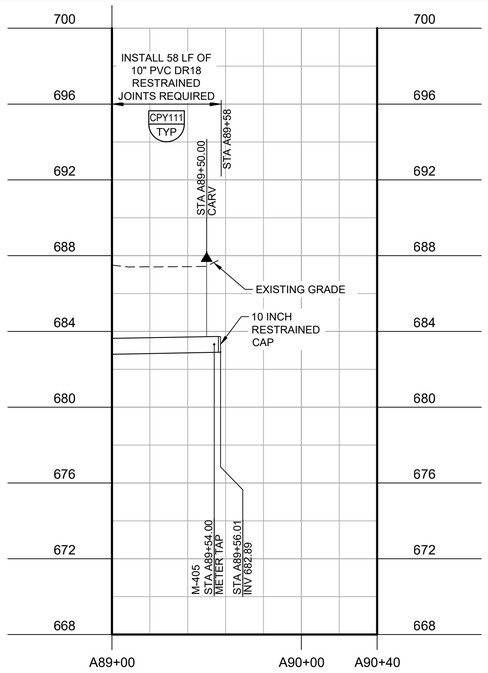
JOB NO. 8660F.10
DRAWING NO. 99C08
SHEET NO. 38 OF 200

FILE NAME: 8660F1099C08.dwg
PROJECT NO. 8660F10
LAST SAVED BY: JDiDonato



PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

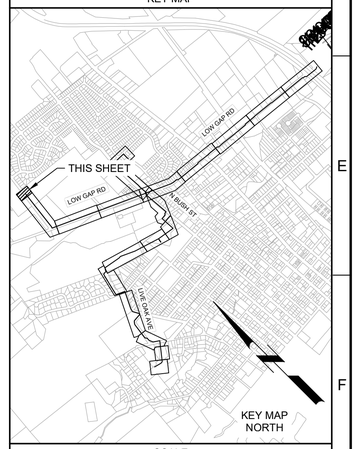
GENERAL NOTES:

1. CONTRACTOR TO VERIFY ALL UTILITY CROSSINGS PRIOR TO CONSTRUCTION.

811

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KEY MAP



SCALE

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carollo

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

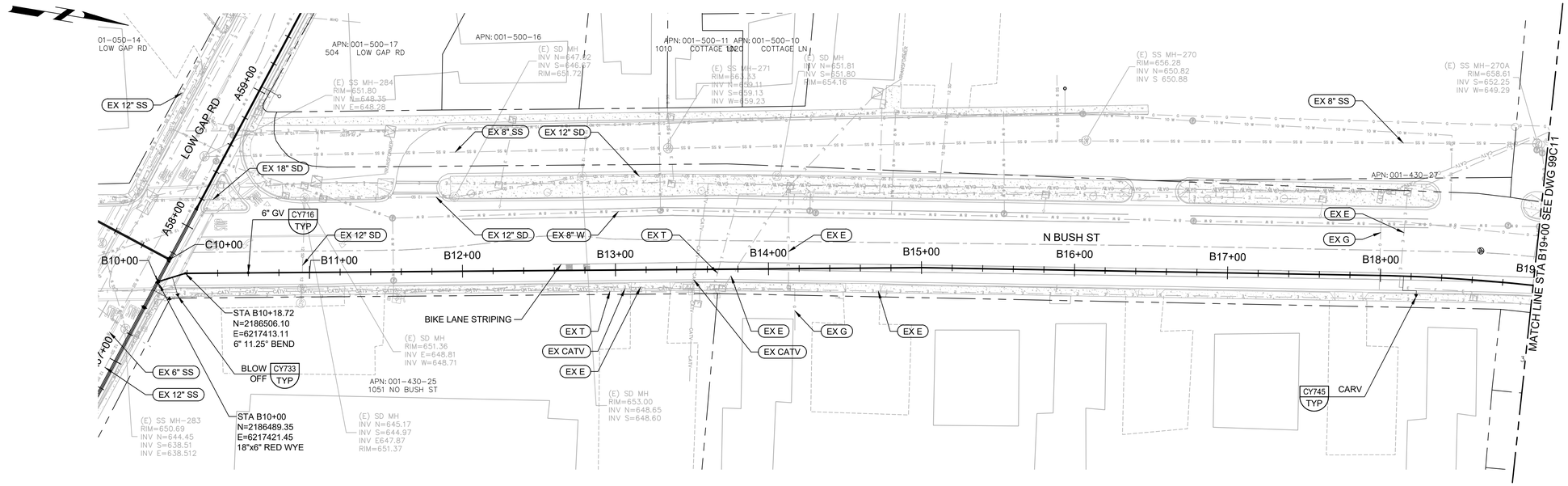
CIVIL

PLAN AND PROFILE ALIGNMENT A
STA A89+00 TO STA A89+55.99

VERIFY SCALES
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0 1"
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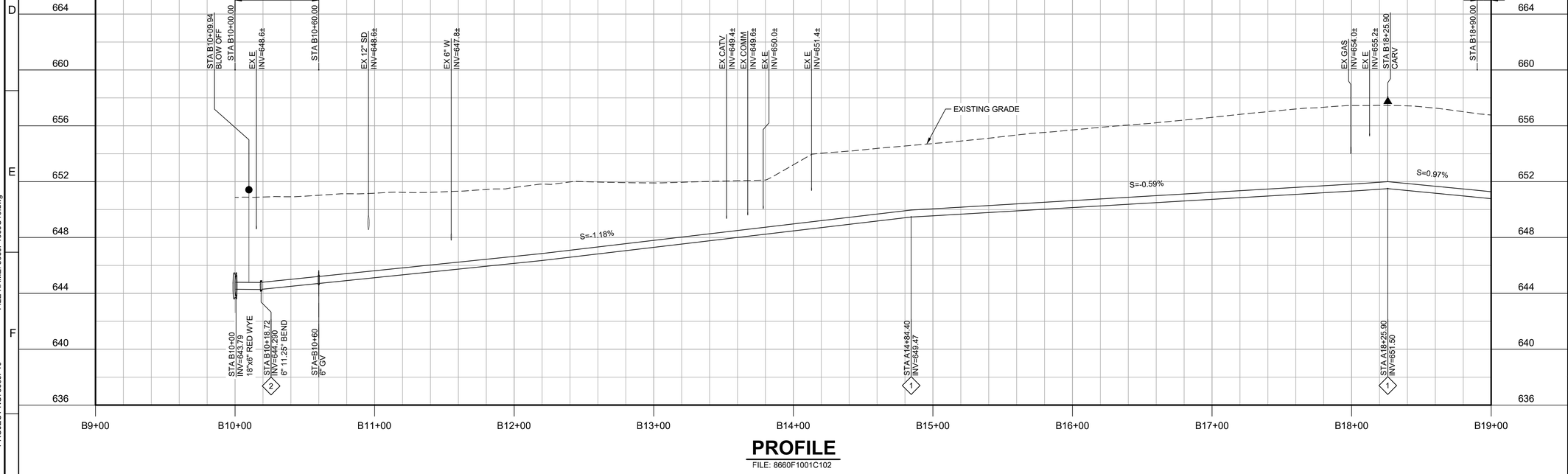
JOB NO. 8660F.10
DRAWING NO. 99C09
SHEET NO. 39 OF 200

Plot Date: 7/12/2023 11:50:44 AM
FILE NAME: 8660F1099C09.dwg
PROJECT NO. 8660F10
LAST SAVED BY: JDiDonato



PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

GENERAL NOTES:

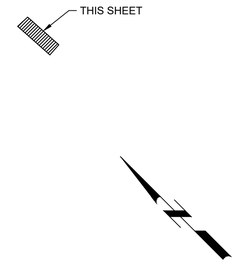
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KEY MAP



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** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

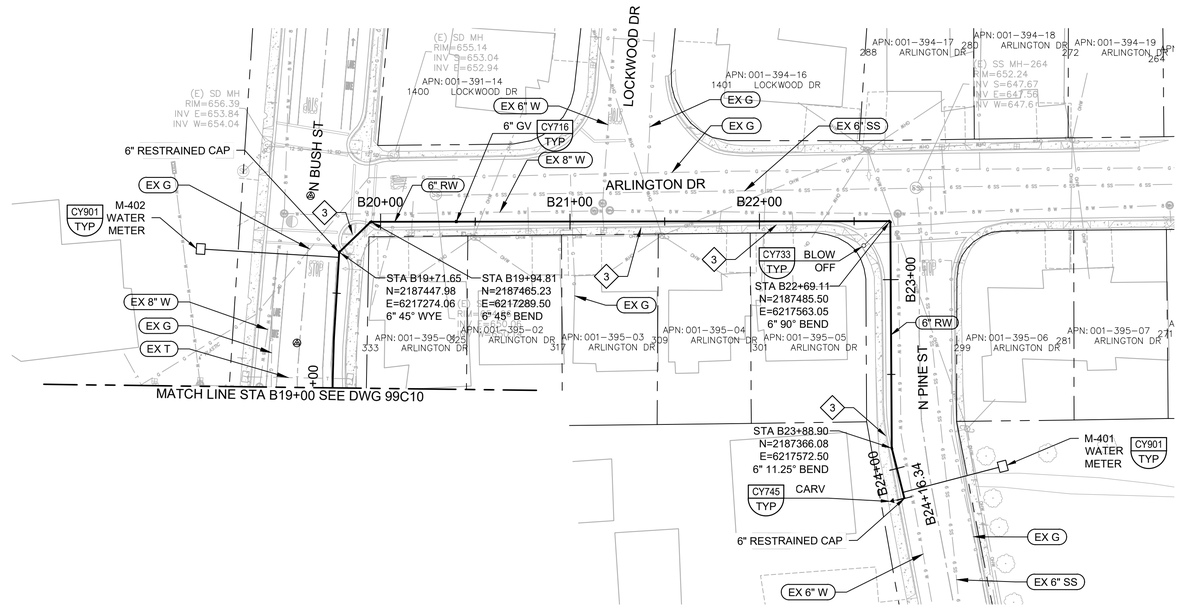
CIVIL

PLAN AND PROFILE ALIGNMENT B
STA B9+00 TO STA B19+00

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

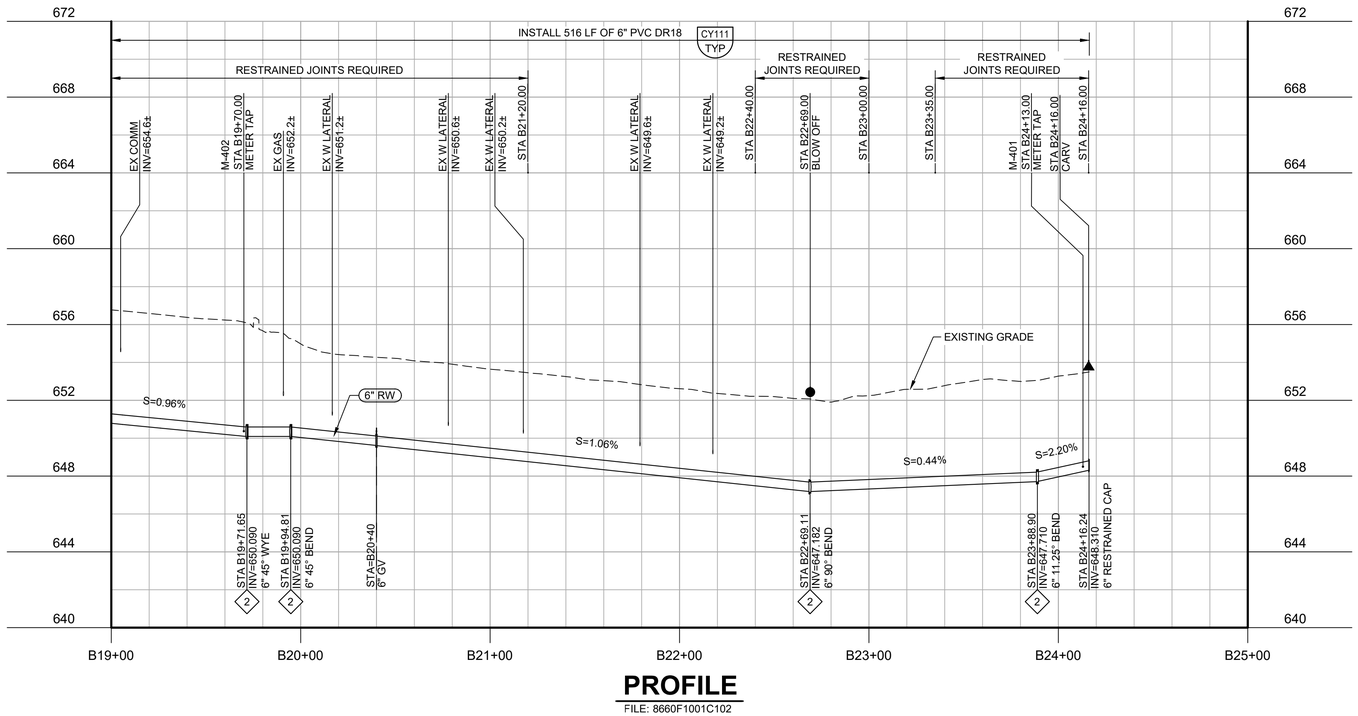
JOB NO. 8660F.10
DRAWING NO. 99C10
SHEET NO. 40 OF 200

Plot Date: 7/12/2023 11:47:17 AM
FILE NAME: 8660F-1099C10.dwg
PROJECT NO. 8660F10
LAST SAVED BY: JDiDonato



PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

GENERAL NOTES:

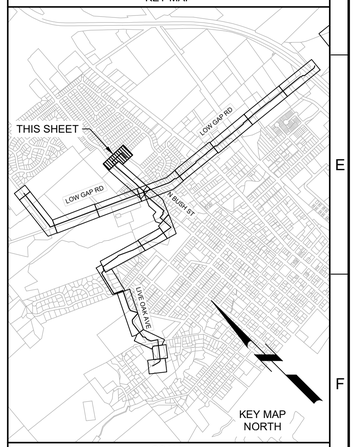
1. CONTRACTOR TO VERIFY ALL UTILITY CROSSINGS PRIOR TO CONSTRUCTION.
2. CONTRACTOR SHALL ASSUME THAT ANY VERTICAL BENDS SHOWN ARE ROTATED FROM CORRESPONDING HORIZONTAL BENDS UNLESS NOTED OTHERWISE.
3. CONTRACTOR TO REPLACE ALL ROAD STRIPING DAMAGED BY PIPELINE REPLACEMENT PER SECTION 02762. CONTRACTOR SHALL REPLACE ENTIRETY OF DAMAGED STRIPING.

KEY NOTES:

1. VERTICAL BEND TO BE ACHIEVED BY PULLED PIPE. MAXIMUM ALLOWED DEFLECTION IS HALF OF THE MANUFACTURER'S SPECIFIED DEFLECTION. CONTRACTOR MAY DEFLECT MORE THAN ONE JOINT TO ACHIEVE TOTAL DEFLECTION.
2. VERTICAL BEND ACHIEVED BY ROLLING HORIZONTAL BEND.
3. CONTRACTOR SHALL REPLACE ANY CURB AND GUTTER THAT IS DAMAGED AS A RESULT OF PIPELINE INSTALLATION. REPLACE PER CITY OF UKIAH STANDARD SPECIFICATIONS AND SECTION 02772.

811 Know what's **below.** **Call** before you dig.

KEY MAP



SCALE

0 20' 40' 80'
SCALE: 1" = 40' (HORIZ)

0 2' 4' 8'
SCALE: 1" = 4' (VERT)

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN BH
CHECKED BWA
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

City of Ukiah

CITY OF UKIAH

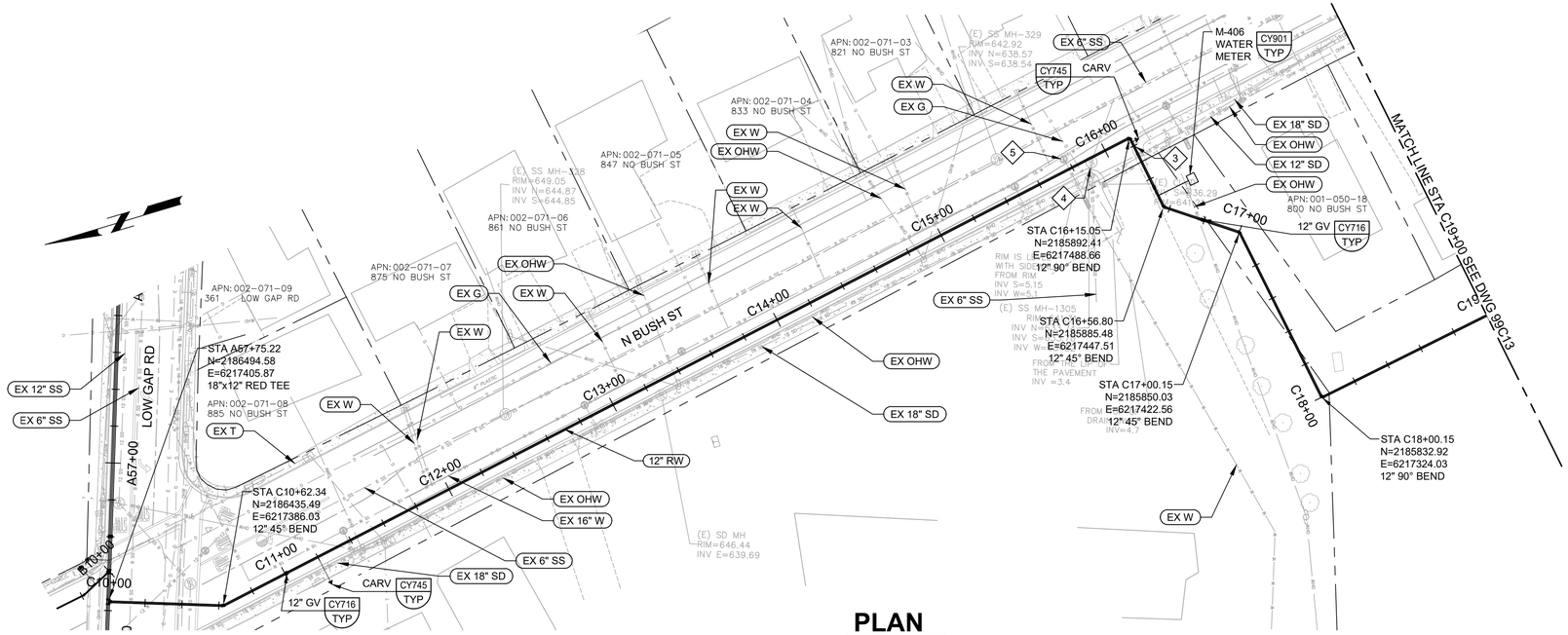
RECYCLED WATER PROJECT - PHASE 4

CIVIL

PLAN AND PROFILE ALIGNMENT B
STA B19+00 TO STA B24+16.34

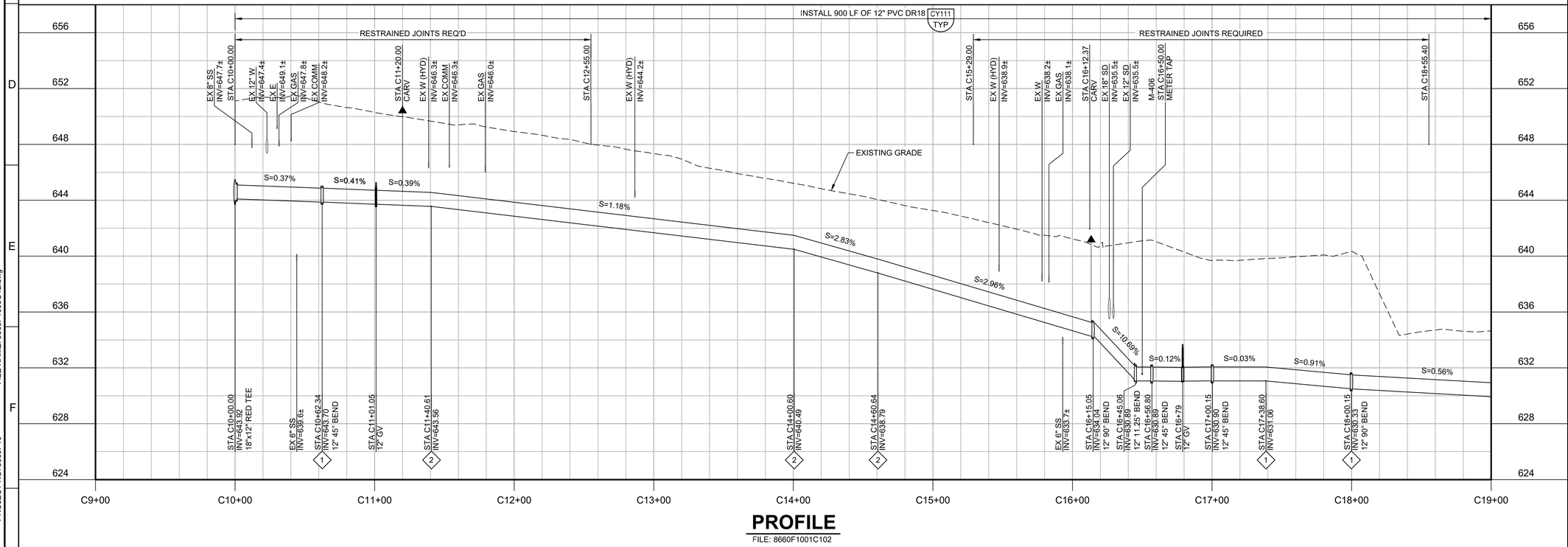
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99C11
SHEET NO. 41 OF 200



PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

GENERAL NOTES:

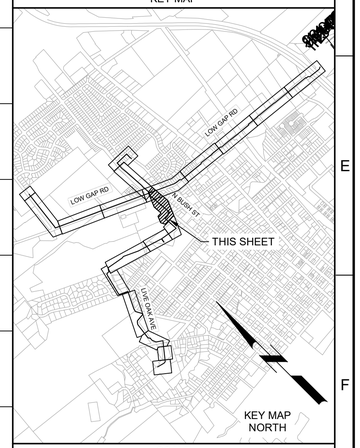
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KEY NOTES:

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4. CONTRACTOR SHALL PROTECT EXISTING SSMH DURING PIPELINE INSTALLATION. REPLACE IF DAMAGED. ADJUST PIPELINE ALIGNMENT AS REQUIRED.
5. CONTRACTOR SHALL PROTECT EXISTING VALVE DURING PIPELINE INSTALLATION. REPLACE IF DAMAGED. ADJUST PIPELINE ALIGNMENT AS REQUIRED.

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KEY MAP



SCALE

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SCALE: 1" = 4' (VERT)

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN BH
CHECKED BWA
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

City of Ukiah

CITY OF UKIAH

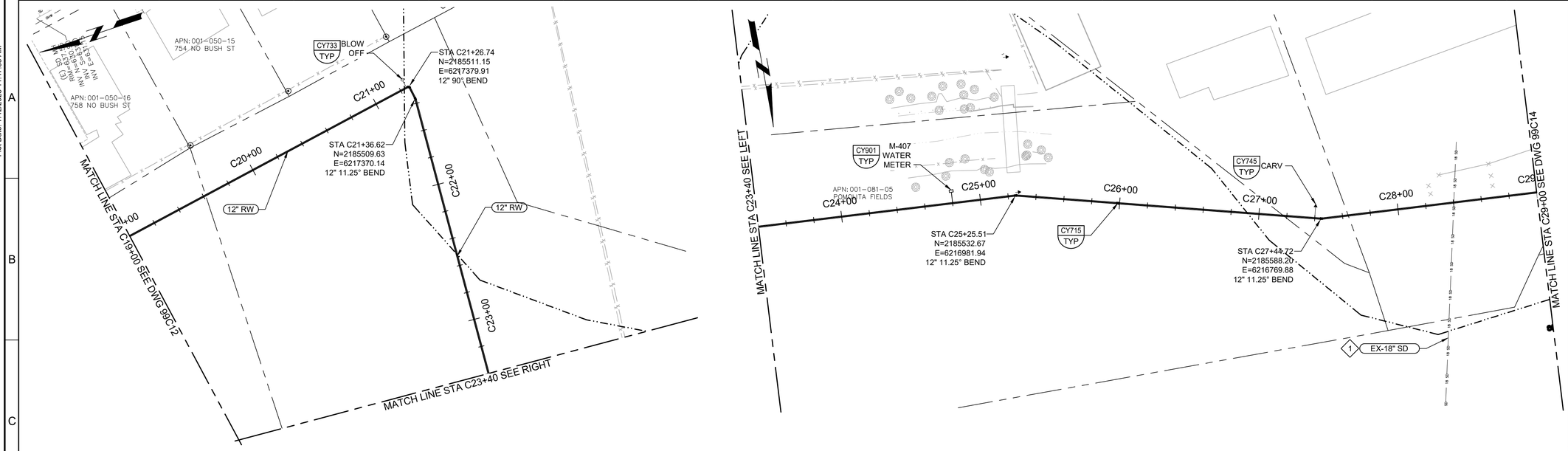
RECYCLED WATER PROJECT - PHASE 4

CIVIL

PLAN AND PROFILE ALIGNMENT C
STA C10+00 TO STA C19+00

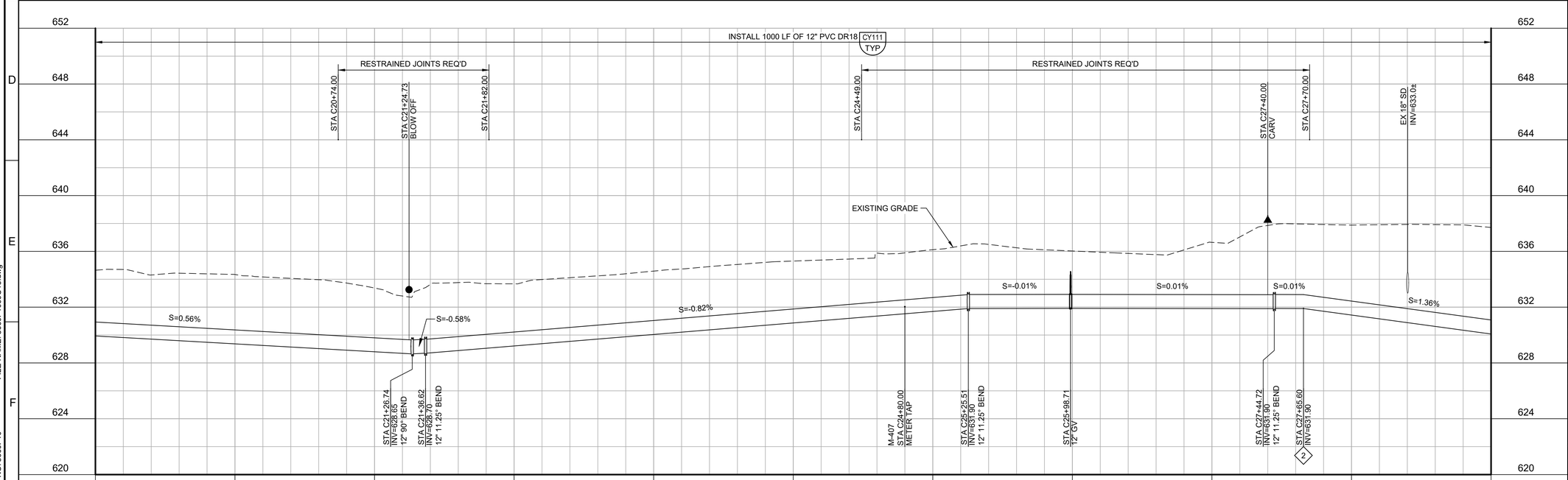
VERIFY SCALES
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0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99C12
SHEET NO. 42 OF 200



PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

GENERAL NOTES:

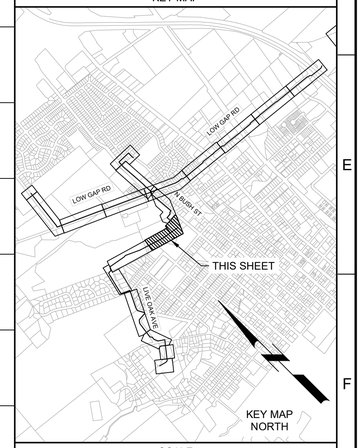
1. CONTRACTOR TO VERIFY ALL UTILITY CROSSINGS PRIOR TO CONSTRUCTION.

(#) KEY NOTES:

1. APPROXIMATE SD LOCATION AND ELEVATION BASED ON CITY GIS MAP. OUTFALL TO CREEK WAS NOT FOUND IN THE FIELD. CONTRACTOR TO FIELD VERIFY PRIOR TO CONSTRUCTION.
2. VERTICAL BEND TO BE ACHIEVED BY PULLED PIPE. MAXIMUM ALLOWED DEFLECTION IS HALF OF THE MANUFACTURER'S SPECIFIED DEFLECTION. CONTRACTOR MAY DEFLECT MORE THAN ONE JOINT TO ACHIEVE TOTAL DEFLECTION.

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REV	DATE	BY	DESCRIPTION
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DESIGNED CDA
DRAWN BH
CHECKED BWA
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

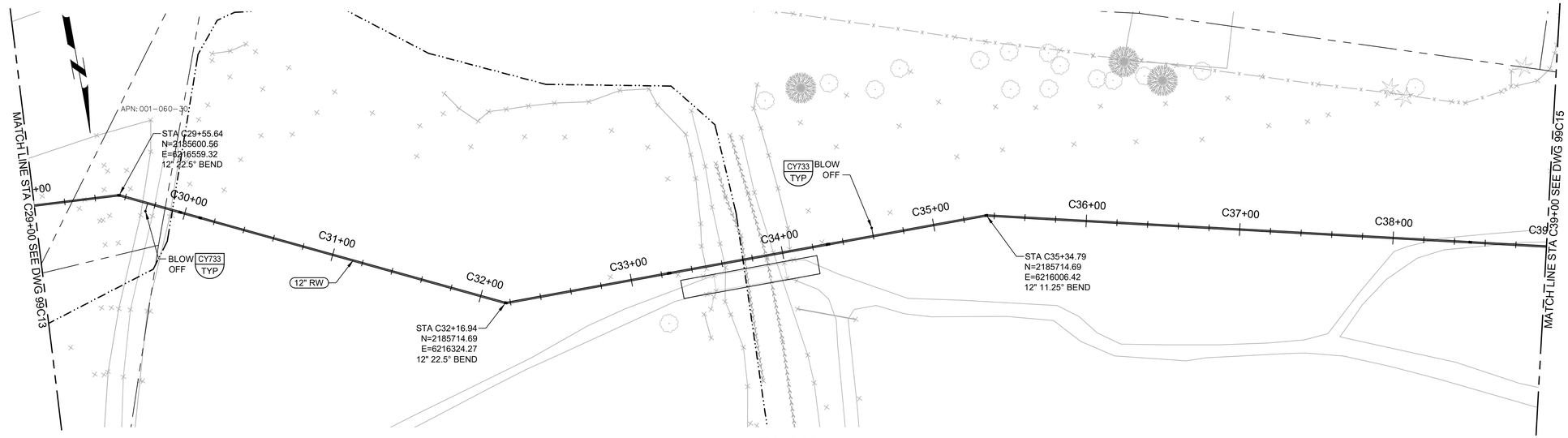
CIVIL

PLAN AND PROFILE ALIGNMENT C
STA C19+00 TO STA C29+00

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

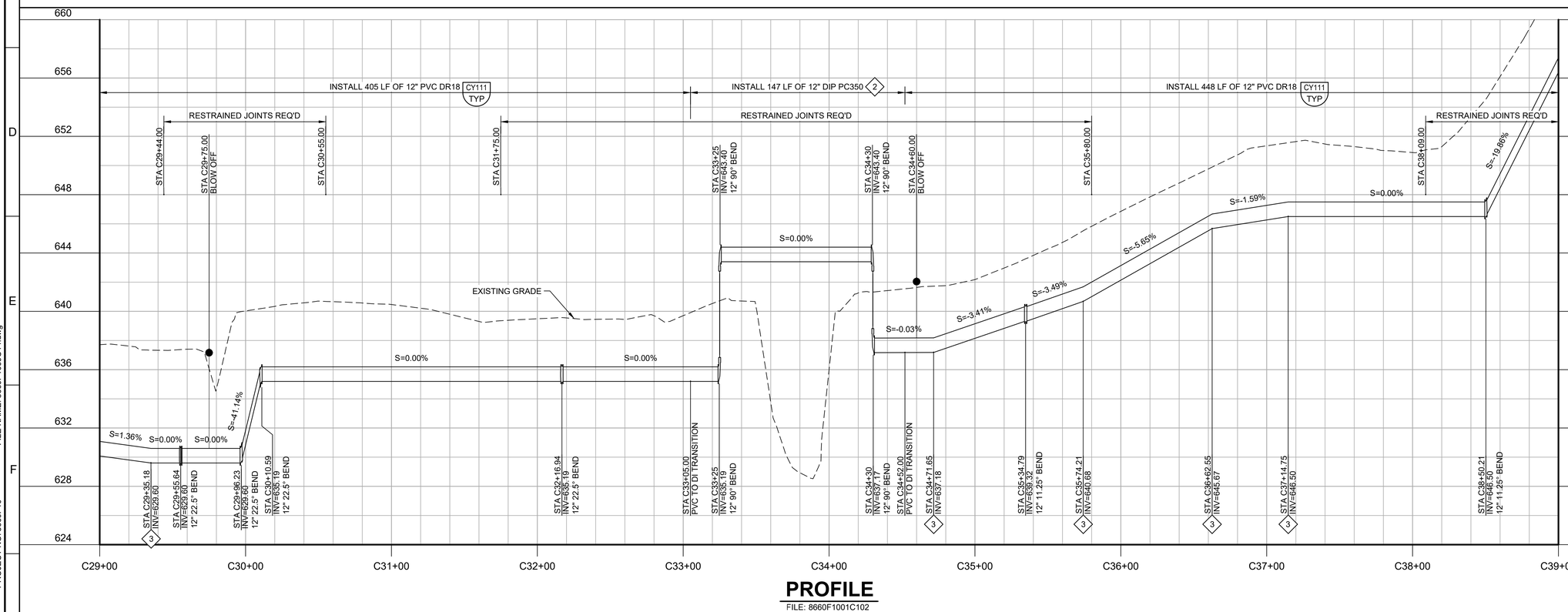
JOB NO. 8660F.10
DRAWING NO. 99C13
SHEET NO. 43 OF 200

Plot Date: 7/12/2023 11:47:38 AM
FILE NAME: 8660F1099C13.dwg
PROJECT NO. 8660F10
LAST SAVED BY: JDiDonato



PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

GENERAL NOTES:

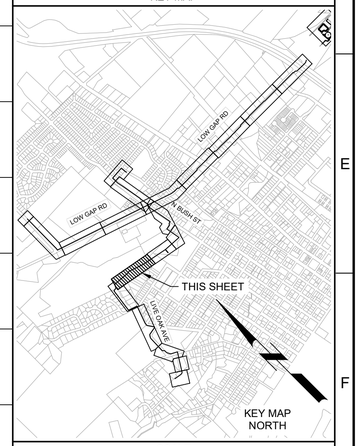
1. NOT USED.

KEY NOTES:

1. HORIZONTAL BEND ACHIEVED BY ROTATING DUAL 90 DEGREE VERTICAL BENDS.
2. REFER TO SHEET 99S12 FOR BRIDGE, ABUTMENT, AND PIPE CONNECTION DETAILS.
3. VERTICAL BEND TO BE ACHIEVED BY PULLED PIPE. MAXIMUM ALLOWED DEFLECTION IS HALF OF THE MANUFACTURER'S SPECIFIED DEFLECTION. CONTRACTOR MAY DEFLECT MORE THAN ONE JOINT TO ACHIEVE TOTAL DEFLECTION.

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REV	DATE	BY	DESCRIPTION
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DESIGNED CDA
DRAWN BH
CHECKED BWA
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

City of Ukiah

CITY OF UKIAH

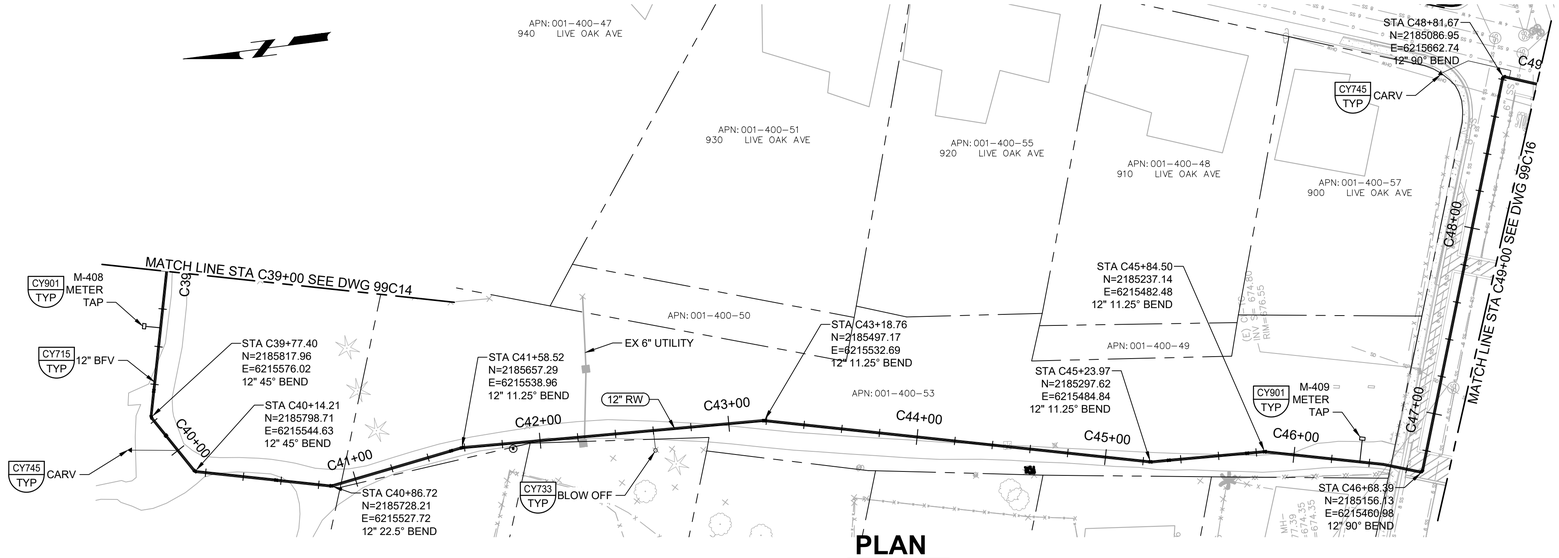
RECYCLED WATER PROJECT - PHASE 4

CIVIL

PLAN AND PROFILE ALIGNMENT C
STA C29+00 TO STA C39+00

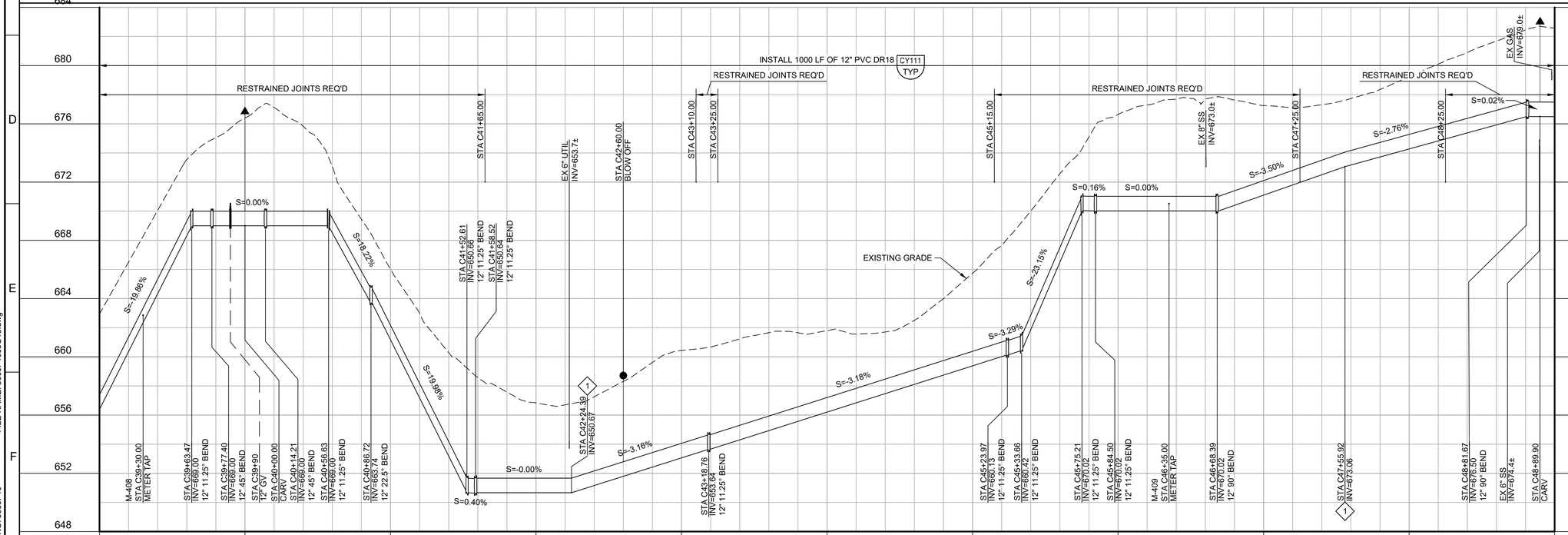
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99C14
SHEET NO. 44 OF 200



PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

GENERAL NOTES:

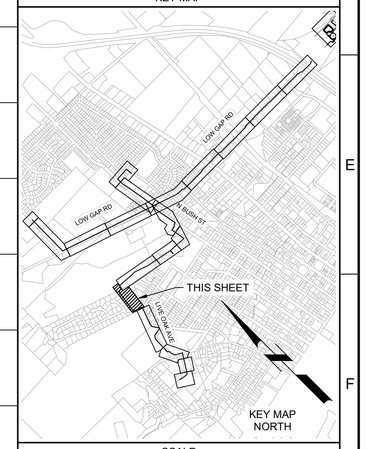
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KEY MAP



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REV	DATE	BY	DESCRIPTION
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DESIGNED CDA
DRAWN BH
CHECKED BWA
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

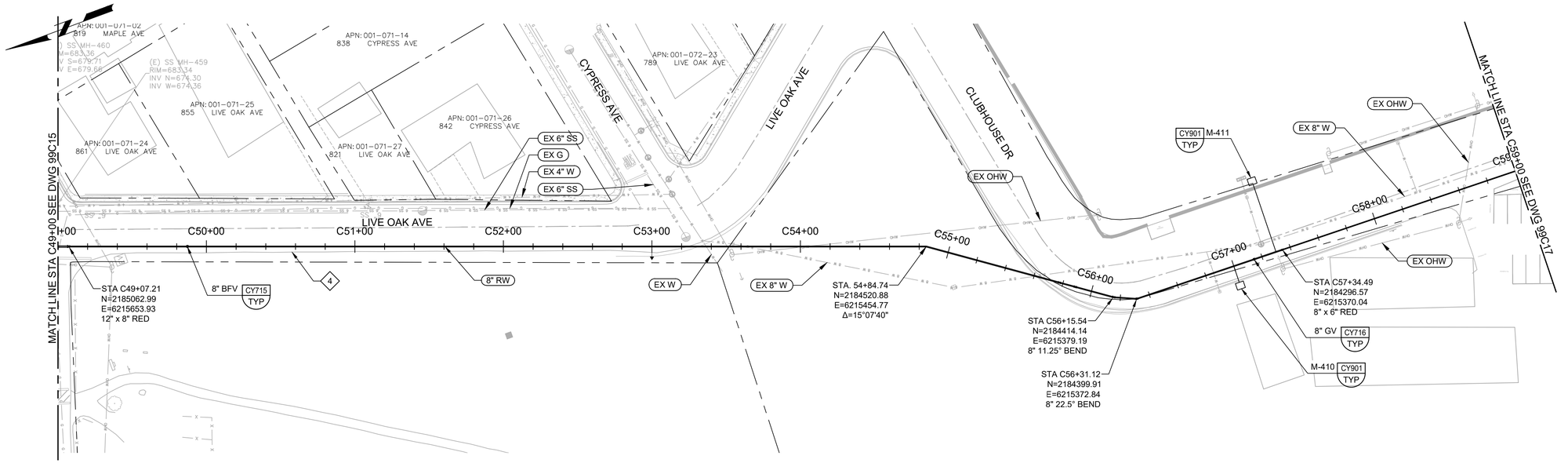
CIVIL

PLAN AND PROFILE ALIGNMENT C
STA C39+00 TO STA C49+00

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

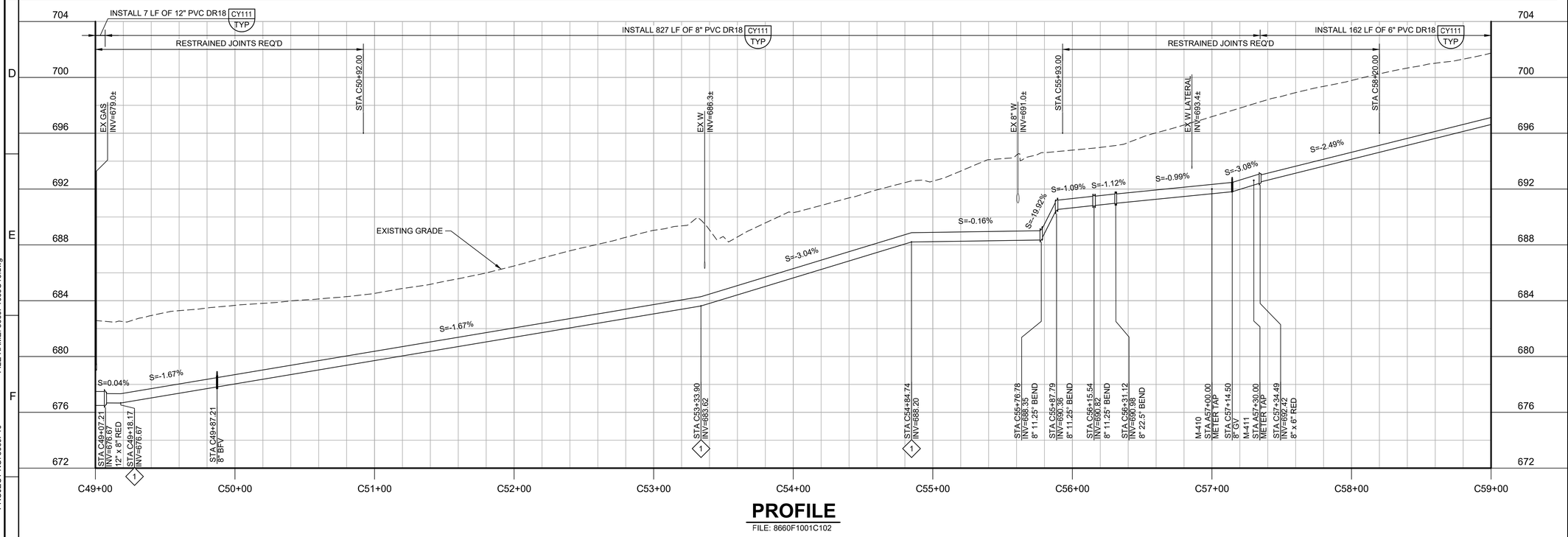
JOB NO. 8660F.10
DRAWING NO. 99C15
SHEET NO. 45 OF 200

Plot Date: 7/12/2023 11:49:08 AM
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PROJECT NO. 8660F10
LAST SAVED BY: JDiDonato



PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

GENERAL NOTES:

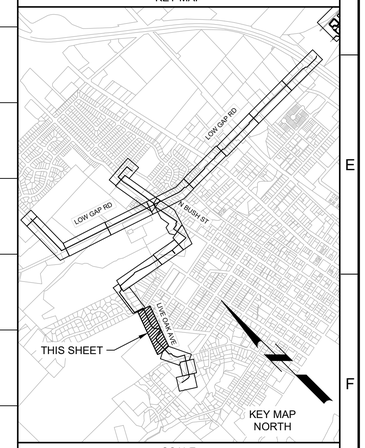
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KEY MAP



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DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

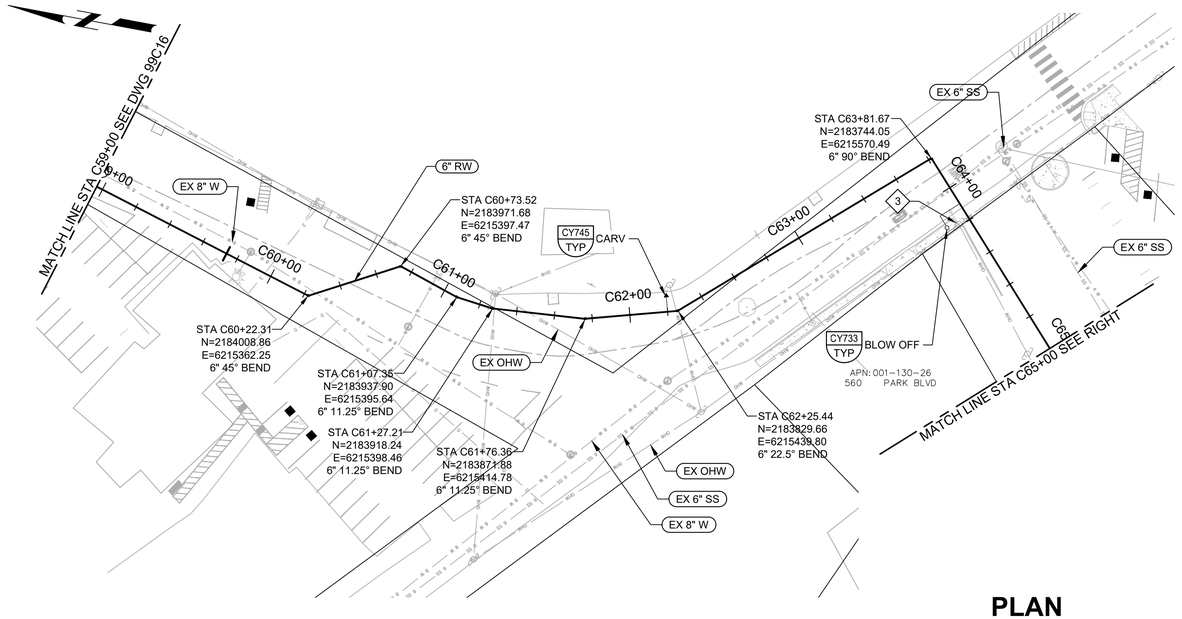
City of Ukiah

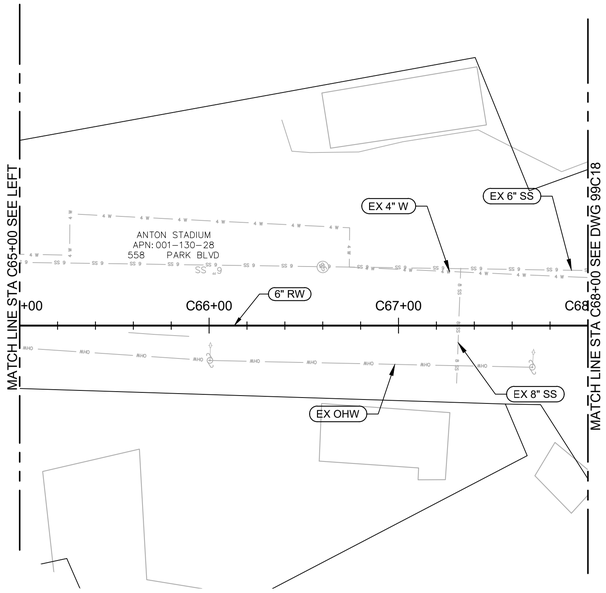
CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
CIVIL
PLAN AND PROFILE ALIGNMENT C
STA C49+00 TO STA C59+00

VERIFY SCALES
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0 1"
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JOB NO. 8660F.10
DRAWING NO. 99C16
SHEET NO. 46 OF 200

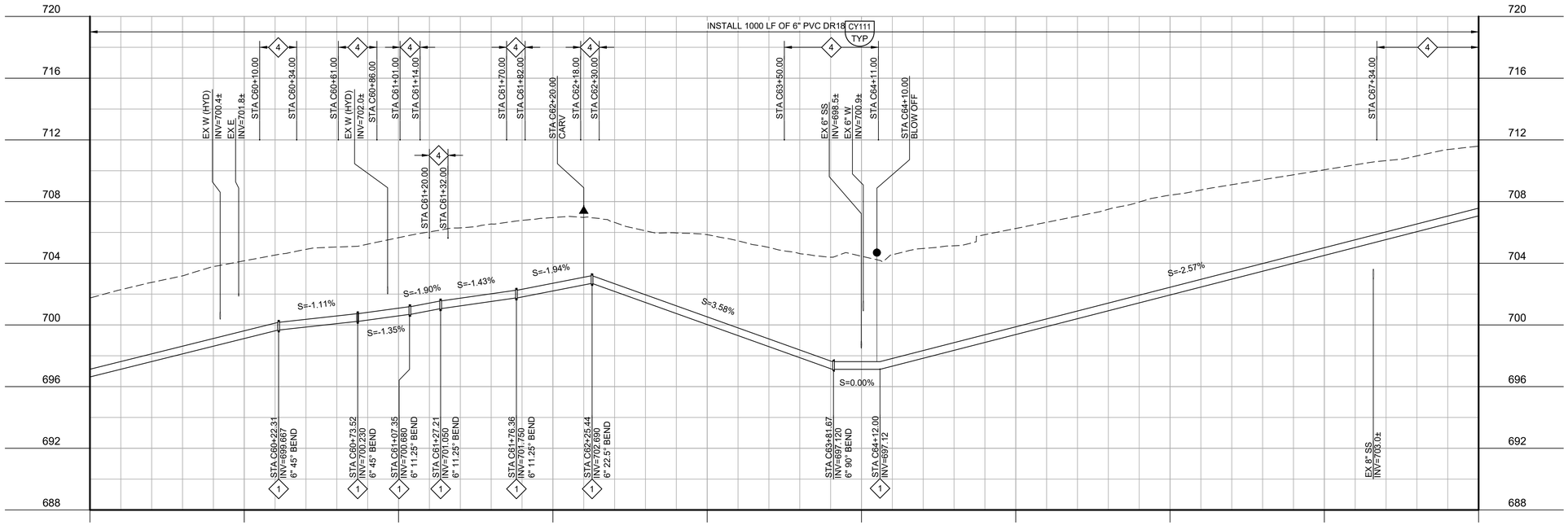
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PROJECT NO. 8660F10
LAST SAVED BY: JDiDonato





PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

GENERAL NOTES:

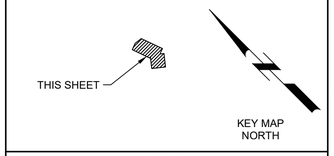
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2. VERTICAL BEND TO BE ACHIEVED BY ROTATING HORIZONTAL BEND.
3. CONTRACTOR TO SUPPORT UTILITY POLE AS REQUIRED BY UTILITY POLE OWNER.
4. RESTRAINED JOINTS REQUIRED.

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KEY MAP



SCALE

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REV	DATE	BY	DESCRIPTION
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DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

City of Ukiah

CITY OF UKIAH

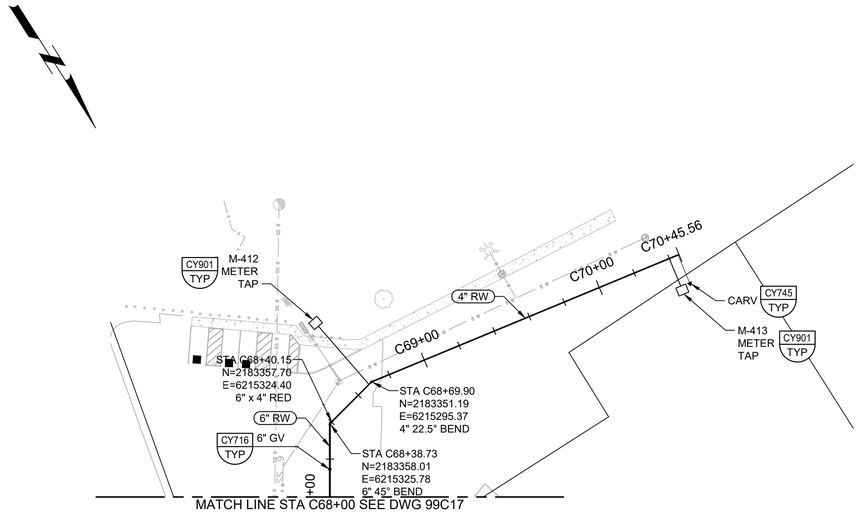
RECYCLED WATER PROJECT - PHASE 4

CIVIL

PLAN AND PROFILE ALIGNMENT C
STA C59+00 TO C68+00

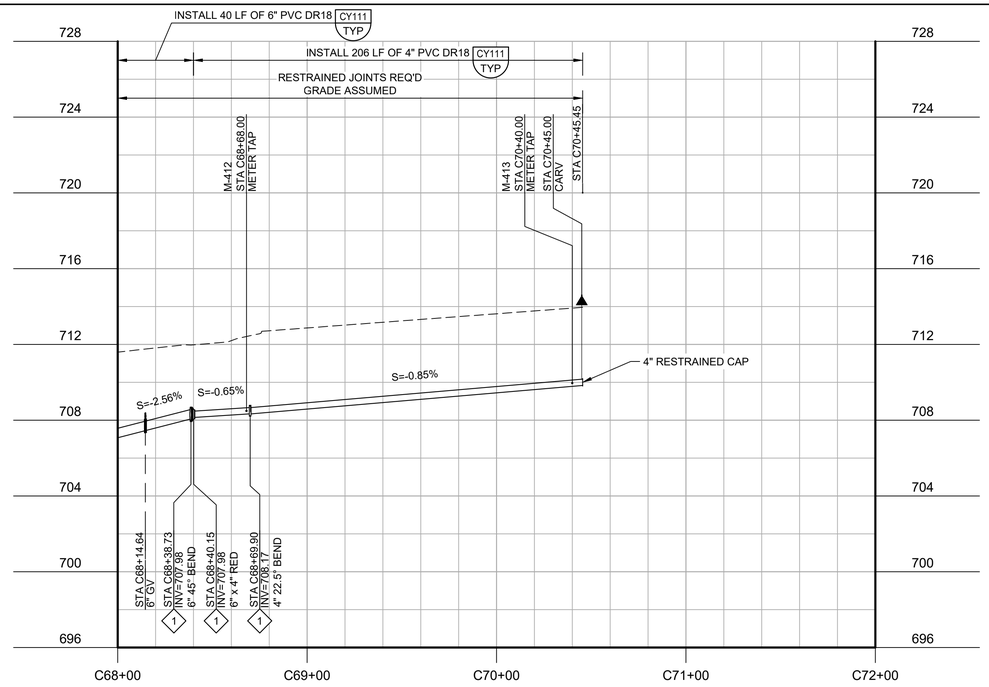
VERIFY SCALES
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JOB NO. 8660F.10
DRAWING NO. 99C17
SHEET NO. 47 OF 200



PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

GENERAL NOTES:

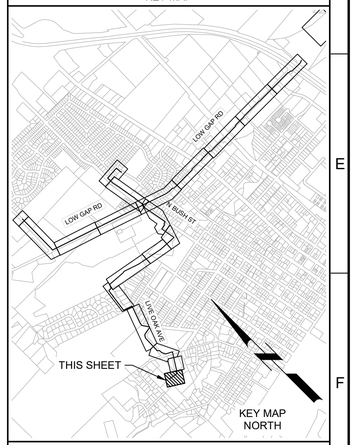
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2. VERTICAL BEND TO BE ACHIEVED BY ROTATING HORIZONTAL BEND.

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KEY MAP



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DRAWN BH
CHECKED BWA
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

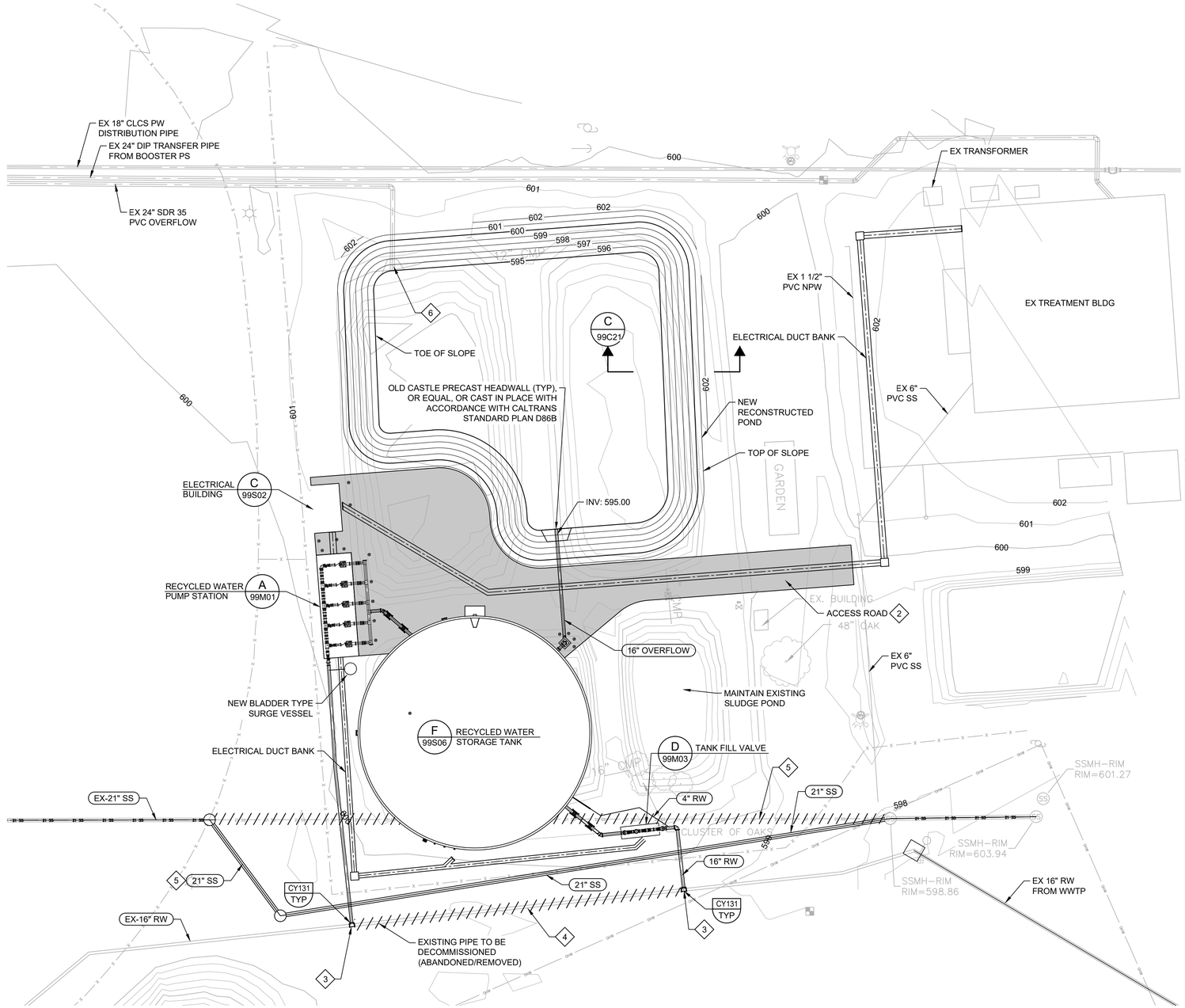
CIVIL

PLAN AND PROFILE ALIGNMENT C
STA C68+00 TO STA C70+45.56

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99C18
SHEET NO. 48 OF 200

Plot Date: 7/12/2023 11:47:53 AM
FILE NAME: 8660F1099C18.dwg
PROJECT NO. 8660F10
LAST SAVED BY: JDiDonato



PLAN

FILE: 8660F1001C102

GENERAL NOTES:

1. SEE ELECTRICAL DRAWINGS FOR ELECTRICAL ROUTING AND DETAILS.

KEY NOTES:

1. MAINTAIN USE OF EXISTING POND. DAMAGE TO EXISTING BANK MUST BE PROTECTED OR REPAIRED.
2. CONSTRUCT NEW ACCESS ROAD. TIE INTO EXISTING PAVING.
3. NEW CONNECTION TO PHASES 1-3 PIPELINE. 16" 90-DEGREE BEND. PROVIDE THRUST BLOCK PER CY131/TYP.
4. EXISTING PIPE TO BE DEWATERED, CAPPED, AND ABANDONED IN PLACE.
5. REROUTE 360 LF OF 21" SANITARY SEWER. SEE DWG 99C22.
6. PROTECT 24" DIP IN PLACE DURING POND RECONSTRUCTION. REPLACE IN PLACE SEGMENT OF PIPE DAYLIGHTED DUE TO POND EXCAVATION AND CONSTRUCTION.

811 Know what's below. Call before you dig.

0 15' 30' 60'
SCALE: 1" = 30'

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN BH
CHECKED BWA
DATE JULY 2023

** ORIGINAL SEALED BY REACE P. FISHER 4/7/2023 CA PE NO. 81261 **

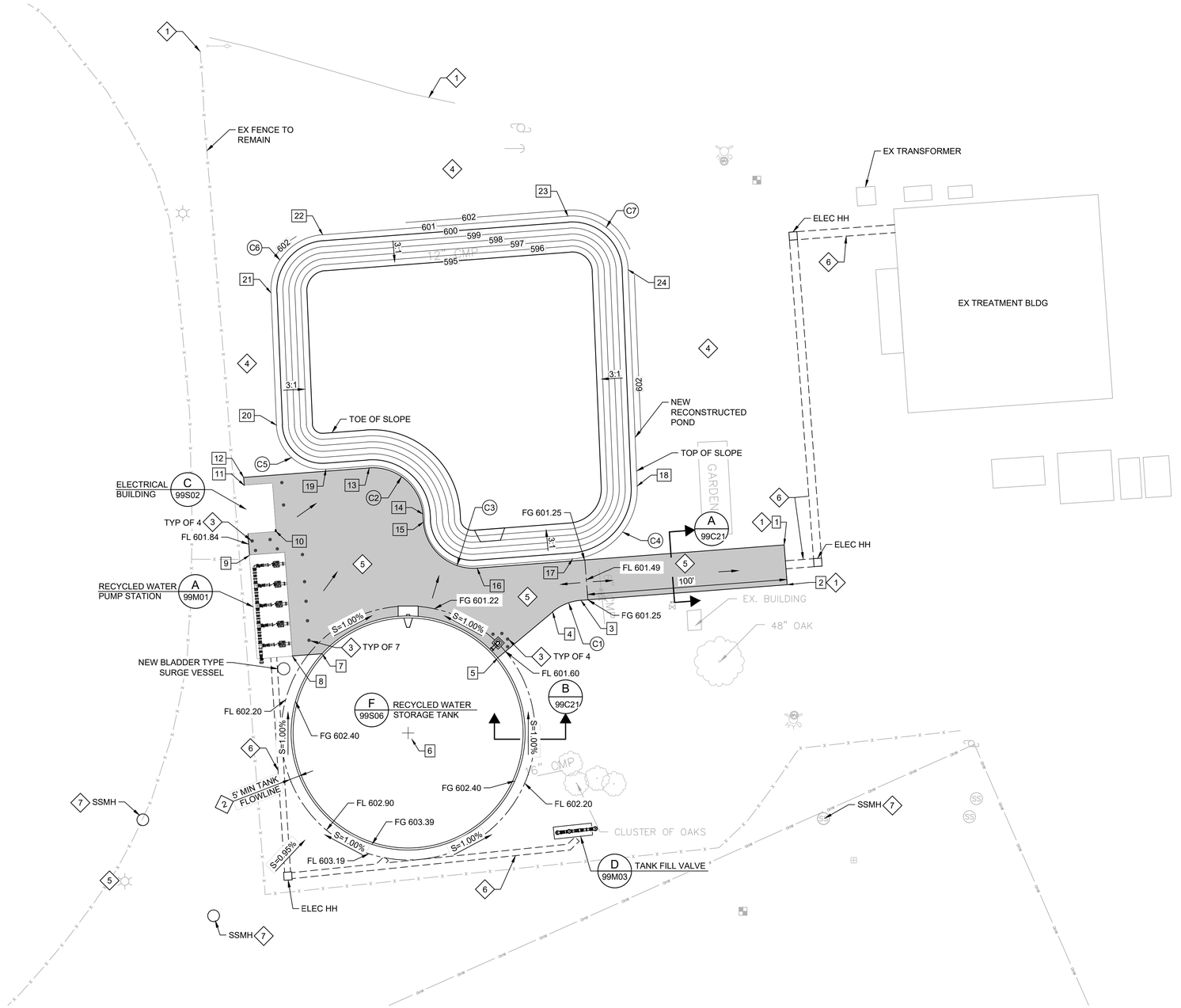
carollo

City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
CIVIL
PUMP STATION AND STORAGE SITE PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99C19
SHEET NO. 49 OF 200



PLAN

FILE: 8660F1001C102

COORDINATE CONTROL POINTS

POINT	NORTHING	EASTING	ELEVATION	DESCRIPTION
1	2186432.31	6223035.61	598.4±	PI ROAD
2	2186412.37	6223037.12	597.6±	PI ROAD
3	2186404.57	6222933.98	601.20	PC C1
4	2186398.81	6222919.81	601.30	PT C1
5	2186375.82	6222892.36	601.70	PI ASPHALT
6	2186338.26	6222847.51	-	CENTER OF TANK
7	2186377.89	6222804.48	602.00	PI ASPHALT
8	2186376.76	6222789.53	602.00	PUMP STA SE CORNER
9	2186427.13	6222768.18	601.95	PUMP STA NW CORNER
10	2186439.15	6222781.31	601.75	ELEC BLDG SE CORNER
11	2186462.03	6222765.54	601.65	ELEC BLDG NW CORNER
12	2186466.02	6222765.23	601.60	PI ASPHALT
13	2186470.77	6222828.07	601.20	PC C2
14	2186447.73	6222854.89	601.20	PT C2
15	2186443.74	6222855.19	601.20	PC C3
16	2186420.69	6222882.00	601.20	PT C3
17	2186425.31	6222929.76	601.00	PC C4
18	2186461.67	6222962.09	601.00	PT C4
19	2186470.13	6222806.37	601.00	PC C5
20	2186492.11	6222781.66	601.00	PT C5
21	2186558.26	6222778.90	601.00	PC C6
22	2186587.34	6222804.76	601.00	PT C6
23	2186596.62	6222927.48	601.00	PC C7
24	2186569.87	6222957.57	601.00	PT C7

CURVE TABLE

NO. XX	LENGTH	RADIUS	DELTA	TANGENT
C1	15.54'	25.00'	35°37'06"	8.03'
C2	39.27'	25.00'	90°00'00"	25.00'
C3	39.27'	25.00'	90°00'00"	25.00'
C4	53.80'	35.00'	88°03'54"	33.84'
C5	36.91'	23.00'	91°56'06"	23.79'
C6	43.04'	28.00'	88°03'54"	27.07'
C7	44.93'	28.00'	91°56'06"	28.96'

GENERAL NOTES:

1. SEE ELECTRICAL DRAWINGS FOR ELECTRICAL ROUTING AND DETAILS.

KEY NOTES:

1. MATCH EXISTING GRADE WHERE INDICATED.
2. GRADE MIN 4% AWAY FROM TANK IN ALL DIRECTIONS.
3. REMOVABLE GUARD POST PER CF161/TYP.
4. ALL UNPAVED AREAS WITHIN THE PROJECT SITE SHALL BE COMPACTED AND RESEEDED PER SPECIFICATIONS UNLESS NOTED OTHERWISE.
5. GRAVEL ACCESS ROAD SHALL BE 0'=6" AB OVER GEOTEXTILE FABRIC WITH 1'=0" SUBGRADE AT 95% RC UNLESS OTHERWISE NOTED.
6. CONDUIT TRENCH PATCH TO MATCH EXISTING GRADE.
7. REFER TO DWG 99C22 FOR SSMH LOCATIONS.

811 Know what's **below.** **Call** before you dig.

0 15' 30' 60'

SCALE: 1" = 30'

REV	DATE	BY	DESCRIPTION

CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN BH
CHECKED BWA
DATE JULY 2023

** ORIGINAL SEALED BY REACE P. FISHER 4/7/2023 CA PE NO. 81261 **

carollo

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

CIVIL

GRADING AND DRAINAGE PLAN

VERIFY SCALES

BAR IS ONE INCH ON ORIGINAL DRAWING

0 1"

IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10

DRAWING NO. 99C20

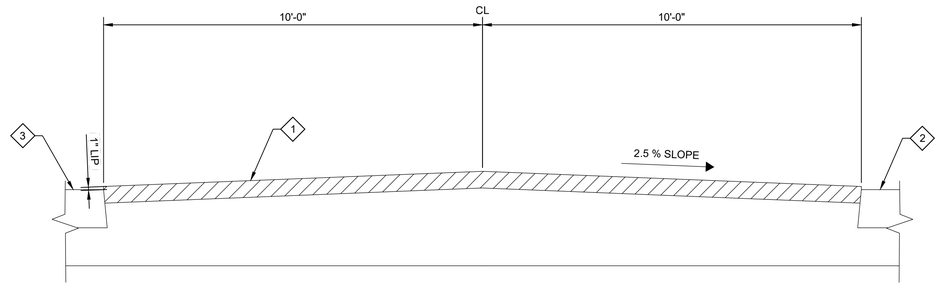
SHEET NO. 50 OF 200

Plot Date: 7/12/2023 11:49:53 AM

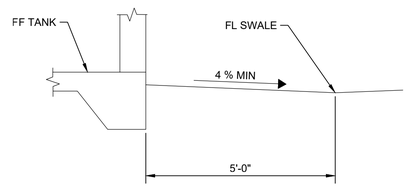
FILE NAME: 8660F1099C20.dwg

PROJECT NO. 8660F10

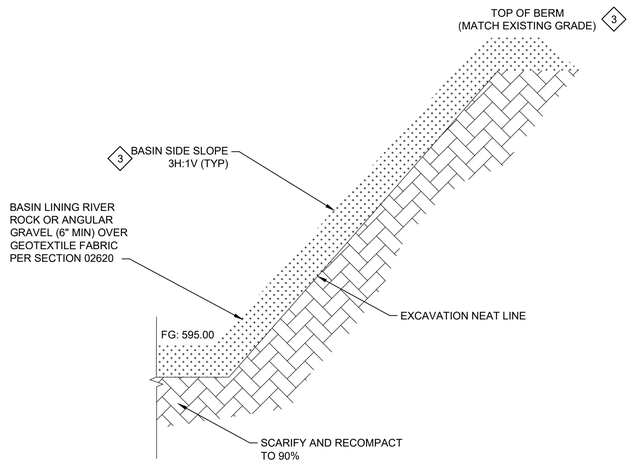
LAST SAVED BY: JDiDonato



A 99C20 SECTION
SCALE: 1/2" = 1'-0"
FILE: 8660F1001C107



B 99C20 SECTION
SCALE: 1/2" = 1'-0"
FILE: 8660F1001C107



C 99C19 SECTION - TYPICAL POND BERM
SCALE: NO SCALE
FILE: 8660F1001C107

GENERAL NOTES:

1. REFER TO SPECIFICATIONS AND GEOTEXTILE REPORT FOR SUBGRADE PREPARATION REQUIREMENTS.

X KEY NOTES:

1. GRAVEL ACCESS ROAD SHALL BE 0'-6" AB OVER GEOTEXTILE FABRIC WITH 1'-0" SUBGRADE AT 95% RC UNLESS OTHERWISE NOTED.
2. ALL UNPAVED AREAS WITHIN THE PROJECT SITE SHALL BE COMPACTED AND RESEEDED PER SPECIFICATIONS UNLESS OTHERWISE NOTED.
3. REFER TO DWG 99C20 FOR FINAL GRADING ELEVATIONS.

Call before you Dig
Avoid cutting underground utility lines. It's costly.
Call 811
OR
1-800-227-2600

SCALE

0 1' 2' 4'
SCALE: ½" = 1'-0"

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN JRD
CHECKED BWA
DATE JULY 2023

** ORIGINAL SEALED BY REACE P. FISHER 4/7/2023 CA PE NO. 81261 **

carollo

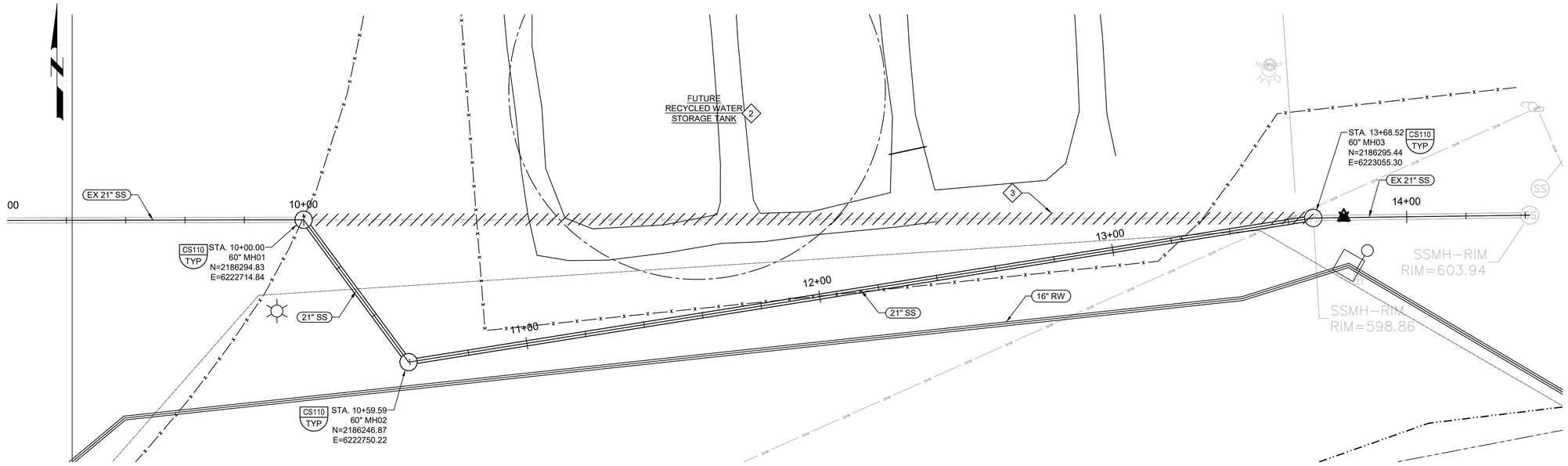
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
CIVIL
SECTIONS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
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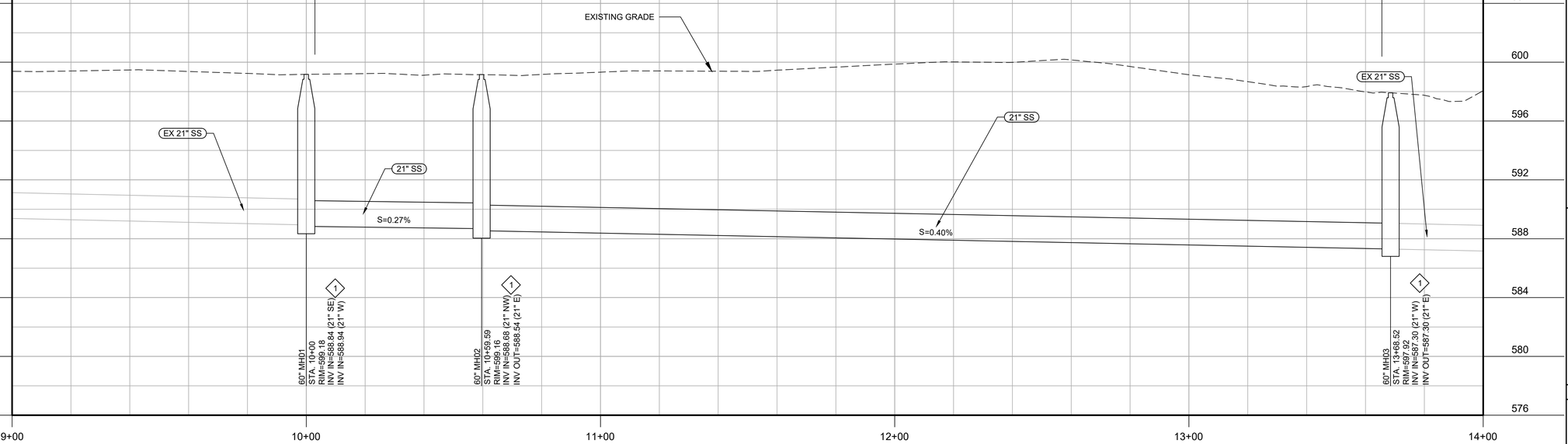
JOB NO. 8660F.10
DRAWING NO. 99C21
SHEET NO. 51 OF 200

Plot Date: 7/12/2023 11:49:57 AM
FILE NAME: 8660F1099C21.dwg
PROJECT NO. 8660F10
LAST SAVED BY: JDiDonato



PLAN

FILE: 8660F1001C102



PROFILE

FILE: 8660F1001C102

GENERAL NOTES:

1. CONTRACTOR TO VERIFY THE HORIZONTAL AND VERTICAL LOCATIONS OF ALL EXISTING UTILITIES PRIOR TO THE START OF CONSTRUCTION AND NOTIFY THE ENGINEER OF ANY DISCREPANCIES OR CONFLICTS.
2. EXISTING SEWER SEGMENT TO BE REMOVED AND REPLACED AS SHOWN IN THE NEW SEWER ALIGNMENT PRIOR TO THE CONSTRUCTION OF STORAGE TANK.
3. CONTRACTOR TO BYPASS SEWER FLOWS DURING REPLACEMENT OF SEWER.

X KEY NOTES:

1. CONTRACTOR TO VERIFY THE INVERTS OF ALL REPLACEMENT MANHOLES PRIOR TO REPLACEMENT
2. STORAGE TANK, YARD PIPING, AND ELECTRICAL DUCT BANK SHOWN FOR REFERENCE ONLY. REFER TO SPECIFIC DRAWINGS FOR CONSTRUCTION DETAILS. INSTALLATION OF THE STORAGE TANK, YARD PIPING, AND ELECTRICAL DUCT BANKS SHALL OCCUR AFTER THE REPLACEMENT SEWER HAS BEEN CONSTRUCTED
3. SEGMENT OF EXISTING 21-INCH SEWER TO BE REMOVED.
4. SEGMENT OF EXISTING 16-INCH RECYCLED WATER PIPELINE TO BE DECOMMISSIONED

811 Know what's below. Call before you dig.

SCALE

0 10' 20' 40'
SCALE: 1" = 20' (HORIZ)

0 2' 4' 8'
SCALE: 1" = 4' (VERT)

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CDA
DRAWN JDM
CHECKED BWA
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo

City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
CIVIL
SEWER REALIGNMENT

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99C22
SHEET NO. 52 OF 200

2022 CALIFORNIA BUILDING CODE

ROOM NO.	ROOM NAME	OCCUPANCY	CONSTRUCTION TYPE	BASIC ALLOW STORIES/HEIGHT	BASIC ALLOWABLE AREA	ACTUAL SQ FT	ALLOWABLE FLOOR AREA PER OCCUP	OCCUPANCY LOAD	EXITS REQUIRED/ PROVIDED	SPRINKLERED	OCCUPANCY SEPARATION	ACCESSIBILITY	COMMENTS
ELECTRICAL BUILDING													
101	ELECTRICAL ROOM	F-1	II-B	2 STORIES/55 FT	15,500	264	300	1	2/2	NR	NR	NR*	-
	BUILDING ACTUAL	F-1	II-B	2 STORIES/55 FT	15,500	264							

* IN ACCORDANCE WITH SECTION 11B-203.5 OF THE 2022 CALIFORNIA BUILDING CODE, ELECTRICAL ROOMS ARE EXEMPT FROM ACCESSIBILITY REQUIREMENTS

DOOR AND HARDWARE SCHEDULE

DOOR NO.	DOOR						FRAME						DETAILS			UL LABEL	CARD READER	HW GROUP	REMARKS
	WIDTH	HEIGHT	THICK	TYPE (AJ103 TYP)	MAT'L	FINISH	WIDTH	HEIGHT	DEPTH	TYPE (AJ100 TYP)	MAT'L	FINISH	HEAD (AJ105 TYP)	JAMB (AJ107 TYP)	SILL (AJ109 TYP)				
ELECTRICAL BUILDING																			
101-1	PR (3'-0")	7'-2"	1 3/4"	V	HM	COATING	6'-8"	7'-4"	8"	R	HM	COATING	C	C	E	NR	NR	HW-1	-
101-2	3'-0"	7'-2"	1 3/4"	V	HM	COATING	3'-4"	7'-4"	8"	R	HM	COATING	C	C	E	NR	NR	HW-2	-

ROOM FINISH SCHEDULE

ROOM NO.	ROOM NAME	FLOOR		BASE	NORTH WALL		SOUTH WALL		EAST WALL		WEST WALL		CEILING		
		MAT'L	FINISH	MAT'L	MAT'L	FINISH	MAT'L	FINISH	MAT'L	FINISH	MAT'L	FINISH	MAT'L	HEIGHT	FINISH
ELECTRICAL BUILDING															
101	ELECTRICAL ROOM	CONC	SEALER	CMU	CMU	PAINTING	CMU	PAINTING	CMU	PAINTING	CMU	PAINTING	MTLDK	±18'-0"	EXPO

CODE ANALYSIS ABBREVIATION LIST:

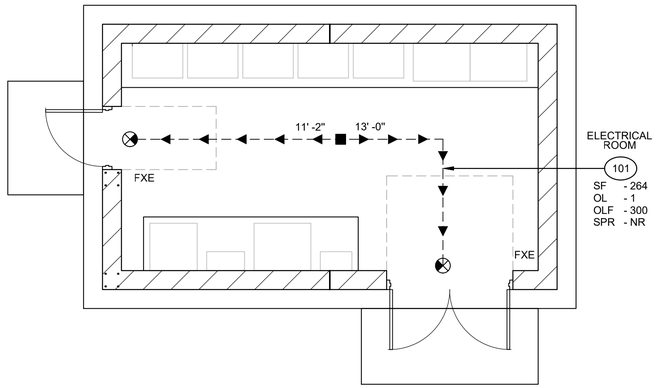
F-1	FACTORY INDUSTRIAL GROUP, MODERATE HAZARD OCCUPANCY (2022, CBC)
NR	NOT REQUIRED
R	REQUIRED
R-VALUE	THERMAL RESISTANCE, IS THE INVERSE OF THE TIME RATE OF HEAT FLOW THROUGH A BODY FROM ONE OF ITS BOUNDING SURFACES TO THE OTHER SURFACE FOR A UNIT TEMPERATURE DIFFERENCE BETWEEN THE TWO SURFACES, UNDER STEADY STATE CONDITIONS, PER UNIT AREA (2022, CBC)
SQ FT	SQUARE FEET
U-FACTOR	THERMAL TRANSMITTANCE, IS THE COEFFICIENT OF HEAT TRANSMISSION (AIR TO AIR) THROUGH A BUILDING COMPONENT OR ASSEMBLY, EQUAL TO THE TIME RATE OF HEAT FLOW PER UNIT AREA AND UNIT TEMPERATURE DIFFERENCE BETWEEN THE WARM SIDE AND COLD SIDE AIR FILMS (2022, CBC)
MAT'L	MATERIAL
HW	HARDWARE GROUP, REFERENCE SPECIFICATION SECTION 08710
NR	NOT REQUIRED
R	REQUIRED
UL	UNDERWRITERS LABORATORIES FIRE RATING

2022 CALIFORNIA ENERGY CODE

BUILDING ENVELOPE REQUIREMENTS - MENDOCINO COUNTY, CLIMATE ZONE 2

ENVELOPE COMPONENT	U-VALUE REQUIRED	U-VALUE PROVIDED
ROOFS - ABOVE ROOF DECK	U - 0.034	R-25
WALLS ABOVE GRADE, MASS	U - 0.170	*
FLOORS, MASS	U - 0.039	*
DOORS - SWINGING	U - 1.45	*
DOORS - NONSWINGING	U - 0.70	*

* IN ACCORDANCE WITH SECTION 100.0(e)2.C OF THE 2022 CALIFORNIA ENERGY CODE, PROCESS SPACES. REFERENCE TITLE 24 DOCUMENTS FOR COMPLIANCE.



A ELECTRICAL BUILDING - EGRESS PLAN
SCALE: 1/4" = 1'-0"
FILE: 8660F10S100

EGRESS ABBREVIATION AND SYMBOL LIST

SF:	SQUARE FEET
OL:	OCCUPANT LOAD
OLF:	OCCUPANT LOAD FACTOR
SPR:	AUTOMATIC SPRINKLER
NA:	NOT APPLICABLE
●##▶	DIRECTION OF EGRESS PATH ## LENGTH OF EGRESS IN FEET
⊗	EXIT SIGN
○	FIRE EXTINGUISHER

CONFORMED DOCUMENTS

REV	DATE	BY	DESCRIPTION

DESIGNED MH
DRAWN RGU
CHECKED JKN
DATE JULY 2023

** ORIGINAL SEALED BY MATTHEW C. KALLEVANT 4/7/2023 CA PE NO. 84405 **

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

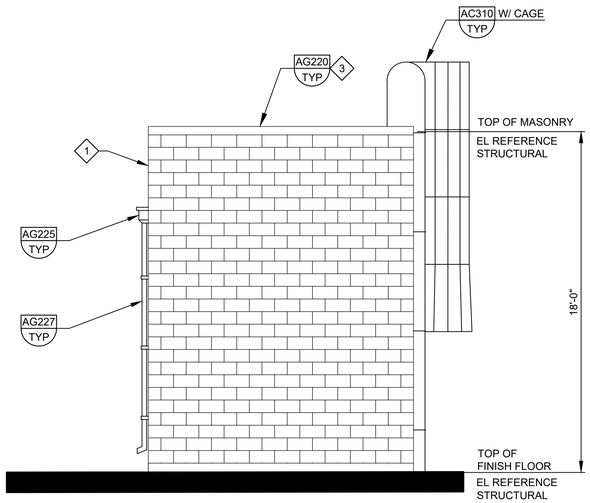
ARCHITECTURAL

ELECTRICAL BUILDING
CODE ANALYSIS, SCHEDULES, AND EGRESS PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99A01
SHEET NO. 53 OF 200

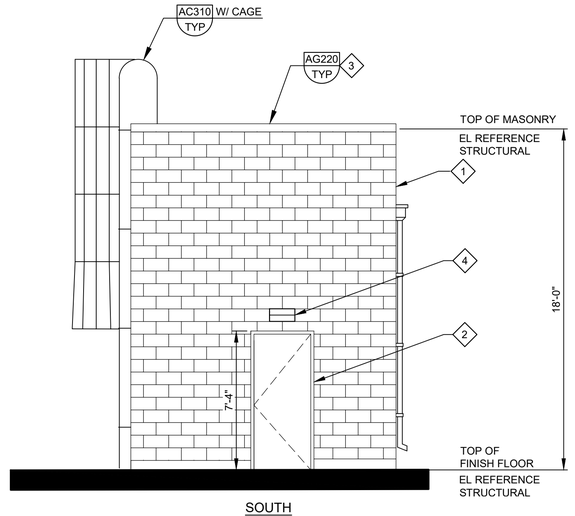
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PROJECT NO. 8660F10
LAST SAVED BY: obonafaux



NORTH

E ELEVATION

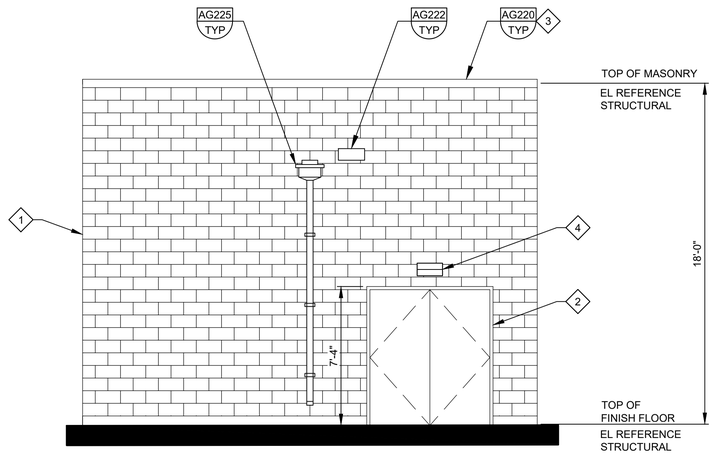
SCALE: 1/4" = 1'-0"
FILE: 8660F1001A201



SOUTH

F ELEVATION

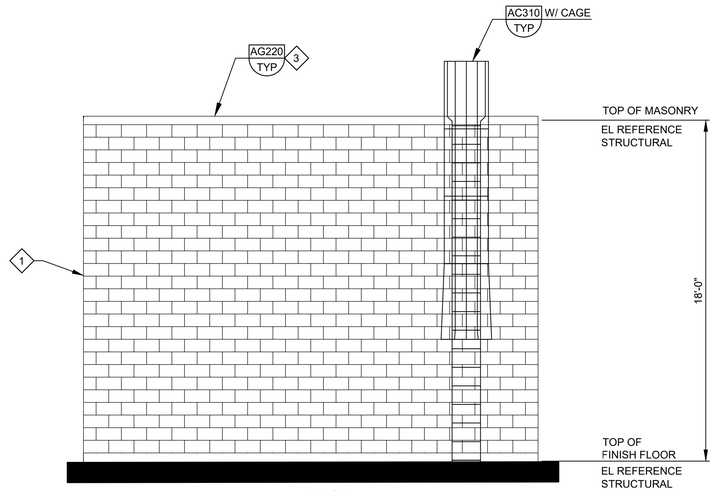
SCALE: 1/4" = 1'-0"
FILE: 8660F1001A201



EAST

G ELEVATION

SCALE: 1/4" = 1'-0"
FILE: 8660F1001A201



WEST

H ELEVATION

SCALE: 1/4" = 1'-0"
FILE: 8660F1001A201

GENERAL NOTES:

1. FOR GENERAL STRUCTURAL NOTES, REFER TO DRAWING 00S01.
2. FOR DOOR SCHEDULES, REFER TO DRAWING 98A01.
3. EXTERIOR CONCRETE MASONRY UNITS TO BE FINISHED WITH WATER REPELLANT.

KEY NOTES:

1. 12"x8"x16" STANDARD CONCRETE MASONRY UNIT. REFER TO SPECIFICATION SECTION 04220.
2. HOLLOW METAL DOOR AND FRAME. SPEC SECTION 08110.
3. ALUMINUM COPING OVER PARAPET IN ACCORDANCE WITH SPECIFICATION SECTION 07700.
4. EXTERNAL LIGHT FIXTURE REFERENCE ELECTRICAL DRAWINGS.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED MH
DRAWN RGU
CHECKED JKN
DATE JULY 2023

** ORIGINAL SEALED BY MATTHEW C. KALLEVANT 4/7/2023 CA PE NO. 84405 **

carollo

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

ARCHITECTURAL

ELECTRICAL BUILDING ELEVATIONS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99A02
SHEET NO. 54 OF 200

Plot Date: 7/20/2023 9:52:25 AM
$$$$DATE$$$$
$$$$USER$$$$
PROJECT NO. 8660F10
FILE NAME: 8660F-1000S01.dwg
$$$$LAST SAVED BY: obonafoux

GENERAL NOTES:

1. USE STRUCTURAL DRAWINGS IN CONJUNCTION WITH PROJECT DRAWINGS BY OTHER DISCIPLINES AND WITH THE SPECIFICATIONS.

2. UNLESS DETAILED, SPECIFIED, OR INDICATED OTHERWISE, CONSTRUCTION SHALL BE AS INDICATED IN THE GENERAL NOTES AND TYPICAL DETAILS.

3. PRESENTATION CONVENTIONS FOR STRUCTURAL DRAWINGS:

   A. SCREENED LINE WORK INDICATES EXISTING CONDITIONS.
   B. WRITTEN DIMENSIONS TAKE PRECEDENCE OVER SCALED SIZES.
   C. PLANS ARE TREATED AS HORIZONTAL SECTIONS. (I.E.: "PLAN AT ELEVATION 110" SHOWS CONSTRUCTION AT AND BELOW ELEVATION 110.)

4. VERIFY DIMENSIONS AND CONDITIONS BEFORE BEGINNING WORK. ADVISE ENGINEER IMMEDIATELY OF DISCREPANCIES BETWEEN EXISTING CONDITIONS AND DIMENSIONS, AND INFORMATION SHOWN ON THESE DRAWINGS. CONFIRM THE FOLLOWING BEFORE PREPARATION AND SUBMITTAL OF SHOP DRAWINGS:

   A. DIMENSIONS AND WEIGHTS FOR EQUIPMENT SELECTED.
   B. SIZES AND LOCATIONS OF EQUIPMENT PADS FOR EQUIPMENT SELECTED.

5. TYPICAL DETAILS ARE INCLUDED ON THE "TS" DRAWINGS.

   A. TYPICAL DETAILS ARE INTENDED TO APPLY AT LOCATIONS DESCRIBED BY THEIR TITLES, EVEN WHEN NOT SPECIFICALLY REFERENCED ON THE DRAWINGS.
   B. IN STRUCTURAL TYPICAL DETAILS, ORIENTATION OF BARS IN EACH MAT OF REINFORCEMENT (WHETHER "LINES" OR "DOTS"ARE CLOSER TO THE FACE OF THE CONCRETE) IS GENERALLY ARBITRARY. SEE DRAWINGS OF EACH STRUCTURE FOR ORIENTATION REQUIRED AT THAT STRUCTURE.

6. SEE CIVIL DRAWINGS FOR STRUCTURE COORDINATES. POINTS ON THE STRUCTURES TO WHICH SITE COORDINATES REFER ARE SHOWN ON THE STRUCTURAL PLANS.

7. DRAWINGS PREPARED BY OTHER DISCIPLINES INCLUDE OPENINGS, ANCHORS, PIPES, CONDUITS, AND OTHER ITEMS THAT ARE EMBEDDED INTO OR PASS THROUGH STRUCTURES.

   A. CONFIRM SIZE AND LOCATIONS OF OPENINGS, PENETRATIONS AND EMBEDMENT FOR ITEMS AND EQUIPMENT FURNISHED.
   B. IN GENERAL, OPENINGS, EMBEDMENTS, AND PENETRATIONS LESS THAN 12 INCHES IN DIAMETER ARE NOT SHOWN ON THE STRUCTURAL DRAWINGS.
   C. SEE MECHANICAL DRAWINGS FOR DETAILS OF PIPE PENETRATIONS, PIPE SUPPORTS, AND ASSOCIATED STRUCTURAL REQUIREMENTS.
   D. SEE MECHANICAL DRAWINGS FOR EQUIPMENT PADS AND PIPE SUPPORTS.

8. SEE STRUCTURAL DRAWINGS FOR LOCATIONS AND SIZES OF DOOR AND WINDOW OPENINGS.

STRUCTURAL DESIGN CRITERIA - GENERAL:

SEE DRAWINGS OF INDIVIDUAL STRUCTURES FOR SPECIFIC DESIGN CRITERIA BASED ON THESE OVERALL CRITERIA FOR THE SITE.

1. BUILDING CODE:

   A. 2022 CALIFORNIA BUILDING CODE ("CBC 2022") WITH ASCE 7-16.
   B. LOCAL AMENDMENTS: UKIAH CITY CODE.

2. STRUCTURE RISK CATEGORY: III EXCEPT FOR TANK AND PEDESTRIAN BRIDGE, RISK CATEGORY IV (1)

3. DEAD LOADS: CALCULATED FOR STRUCTURE SELF-WEIGHT.

4. LIVE LOADS: (REDUCTIONS NOT USED)

   A. FLOOR LIVE LOAD: SEE PLANS.
   B. GRATING AND CHECKERED PLATE: 100 PSF (UNO).
   C. ROOF LIVE LOAD: SEE PLANS (20 PSF MINIMUM).
   D. EQUIPMENT LOADS: SEE PLANS.
   E. CONCENTRATED AND IMPACT LOADS: SEE PLANS.

5. FLUID PRESSURE LOADS: 63 PSF/FT (UNO).

6. WIND DESIGN DATA:

   A. SPECIAL WIND REGION: NO
   B. WIND-BORNE DEBRIS REGION: NO
   C. BASIC WIND SPEED (3 SEC GUST, 33 FEET ABOVE GROUND): 110 MPH.

7. EARTHQUAKE DESIGN DATA:

   PEDESTRIAN BRIDGE (1)

	0.2 SECOND	*1.0 SECOND
A. SITE CLASS: F.		
B. MAPPED SPECTRAL RESPONSE ACCELERATIONS:	Ss=2.129g	S1=0.821g
C. SITE COEFFICIENTS:	Fa=1	Fv=4
D. MAXIMUM CONSIDERED ACCELERATIONS:	*Sms=2.22g	Sm1=2.37g
E. DESIGN SPECTRAL RESPONSE ACCELERATIONS:	*Sds=1.48g	Sd1=1.58g

   ALL OTHER STRUCTURES UNLESS NOTES OTHERWISE

	0.2 SECOND	*1.0 SECOND
A. SITE CLASS: D.		
B. MAPPED SPECTRAL RESPONSE ACCELERATIONS:	Ss=1.88g	S1=0.719g
C. SITE COEFFICIENTS:	Fa=1	Fv=2.5
D. MAXIMUM CONSIDERED ACCELERATIONS:	*Sms=1.506g	Sm1=1.438g
E. DESIGN SPECTRAL RESPONSE ACCELERATIONS:	*Sds=1.004g	Sd1=0.959g

8. CONSTRUCTION LOADS:

   A. STRUCTURES HAVE BEEN DESIGNED FOR OPERATING LOADS ON COMPLETED FACILITIES. UNTIL CONSTRUCTION IS COMPLETE AND MEMBERS HAVE ACHIEVED THEIR DESIGN STRENGTH, PROTECT STRUCTURES AS REQUIRED BY SHORING, BRACING, AND BALANCING.

9. FLOOD LOADS:

   A. FLOOD HAZARD AREA : NO

10. RAIN LOADS:

    A. DESIGN RAINFALL INTENSITY: i = 1.35 INCHES / HOUR. (100 YEAR / 1 HOUR EVENT)

11. ICE LOADS: (1)

    A. NOMINAL UNIFORM ICE THICKNESS W/ 3-SECOND WIND GUST: 0 INCH / 30 MPH
    B. ICE DENSITY FOR CALCULATING ICE WEIGHT: 56 PCF (MIN)

GEOTECHNICAL REPORT / FOUNDATION DESIGN CRITERIA:

1. GEOTECHNICAL INVESTIGATION REPORT:

   TITLE: GEOTECHNICAL REPORT CITY OF UKIAH RECYCLED WATER PIPELINE PHASE 4 DESIGN PROJECT
   PREPARED BY: CRAWFORD AND ASSOCIATES.
   REPORT NO: CRAWFORD FILE NO. 19-503.1 DATED: FEBRUARY 2023.

2. FOUNDATION DESIGNS ARE BASED ON RECOMMENDATIONS IN THE GEOTECHNICAL INVESTIGATION REPORT.

   A. NET ALLOWABLE BEARING PRESSURE
      TANK: 2000 PSF
      PUMP STATION: 3000 PSF (1)

   B. LATERAL EARTH PRESSURE (UNO):
      SURCHARGE: EQUIVALENT TO 2 FEET OF SOIL ABOVE FINISHED GRADE.

	STATIC	SEISMIC
ACTIVE (PSF/FT):	50	50
AT REST (PSF/FT):	65	65
SLIDING COEFFICIENT OF FRICTION:	0.3	0.3

TYPICAL STRUCTURAL MATERIALS:

1. MATERIALS SHALL CONFORM TO THE FOLLOWING REQUIREMENTS UNLESS OTHERWISE INDICATED ON THE DRAWINGS.

2. SEE PROJECT SPECIFICATIONS AND NOTES ON DRAWINGS OF SPECIFIC STRUCTURES FOR DETAILED AND LOCATION-SPECIFIC REQUIREMENTS.

REINFORCING STEEL (FOR CONCRETE AND MASONRY):

1. DEFORMED BARS:
   A. TYPICAL: ASTM A 615, GRADE 60.
   B. WHERE INDICATED ON THE DRAWINGS: ASTM A 706.
   C. ASTM A615 GRADE 80 SPIRALS FOR PILES AS INDICATED ON DRAWINGS.

2. WELDED WIRE FABRIC: ASTM A 1064.

CONCRETE:

1. NORMAL DENSITY.

2. MINIMUM SPECIFIED CONCRETE COMPRESSIVE STRENGTH, f'c (AT 28 DAYS UNO).

   A. STRUCTURES: "CLASS A"& DRILLED PIERS f'c = 4500 PSI.
   B. FILL AND THRUST BLOCKS: "CLASS C" f'c = 2500 PSI.
   C. PIPE ENCASEMENT: "CLASS A" f'c = 4500 PSI.
   D. ELECTRICAL DUCT ENCASEMENT: "CLASS CE" f'c = 3000 PSI.
   E. STORAGE POND: "CLASS A" f'c = 5000 PSI.

STRUCTURAL STEEL:

1. SECTIONS

   A. SHAPES W, WT: ASTM A 992 (Fy = 50 KSI)
   B. SHAPES S, ST, M, MT, HP, C, MC, L: ASTM A 36 (Fy = 36 KSI)
   C. PLATES AND BARS: ASTM A 36 (Fy = 36 KSI)
   D. PIPES: ASTM A 53, GRADE B (Fy = 35 KSI)
   E. HOLLOW STRUCTURAL SECTIONS:
      ROUND: ASTM A 500, GRADE B (Fy = 42 KSI)
      SQUARE AND RECTANGULAR: ASTM A 500, GRADE B (Fy = 46 KSI)

2. CONNECTIONS:

   A. BOLTS - STEEL TO STEEL:
      ASTM A 325 HIGH-STRENGTH BOLTS, WITH LOAD INDICATOR WASHERS.
   B. BOLTS - STEEL TO CONCRETE OR MASONRY:
      ANCHOR BOLTS WITH HEX FORGED HEAD.
      ASTM F 593, STAINLESS TYPE 316
      ASTM F 1554, GRADE 36 GALVANIZED.
   C. WELDS - SHIELDED METAL ARC PROCESS USING E70-XX ELECTRODES.

STAINLESS STEEL:

1. ANSI TYPE 316/316L EXCEPT WHERE TYPE 304/304L IS INDICATED ON THE DRAWINGS.

2. SECTIONS: SHAPES AND BARS: ASTM A 276.

3. BOLTED CONNECTIONS - BOLTS AND ANCHOR BOLTS:

   A. MATCH ALLOY OF THE STRUCTURAL MEMBERS CONNECTED.
   B. TYPE 316/316L: ASTM F 593, GRADE B8M, CLASS 1, HEAVY HEX.
   C. TYPE 304/304L: ASTM F 593, GRADE B8, CLASS 1, HEAVY HEX.

4. WELDED CONNECTIONS:

   A. TYPE 316L: E316L-15 ELECTRODES.
   B. TYPE 304L: E304L-15 ELECTRODES.

STRUCTURAL ALUMINUM:

1. SECTIONS

   A. SHAPES: ASTM B 308, ALLOY 6061-T6.
   B. SHEET AND PLATE: ASTM B 209, ALLOY 6061-T6.

2. BOLTED CONNECTIONS - BOLTS AND ANCHOR BOLTS:

   A. STAINLESS STEEL - TYPE 316, ASTM F 593, GRADE B8M, CLASS 1, HEAVY HEX.

3. WELDED CONNECTIONS:

   A. GAS METAL ARC (MIG) OR GAS TUNGSTEN ARC (TIG) PROCESS USING FILLER ALLOY 4043 ELECTRODES.

CONSTRUCTION:

CONFORM TO THE FOLLOWING REQUIREMENTS UNLESS OTHERWISE INDICATED ON THE DRAWINGS.

EXCAVATION AND BACKFILLING:

1. EXPOSE AND PREPARE SUBGRADE AS SHOWN ON THE DRAWINGS AND SPECIFIED. OBTAIN ENGINEER'S OBSERVATION OF SUBGRADE SURFACES, AS EXPOSED AND AS PREPARED, BEFORE PROCEEDING WITH FOUNDATION CONSTRUCTION.

2. DO NOT PLACE BACKFILL AGAINST WALLS UNTIL STRUCTURES SUPPORTING THE TOP OF THE WALL ARE IN PLACE, ARE COMPLETE, AND (IN THE CASE OF CONCRETE) HAVE CURED TO THEIR MINIMUM SPECIFIED 28-DAY COMPRESSIVE STRENGTH.

3. WHERE BACKFILL MUST BE PLACED AGAINST WALLS BEFORE STRUCTURES ABOVE ARE COMPLETE, PROVIDE BRACING FOR WALLS. KEEP BRACING IN PLACE UNTIL THE STRUCTURE ABOVE IS COMPLETE AND (IN THE CASE OF CONCRETE) HAS CURED TO ITS MINIMUM SPECIFIED 28-DAY COMPRESSIVE STRENGTH.

CONCRETE:

1. SEE S101/TYP FOR CONCRETE NOTES, INCLUDING CLEAR COVER AND LAP SPLICE LENGTH REQUIREMENTS FOR REINFORCING.

2. SUBMIT LOCATIONS OF CONSTRUCTION JOINTS NOT SHOWN ON THE DRAWINGS FOR ACCEPTANCE BY THE ENGINEER BEFORE FORM LAYOUT.

3. PROVIDE CHAMFER AT EXPOSED EDGES OF CAST-IN-PLACE CONCRETE. SEE SPECIFICATION 03102 FOR CHAMFERS.

4. PROVIDE REINFORCING:

   A. AT CORNERS AND JUNCTIONS - AS INDICATED IN S144/TYP, SUPPLEMENT WITH ADDED BARS WHERE INDICATED ON THE DRAWINGS.
   B. AT OPENINGS - AS INDICATED IN S180/TYP.

5. WELDING OF REINFORCING IS NOT PERMITTED UNLESS DETAILED ON THE DRAWINGS OR ACCEPTED IN ADVANCE BY THE ENGINEER.

6. MAINTAIN MINIMUM 3 INCHES CLEAR CONCRETE COVER BETWEEN REINFORCING AND EMBEDMENTS.

7. FINISH CONCRETE AS SPECIFIED IN SECTION 03366.

8. CONCRETE PADS

   A. (E) EQUIPMENT PAD SEE S302/TYP.
   B. (H) HOUSEKEEPING PAD FOR ELECTRICAL EQUIPMENT SEE S350/TYP.

MASONRY:

1. SEE S400/TYP FOR MASONRY NOTES, INCLUDING LAP SPLICE LENGTHS.

2. PROVIDE REINFORCING:

   A. AT CORNERS AND JUNCTIONS AS INDICATED IN S412/TYP.
   B. AT OPENINGS AS INDICATED IN S410/TYP.

3. WELDING OF REINFORCING IS NOT PERMITTED UNLESS DETAILED ON THE DRAWINGS OR ACCEPTED IN ADVANCE BY THE ENGINEER.

4. GROUTING:

   A. FULLY GROUTED.

STEEL, STAINLESS STEEL, AND ALUMINUM - CONNECTIONS:

1. BOLTED:

   A. MADE USING 3/4-INCH DIAMETER BOLTS.
   B. HAVING A MINIMUM OF 2 BOLTS, SPACED NOT CLOSER THAN 3 INCHES ON CENTER.
   C. WITH A DISTANCE OF AT LEAST 1 1/2 INCHES FROM CENTER OF BOLT TO ANY EDGE OF A PLATE OR STRUCTURAL ELEMENT.

2. WELDED:

   A. FILLET WELDS: PER AWS CODE BASED ON THE THICKNESS OF THE MATERIALS BEING JOINED, AND FULL LENGTH OF THE JOINT.

3. INTERFACE BETWEEN MATERIALS:

   A. AT BOLTED CONNECTIONS THAT INCLUDE DIFFERENT METALS (E.G.: STEEL AND STAINLESS STEEL, OR ALUMINUM AND STEEL) PROVIDE ISOLATING SLEEVES AND WASHERS AS SPECIFIED IN SECTION 05190.
   B. WHERE ALUMINUM IS IN CONTACT WITH MASONRY OR CONCRETE, COAT ALUMINUM SURFACES AS SPECIFIED IN SECTION 09960.

4. POST-INSTALLED ANCHORS IN CONCRETE AND MASONRY:

   A. INSTALL IN FULL COMPLIANCE WITH ACCEPTED BUILDING CODE EVALUATION REPORT AND MANUFACTURER'S INSTRUCTIONS.
   B. DO NOT CUT, DAMAGE, OR INTERRUPT EXISTING REINFORCEMENT TO INSTALL ANCHORS. USE NON-DESTRUCTIVE TESTING EQUIPMENT TO IDENTIFY LOCATIONS OF REINFORCEMENT IN MEMBERS BEFORE DRILLING HOLES FOR ANCHORS.

METAL FABRICATIONS:

1. HANDRAILS AND GUARDRAILS:

   A. ALUMINUM, EXCEPT WHERE OTHER MATERIALS ARE NOTED.

2. GRATING:

   A. ALUMINUM WITH TYPE 316 STAINLESS STEEL FASTENERS, UNLESS OTHERWISE NOTED.
   B. GRATING AND ITS SEATS OR SUPPORTS SHALL BE OF THE SAME MATERIAL.
   C. UNLESS INDICATED ON THE DRAWINGS AS "REMOVABLE GRATING", SECURELY FASTEN GRATING TO SUPPORTS AS INDICATED IN S559/TYP.

3. COVER PLATES:

   A. ALUMINUM WITH TYPE 316 STAINLESS STEEL FASTENERS, UNLESS OTHERWISE NOTED.
   B. COVER PLATE AND ITS SEATS OR SUPPORTS SHALL BE OF THE SAME MATERIAL.

SPECIAL INSPECTION

1. SPECIAL INSPECTION IS REQUIRED FOR THE FOLLOWING STRUCTURAL MATERIALS AND CONSTRUCTION. SEE SPECIFICATION SECTION 01455 FOR DETAILS.

2. DIVISION 2 SITE CONSTRUCTION (EARTHWORK)

   A. EXCAVATION DEPTH.
   B. ADEQUACY OF EXPOSED SURFACE TO PROVIDE REQUIRED SUPPORT.
   C. PREPARATION OF SOILS/SURFACES SUPPORTING CONSTRUCTION.
   D. FILL AND BACKFILL.

3. DIVISION 3 CONCRETE:

   A. LOCATIONS.
   B. FORMWORK AND MEMBER SIZES.
   C. REINFORCING STEEL.
   D. ANCHORS: CAST-IN AND POST-INSTALLED.
   E. CONCRETE MIX AND PLACEMENT.
   F. PROTECTION AND CURING PROCEDURES.

4. DIVISION 4 MASONRY

   A. LOCATIONS.
   B. MEMBER SIZES.
   C. REINFORCING STEEL.
   D. ANCHORS: BUILT-IN AND POST-INSTALLED.
   E. MORTAR AND JOINTS.
   F. GROUT AND GROUTING.
   G. PROTECTION AND CURING PROCEDURES.

5. DIVISION 5 METALS

   A. GENERAL ALL METALS:
      1) MEMBER LOCATIONS.
      2) MEMBER SIZES/TYPES.
      3) ANCHORS - CAST-IN AND BUILT-IN ANCHOR BOLTS.
      4) ANCHORS - POST-INSTALLED MECHANICAL AND ADHESIVE.

   B. STRUCTURAL STEEL (CARBON AND STAINLESS).
      1) HIGH-STRENGTH BOLTING.
      2) WELDING.

   C. STRUCTURAL ALUMINUM.
      1) BOLTING.
      2) WELDING.

STRUCTURAL OBSERVATION:

1. STRUCTURAL OBSERVATION IS REQUIRED DURING AND AT SPECIFIC STAGES OF CONSTRUCTION WHILE CORRECTIONS CAN BE MADE.

2. ALL STRUCTURAL IN ALL AREAS:

   A. FOUNDATIONS
      1. AFTER REINFORCING STEEL AND STRUCTURAL EMBEDS ARE IN PLACE, BUT PRIOR TO CASTING OF CONCRETE.
   B. CONCRETE WALLS
      1. AFTER REINFORCING STEEL AND STRUCTURAL EMBEDS ARE IN PLACE, BUT PRIOR TO CASTING OF CONCRETE.
   C. ELEVATED SLABS
      1. AFTER REINFORCING STEEL AND STRUCTURAL EMBEDS ARE IN PLACE, BUT PRIOR TO CASTING OF CONCRETE.

STRUCTURAL SYMBOLS:

1. SEE DRAWING 00G03 FOR KEY TO DRAWING TITLES AND SECTION CUTS, AND FOR DEFINITION OF MATERIALS SHADING PATTERNS.

2. WELDING: SYMBOLS: IN ACCORDANCE WITH AMERICAN WELDING SOCIETY (AWS) A2.4.

STRUCTURAL ABBREVIATIONS:

1. SEE DRAWING 00G03 FOR GENERAL LIST OF ABBREVIATIONS USED ON DRAWINGS.

2. ABBREVIATIONS FOR NAMES OF TECHNICAL GROUPS MAY BE FOUND IN THE PROJECT SPECIFICATIONS.

3. STRUCTURAL MEMBERS:

A. STEEL: ABBREVIATIONS AND DESIGNATIONS ARE IN ACCORDANCE WITH THE AMERICAN INSTITUTE OF STEEL CONSTRUCTION'S STEEL CONSTRUCTION MANUAL, CURRENT EDITION.

B. ALUMINUM: ABBREVIATIONS AND DESIGNATIONS ARE IN ACCORDANCE WITH THE ALUMINUM ASSOCIATION'S ALUMINUM DESIGN MANUAL, CURRENT EDITION.

4. ABBREVIATIONS FOR STRUCTURAL DRAWINGS:
   WHEN USED ON THE STRUCTURAL DRAWINGS, THE FOLLOWING ABBREVIATIONS HAVE THE MEANINGS LISTED.

REINFORCEMENT:		OTHER:	
BO	BOTTOM OF	L	ANGLE
EF	EACH FACE	PL	PLATE
I.F.	INSIDE FACE		
O.F.	OUTSIDE FACE		
T.O.	TOP OF		
#	NUMBER (REINFORCING BAR SIZE)		

DEFERRED DESIGN SUBMITTALS

AS DEFINED IN THE BUILDING CODE, DEFERRED DESIGN SUBMITTALS ARE PORTIONS OF THE DESIGN THAT ARE NOT SUBMITTED AT THE TIME OF PERMIT APPLICATION, AND THAT ARE TO BE REVIEWED BY THE REGISTERED DESIGN PROFESSIONAL AND SUBSEQUENTLY SUBMITTED TO THE BUILDING OFFICIAL.

DEFERRED DESIGN SUBMITTALS FOR THIS PROJECT INCLUDE:

1. DIVISION 2 EARTHWORK
   A. 2300 EARTHWORK
   B. 02460 PILE LOAD TESTS

2. DIVISION 2 METALS
   A. 05500 TRASH RACK GRATING

3. DIVISION 8 DOORS AND WINDOWS (1)
   A. 08320 ACCESS HATCH

4. DIVISION 15 MECHANICAL
   A. 15050 MECHANICAL EQUIPMENT SUPPORTS
   B. 15500 HVAC SUPPORTS

4. DIVISION 16 ELECTRICAL
   A. 16050 ELECTRICAL EQUIPMENT SUPPORTS

REV	DATE	BY	DESCRIPTION
1	06-02-23	JKN	ADDENDUM 3

CONFORMED DOCUMENTS

DESIGNED JKN
DRAWN AL
CHECKED KP
DATE JULY 2023

** ORIGINAL SEALED BY JITESH K. RE NALAGOTLA 4/7/2023 CA PE NO. 86094 **

carollo®

City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
STRUCTURAL
GENERAL STRUCTURAL NOTES

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00S01
SHEET NO. 55 OF 200

Plot Date: 12-JUL-2023 11:52:38 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: obonafoux

GENERAL NOTES:

1. BACKGROUND IS BASED ON THE 1994 RECORD DRAWINGS. CONTRACTOR TO FIELD VERIFY EXISTING DIMENSIONS.
2. ACCESSING ALL OF THE SURFACE REQUIRES THIS WORK TO BE DONE DURING THE MEDIA REPLACEMENT PROCESS (REFER TO SPECIFICATION SECTION 01140 FOR CONSTRAINTS AND POSSIBLE WORK SEQUENCING).

◇# KEY NOTES:

1. CONTRACTOR TO FULLY RECOAT INTERIOR AND EXTERIOR SURFACES OF THE CLARIFIER/FILTER TANKS PER SPECIFICATION SECTION 09960 DURING THE MEDIA REPLACEMENT PROCESS.
2. CONTRACTOR TO FULLY RECOAT THE INTERIOR AND EXTERIOR SURFACES OF THE COLLECTION TROUGHS PER SPECIFICATION SECTION 09960.
3. EXISTING TANK CORROSION; CONTRACTOR TO ALLOW FOR 3 TYPES OF CORROSION REMEDIATION AS PART OF THE DEMOLITION , PREPARATION AND COATING OF THE EXISTING TANK AS FOLLOWS:

   TYPE **I** - UNIFORM SURFACE CORROSION TREATMENT: REMOVE WITH ABRASIVE BLAST ALL SURFACES IN ACCORDANCE WITH SECTION 09960. BID QUANTITY = 10000 SF.

   TYPE **II** - LOCALIZED SURFACE PITTING GREATER THAN 1/16" DEEP OVER AN AREA LESS THAN OR EQUAL TO 1 SQ FT TREATMENT: FILL WITH WELD METAL. BID QUANTITY = 200 SF.

△1 TYPE **III** - WIDE SPREAD SURFACE PITTING GREATER THAN 1/16" DEEP OVER GREATER THAN 1 SQ FT TREATMENT: FILLET WELD USING 1/4" WELDS, 1/4" PLATE OVER CORROSION AREA, EXTEND PLATE 3" BEYOND CORROSION LIMITS. BID QUANTITY = 200 SF.



A PLAN
SCALE: 3/16"=1'-0"
FILE: 8660F1085S100

REV	DATE	BY	DESCRIPTION
△1	06-02-23	JKN	ADDENDUM 3

CONFORMED DOCUMENTS

DESIGNED JKN
DRAWN TU
CHECKED KP
DATE JULY 2023

**
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4/7/2023
CA PE NO. 86094
**

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City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

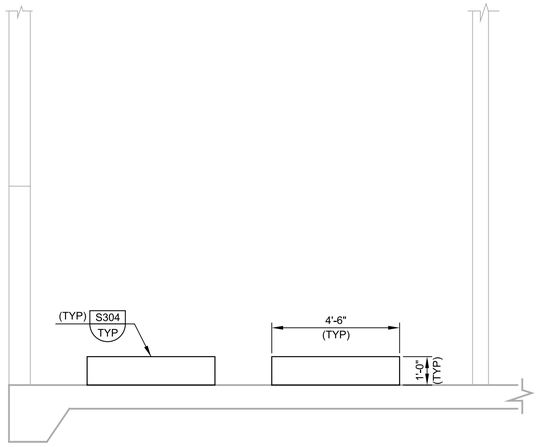
STRUCTURAL

AWT CLARIFIER/FILTER PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 85S01
SHEET NO. 56 OF 200

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ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: kjackson



B SECTION
85S01
SCALE: 3/8"=1'-0"
FILE: 8660F1085S9303



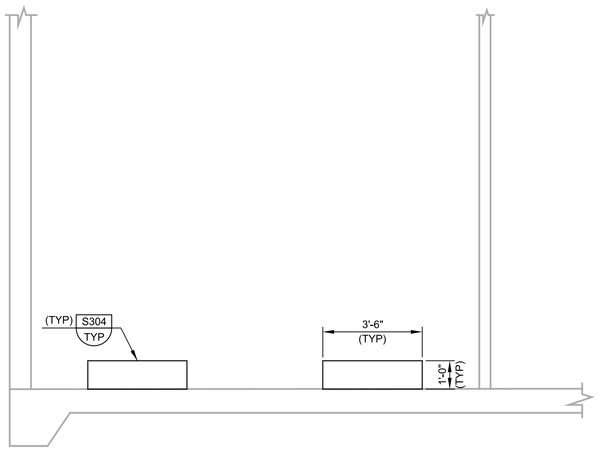
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GENERAL NOTES:

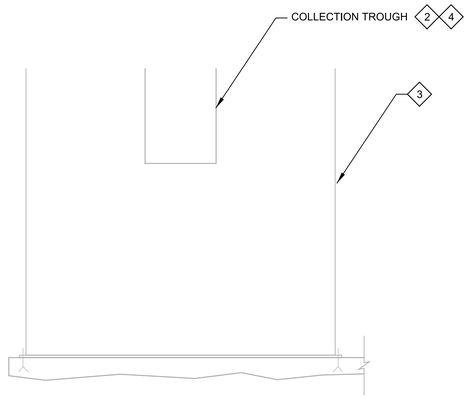
1. REFER TO GENERAL NOTES ON 00S01.

KEY NOTES:

1. REPAIR AND REPLACE EXISTING ANCHOR BOLTS AS NEEDED. EACH AWT CLARIFIER/FILTER TANK HAS SIX ANCHOR BOLTS.
2. CONTRACTOR TO FULLY RECOAT THE INTERIOR AND EXTERIOR SURFACES OF THE COLLECTION TROUGHS PER SPECIFICATION SECTION 09960.
3. CONTRACTOR TO FULLY RECOAT THE INTERIOR AND EXTERIOR SURFACES OF THE CLARIFIER/FILTER TANKS PER SPECIFICATION SECTION 09960.
4. CONTRACTOR TO FIELD VERIFY DIMENSIONS OF COLLECTION TROUGH.



C SECTION
85S01
SCALE: 3/8"=1'-0"
FILE: 8660F1085S9304



D SECTION
85S01
SCALE: 3/8"=1'-0"
FILE: 8660F1085S9305

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED JKN
DRAWN TU
CHECKED KP
DATE JULY 2023

**
ORIGINAL
SEALED BY
JITESH K. RE NALAGOTLA
4/7/2023
CA PE NO. 86094
**

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City of Ukiah

CITY OF UKIAH

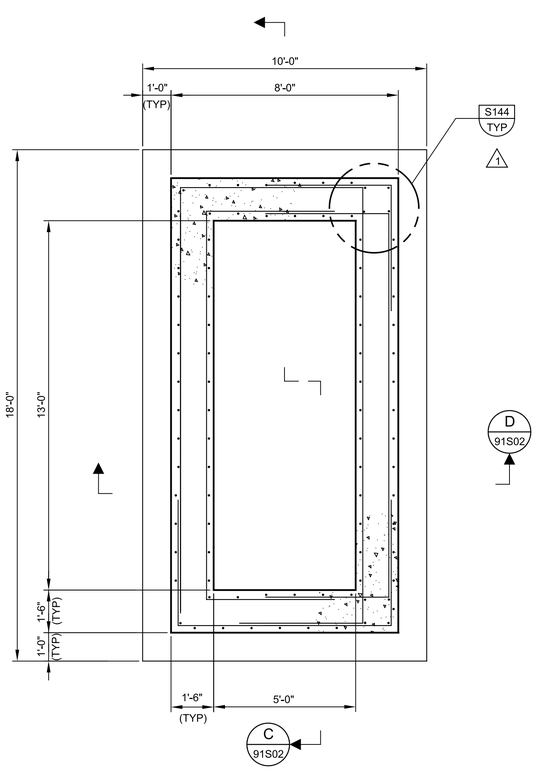
RECYCLED WATER PROJECT - PHASE 4

STRUCTURAL

AWT CLARIFIER/FILTER
SECTIONS AND PHOTO

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

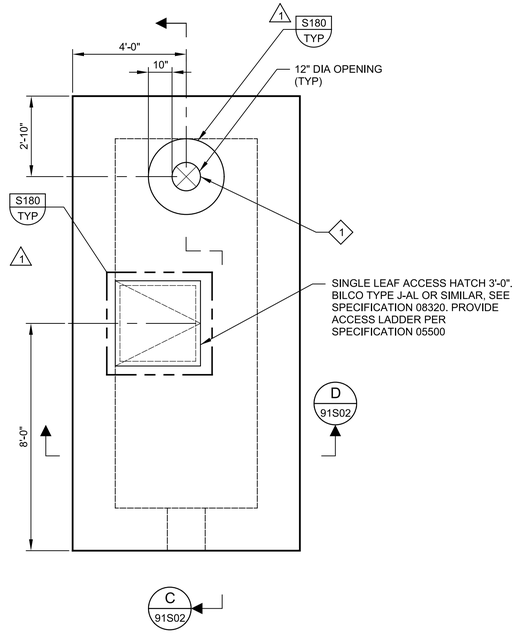
JOB NO. 8660F.10
DRAWING NO. 85S02
SHEET NO. 57 OF 200



PAU PUMP STATION - FOUNDATION

A PLAN

SCALE: 3/8"=1'-0"
FILE: 866F1091S100



PAU PUMP STATION - TOP

B PLAN

SCALE: 3/8"=1'-0"
FILE: 866F1091S101

GENERAL NOTES:

1. FOR GENREAL STRUCTURAL NOTES, REFER TO DRAWING 00S01.

◇# KEY NOTES:

1. CONTRACTOR SHALL VERIFY SIZE, LOCATION OF PIPE, AND PIPE PENETRATION WITH MECHANICAL DRAWINGS.

REV	DATE	BY	DESCRIPTION
1	06-02-23	JKN	ADDENDUM 3

CONFORMED DOCUMENTS

DESIGNED JKN
DRAWN TU
CHECKED KP
DATE JULY 2023

** ORIGINAL SEALED BY JITESH K. RE NALAGOTLA 4/7/2023 CA PE NO. 86094 **

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

STRUCTURAL

PAU PUMP STATION PLANS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 91S01
SHEET NO. 58 OF 200

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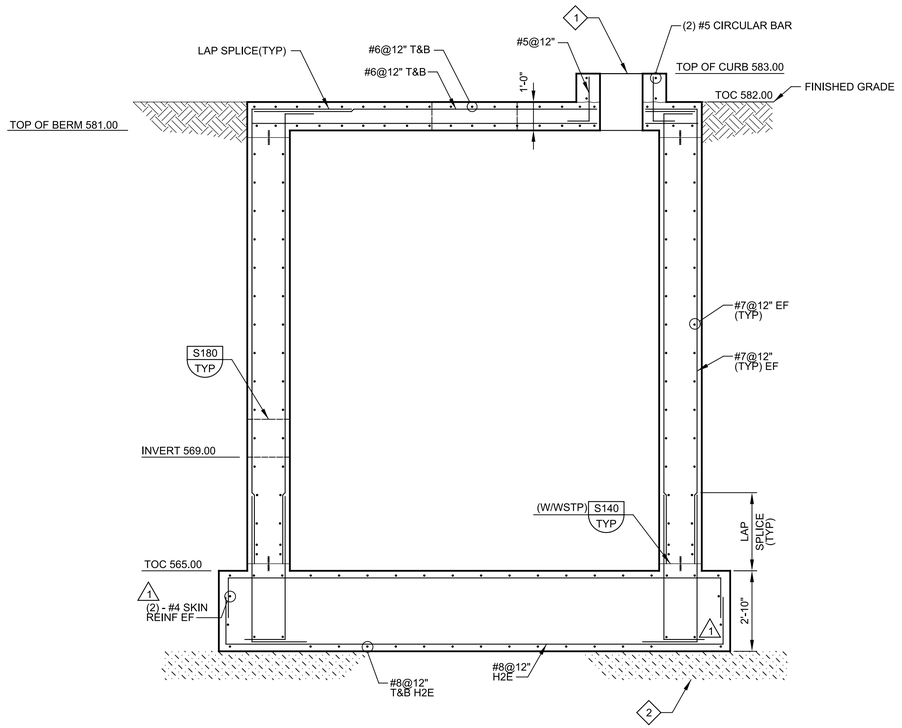
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LAST SAVED BY: obonafoux

GENERAL NOTES:

1. FOR GENERAL STRUCTURAL NOTES, REFER TO DRAWING 00S01.

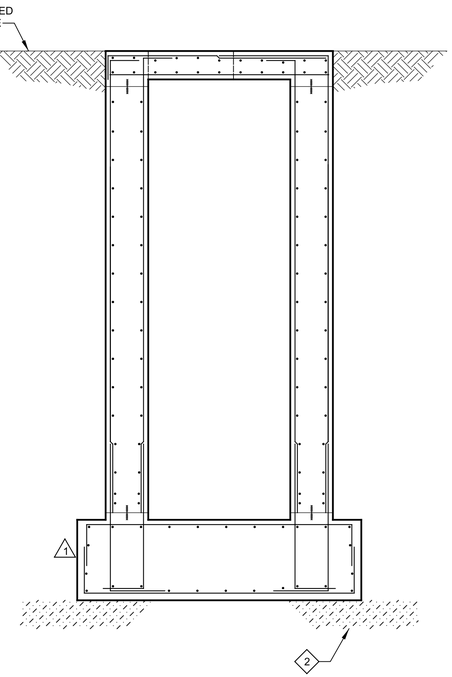
KEY NOTES:

1. CONTRACTOR SHALL VERIFY SIZE, LOCATION OF PIPE, AND PIPE PENETRATION WITH MECHANICAL DRAWINGS.
2. OVER EXCAVATION, COMPACTION AND AGGREGATE BASE PER GEOTECHNICAL REPORT. PROVIDE MINIMUM 12 INCHES OF AGGREGATE BASE LEVELING COURSE OVER 10 INCHES OF SCARIFIED NATIVE MATERIAL COMPACTED TO 95% RELATIVE COMPACTION AND MOISTURE CONDITIONED AS PER ASTM D1557.



C SECTION

91S01 SCALE: 3/8"=1'-0"
FILE: 866F1091SS300



D SECTION

91S01 SCALE: 3/8"=1'-0"
FILE: 866F1091SS300

REV	DATE	BY	DESCRIPTION
1	06-02-23	JKN	ADDENDUM 3

CONFORMED DOCUMENTS

DESIGNED JKN
DRAWN TU
CHECKED KP
DATE JULY 2023

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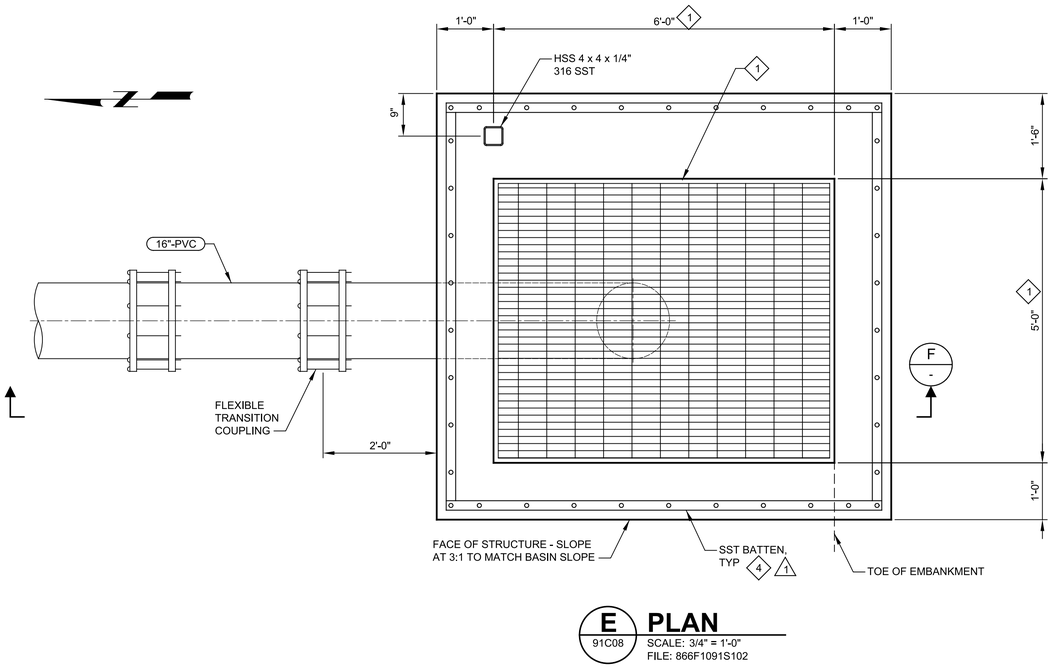
RECYCLED WATER PROJECT - PHASE 4

STRUCTURAL

PAU PUMP STATION SECTIONS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 91S02
SHEET NO. 59 OF 200



E PLAN

91C08

SCALE: 3/4" = 1'-0"
FILE: 866F1091S102

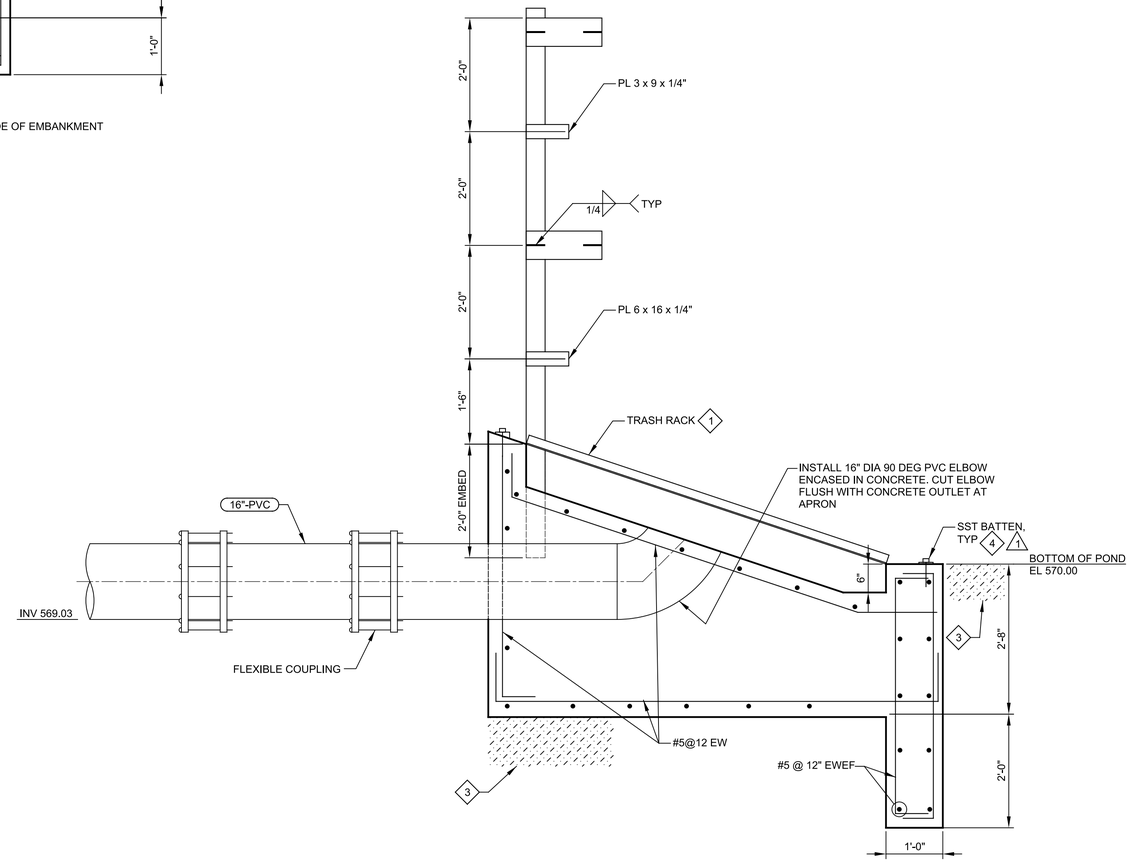
GENERAL NOTES:

1. THE STAFF GAUGES SHOULD BE MADE OF A DURABLE MATERIAL(S) THAT RESIST RUST AND DISCOLORATION, AND STURDY ENOUGH TO MINIMIZE MOVEMENT DUE TO WIND AND WAVE ACTION. RECOMMENDED MATERIALS INCLUDE PORCELAIN ENAMELED IRON, STEEL PIPE OR FIBERGLASS. MANUFACTURERS INCLUDE STEVENS, BEN MEADOWS, AND FORESTRY SUPPLIERS.

KEY NOTES:

1. CONTRACTOR SHALL PROVIDE STAINLESS STEEL TRASH GRATE DESIGNED AND DETAILED FOR A LIVE LOAD OF 100 PSF. CONTRACTOR SHALL PROVIDE SHOP DRAWINGS AND CALCULATIONS STAMPED AND SIGNED BY A REGISTERED PROFESSIONAL ENGINEER IN STATE OF CALIFORNIA. FINAL DIMENSION TO BE DETERMINED AFTER GRATE IS APPROVED.
2. INTERMEDIATE DEPTH GAUGE TO BE LOCATED AS SHOWN IN C-26. FOUNDATION TO BE USED TO SUPPORT LEVEL TRANSDUCER PERFORATED SUPPORT SLEEVE.
3. OVER EXCAVATION, COMPACTION AND AGGREGATE BASE PER GEOTECHNICAL REPORT. PROVIDE MINIMUM 12 INCHES OF AGGREGATE BASE LEVELING COURSE OVER 10 INCHES OF SCARIFIED NATIVE MATERIAL COMPACTED TO 95% RELATIVE COMPACTION AND MOISTURE CONDITIONED AS PER ASTM D1557.
4. STAINLESS STEEL BATTEN ANCHOR BOLTS, EMBEDMENT AND SPACING PER MANUFACTURER. PROVIDE MINIMUM 3/4" DIAMETER BOLTS, MAXIMUM 18" SPACING AND 6" EMBED.

△1



F - SECTION

SCALE: 3/4" = 1'-0"
FILE: 8660F1000S301

REV	DATE	BY	DESCRIPTION
1	06-02-23	JKN	ADDENDUM 3

CONFORMED DOCUMENTS

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RECYCLED WATER PROJECT - PHASE 4

STRUCTURAL

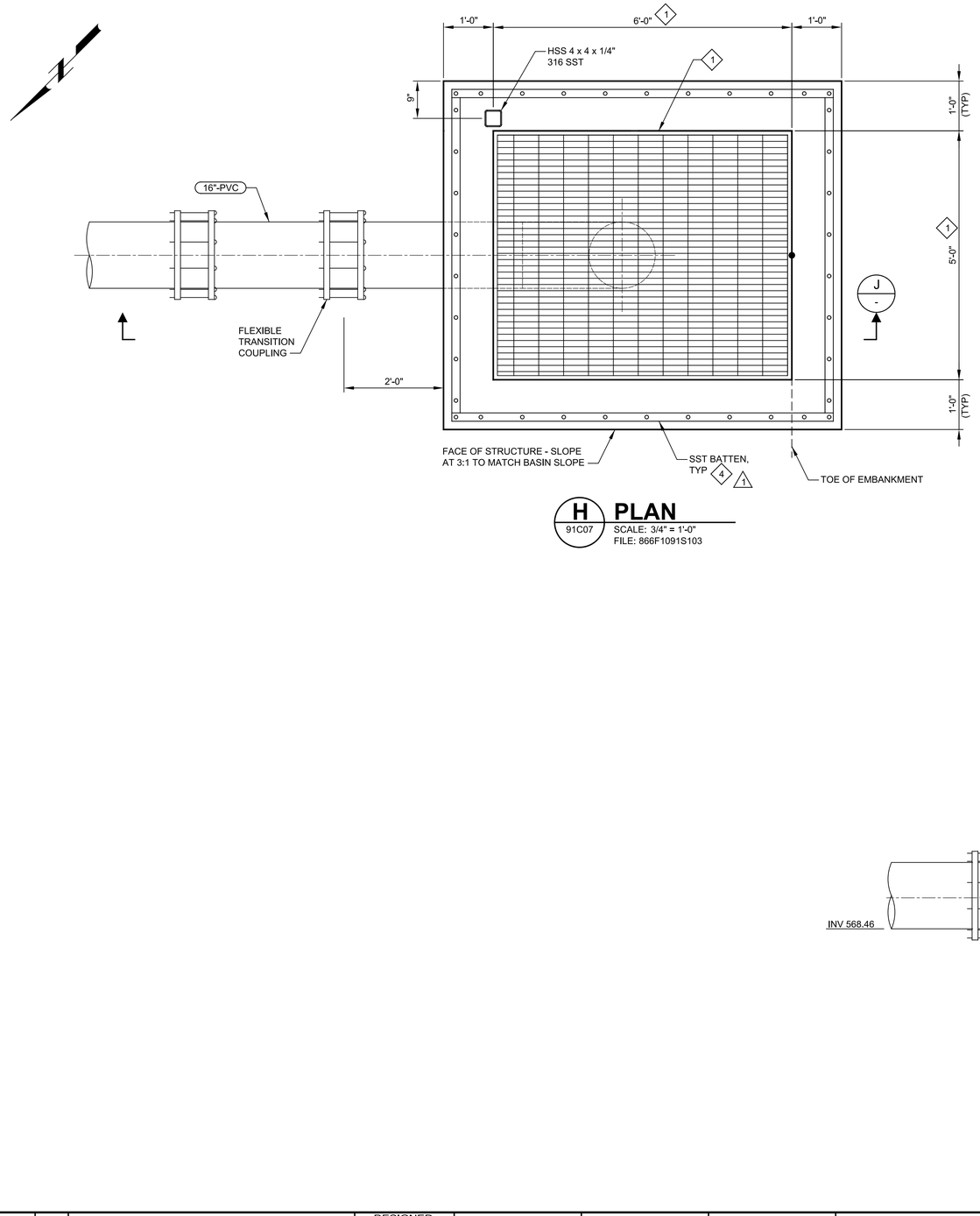
PAU PUMP STATION INLET STRUCTURE
PLAN AND SECTION

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

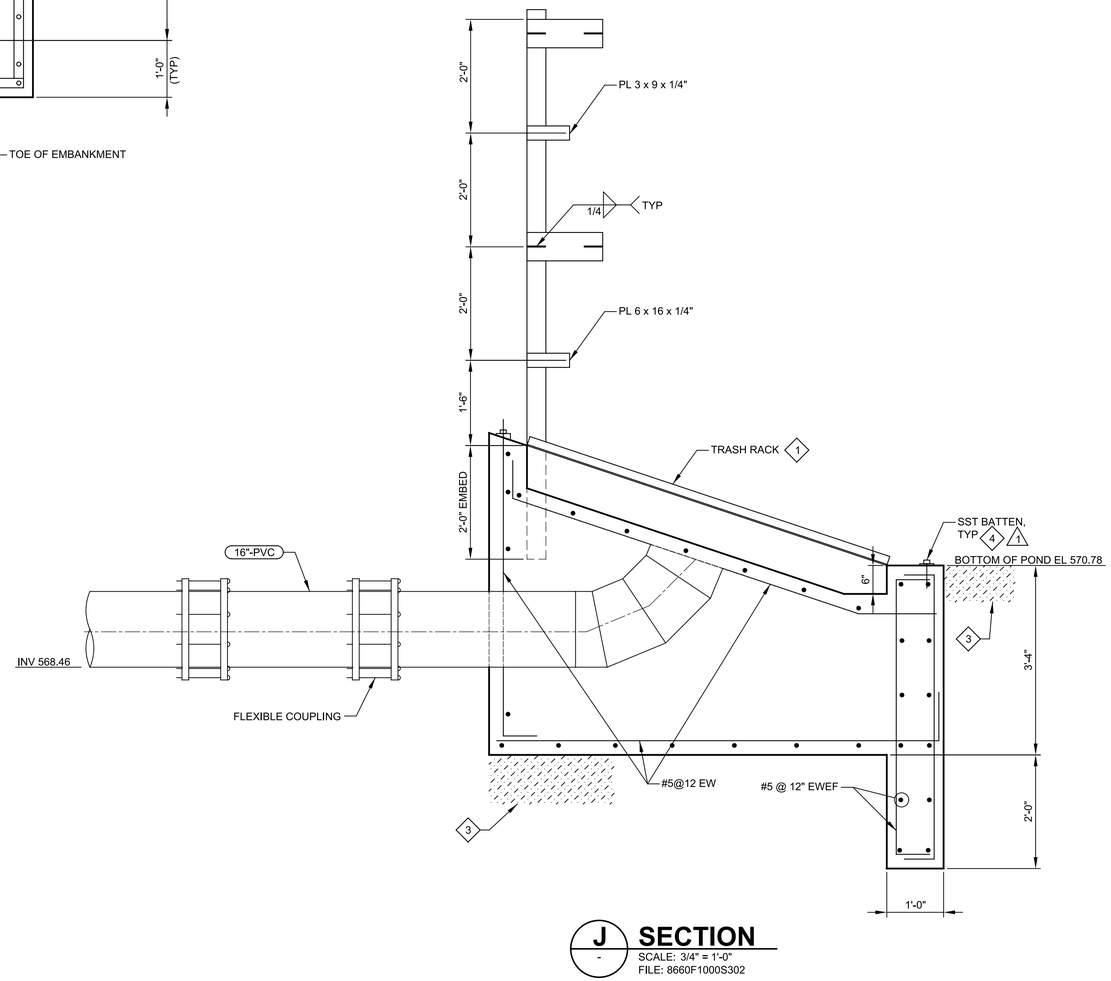
JOB NO. 8660F.10
DRAWING NO. 91S03
SHEET NO. 60 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1091S03.dgn

Plot Date: 12-JUL-2023 11:52:03 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: obonafoux



H PLAN
91C07 SCALE: 3/4" = 1'-0"
FILE: 866F1091S103



J SECTION
SCALE: 3/4" = 1'-0"
FILE: 8660F1000S302

GENERAL NOTES:

1. THE STAFF GAUGES SHOULD BE MADE OF A DURABLE MATERIAL(S) THAT RESIST RUST AND DISCOLORATION, AND STURDY ENOUGH TO MINIMIZE MOVEMENT DUE TO WIND AND WAVE ACTION. RECOMMENDED MATERIALS INCLUDE PORCELAIN ENAMELED IRON, STEEL PIPE OR FIBERGLASS. MANUFACTURERS INCLUDE STEVENS, BEN MEADOWS, AND FORESTRY SUPPLIERS.

KEY NOTES:

1. CONTRACTOR SHALL PROVIDE STAINLESS STEEL TRASH GRATE DESIGNED AND DETAILED FOR A LIVE LOAD OF 100 PSF. CONTRACTOR SHALL PROVIDE SHOP DRAWINGS AND CALCULATIONS STAMPED AND SIGNED BY A REGISTERED PROFESSIONAL ENGINEER IN STATE OF CALIFORNIA. FINAL DIMENSION TO BE DETERMINED AFTER GRATE IS APPROVED.
2. INTERMEDIATE DEPTH GAUGE TO BE LOCATED AS SHOWN IN C-26. FOUNDATION TO BE USED TO SUPPORT LEVEL TRANSDUCER PERFORATED SUPPORT SLEEVE.
3. OVER EXCAVATION, COMPACTION AND AGGREGATE BASE PER GEOTECHNICAL REPORT. PROVIDE MINIMUM 12 INCHES OF AGGREGATE BASE LEVELING COURSE OVER 10 INCHES OF SCARIFIED NATIVE MATERIAL COMPACTED TO 95% RELATIVE COMPACTION AND MOISTURE CONDITIONED AS PER ASTM D1557.
4. STAINLESS STEEL BATTEN ANCHOR BOLTS, EMBEDMENT AND SPACING PER MANUFACTURER. PROVIDE MINIMUM 3/4" DIAMETER BOLTS, MAXIMUM 18" SPACING AND 6" EMBED.

1

REV	DATE	BY	DESCRIPTION
1	06-02-23	JKN	ADDENDUM 3

CONFORMED DOCUMENTS

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CHECKED KP
DATE JULY 2023

** ORIGINAL SEALED BY JITESH K. RE NALAGOTLA 4/7/2023 CA PE NO. 86094 **

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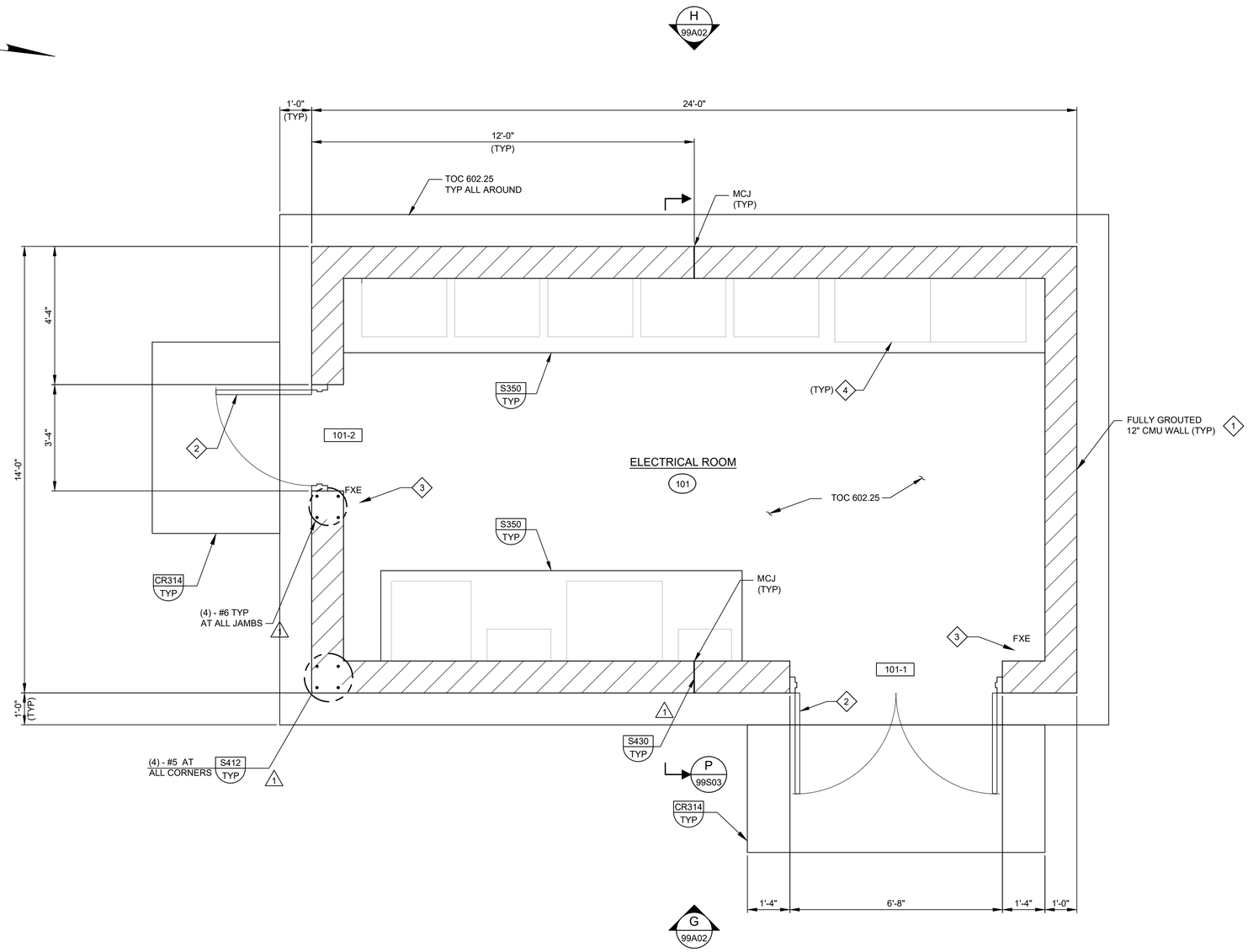
CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
STRUCTURAL
PAU INLET STRUCTURE
PLAN AND SECTION

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 95S01
SHEET NO. 61 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1095S01.dgn

Plot Date: 12-JUL-2023 11:51:41 AM
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DesignScript: Carollo_Std_Pen_v0905.pen
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Model: Layout1
LAST SAVED BY: obonafoux



FOUNDATION PLAN

B PLAN

SCALE: 1/2" = 1'-0"
FILE: 8660F1001S100

GENERAL NOTES:

1. FOR GENERAL STRUCTURAL NOTES, REFER TO DRAWING 00S01.
2. FOR DOOR SCHEDULES, REFER TO DRAWING 99A01.
3. SEE TYPICAL MASONRY WALL DETAILS ON SHEETS 00TS04, 00TS05, 00TS06 AND 00TS07. SEE TYPICAL DETAIL S410 FOR REINFORCEMENT AT OPENINGS IN MASONRY WALL, S412 FOR TYPICAL REINFORCEMENT AT MASONRY WALL INTERSECTIONS, S430 FOR MASONRY CONTROL JOINTS, S440 FOR ANCHOR BOLTS IN MASONRY WALL, S451 FOR STEEL BEAM TO MASONRY WALL CONNECTION AND S461 FOR METAL DECK TO MASONRY WALL CONNECTIONS. (1)
4. EXTERIOR CONCRETE MASONRY UNITS TO BE FINISHED WITH WATER REPELLANT.
5. COORDINATE LOCATION AND DIMENSIONS OF ALL EQUIPMENT PADS WITH ELECTRICAL AND MECHANICAL DRAWINGS AND EQUIPMENT MANUFACTURER'S ANCHORAGE REQUIREMENTS.
6. COORDINATE OPENING SIZE AND LOCATION WITH MECHANICAL EQUIPMENT.

KEY NOTES:

1. 12"x8"x16" STANDARD CONCRETE MASONRY UNIT. REFER TO SPECIFICATION SECTION 04220. PROVIDE #5@16" EACH WAY EACH FACE REBAR IN FULLY GROUTED CMU WALL.
2. HOLLOW METAL DOOR AND FRAME REFER TO SPECIFICATION SECTION 08110.
3. FIRE EXTINGUISHER PER DETAIL AN400/TYPE. REFER TO SPECIFICATION SECTION 10520.
4. REFERENCE ELECTRICAL DRAWINGS FOR EQUIPMENT REQUIREMENTS.

REV	DATE	BY	DESCRIPTION
1	06-02-23	JKN	ADDENDUM 3

CONFORMED DOCUMENTS

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RECYCLED WATER PROJECT - PHASE 4

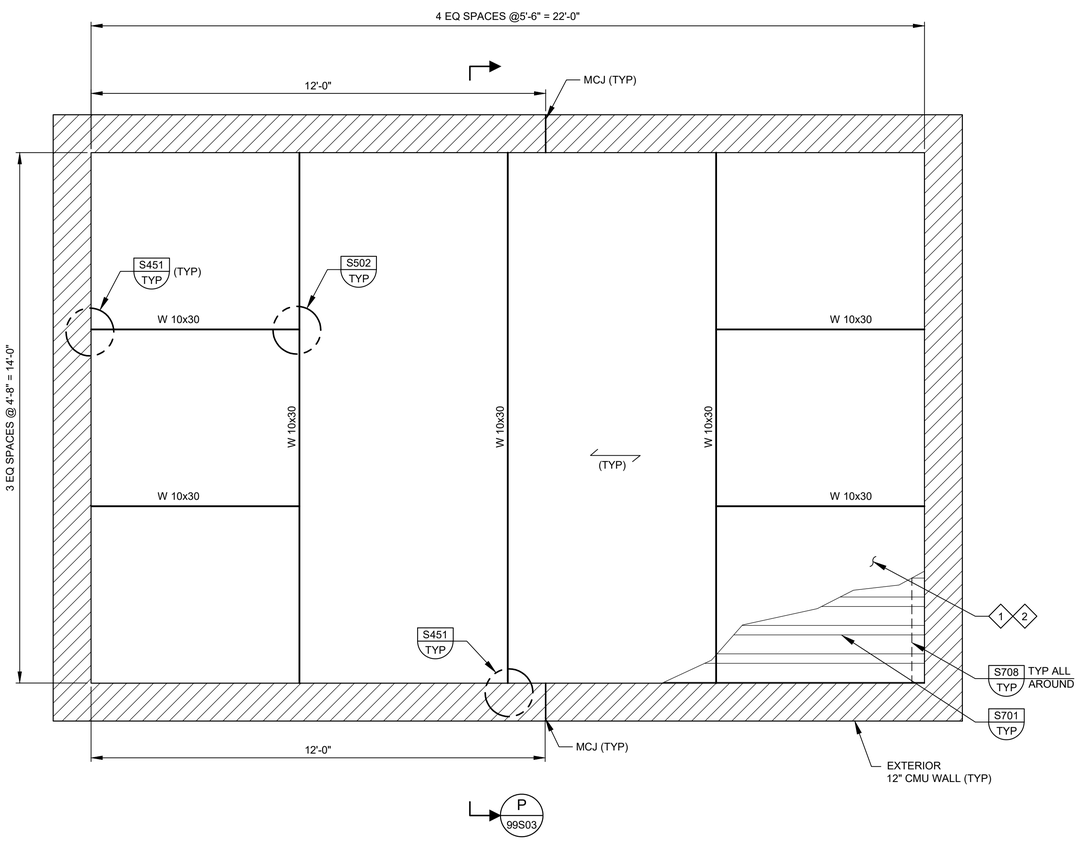
STRUCTURAL

ELECTRICAL BUILDING FOUNDATION PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99S01
SHEET NO. 62 OF 200

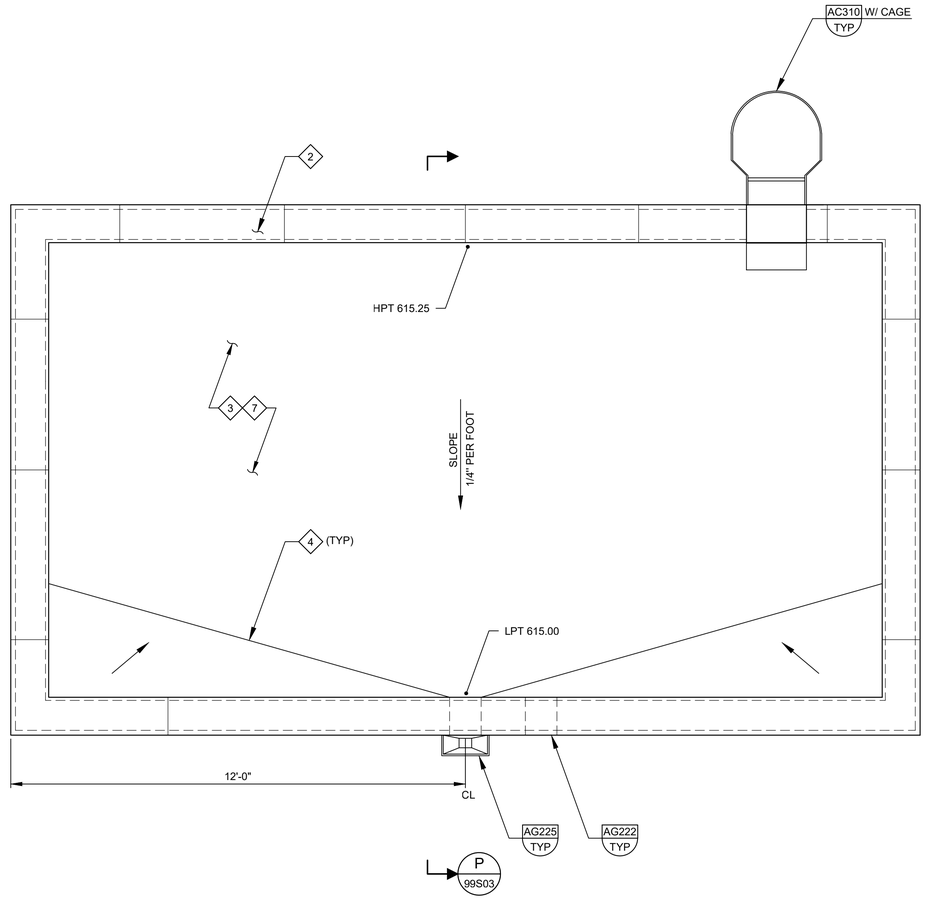
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FILE NAME: 8660F1099S02.dwg
PROJECT NO. 8660F10
LAST SAVED BY: kjackson



ROOF FRAMING

C PLAN

SCALE: 1/2" = 1'-0"
FILE: 8660F1001S101



ROOF

D PLAN

SCALE: 1/2" = 1'-0"
FILE: 8660F1001S102

GENERAL NOTES:

1. ROOF LOADING:

   ROOF DESIGN LIVE LOAD = 20 PSF
   ROOF DESIGN DEAD LOAD = 20 PSF

2. FOR GENERAL ARCHITECTURAL NOTES, REFER TO DRAWING 98A01.
3. FOR GENERAL STRUCTURAL NOTES SEE DRAWING 00S01.
4. INDICATES METAL DECK SPAN DIRECTION.
5. COORDINATE ROOF OPENING SIZE AND LOCATION AS REQUIRED WITH MECHANICAL EQUIPMENT AND APPROVED HVAC MANUFACTURER. MAXIMUM ROOF OPENING SHALL BE LIMITED TO 12" IN DIAMETER OR WIDTH. PROVIDE ROOF OPENING AS PER DETAIL S720/TYP.

KEY NOTES:

1. 1 1/2" DEEP 18 GAUGE METAL DECK.
2. ALUMINUM COPING OVER PARAPET PER DETAIL AG220/TYP IN ACCORDANCE WITH SPECIFICATION SECTION 07700.
3. TPO MEMBRANE ROOFING SYSTEM OVER PROTECTIVE BOARD AND RIGID INSULATION PER DETAIL AG160/TYP.
4. CRICKET AS RECOMMENDED BY MANUFACTURER.
5. REFERENCE HVAC DRAWINGS FOR EQUIPMENT REQUIREMENTS AND PLACEMENT. FCU SUSPENDED FROM ROOF PER MFR DETAIL. PROVIDE SEISMIC BRACING AS REQUIRED BY STRUCTURAL CALCULATIONS. SECONDARY FRAMING AND ATTACHMENTS ANCHORED TO MEET APPLICABLE BUILDING CODES SHALL BE PROVIDED BY THE CONTRACTOR.
6. CONTRACTOR SHALL COORDINATE WITH EXISTING CONDITIONS AND PROVIDE FOR ENGINEERS REVIEW A WATERPROOF AND WEATHERTIGHT CONDUIT PENETRATION SEAL. SEAL SHALL INCLUDE CAULKING AND PLATE AS RECOMMENDED BY MANUFACTURER.
7. SLOPE OF THE ROOF SHALL BE ACHIEVED BY TAPERED RIGID INSULATION.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

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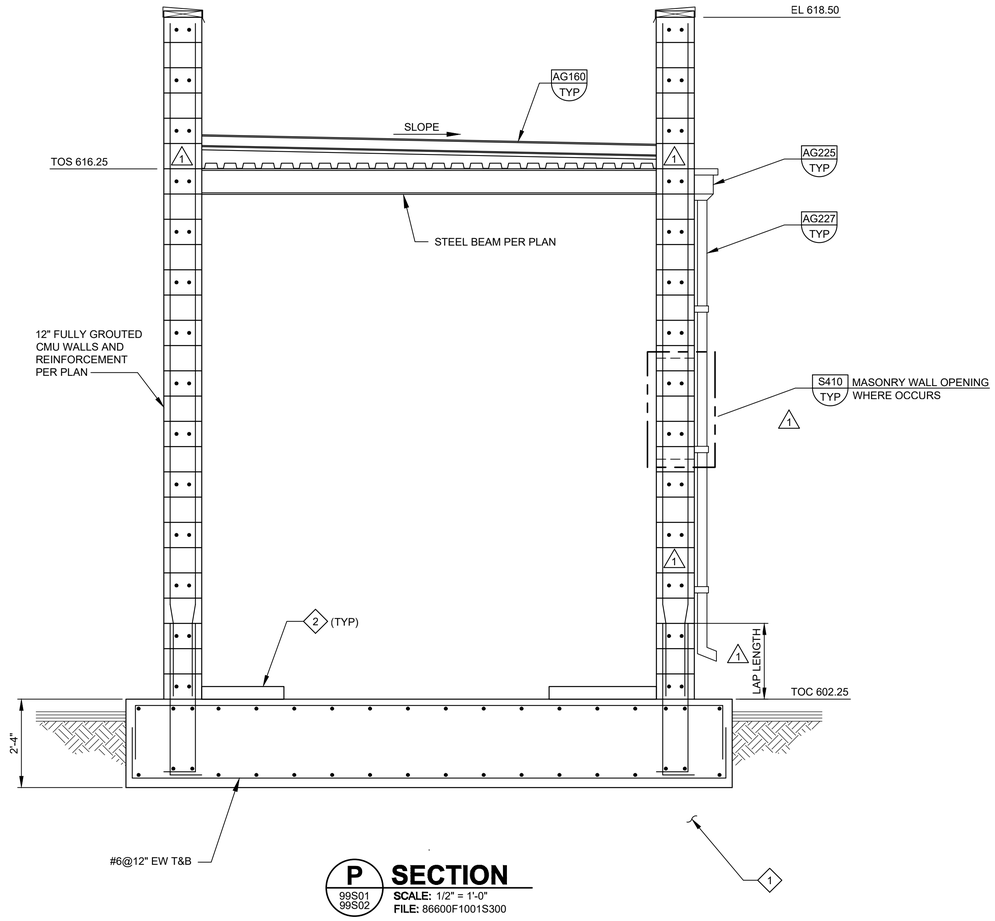
RECYCLED WATER PROJECT - PHASE 4

STRUCTURAL

ELECTRICAL BUILDING
ROOF FRAMING AND ROOF PLANS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99S02
SHEET NO. 63 OF 200



P SECTION
99S01
99S02
SCALE: 1/2" = 1'-0"
FILE: 86600F1001S300

GENERAL NOTES:

1. FOR GENERAL ARCHITECTURAL NOTES, REFER TO DRAWING 99A01.
2. FOR GENERAL STRUCTURAL NOTES SEE DRAWING 00S01.

KEY NOTES:

1. REFER TO GEOTECHNICAL REPORT FOR SUBGRADE PREPARATION. PROVIDE MINIMUM 12 INCHES OF AGGREGATE BASE LEVELING COURSE OVER 10 INCHES OF SCARIFIED NATIVE MATERIAL COMPACTED TO 95% RELATIVE COMPACTION AND MOISTURE CONDITIONED AS PER ASTM D1557.
2. REFER TO ELECTRICAL DRAWINGS FOR LOCATIONS AND DIMENSIONS OF HOUSEKEEPING PADS.

REV	DATE	BY	DESCRIPTION
1	06-02-23	JKN	ADDENDUM 3

CONFORMED DOCUMENTS

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DRAWN JLG
CHECKED KP
DATE JULY 2023

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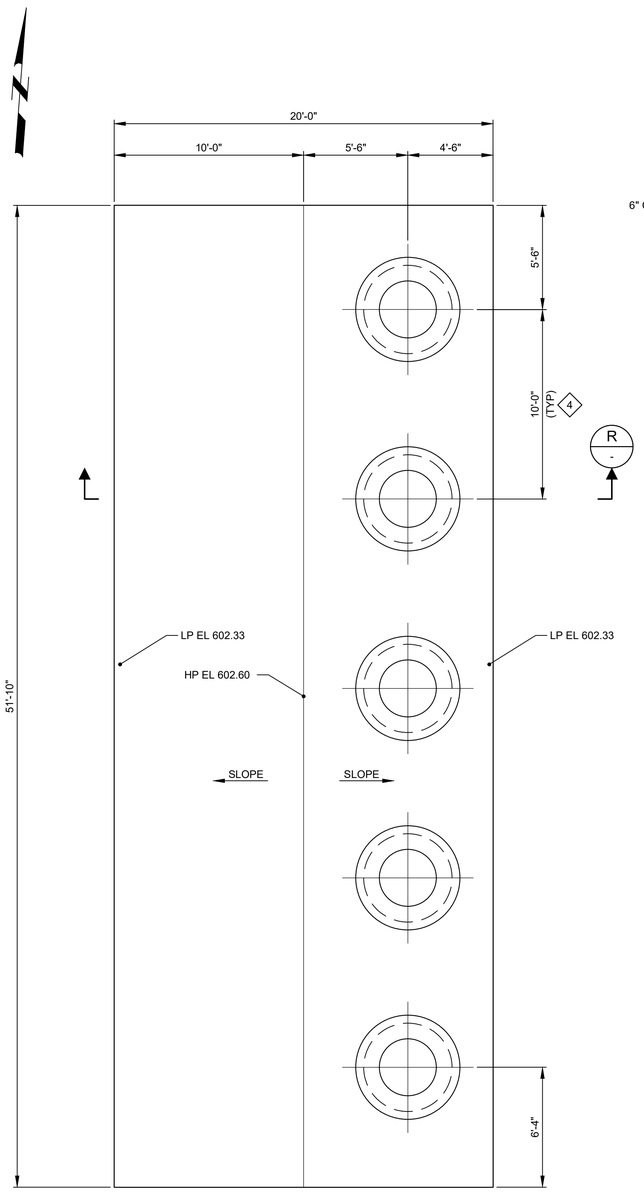
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RECYCLED WATER PROJECT - PHASE 4
STRUCTURAL
ELECTRICAL BUILDING SECTION

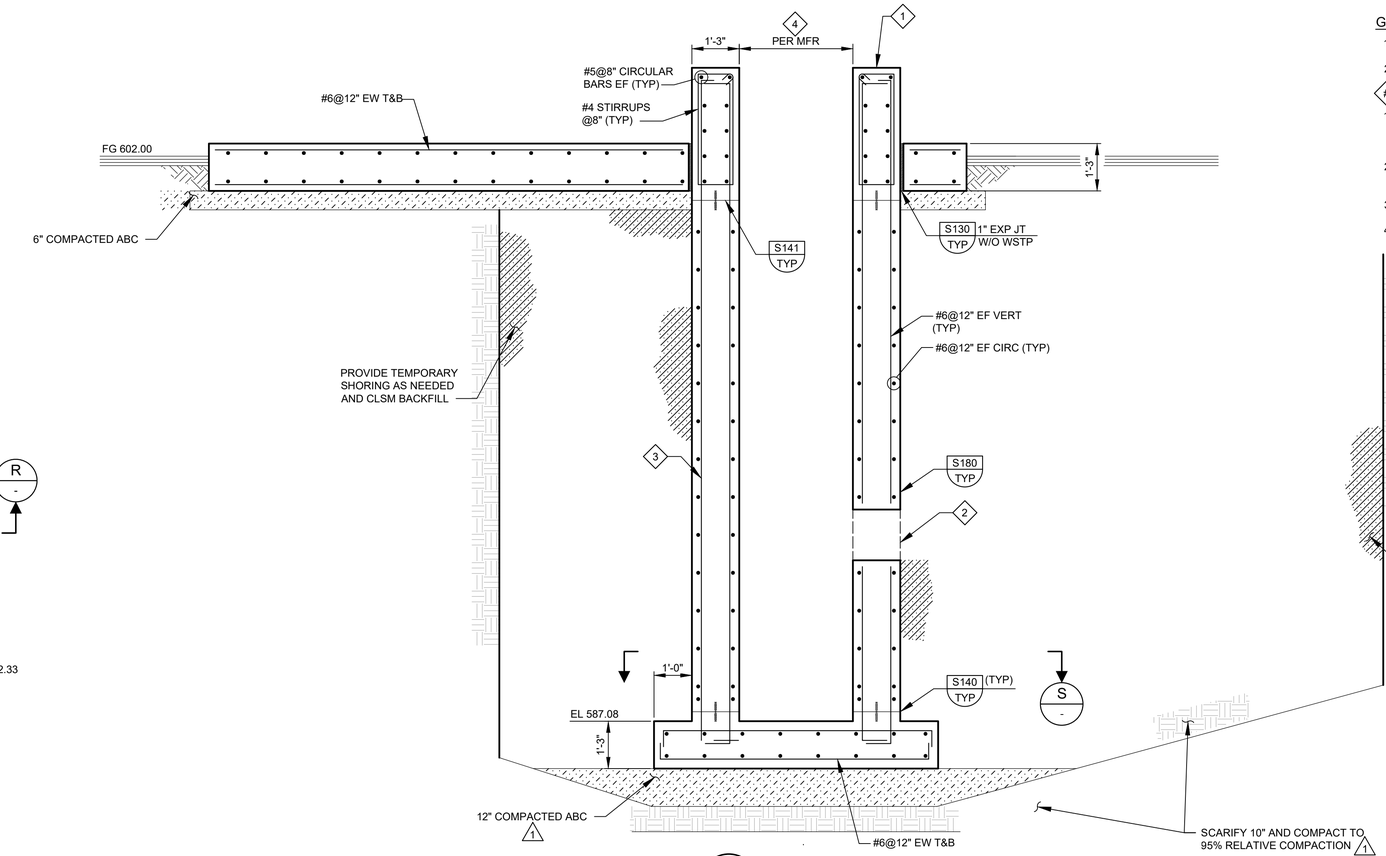
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99S03
SHEET NO. 64 OF 200



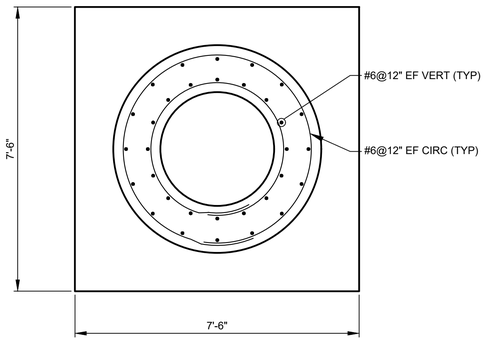
Q PLAN

SCALE: 1/4"=1'-0"
FILE: 8660F1001S130



R SECTION

SCALE: 1/2"=1'-0"
FILE: 8660F1001S330



S SECTION

SCALE: 1/2"=1'-0"
FILE: 8660F1001S330

GENERAL NOTES:

1. FOR GENERAL STRUCTURAL NOTES, REFER TO DRAWING 00S01.
2. REFER TO SHEET 99M02 FOR PUMP DETAILS AND LOCATION.

KEY NOTES:

1. CONTRACTOR TO COORDINATE HEIGHT OF THE CURB WALL WITH PUMP MANUFACTURER. MAX HEIGHT OF THE CURB WALL IS 2'-0".
2. CONTRACTOR TO COORDINATE SIZE OF THE OPENING WITH MECHANICAL.
3. END REBAR WITH STD HOOK.
4. VERIFY DIMENSIONS WITH MANUFACTURER.

REV	DATE	BY	DESCRIPTION
1	06-02-23	JKN	ADDENDUM 3

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RECYCLED WATER PROJECT - PHASE 4

STRUCTURAL

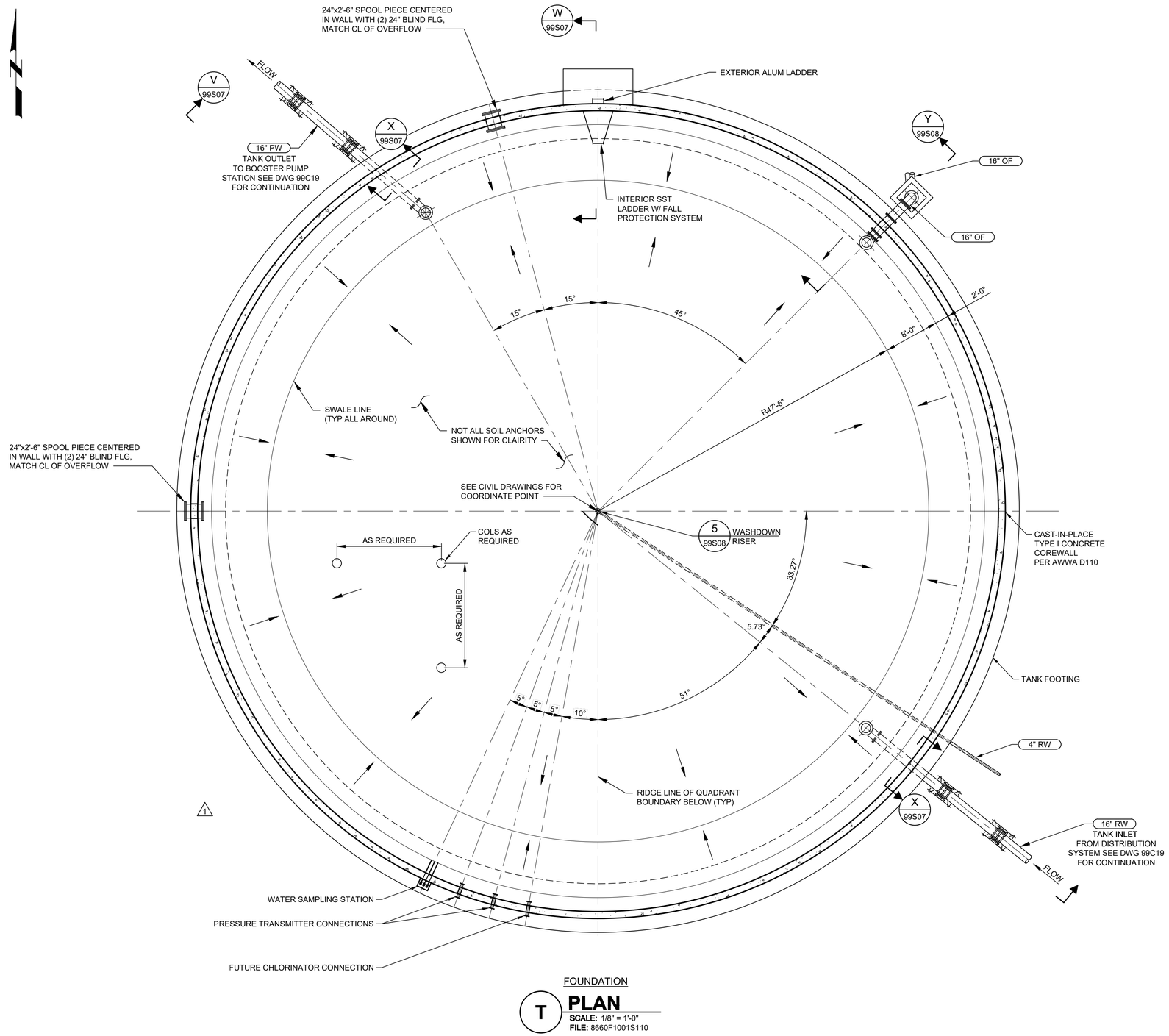
RECYCLED WATER PUMP STATION PLAN AND SECTIONS

VERIFY SCALES
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99S04
SHEET NO. 65 OF 200

$$$$DATE$$$$
$$$$USER$$$$
$$$$PLOT_INFO$$$$
LAST SAVED BY: JGarretty

PROJECT NO. 8660F10 FILE NAME: 8660F1099S04.dwg



FOUNDATION

T PLAN

SCALE: 1/8" = 1'-0"
FILE: 8660F1001S110

GENERAL NOTES:

1. FOR GENERAL STRUCTURAL NOTES, REFER TO DRAWING 00S01.
2. SEE DRAWING 99S07 FOR THE TANK DESIGN CRITERIA.
3. THE TANK SHALL BE AN AWWA D110, TYPE I, STRAND WOUND, PRESTRESSED CONCRETE TANK DESIGNED AND CONSTRUCTED BY QUALIFIED TANK CONTRACTOR IN ACCORDANCE WITH THE REQUIREMENTS SET FORTH IN SPECIFICATION 13207.
4. DRAWINGS SHOW THE GENERAL ARRANGEMENT FOR AWWA D110, TYPE I TANK. DETAILED ASPECTS OF THE TANK, INCLUDING SHOTCRETE WATERSTOPS, BEARING PADS, REINFORCING STEEL, PRESTRESSING CONNECTIONS, SEISMIC CABLES, JOINTS, ETC. ARE NOT SHOWN.
5. ALL STAINLESS STEEL SHALL BE A MINIMUM OF 316/316L FOR WELDING FABRICATIONS UNLESS NOTED OTHERWISE.
6. FOR WATERSTOP SEE DETAILS S106/TYP AND S107/TYP. WATERSTOP SHALL BE CONTINUOUS WITH CLOSED LOOP ALL AROUND JOINTS.
7. FOR CONSTRUCTION JOINT SEE DETAIL S110/TYP.
8. COORDINATE ALL PIPE PENETRATIONS WITH DETAILED DESIGN FOR THE PRESTRESSED CONCRETE TANK.
9. SEE SHEET 99C19 FOR CONTINUATION OF YARD PIPING.
10. FINAL COORDINATES FOR THE ACCESS HATCHES TO BE COORDINATED WITH TANK DESIGN AND APPROVED BY THE OWNER.
11. FINAL TANK DESIGN TO BE DETERMINED BY THE TANK DESIGNER.
12. FOR BIDDING PURPOSES, NOT FOR CONSTRUCTION.
13. SOIL ANCHOR SYSTEM TO BE DESIGNED BY TANK CONTRACTOR PER SPECIFICATION SECTION 13207. 1

REV	DATE	BY	DESCRIPTION
1	06-02-23	JKN	ADDENDUM 3

CONFORMED DOCUMENTS

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DATE JULY 2023

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RECYCLED WATER PROJECT - PHASE 4

STRUCTURAL

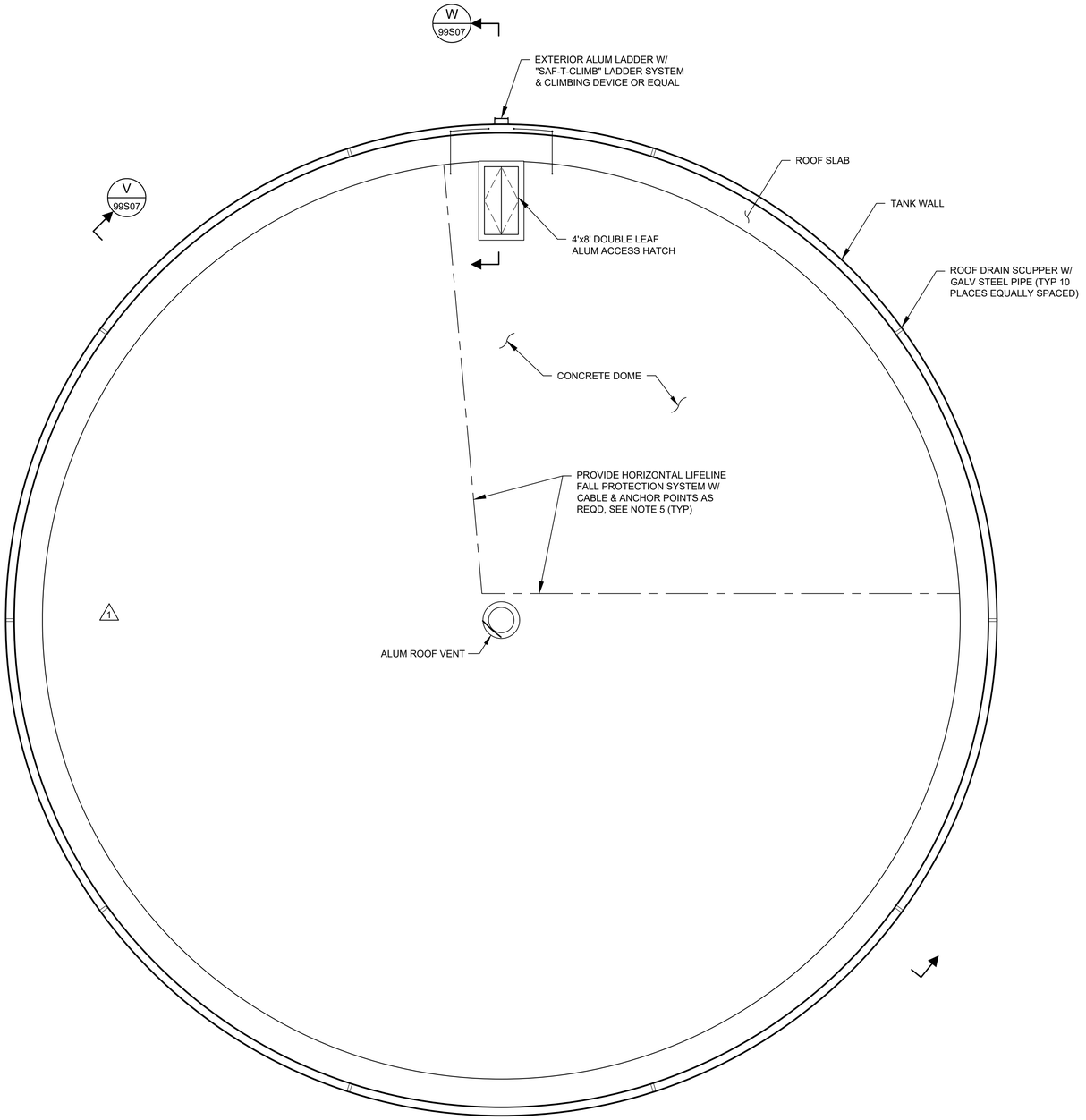
STORAGE TANK FOUNDATION PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99S05
SHEET NO. 66 OF 200

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FILE NAME: 8660F1099S05.dwg
PROJECT NO. 8660F10
LAST SAVED BY: obonafoux

Plot Date: 7/12/2023 11:52:16 AM
FILE NAME: 8660F1099S06.dwg
PROJECT NO. 8660F10
LAST SAVED BY: Alaico



ROOF

U PLAN

SCALE: 1/8" = 1'-0"
FILE: 8660F1001S110

GENERAL NOTES:

1. FOR GENERAL STRUCTURAL NOTES, REFER TO DRAWING 00S01.
2. SEE DRAWING 99S07 FOR THE TANK DESIGN CRITERIA.
3. THE TANK SHALL BE AN AWWA D110, TYPE I, STRAND WOUND, PRESTRESSED CONCRETE TANK DESIGNED AND CONSTRUCTED BY QUALIFIED TANK CONTRACTOR IN ACCORDANCE WITH THE REQUIREMENTS SET FORTH IN SPECIFICATION 13207.
4. DRAWINGS SHOW THE GENERAL ARRANGEMENT FOR AWWA D110, TYPE I TANK. DETAILED ASPECTS OF THE TANK, INCLUDING SHOTCRETE WATERSTOPS, BEARING PADS, REINFORCING STEEL, PRESTRESSING CONNECTIONS, SEISMIC CABLES, JOINTS, ETC. ARE NOT SHOWN.
5. ALL STAINLESS STEEL SHALL BE A MINIMUM OF 316/316L FOR WELDING FABRICATIONS UNLESS NOTED OTHERWISE.
6. FOR WATERSTOP SEE DETAILS S106/TYP AND S107/TYP. WATERSTOP SHALL BE CONTINUOUS WITH CLOSED LOOP ALL AROUND JOINTS.
7. FOR CONSTRUCTION JOINT SEE DETAIL S110/TYP.
8. FINAL TANK DESIGN TO BE DETERMINED BY THE TANK DESIGNER.
9. FOR BIDDING PURPOSES, NOT FOR CONSTRUCTION.

REV	DATE	BY	DESCRIPTION
1	06-02-23	JKN	ADDENDUM 3

CONFORMED DOCUMENTS

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DRAWN NGB
CHECKED KP
DATE JULY 2023

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4/7/2023
CA PE NO. 86094
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CITY OF UKIAH

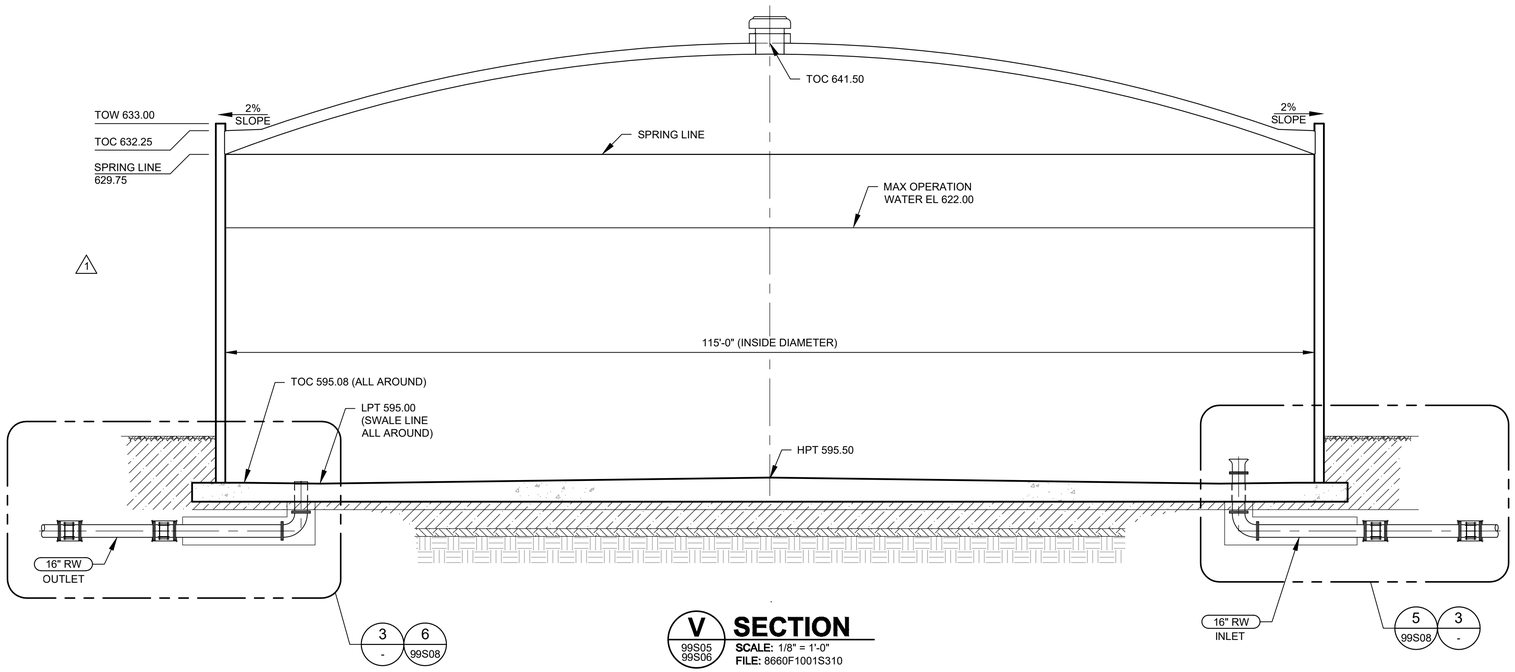
RECYCLED WATER PROJECT - PHASE 4

STRUCTURAL

STORAGE TANK
ROOF PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

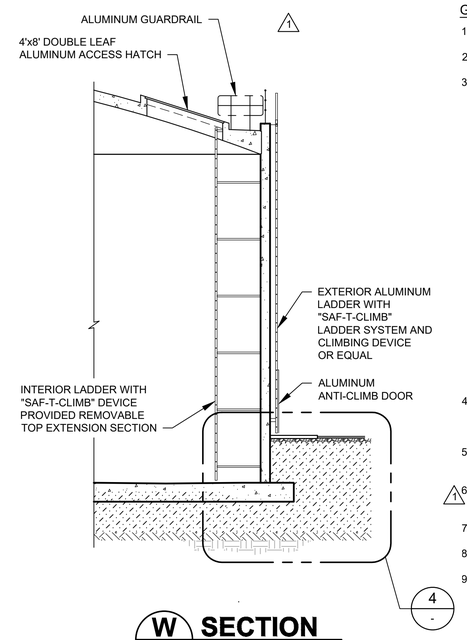
JOB NO. 8660F.10
DRAWING NO. 99S06
SHEET NO. 67 OF 200



V SECTION

99S05
99S06

SCALE: 1/8" = 1'-0"
FILE: 8660F1001S310



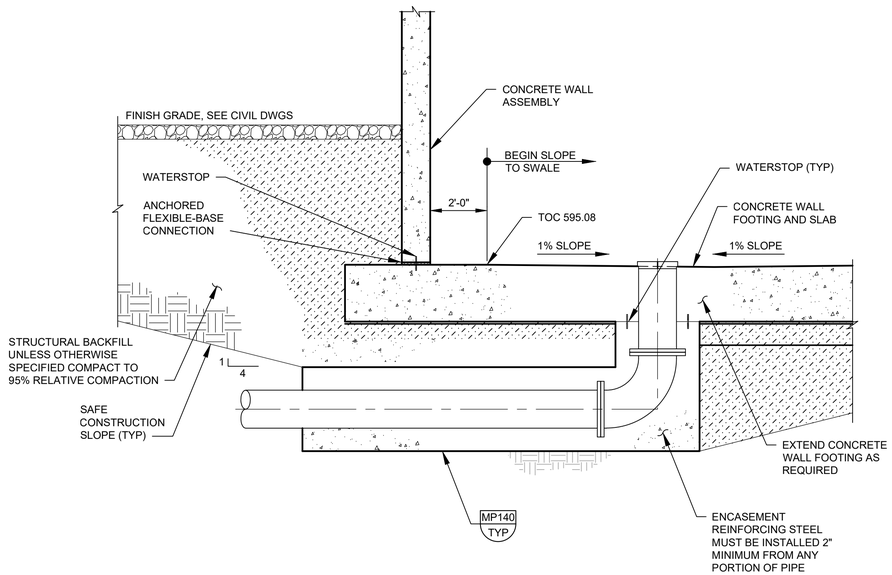
W SECTION

99S05

SCALE: 1/8" = 1'-0"
FILE: 8660F1001S310

GENERAL NOTES:

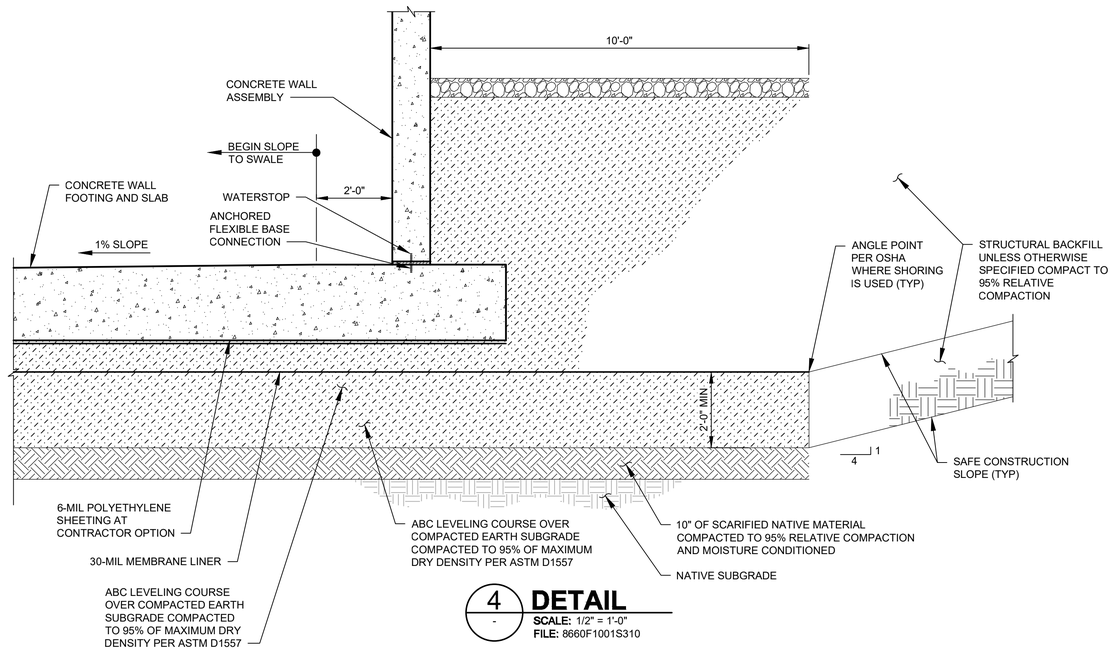
1. FOR GENERAL STRUCTURAL NOTES, REFER TO DRAWING 00S01.
2. SEE ADDITIONAL NOTES ON SHEET 99S05.
3. THE TANK DESIGN SHALL, AS A MINIMUM, MEET THE FOLLOWING STRUCTURAL DESIGN CRITERIA PER 2019 CALIFORNIA BUILDING CODE. SEE SPECIFICATION 13027 FOR ADDITIONAL DESIGN CRITERIA FOR THE TANK DESIGN.
   a. ROOF LIVE LOAD: 40PSF (NON-REDUCIBLE) WITH A 300 LBS CONCENTRATED LOAD.
   b. WIND DESIGN DATA:
      i. ULTIMATE DESIGN WIND SPEED, Vult (3-SEC GUST): 104 MPH
      ii. EXPOSURE: C
   c. EARTHQUAKE DESIGN DATA (ASCE 7-16):
      i. RISK CATEGORY: IV
      ii. SEISMIC IMPORTANCE FACTOR, Ie: 1.50
      iii. DESIGN SPECTRAL RESPONSE ACCELERATION, SDS*: 1.48g
      iv. DESIGN SPECTRAL RESPONSE ACCELERATION, SD1*: 1.58g
      v. SEISMIC DESIGN CATEGORY: D
      vi. RESPONSE MODIFICATION FACTOR, R: 3.25 (ANCHORED FLEXIBLE-BASE TANK)
      vii. LONG-PERIOD TRANSITION PERIOD, TL: 8 SECONDS
      * SITE-SPECIFIC GROUND MOTION HAZARD ANALYSIS PER ASCE 7-16 CH 21.2 METHOD 1.
   d. GEOTECHNICAL DESIGN DATA:
      i. ALLOWABLE GROSS BEARING PRESSURE
         1. CENTER 2000 PSF
         2. PERIMETER 4000 PSF
4. INSPECTION OF REBAR BY ENGINEER REQUIRED PRIOR TO PLACEMENT OF CONCRETE FOR PIPE ENCASEMENT (VERIFY MINIMUM CONCRETE COVER AT TANK CONNECTION).
5. FOR WATERSTOP SEE DETAILS S106/TYP & S107/TYP. WATERSTOP SHALL BE CONTINUOUS WITH CLOSED LOOP ALL AROUND JOINTS.
6. (1) CONTRACTOR TO PROVIDE SHORING FOR ALL EARTHWORK WHERE APPLICABLE .
7. FINAL TANK DESIGN TO BE DETERMINED BY THE TANK DESIGNER.
8. FOR BIDDING PURPOSES, NOT FOR CONSTRUCTION.
9. SOIL ANCHOR SYSTEM NOT SHOWN. TO BE DESIGNED BY TANK CONTRACTOR PER SPECIFICATION SECTION 13207. (1)



3 DETAIL

-

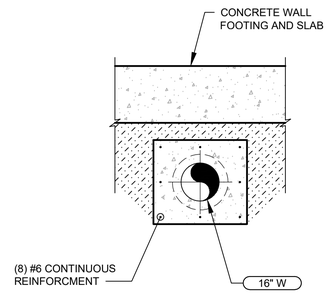
SCALE: 3/8" = 1'-0"
FILE: 8660F1001S310



4 DETAIL

-

SCALE: 1/2" = 1'-0"
FILE: 8660F1001S310



TANK OUTLET PIPE

X SECTION

99S05

SCALE: 3/8" = 1'-0"
FILE: 8660F1001S310

REV	DATE	BY	DESCRIPTION
1	06-02-23	JKN	ADDENDUM 3

CONFORMED DOCUMENTS

DESIGNED JKN
DRAWN NGB
CHECKED KP
DATE JULY 2023

** ORIGINAL SEALED BY JITESH K. RE NALAGOTLA 4/7/2023 CA PE NO. 86094 **

carollo

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

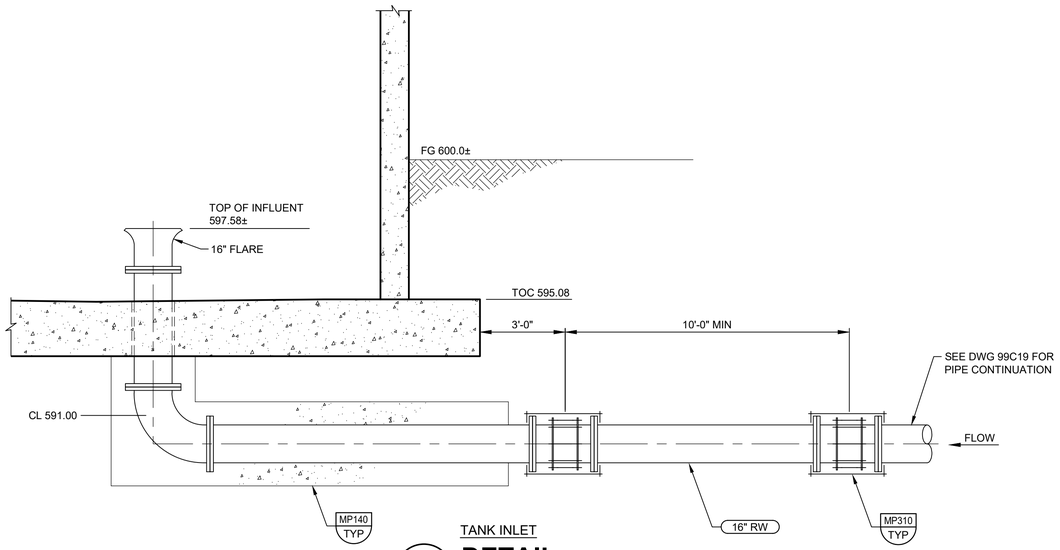
STRUCTURAL

STORAGE TANK
SECTIONS AND DETAILS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99S07
SHEET NO. 68 OF 200

Plot Date: 7/12/2023 11:52:24 AM
FILE NAME: 8660F1099S07.dwg
PROJECT NO. 8660F10
LAST SAVED BY: obonafoux

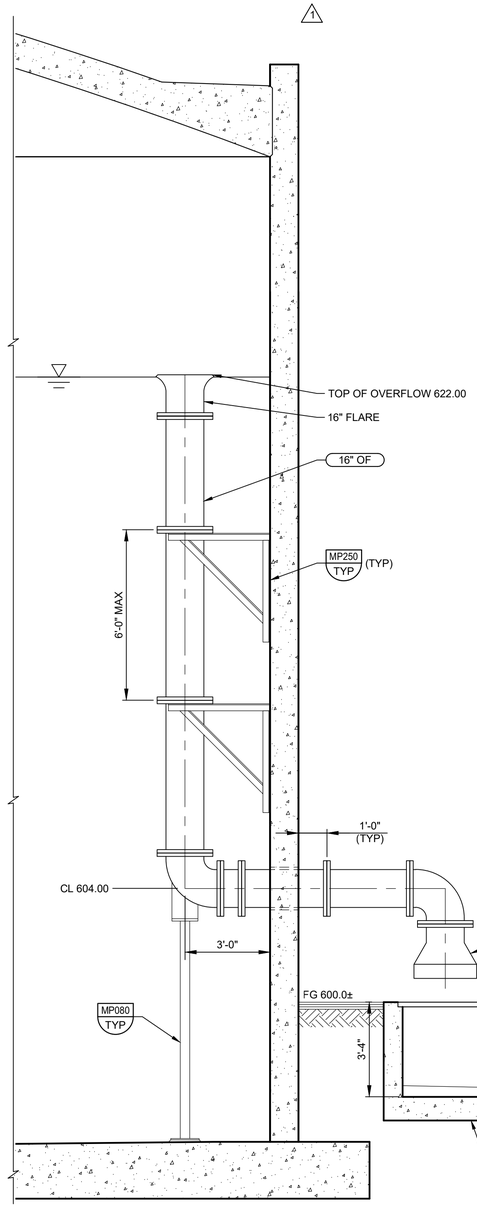


TANK INLET

5 DETAIL

99S07

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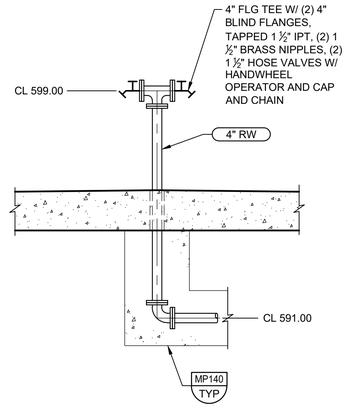


TANK OVERFLOW

Y SECTION

99S08

SCALE: 3/8" = 1'-0"
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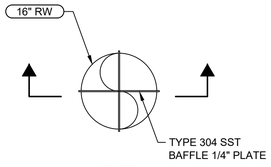


TANK WASHDOWN RISER

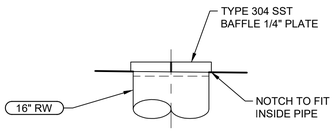
7 DETAIL

99S05

SCALE: 3/8" = 1'-0"
FILE: 8660F1000S310



PLAN



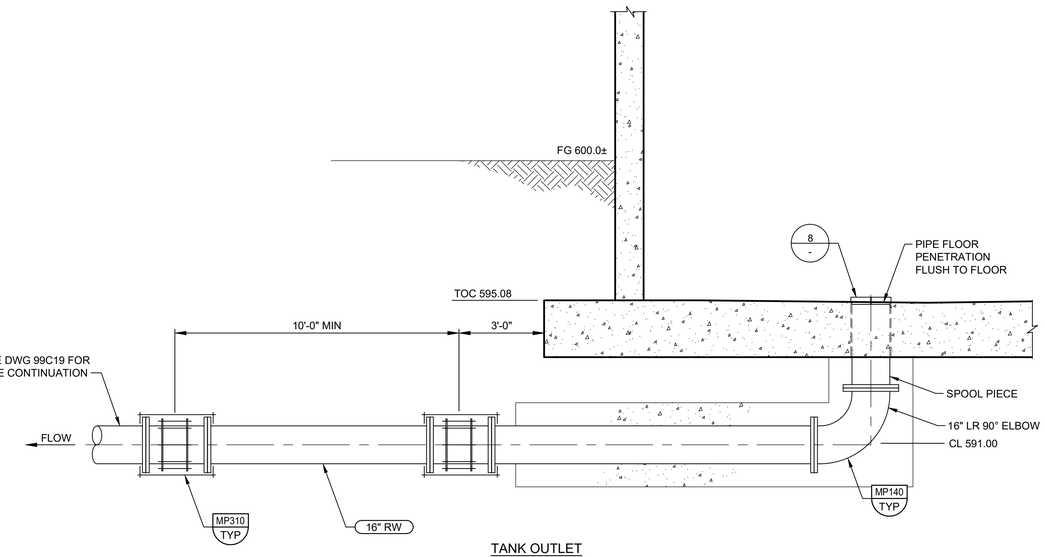
SECTION

ANTI-VORTEX

8 DETAIL

-

SCALE: 3/4" = 1'-0"
FILE: 8660F1000S310



TANK OUTLET

6 DETAIL

99S07

SCALE: 3/8" = 1'-0"
FILE: 8660F1000S310

REV	DATE	BY	DESCRIPTION
1	06-02-23	JKN	ADDENDUM 3

CONFORMED DOCUMENTS

DESIGNED JKN
DRAWN NGB
CHECKED KP
DATE JULY 2023

** ORIGINAL SEALED BY JITESH K. RE NALAGOTLA 4/7/2023 CA PE NO. 86094 **

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City of Ukiah

CITY OF UKIAH

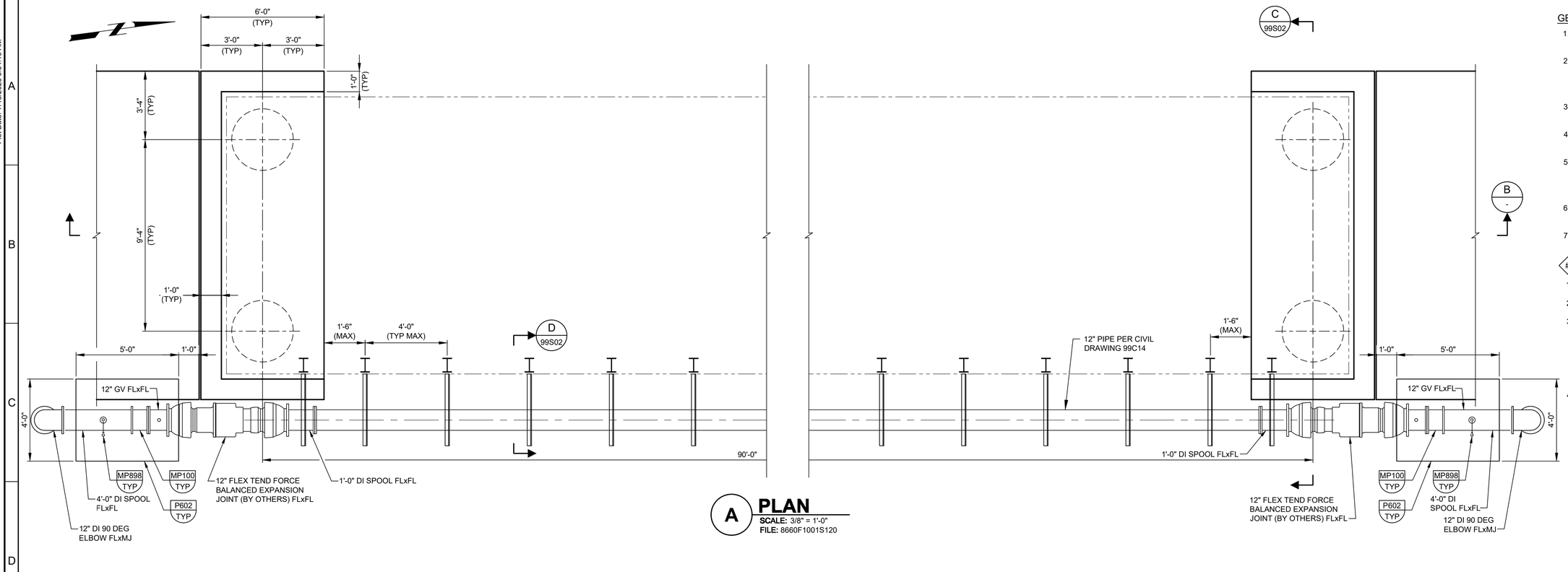
RECYCLED WATER PROJECT - PHASE 4

STRUCTURAL

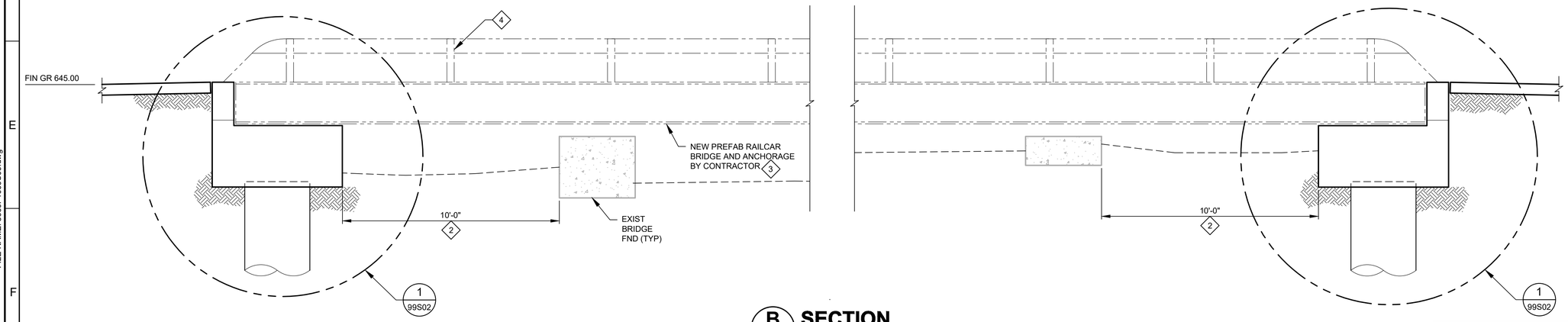
STORAGE TANK
SECTION AND DETAILS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99S08
SHEET NO. 69 OF 200



A PLAN
SCALE: 3/8" = 1'-0"
FILE: 8660F1001S120



B - SECTION
SCALE: 3/8" = 1' - 0"
FILE: 8660F1001S320

GENERAL NOTES:

1. FOR GENERAL STRUCTURAL NOTES, REFER TO DRAWING 00S01.
2. BRIDGE STRUCTURAL DESIGN CRITERIA.

   DESIGN LIVE LOADS:
   A. H-20 LIVE LOAD
3. CONTRACTORS OPTION TO PROVIDE BAR END TERMINATOR RATHER THAN STANDARD HOOK.
4. PROVIDE SPIRALS WITH YIELD STRENGTH OF 80,000 PSI (ASTM615 GR 80).
5. IF LAPS ARE REQUIRED FOR SPIRALS, LAP AND TIE IN ACCORDANCE WITH ACI 318 REQUIREMENTS AND AS APPROVED BY THE ENGINEER.
6. FOR CONCRETE CLASS, SEE SPECIFICATION SECITON 03300.
7. PRIOR TO DRILLING OF PIERS, ALL KNOWN UTILITIES SHALL BE EXPOSED.

KEY NOTES:

1. MINIMUM BEARING SEAT WIDTH = 20 INCHES.
2. CONTRACTOR TO VERIFY DIMENSION.
3. PRE-MANUFACTURED 12' WIDE STEEL RAILCAR BRIDGE WITH 3" MINIMUM ASPHALT CONCRETE TOPPING AND A CROSS SLOPE OF 2% MAXIMUM. CONTRACTOR SHALL PROVIDE SHOP DRAWINGS, CALCULATIONS AND DETAILS STAMPED AND SIGNED BY A CALIFORNIA REGISTERED PROFESSIONAL ENGINEER.
4. CONTRACTOR SHALL PROVIDE MINIMUM 3'-6" TALL GUARD RAIL, SHOP DRAWINGS, CALCULATIONS AND DETAILS STAMPED AND SIGNED BY A CALIFORNIA REGISTERED PROFESSIONAL ENGINEER.

THIS DRAWING IS FOR BID PURPOSES ONLY. NOT FOR CONSTRUCTION. CONSTRUCTION DRAWINGS WILL BE PROVIDED AS A DESIGN CHANGE DURING CONSTRUCTION.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED JKN
DRAWN NGB
CHECKED KP
DATE JULY 2023

THIS DOCUMENT IS RELEASED FOR THE PURPOSE OF BIDDING UNDER THE AUTHORITY OF BRIAN W. AVON, APRIL 2023, CA PE NO. 76832. IT IS NOT TO BE USED FOR CONSTRUCTION PURPOSES.

carollo

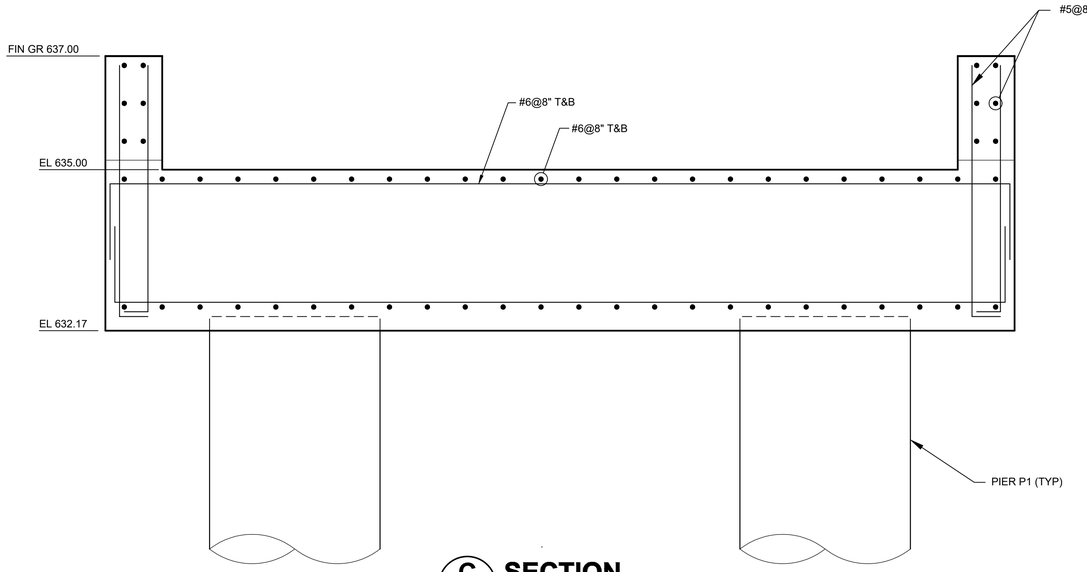
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
STRUCTURAL
BRIDGE
PLAN AND SECTION

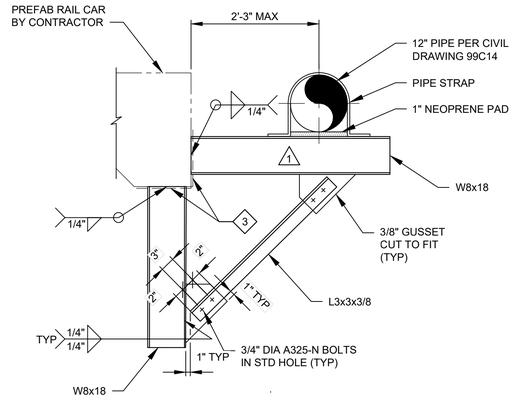
VERIFY SCALES
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0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99S09
SHEET NO. 70 OF 200

Plot Date: 7/13/2023 5:34:10 AM
FILE NAME: 8660F1099S09.dwg
PROJECT NO. 8660F10
LAST SAVED BY: obonafaux



C SECTION
S01
SCALE: 3/4" = 1' - 0"
FILE: 8660F1001S320



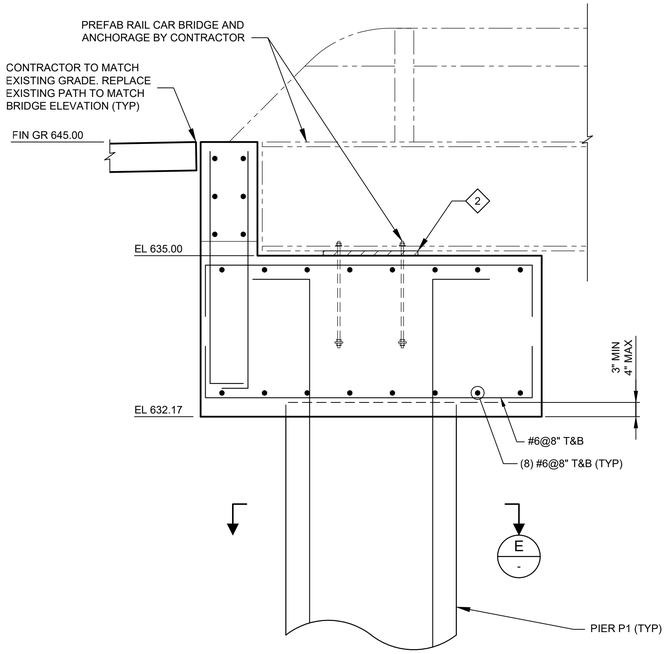
D SECTION
S01
SCALE: 3/4" = 1' - 0"
FILE: 8660F1001S320

GENERAL NOTES:

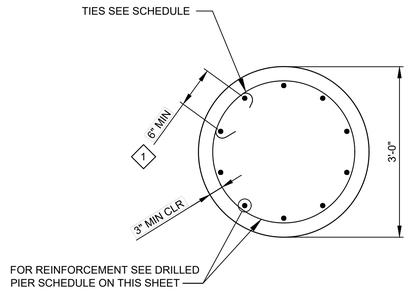
1. FOR GENERAL STRUCTURAL NOTES, REFER TO DRAWING 00S01.
2. CONTRACTORS OPTION TO PROVIDE BAR END TERMINATOR RATHER THAN STANDARD HOOK.
3. PROVIDE SPIRALS WITH YIELD STRENGTH OF 80,000 PSI (ASTM615 GR 80)
4. IF LAPS ARE REQUIRED FOR SPIRALS, LAP AND TIE IN ACCORDANCE WITH ACI 318 REQUIREMENTS AND AS APPROVED BY THE ENGINEER.
5. FOR CONCRETE CLASS, SEE SPECIFICATION SECTION 03300.
6. PRIOR TO DRILLING OF PIERS, ALL KNOWN UTILITIES SHALL BE EXPOSED.
7. ALL PILES SHALL BE CAST-IN-PLACE DRILLED HOLE CONCRETE PILES OR AUGURED PRESSURE-GROUTED PILES. SEE SPECIFICATION SECTIONS 2467A AND 2466B FOR ADDITIONAL INFORMATION. CONDUCT PIER LOAD TESTING PER SPECIFICATION SECTION 2460.
8. FOR REBAR CAGES THAT ARE REDUCED IN LENGTH ON SITE PER NEW PIER LENGTHS, ENSURE THAT THE SPIRAL IS TERMINATED WITH (2) EXTRA TURNS AND A 135 DEGREE HOOK BEND INTO THE CONCRETE CORE AT ENDS.

◇ KEY NOTES:

1. TIES ENDS SHALL TERMINATE WITH 135 DEGREE MINIMUM STANDARD HOOKS AND ENGAGE A LONGITUDINAL BAR WITH 6" MINIMUM OVERLAP. ENDS OF ADJACENT CIRCULAR TIES SHALL BE STAGGERED AROUND THE PERIMETER ENCLOSING THE LONGITUDINAL BAR.
2. BRIDGE BEARING PLATE AND ANCHOR BOLTS PER MANUFACTURER. PROVIDE SLOTTED HOLES TO ALLOW LONGITUDINAL MOVEMENT (TYP).
3. PROVIDE 3/8" THICK OVERSIZED STEEL PLATE WELDED TO BRIDGE BEAM AND W8X ON ALL SIDES WITH A 1/4" THICK FILLET WELD IF REQUIRED FOR FULL BEARING AND CONNECTION OF W8X.
4. EXTEND SPIRALS 12 INCHES INTO PIER CAP.



1 DETAIL
-
SCALE: 3/4" = 1' - 0"
FILE: 8660F1001S320



E SECTION
-
SCALE: 3/4" = 1' - 0"
FILE: 8660F1001S320

DRILLED PIER SCHEDULE				
LABEL	DIAMETER (FT)	PIER LENGTH (FT)	VERTICAL REINFORCEMENT	TIES OR SPIRAL
P1	3'-0"	45'-0"	(16) #10	BUNDLED SPIRAL (2) #5@6" 4

REV	DATE	BY	DESCRIPTION
1	06-02-23	JKN	ADDENDUM 3

CONFORMED DOCUMENTS

DESIGNED JKN
DRAWN NGB
CHECKED KP
DATE JULY 2023

** ORIGINAL SEALED BY JITESH K. RE NALAGOTLA 4/7/2023 CA PE NO. 86094 **

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City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
STRUCTURAL
BRIDGE
SECTIONS AND DETAILS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99S10
SHEET NO. 71 OF 200

Plot Date: 7/12/2023 11:52:25 AM
FILE NAME: 8660F1099S10.dwg
PROJECT NO. 8660F10
LAST SAVED BY: JGarrety

PIPING SYMBOLS

DOUBLE LINE	SINGLE LINE	DESCRIPTION
		WELDED JOINT
		GROOVED END JOINT
		FLANGED JOINT
		HUB & SPIGOT JOINT (RUBBER GASKET)
		PUSH-ON JOINT (RESTRAINED)
		ADAPTER SIDE GROOVED END ADAPTER FLANGE
		FLANGED COUPLING ADAPTER
		FLANGED COUPLING ADAPTER WITH THRUST TIES
		FLEXIBLE COUPLING
		FLEXIBLE COUPLING WITH THRUST TIES
		METAL BELLOWS EXP JOINT
		ELASTOMER BELLOWS EXP JOINT
		FLEXIBLE COUPLING ADAPTER
		DISMANTLING JOINT
		EXPANSION COMPENSATOR
		ELBOW UP
		ELBOW DOWN
		TEE UP
		TEE DOWN
		LATERAL UP
		LATERAL DOWN
		CONCENTRIC REDUCER
		ECCENTRIC REDUCER (FOT. FOB)
		UNION
		CAP
		ANCHOR
		ELBOW, 90 DEGREE
		CROSS
		TEE
		ELBOW, 45 DEGREE
		ELBOW, 22.5 DEGREE
		ELBOW, 11.25 DEGREE
		LATERAL

DOUBLE LINE	SINGLE LINE	DESCRIPTION
		GATE VALVE
	K	KNIFE GATE VALVE
		BUTTERFLY VALVE
V	V	CHARACTERIZED BALL CONTROL VALVE
		BALL VALVE
		GLOBE VALVE
		3-WAY GLOBE TYPE MIXING VALVE
M		DIAPHRAGM VALVE
		PLUG VALVE
		LUBRICATED PLUG VALVE
		ECCENTRIC PLUG VALVE
		SWING CHECK VALVE
		WAFER CHECK VALVE
		PINCH VALVE
		BALL CHECK VALVE
		DUAL CHECK VALVE
		SILENT CHECK VALVE
		MUD VALVE (PLAN VIEW)
		NEEDLE VALVE
		CHECK BACKFLOW PREVENTER
		PIPE MATERIAL CHANGE

MECHANICAL SYMBOLS

SINGLE LINE	DESCRIPTION
	AIR OR CHEMICAL DIFFUSER
	QUICK DISCONNECT HIGH PRESSURE AIR OR FLUSHING
	BATCHMETER
	AIR VENT
	BASKET STRAINER
	BLOWER
	CALIBRATION COLUMN
	COMPRESSOR/TURBINE
	COMPRESSOR: RECIPROCATING
	DIAPHRAGM SEAL
	DRAIN
	EJECTOR OR EDUCTOR
M	ELECTRIC MOTOR
	EQUIPMENT DRAIN
	EXPANSION JOINT, FLEXIBLE VIBRATION JOINT
	FAN: EXHAUST/SUPPLY
	FILTER
	FIRE HYDRANT
	FLAME ARRESTER
	FLAME ARRESTER WITH THERMALLY OPERATED VALVE
	FLOOR DRAIN
	FLOW SWITCH
	GAUGE: PRESSURE
	GAUGE: DIFFERENTIAL PRESSURE
	WEIR
	MIXER
	OIL OR MOISTURE TRAP
	PRIMARY LEVEL ELEMENT: BUBBLER
	PRIMARY LEVEL ELEMENT: ELECTRODE
	PRIMARY LEVEL ELEMENT: FLOAT SWITCH
	PRIMARY LEVEL ELEMENT: FLUID
	PRIMARY LEVEL ELEMENT: INVERTED COLUMN

SINGLE LINE	DESCRIPTION
	PRIMARY LEVEL ELEMENT: RADAR
	PRIMARY LEVEL ELEMENT: ULTRASONIC
	PRIMARY FLOW ELEMENT: FLUME
X	PRIMARY FLOW ELEMENT: X = C - CORIOLIS X = M - MAGNETIC X = P - PROPELLER X = PT - PITOT TUBE X = R - ROTAMETER X = T - TURBINE X = TH - THERMAL X = U - ULTRASONIC X = D - DENSITY
	PRIMARY FLOW ELEMENT: ORIFICE PLATE
	PRIMARY FLOW ELEMENT: VENTURI TUBE
	PRIMARY FLOW ELEMENT: WEIR
	PULSATION DAMPENER
	PUMP: CENTRIFUGAL
	PUMP: DIAPHRAGM
	PUMP: METERING
	PUMP: PLUNGER
	PUMP: PERISTALTIC TUBE METERING
	PUMP: PROGRESSIVE CAVITY
	PUMP: RECIPROCATING
	PUMP: ROTARY
	PUMP: SCREW
	PUMP: SUBMERSIBLE
	PUMP: VERTICAL LIFT
	PIPE REDUCER: CONCENTRIC
	PIPE REDUCER: ECCENTRIC (FOT, FOB)
	ROTARY CHEMICAL FEEDER
	RUPTURE DISK
	SAMPLE PORT
	SIGHT GLASS
	SLIDE GATE
	SLUICE GATE
	STRAINER: WYE TYPE

SINGLE LINE	DESCRIPTION
	STRAINER: WYE TYPE WITH BLOWOFF
	THERMOMETER
	VALVE: ANGLE
	VALVE: AIR RELIEF
	VALVE: BALL
	VALVE: BALL CHECK
	VALVE: BUTTERFLY
	VALVE: CONE
	VALVE: DIAPHRAGM
	VALVE: FLAPPER CHECK
	VALVE: THREE WAY
	VALVE: FOUR WAY
	VALVE: GATE
	VALVE: GLOBE
	VALVE: HOSE
	VALVE: NEEDLE
	VALVE: PINCH
	VALVE: PLUG CONCENTRIC
	VALVE: PLUG ECCENTRIC
	VALVE: PRESSURE RELIEF PRESSURE-REDUCING REGULATOR
	VALVE: SWING CHECK
	VALVE: TELESCOPING
	VALVE: THREE WAY AIR OPERATED
M	VALVE: THREE WAY MOTOR OPERATED
S	VALVE: THREE WAY SOLENOID OPERATED
	VALVE: VACUUM
	BACKPRESSURE REGULATOR SELF-CONTAINED
	BACKPRESSURE REGULATOR W/ EXTERNAL PRESSURE TAP
	PRESSURE-REDUCING REGULATOR: SELF-CONTAINED
	PRESSURE-REDUCING REGULATOR W/EXTERNAL PRESSURE TAP

IDENTIFICATION SYMBOLS

CHEMICAL INJECTION POINT — CHEMICAL / DWG NO.

PIPE DESIGNATOR — PIPE SIZE, FLOW STREAM, X" XXX

CONTINUATION TAG — UNIQUE IDENTIFIER, CONTINUATION FROM DWG NO., CONTINUATION TO DWG NO., A, B, C

EQUIPMENT / VALVE TAG — XXX-XX-XXXX

LINE SYMBOLS

PIPE ABOVE OR BELOW GROUND

PIPE UNDERNEATH SLAB OR STRUCTURE

FUTURE

EXISTING

DEMO

PROCESS LINE SYMBOLS

PRIMARY PROCESS FLOW IN PIPE

SECONDARY PROCESS FLOW IN PIPE

PRIMARY PROCESS FLOW IN CHANNEL

SECONDARY PROCESS FLOW IN CHANNEL

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED JD
DATE JULY 2023

** ORIGINAL SEALED BY MATTHEW C. KALLEVANT 4/7/2023 CA PE NO. 84405 **

carollo

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

MECHANICAL

GENERAL MECHANICAL SYMBOLS

VERIFY SCALES
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0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00M01
SHEET NO. 72 OF 200

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Model: Layout1
LAST SAVED BY: eparker

PROJECT NO. 8660F10 FILE NAME: 8660F1000M01.dgn

Plot Date: 7/12/2023 12:19:06 PM
FILE NAME: 8660F1000M02.dwg
PROJECT NO. 8660F10
LAST SAVED BY: JGarrett

NOTES

1. SIZES OF EQUIPMENT PADS INDICATED ON THE DRAWINGS ARE APPROXIMATE. EXACT DIMENSIONS SHALL BE DETERMINED BY THE CONTRACTOR FOR THE EQUIPMENT FURNISHED. ALL FLOOR MOUNTED EQUIPMENT SHALL BE SET ON CONCRETE PADS CONFORMING TO DETAILS SHOWN ON THE TYPICAL STRUCTURAL DRAWINGS.
2. DIELECTRIC COUPLINGS, FLANGES OR UNIONS SHALL BE INSTALLED AT ALL CONNECTIONS OF COPPER PIPE TO OTHER TYPES OF METALLIC PIPING.
3. HVAC PIPING AND DUCTWORK DRAWINGS DO NOT SHOW ALL DRAINS, VENTS, OFFSETS AND FITTINGS ETC. REQUIRED FOR THE COMPLETE SYSTEM. SMALL PIPING IS SHOWN APPROXIMATELY TO SCALE BUT NOT EVERY FITTING AND OFFSET IS SHOWN. THE CONTRACTOR SHALL FURNISH, INSTALL AND TEST ALL HVAC SYSTEMS TO PROVIDE THE COMPLETE SYSTEM.
4. UNLESS OTHERWISE SHOWN ON THE DRAWINGS ALL FLOOR SLAB AND WALL PENETRATIONS SHALL BE AS SHOWN ON THE TYPICAL DETAILS.
5. NOT ALL AND ONLY CERTAIN TYPES OF SUPPORTS ARE SHOWN ON THE HVAC DRAWINGS. UNLESS OTHERWISE DETAILED ON THE DRAWINGS ALL PIPE AND DUCT SUPPORTS SHALL BE DESIGNED, FURNISHED AND INSTALLED BY THE CONTRACTOR AS SPECIFIED.
6. THIS IS A GENERAL LIST OF SYMBOLS. NOT ALL ITEMS SHOWN HERE APPEAR ON CONTRACT DRAWINGS.
7. TYPICAL DETAILS SHALL BE USED FOR ALL PERMANENT WORK EVEN THOUGH THEY ARE NOT CALLED OUT AT ALL LOCATIONS WHERE THEY APPLY.
8. COORDINATE FINAL LOUVER SIZE AND LOCATION WITH ARCHITECTURAL AND STRUCTURAL DRAWINGS.
9. PROVIDE TURNING VANES IN ALL ELBOWS. (SHOWN OR NOT)

ABBREVIATIONS

A	@	AT
	AC	AIR CONDITIONING
	AFF	ABOVE FINISHED FLOOR
	AFS	AIR FLOW SWITCH
	AHU	AIR HANDLING UNIT
B	BD	BALANCING DAMPER
	BDD	BACKDRAFT DAMPER
	BLR	BOILER
	BOD	BOTTOM OF DUCT
C	CH	CHILLER
	CO	CARBON MONOXIDE DETECTOR
	CT	COOLING TOWER
	CS	CURRENT SENSOR
	CU	CONDENSING UNIT
D	DG	DOOR GRILLE
	DP	DIFFERENTIAL PRESSURE
E	EA	EXHAUST AIR
	ECU	EVAPORATIVE COOLING UNIT
	EF	EXHAUST FAN
	EUH	ELECTRIC UNIT HEATER
F	FA	FOUL AIR
	FCU	FAN COIL UNIT
	FD	FIRE DAMPER
G	GUH	GAS UNIT HEATER
H	HP	HEAT PUMP
M	MAU	MAKEUP AIR UNIT
	MD	MOTORIZED DAMPER
N	NC	NORMALLY CLOSED
	NO	NORMALLY OPEN
O	OA	OUTSIDE AIR
	OCF	ODOR CONTROL FAN
P	PPU	POSITIVE PRESSURIZATION UNIT
R	RA	RETURN AIR
	RR	RETURN REGISTER OR GRILLE
S	SA	SUPPLY AIR
	SD	SMOKE DAMPER OR SMOKE DETECTOR
	SF	SUPPLY FAN
	SFD	SMOKE & FIRE DAMPER COMBINATION
	SR	SUPPLY REGISTER, GRILLE OR DIFFUSER
V	VAV	VARIABLE AIR VOLUME
W	WUH	WATER UNIT HEATER

DUCTWORK SYMBOLS

FEATURE	SYMBOL
DIRECTION OF FLOW	
DUCT SIZE- FIRST NUMBER IS SIDE SHOWN	12x20
ROUND DUCT	12 DIA OR 12"Ø
DUCT SECTION, POSITIVE PRESS FIRST NUMBER IS TOP	20x12
DUCT SECTION, NEGATIVE PRESS FIRST NUMBER IS TOP	20x12
SIDE MOUNT DEVICE	
ELEVATION CHANGE (R) RISE, (D) DROP	R
ACCESS DOOR	AD / AD
BOTTOM MOUNT DEVICE REGISTER, GRILLE, DIFFUSER OR DUCT TAKEOFF	
FLEXIBLE CONNECTION	
FLEXIBLE DUCT	OR
DUCT INSULATION (INSIDE) OR (OUTSIDE) SIZE VARIES	XX" INSULATION (INSIDE) / XX" INSULATION (OUTSIDE)
TURNING VANES	
RECTANGULAR TO RECTANGULAR TRANSITION	20x12 / 16x8
RECTANGULAR TO ROUND TRANSITION	20x12 / 16 DIA
POSITIVE PRESSURE DUCT - ELBOW TURNED UP (USE ONE DIAGONAL FOR NEGATIVE PRESSURE)	
POSITIVE PRESSURE DUCT - ELBOW TURNED DOWN (USE ONE DIAGONAL FOR NEGATIVE PRESSURE)	
SMOKE DETECTOR CONFIRM ORIENTATION OF INSTALLATION	
DAMPERS	
BACKDRAFT	
BALANCING	
FIRE W/ ACCESS DOOR	FD
MOTORIZED	M
SMOKE CONFIRM ORIENTATION OF INSTALLATION	
COMBINATION SMOKE AND FIRE CONFIRM ORIENTATION OF INSTALLATION	

EQUIPMENT SYMBOLS

FEATURE	SYMBOL
A/C OR HEAT PUMP COMPRESSOR	
CENTRIFUGAL FAN	
CONTROL PANEL	
COOLING COIL	C / C
CURRENT SENSOR	CS
DIRECT EXPANSION COIL	D / X
DUCT SMOKE DETECTOR	
ELECTRIC HEATER	
FILTER	
AIR FLOW SWITCH	AFS
GAS HEATER	
HUMIDISTAT	H
INLINE/AXIAL FAN	
MOTOR OPERATED VALVE	M
PRESSURE DIFFERENTIAL SWITCH	PD
ROOF/SIDEWALL FAN	
ROOF VENT OR ROOF FAN	
SOLENOID VALVE	S
THERMOSTAT 60" ABOVE FINISH FLOOR	T
UNIT HEATER (HORIZONTAL TYPE)	
UNIT HEATER (VERTICAL TYPE)	

NOTE: THIS IS A GENERAL LIST OF SYMBOLS AND ABBREVIATIONS. NOT ALL ITEMS SHOWN HERE APPEAR ON THE CONTRACT DRAWINGS.

REGISTERS, GRILLES & LOUVERS SYMBOLS

FEATURE	SYMBOL
LOUVER/BRICK VENT - FIXED	
LOUVER/BRICK VENT - OPERABLE	
TRANSFER GRILLE	
TO SPACE	
FROM SPACE	
SUPPLY DIFFUSER OR GRILLE ARROWS INDICATE FLOW DIRECTION	
RETURN DIFFUSER OR GRILLE ARROWS INDICATE FLOW DIRECTION	
EXHAUST DIFFUSER OR GRILLE ARROWS INDICATE FLOW DIRECTION	

LEGEND FOR REGISTERS & GRILLES

TYPE OF REGISTER OR GRILLE (AS DESCRIBED IN SPECIFICATIONS) — BOOT (IF REQ'D) — NECK SIZE — SR-1(B)/12x12 — 400/4 — CFM — FLOW PATTERN; SIDEWALL-ADJUSTABLE; C-CORNER

	SUPPLY	RETURN	EXHAUST
DUCT UP THRU ROOF OR FLOOR			
DUCT UP			
DUCT DOWN			

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED JD
DATE JULY 2023

** ORIGINAL SEALED BY MATTHEW C. KALLEVANT 4/7/2023 CA PE NO. 84405 **

carollo

City of Ukiah

CITY OF UKIAH

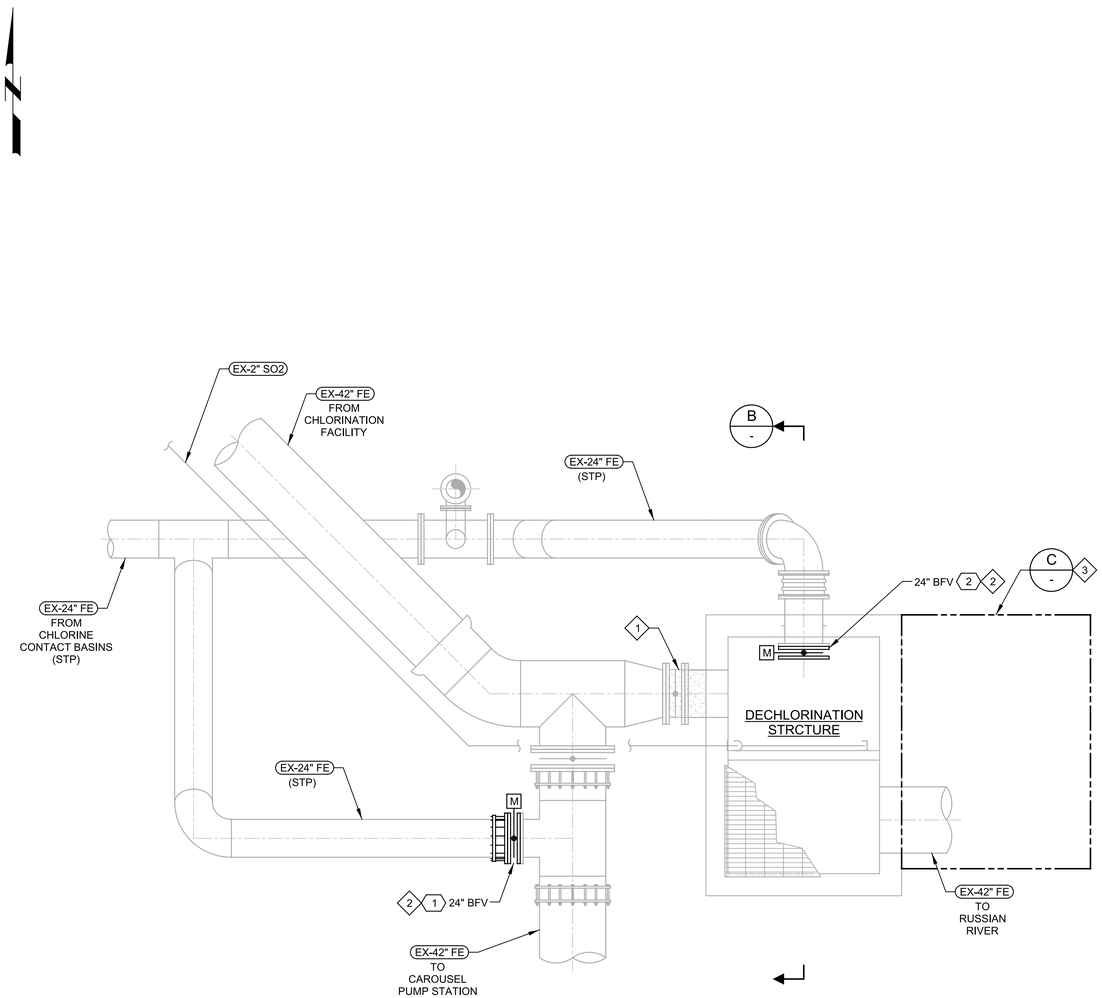
RECYCLED WATER PROJECT - PHASE 4

MECHANICAL

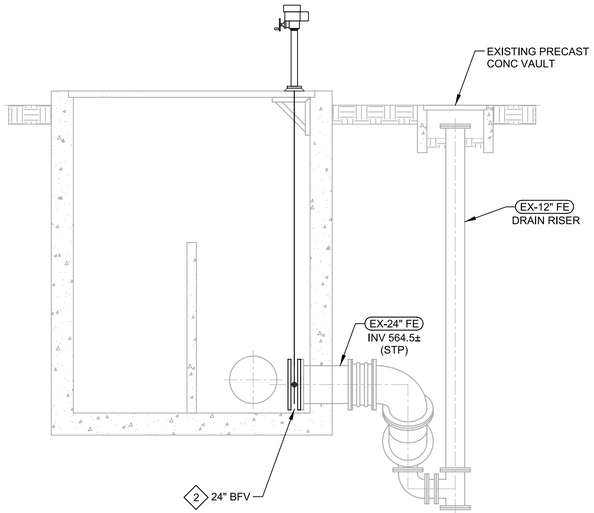
GENERAL HVAC NOTES, ABBREVIATIONS, AND SYMBOLS

VERIFY SCALES
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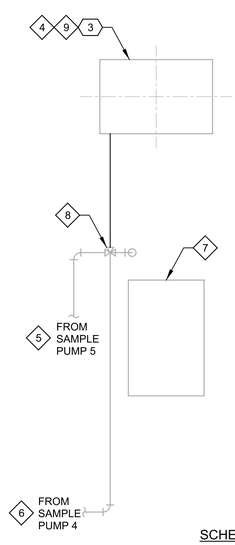
JOB NO. 8660F.10
DRAWING NO. 00M02
SHEET NO. 73 OF 200



A PLAN
SCALE: 1/4" = 1'-0"
FILE: 8660F1060M9101



B SECTION
SCALE: 1/4" = 1'-0"
FILE: 8660F1060M9301



SCHEMATIC

C ENLARGED PLAN
SCALE: NOT TO SCALE
FILE: 8660F1060M9101

GENERAL NOTES:

1. CONTRACTOR SHALL PROVIDE NEW NUTS, BOLTS, AND GASKETS FOR ALL CONNECTIONS, INCLUDING REINSTALLATION OF ANY EXISTING PIPING COMPONENTS. DO NOT REUSE THE OLD NUTS, BOLTS, AND GASKETS.
2. CONTRACTOR SHALL COORDINATE WITH THE CITY, THE LOCATION, AND ORIENTATION OF VALVES AND VALVE ACTUATORS.
3. SEE CIVIL DRAWINGS FOR YARD PIPING CONTINUATION.

KEY NOTES:

1. EXISTING VALVE ABANDONED IN PLACE.
2. VALVE IS 20 +/- FT DEEP. REFER TO SPECIFICATION SECTION 15112 AND SPECIFICATION SECTION 13447.
3. AREA IS A DIAGRAMMATIC VIEW OF PAD EAST OF DECHLORINATION STRUCTURE. CONTRACTOR TO FIELD VERIFY AREA.
4. REPLACE CHLORINE ANALYZER 4 PER SPECIFICATION SECTION 17505. THE EXISTING ENCLOSURE IS TO REMAIN IN USE. PROTECT EXISTING ENCLOSURE IN PLACE. REFER TO ELECTRICAL (60E01) AND INSTRUMENTATION (60N01) DRAWINGS FOR ADDITIONAL INFORMATION.
5. SAMPLE PUMP 5 IS A SUBMERSIBLE PUMP THAT IS USED FOR DECHLORINATED SAMPLES. PUMP SENDS FLOW TO A THREE-WAY AUTOMATED ACTUATION VALVE.
6. SAMPLE PUMP 4 IS A ROTARY PUMP THAT IS USED FOR CHLORINATED SAMPLES. PUMP SENDS FLOW TO A THREE-WAY AUTOMATED ACTUATION VALVE.
7. EXISTING CONCRETE PAD. CONTRACTOR TO FIELD VERIFY DIMENSIONS.
8. TIE INTO EXISTING THREE-WAY VALVE.
9. CONTRACTOR SHALL PROVIDE A DRAIN CONFIGURATION THAT MATCHES THE EXISTING CONFIGURATION.

KEY TAGS:

1.	FCV-60100	DCL STRUCTURE VALVE 1
2.	FCV-60102	DCL STRUCTURE VALVE 2
3.	AE-60101	CHLORINE ANALYZER 4

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED EYY
DRAWN AL
CHECKED JD
DATE JULY 2023

** ORIGINAL SEALED BY MATTHEW C. KALLEVANT 4/7/2023 CA PE NO. 84405 **

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
MECHANICAL
DECHLORINATION STRUCTURE PLANS AND SECTION

VERIFY SCALES
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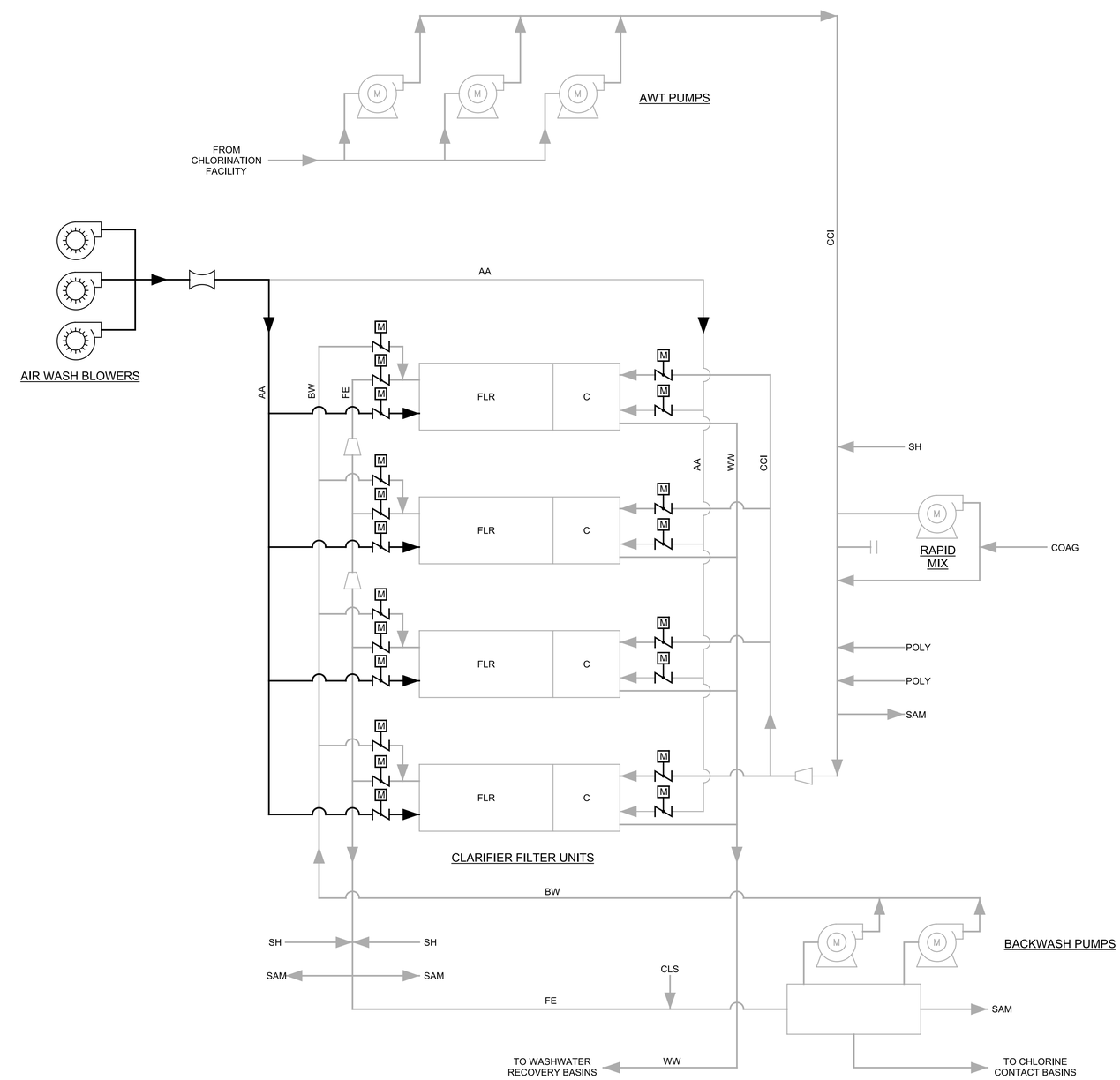
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DRAWING NO. 60M01
SHEET NO. 74 OF 200

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Model: Layout1
LAST SAVED BY: eparker

PROJECT NO. 8660F10 FILE NAME: 8660F1060M01.dgn

LEGEND:

AA - AERATION AIR/AIR WASH
BW - BACKWASH
C - CLARIFIER
CCI - CHLORINE LIQUID
CLS - CHLORINE SOLUTION
COAG - COAGULANT
FE - FINAL EFFLUENT
FLR - FILTER
POLY - POLYMER
SAM - SAMPLE
SH - SODIUM HYDROXIDE
WW - WASHWATER



REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

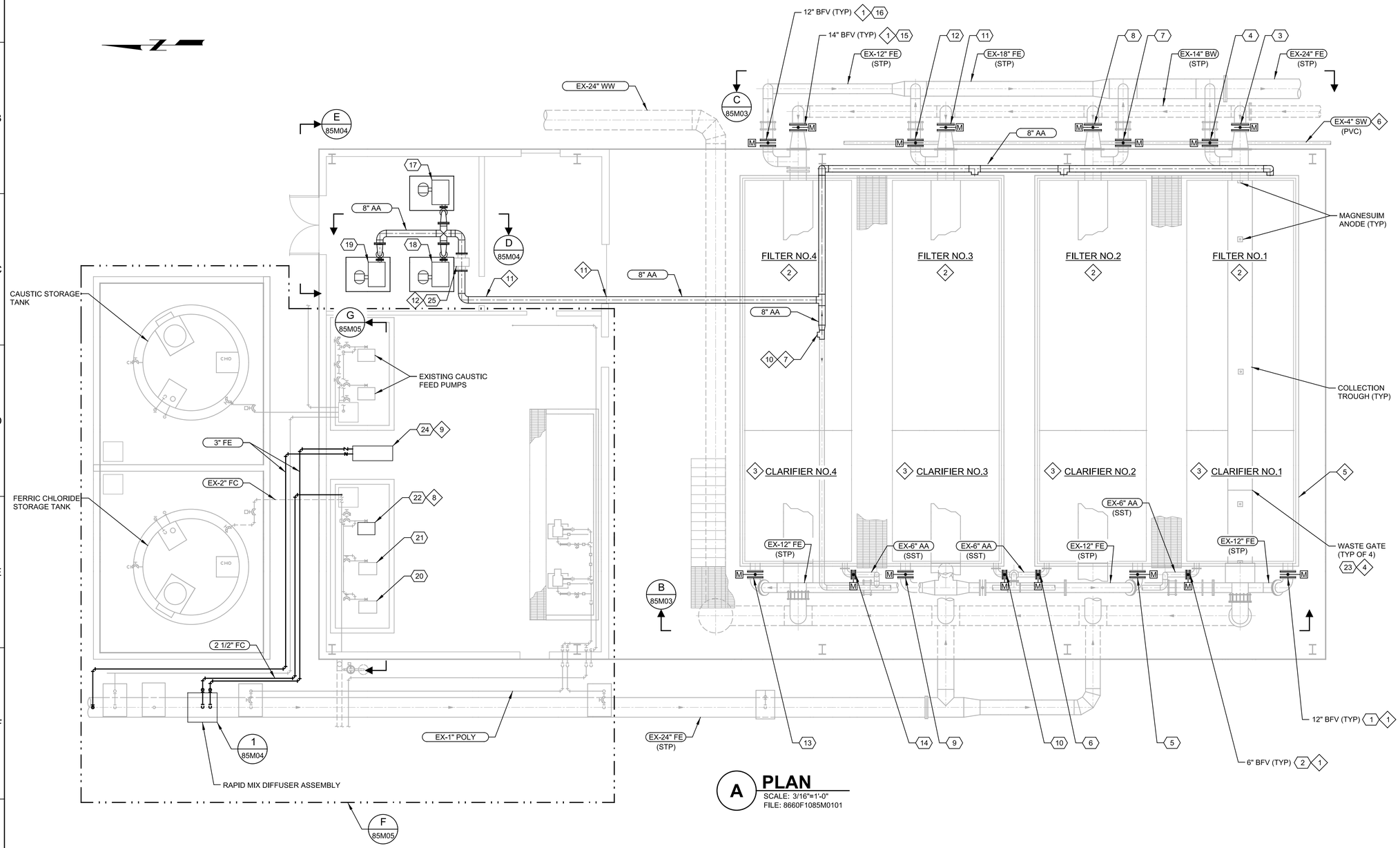
DESIGNED EYY
DRAWN AL
CHECKED JD
DATE JULY 2023

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CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
MECHANICAL
AWT PROCESS FLOW SCHEMATIC

VERIFY SCALES
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JOB NO. 8660F.10
DRAWING NO. 85M01
SHEET NO. 75 OF 200



A PLAN

SCALE: 3/16"=1'-0"
FILE: 8660F1085M0101

GENERAL NOTES:

1. BACKGROUND IS BASED ON THE 1994 RECORD DRAWINGS. CONTRACTOR TO FIELD VERIFY EXISTING DIMENSIONS.
2. CONTRACTOR SHALL PROVIDE NEW NUTS, BOLTS, AND GASKESTS FOR ALL CONNECTIONS, INCLUDING REINSTALLATION OF ANY EXISTING PIPING COMPONENTS. DO NOT REUSE THE OLD NUTS, BOLTS, AND GASKETS.
3. CONTRACTOR SHALL COORDINATE WITH THE CITY THE LOCATION AND ORIENTATION OF VALVES AND VALVE ACTUATORS.
4. SEE CIVIL DRAWINGS FOR YARD PIPING CONTINUATION.
5. REFER TO SPECIFICATION SECTION 11802 FOR WORK ON THE FOUR AWT CLARIFIER/FILTER UNITS.

KEY NOTES:

1. PROVIDE BUTTERFLY VALVE PER SPECIFICATION SECTION 15112 AND ACTUATORS PER SPECIFICATION SECTION 13447.
2. REPLACE FILTER MEDIA AND FILTER GRAVEL SUPPORT.
3. REPLACE ADSORPTION CLARIFIER MEDIA.
4. REPLACE EXISTING PNEUMATIC WASTE GATE ACTUATOR ON EACH AWT CLARIFIER/FILTER UNIT WITH A LINEAR ACTUATOR. REFER TO PHOTO 6/85D03. OTHER WASTE GATES NOT SHOWN FOR CLARITY.
5. CONTRACTOR TO FULLY RECOAT THE CLARIFIER/FILTER TANKS PER SPECIFICATION SECTION 09960 DURING THE MEDIA REPLACEMENT PROCESS.
6. ABANDON LINE IN PLACE. REFER TO 85D01 AND 85D02.
7. PROVIDE A TEE TO TIE INTO THE EXISTING AERATION AIR LINE. REFER TO PHOTO 6/85D03 FOR THE TIE-IN LOCATION.
8. PROVIDE A COAGULANT PUMP PER SEPCIFICATION SECTION 11242. REFER TO PHOTO 4/85D03 FOR THE PUMP THAT WILL BE REPLACED.
9. PROVIDE A RAPID MIX PUMP PER SPECIFICATION SPECIFICATION SECTION 11242.
10. BLIND FLANGE TEE ONCE EXISTING 6-INCH PIPING HAS BEEN REMOVED. REFER TO 85D01 AND SPECIFICATION SECTION 01140.
11. PENETRATE WALL AS REQUIRED FOR NEW 8-INCH AIR PIPING.
12. REINSTALL EXISTING VENTURI FLOW METER.

X KEY TAGS:

1.	FCV-85211	INFLUENT VALVE NO.1
2.	FV-85212	AIR VALVE NO.1
3.	FV-85217	BACKWASH VALVE NO.1
4.	FCV-85218	EFFLUENT VALVE NO.1
5.	FCV-85221	INFLUENT VALVE NO.2
6.	FV-85222	AIR VALVE NO.2
7.	FCV-85228	EFFLUENT VALVE NO.2
8.	FV-85227	BACKWASH VALVE NO.2
9.	FCV-85231	INFLUENT VALVE NO.3
10.	FV-85232	AIR VALVE NO.3
11.	FV-85237	BACKWASH VALVE NO.3
12.	FCV-85238	EFFLUENT VALVE NO.3
13.	FCV-85241	INFLUENT VALVE NO.4
14.	FV-85242	AIR VALVE NO.4
15.	FV-85247	BACKWASH VALVE NO.4
16.	FCV-85248	EFFLUENT VALVE NO.4
17.	LCP-85106	AIR WASH BLOWER NO. 1
18.	LCP-85107	AIR WASH BLOWER NO. 2
19.	LCP-85108	AIR WASH BLOWER NO. 3
20.	PMP-85181	COAGULANT FEED PUMP NO. 1
21.	PMP-85182	COAGULANT FEED PUMP NO. 2
22.	PMP-85183	COAGULANT FEED PUMP NO. 3
23.	FCV-25214	WEST GATE VALVE NO.1
24.	PMP-85104	RAPID MIX PUMP
25.	FE-85105	AIR WASH VENTURI FLOW METER

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED EYY
DRAWN ELP
CHECKED JD
DATE JULY 2023

** ORIGINAL SEALED BY MATTHEW C. KALLEVANT 4/7/2023 CA PE NO. 84405 **

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
MECHANICAL
AWT CLARIFIER/FILTER PLAN

VERIFY SCALES
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0 1"
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JOB NO. 8660F.10
DRAWING NO. 85M02
SHEET NO. 76 OF 200

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GENERAL NOTES:

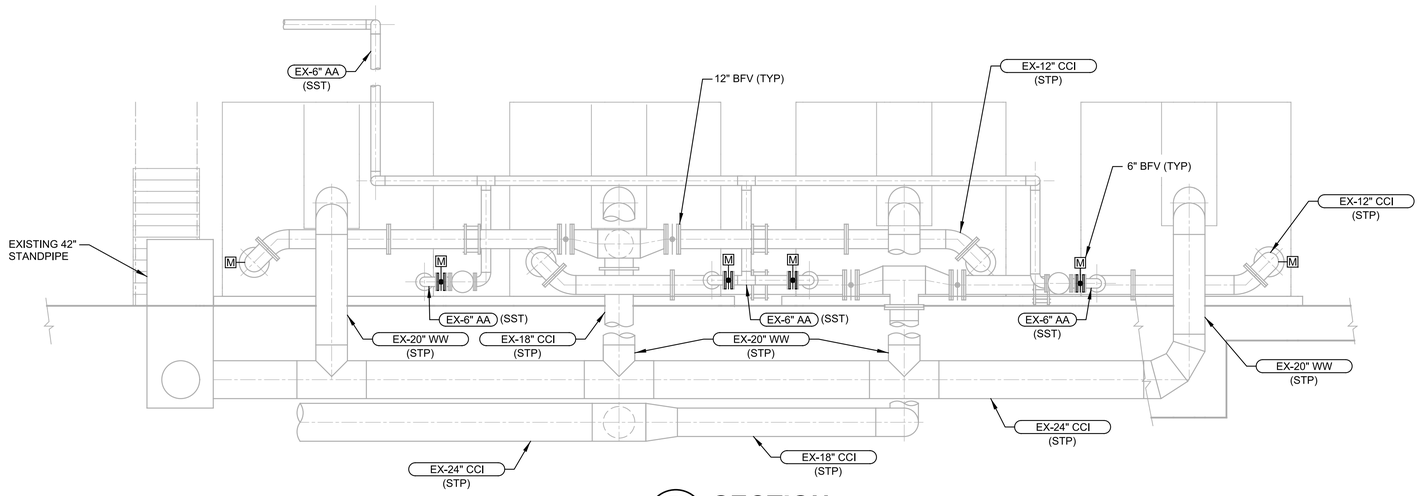
1. REFER TO GENERAL NOTES ON 85M02.

◇ KEY NOTES:

1. PROVIDE NEW PENETRATION IN EXISTING AWT UNITS FOR NEW AIR SCOUR LINE AS DIRECTED BY THE MANUFACTURER. LOCATION TO BE DETERMINED.
2. RESTORE TANK COATINGS AFTER INSTALLING PIPE SUPPORTS. REFER TO SECTION 09960.

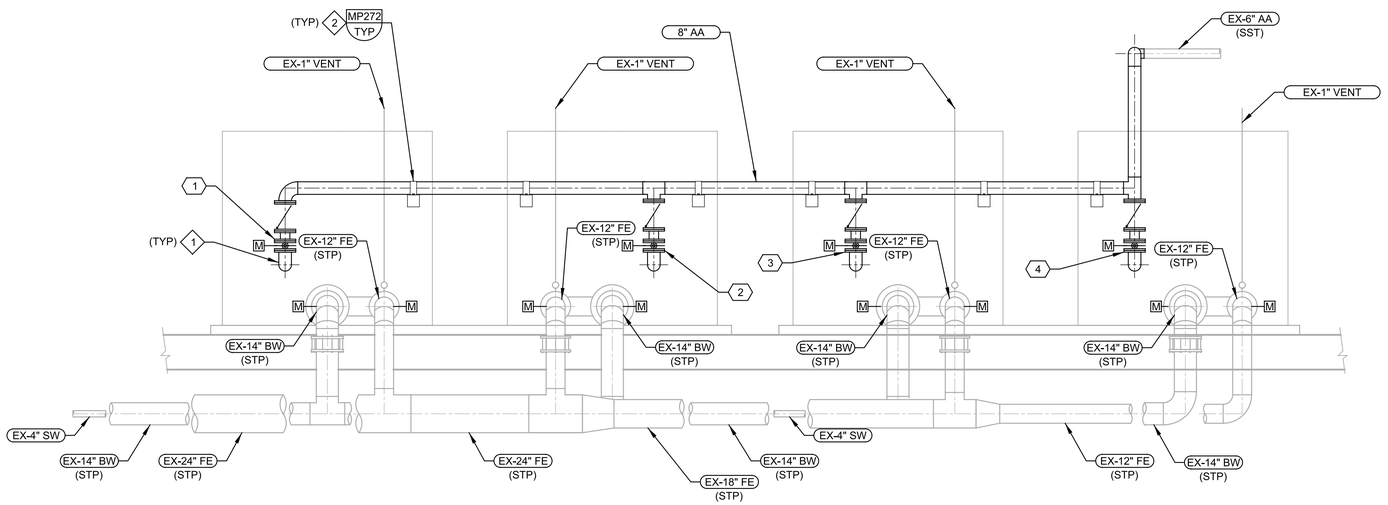
⬡ KEY TAGS:

1.	FV-85219	AC AIR SCOUR VALVE NO. 1
2.	FV-85229	AC AIR SCOUR VALVE NO. 2
3.	FV-85239	AC AIR SCOUR VALVE NO. 3
4.	FV-85249	AC AIR SCOUR VALVE NO. 4



B SECTION

85M02 SCALE: 1/4"=1'-0"
FILE: 8660F1085M0300



C SECTION

85M02 SCALE: 1/4"=1'-0"
FILE: 8660F1085M0302

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED EYY
DRAWN ELP
CHECKED JD
DATE JULY 2023

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City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

MECHANICAL

AWT CLARIFIER/FILTER PLAN AND SECTIONS

VERIFY SCALES
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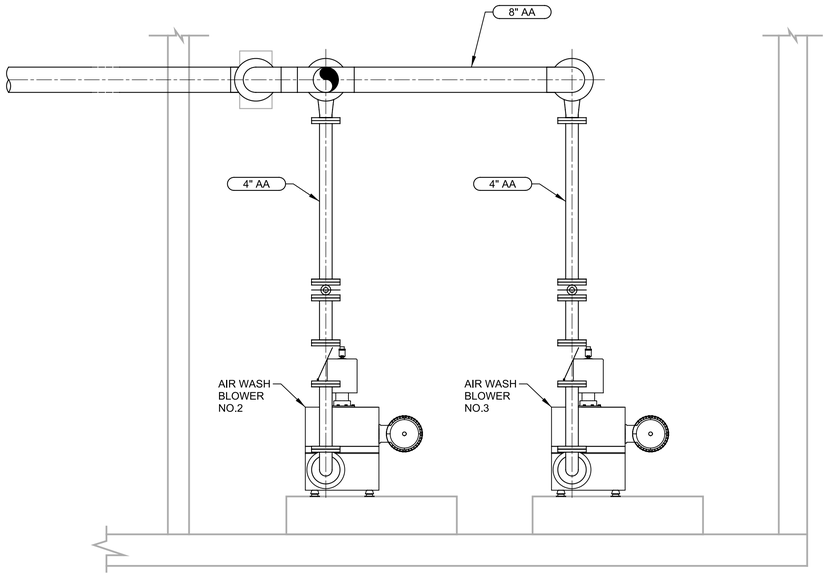
JOB NO. 8660F.10
DRAWING NO. 85M03
SHEET NO. 77 OF 200

GENERAL NOTES:

1. REFER TO GENERAL NOTES ON 85M02.

KEY NOTES:

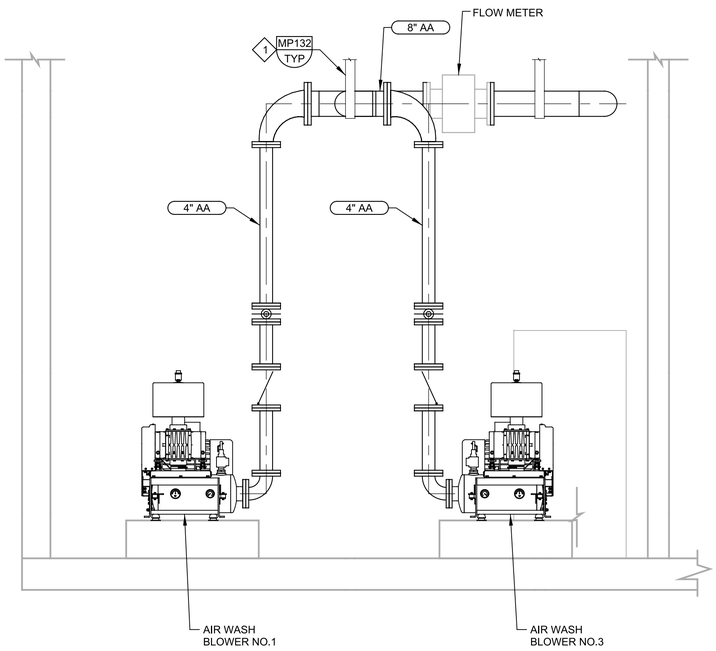
1. PROVIDE OVERHEAD PIPE SUPPORTS FIVE FEET ON CENTER.



D SECTION

85M02

SCALE: 3/8"=1'-0"
FILE: 8660F1085M0301



E SECTION

85M02

SCALE: 3/8"=1'-0"
FILE: 8660F1085M0303

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

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DRAWN ELP
CHECKED JD
DATE JULY 2023

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City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

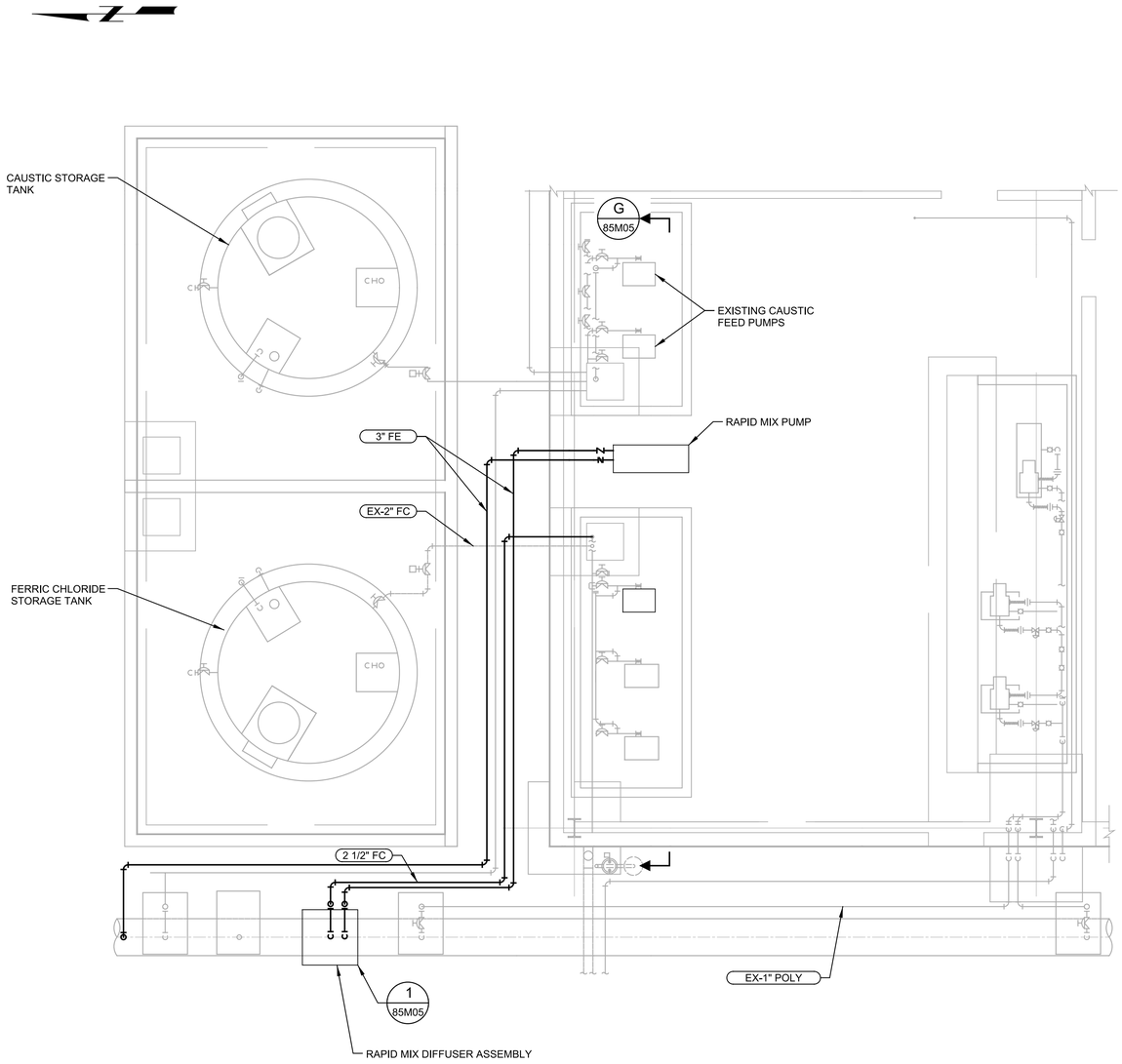
MECHANICAL

AIR WASH BLOWERS SECTIONS

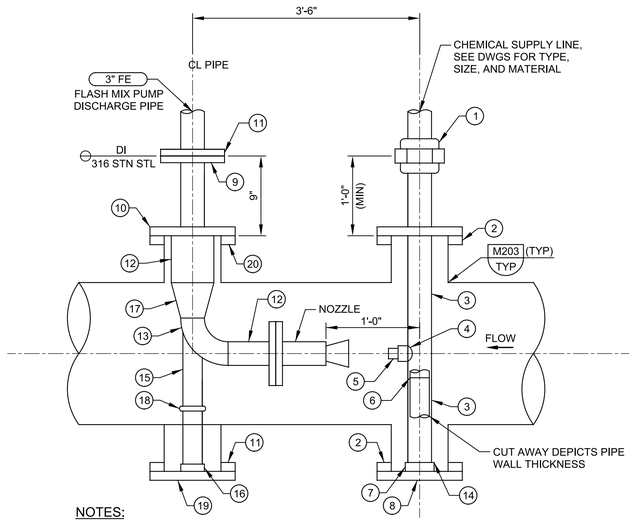
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DRAWING NO. 85M04
SHEET NO. 78 OF 200

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F ENLARGED PLAN
85M02 SCALE: 1/4"=1'-0"
FILE: 8660F1085M0101

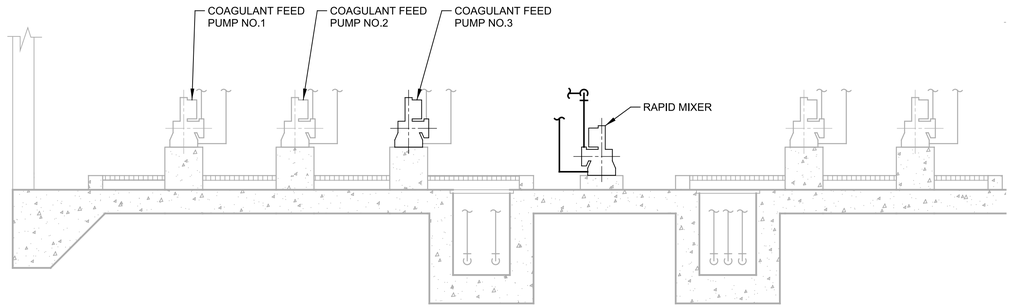


NOTES:

1. NOZZLE - FULL CONE SPRAY PATTERN. 140 GPM @ 19 PSI, SPRAYING SYSTEMS CO. MODEL 2.5 H-SS-90.

RAPID MIX DIFFUSER ASSEMBLY

1 DETAIL
85M02 SCALE: NTS
FILE: 8660F1085M0305



G SECTION
85M02 SCALE: 3/8"=1'-0"
FILE: 8660F1085M0301

GENERAL NOTES:

1. REFER TO GENERAL NOTES ON 85M02.

PIPING MATERIAL LIST

1	UNION
2	6" STEEL FLANGE, 150 LB, FLAT FACE, AWWA
3	LENGTH AS REQD, 2" TITANIUM PIPE
4	1" TITANIUM WELDED OUTLET BRANCH CONNECTION, THREADED
5	1/2" X 1" TITANIUM NIPPLE, THREAD X BUTT
6	1/4" THICK X ID TITANIUM PLUG, FABRICATED AND WELD TO INSIDE WALL OF PIPE
7	2 1/2" 316 STN STL ALIGNING SOCKET , WELD TO BLIND FLANGE
8	6" 316 STN STL, BLIND FLANGE. 150 LB, AWWA
9	3" 316 STN STL, 150 LB FLANGE, FLAT FACE, AWWA
10	6" 316 STN STL, 150 LB BLIND FLANGE
11	3" STL, 150 LB FLANGE, FLAT FACE, AWWA
12	LENGTH AS REQD, 316 STN STL, SCHED 40
13	SHORT RADIUS ELBOW, 316 STN STL, SCHED 40
14	1/4" THICK FOOD GRADE, BUNA RUBBER STRIP WRAPPED AROUND PIPE/TUBE PRIOR TO INSERTION INTO SOCKET.
15	1 1/2" SCH 40, 316 STN STL. WELD TO ELBOW
16	1 1/2" THREADED HALF COUPLING, 316 STN STL, WELD TO BLIND FLANGE
17	3" X 2 1/2" REDUCER, 316 STN STL, SCH 40
18	1 1/2" GROOVED COUPLING, 316 STN STL
19	3" 316 STN STL BLIND FLANGE, 150 LB, AWWA
20	6" STL, 150 LB FLANGE, FLAT FACE, AWWA

PIPING MATERIAL LIST NOTES:

1. THE PIPE MATERIAL LIST FOR THIS DETAIL IS NOT COMPLETE, MANY REQUIRED FITTINGS SUCH AS UNIONS, GASKETS, BOLTS, ELBOWS, REDUCERS, BUSHINGS AND PIPE SUPPORTS OR HANGERS ARE NOT LISTED OR SHOWN. CONTRACTOR SHALL FURNISH AND INSTALL ALL PIPINHG AND EQUIPMENT.
2. PROVIDE ISOLATION GASKETS BETWEEN DISSIMILAR METALS.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED EYY
DRAWN ELP
CHECKED JD
DATE JULY 2023

** ORIGINAL SEALED BY MATTHEW C. KALLEVANT 4/7/2023 CA PE NO. 84405 **

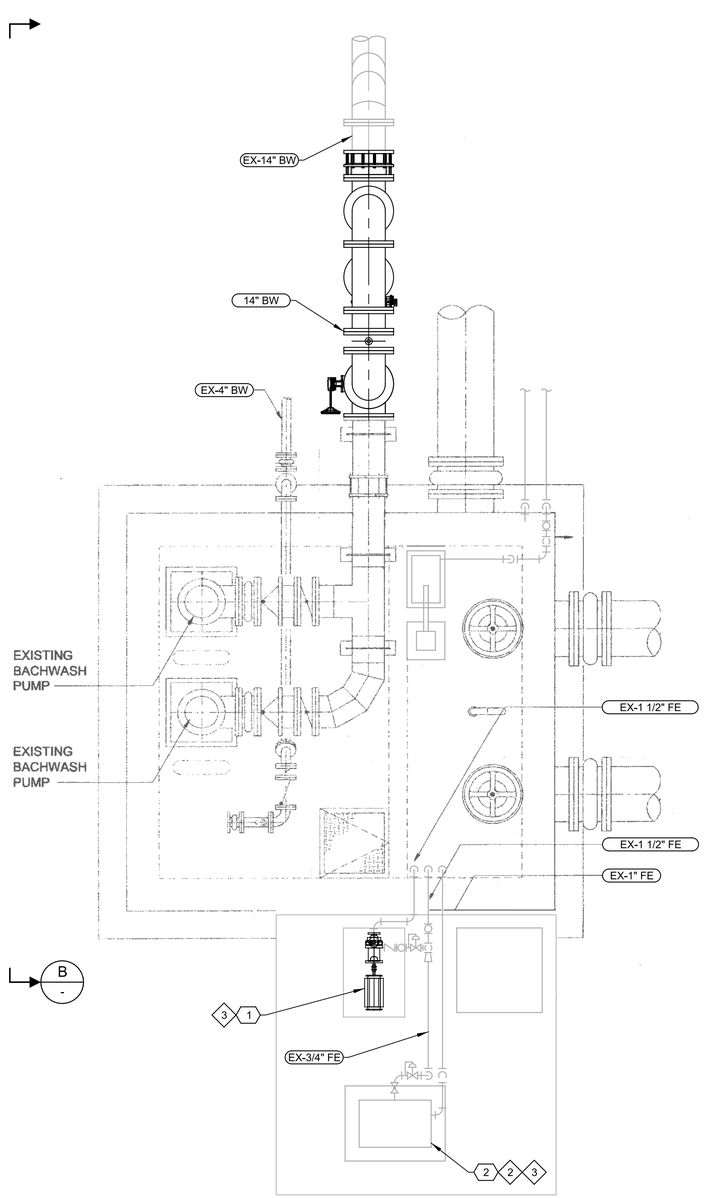
CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
MECHANICAL
COAGULANT FEED PUMP AND RAPID MIX PUMP PLAN, SECTION, AND DETAIL

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
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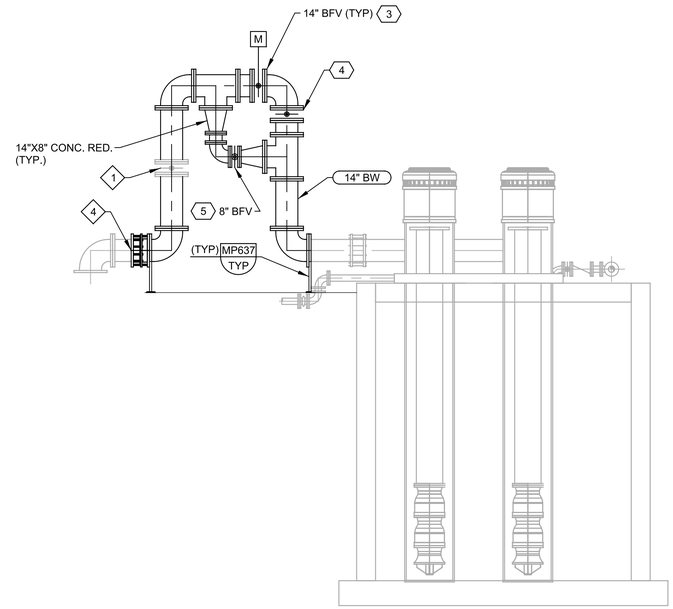
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DRAWING NO. 85M05
SHEET NO. 79 OF 200

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LAST SAVED BY: eparker



A PLAN
SCALE: 3/8"=1'-0"
FILE: 8660F1087M0101



B SECTION
SCALE: 1/4"=1'-0"
FILE: 8660F1087M0301

GENERAL NOTES:

1. BACKGROUND IS BASED ON THE 2005 RECORD DRAWINGS. CONTRACTOR TO FIELD VERIFY EXISTING DIMENSIONS.
2. SEE CIVIL DRAWINGS FOR YARD PIPING CONTINUATION.
3. PIPE LAYOUT DRAWINGS SHALL BE PREPARED BY THE CONTRACTOR AND APPROVED BY THE ENGINEER PRIOR TO FABRICATION.

KEY NOTES:

1. RELOCATE THE EXISTING BUTTERFLY VALVE AS SHOWN.
2. REPLACE CHLORINE ANALYZER 4 PER SPECIFICATION SECTION 17505. THE EXISTING ENCLOSURE IS TO REMAIN IN USE, PROTECT EXISTING ENCLOSURE IN PLACE. REFER TO ELECTRICAL (60E01) AND INSTRUMENTATION (60N01) DRAWINGS FOR ADDITIONAL INFORMATION.
3. SUPPLY ADDITIONAL PIPING AND FITTINGS TO CONNECT NEW EQUIPMENT TO THE EXISTING SAMPLE LINES AS REQUIRED.
4. TIE INTO EXISTING PIPE.

KEY TAGS:

1.	PMP-87134	BACKWASH CHLORINE SAMPLE PUMP
2.	AE-87130	CHLORINE ANALYZER 3
3.	FV-87130	HIGH RATE BACKWASH VALVE
4.	FV-87230	HIGH RATE CONTROL VALVE
5.	FV-87330	LOW RATE CONTROL VALVE

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED EYY
DRAWN ELP
CHECKED JD
DATE JULY 2023

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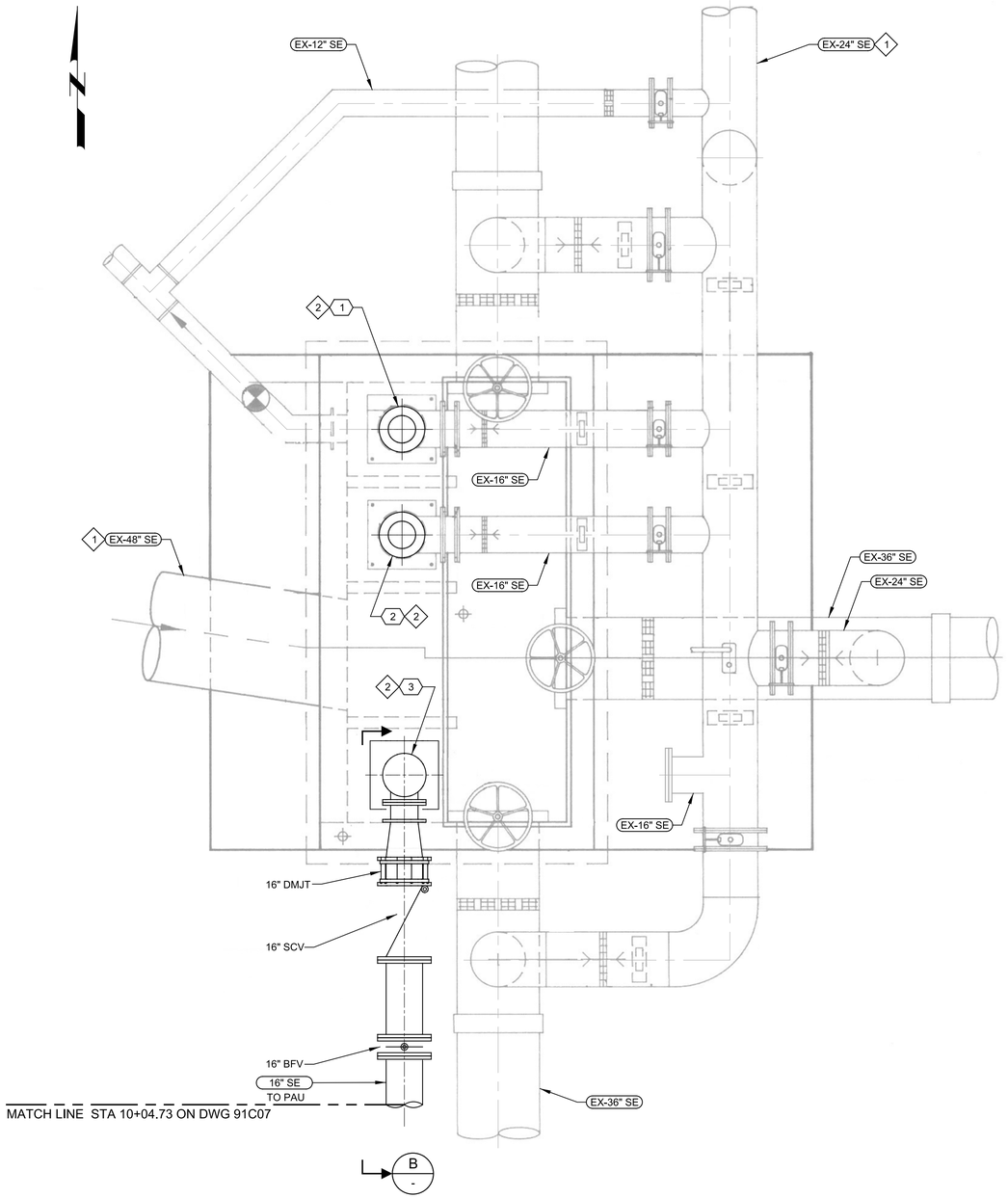
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
MECHANICAL
BACKWASH PUMP STATION PLAN AND SECTION

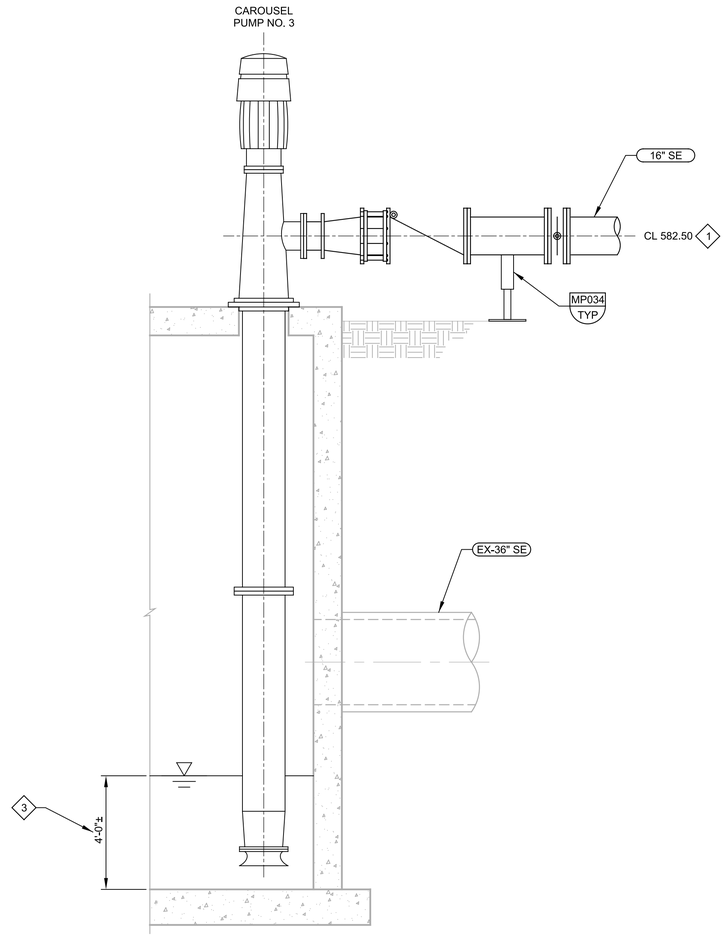
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JOB NO. 8660F.10
DRAWING NO. 87M01
SHEET NO. 80 OF 200

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ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: eparker



A PLAN
SCALE: 3/8" = 1'-0"
FILE: 8660F1089M0101



B SECTION
SCALE: 1/2" = 1'-0"
FILE: 8660F1089M0301

GENERAL NOTES:

1. CONTRACTOR SHALL PROVIDE NEW NUTS, BOLTS, AND GASKETS FOR ALL CONNECTIONS, INCLUDING REINSTALLATION OF ANY EXISTING PIPING COMPONENTS. DO NOT REUSE THE OLD NUTS, BOLTS, AND GASKETS.
2. CONTRACTOR SHALL COORDINATE WITH THE CITY, THE LOCATION, AND ORIENTATION OF VALVES AND VALVE ACTUATORS.
3. SEE CIVIL DRAWINGS FOR YARD PIPING CONTINUATION.

(#) KEY NOTES:

1. FOR PIPING ELEVATION REFER TO DWG 91C07.
2. PROVIDE NEW MOTOR FOR PUMP.
3. WATER LEVEL PER THE 1994 RECORD DRAWINGS.

(#) KEY TAGS:

1.	PMP-89100	CAROUSEL PUMP NO. 1
2.	PMP-89101	CAROUSEL PUMP NO. 2
3.	PMP-89102	CAROUSEL PUMP NO. 3

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CA
DRAWN ELP
CHECKED JM
DATE JULY 2023

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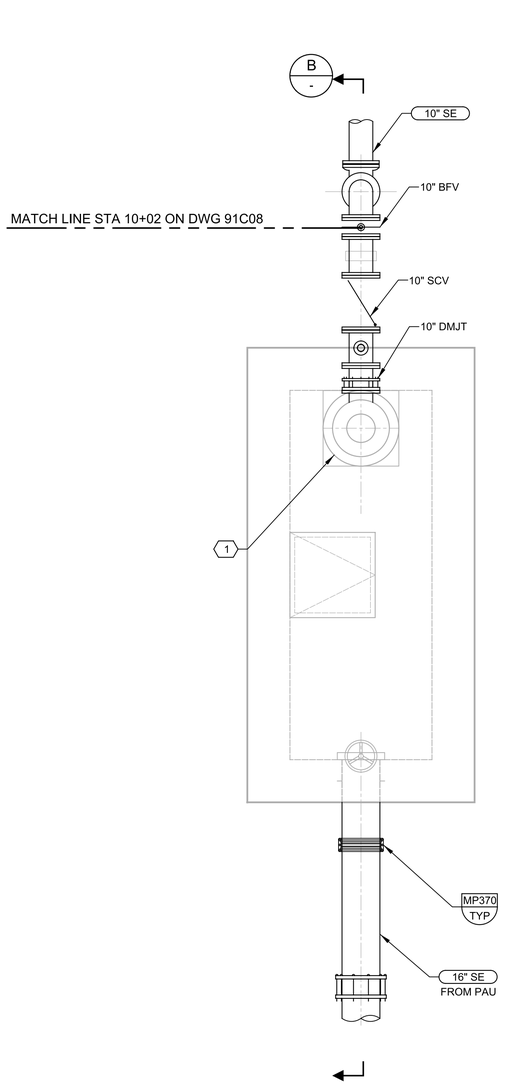
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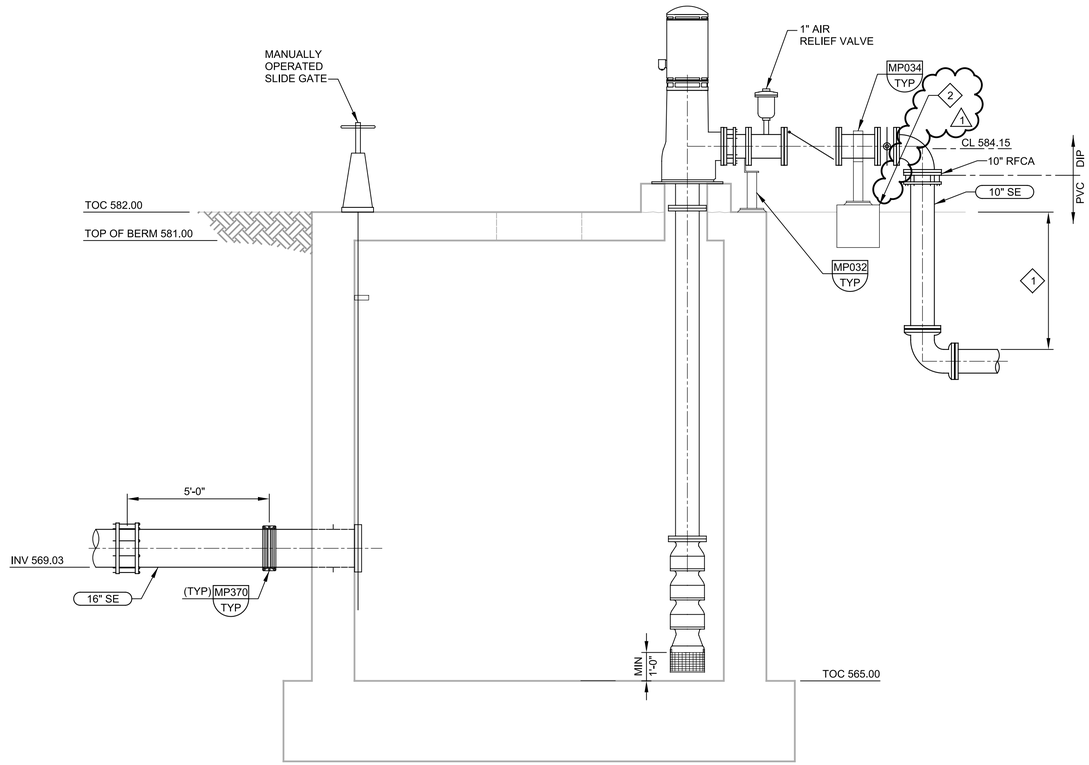
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
MECHANICAL
CAROUSEL PUMP STATION
PLAN AND SECTION

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 89M01
SHEET NO. 81 OF 200





B SECTION

SCALE: 3/8" = 1'-0"
FILE: 8660F1091M0301

A PLAN

SCALE: 3/8" = 1'-0"
FILE: 8660F1091M0101

GENERAL NOTES:

1. CONTRACTOR SHALL PROVIDE NEW NUTS, BOLTS, AND GASKETS FOR ALL CONNECTIONS, INCLUDING REINSTALLATION OF ANY EXISTING PIPING COMPONENTS. DO NOT REUSE THE OLD NUTS, BOLTS, AND GASKETS.
2. CONTRACTOR SHALL COORDINATE WITH THE CITY, THE LOCATION, AND ORIENTATION OF VALVES AND VALVE ACTUATORS.
3. SEE CIVIL DRAWINGS FOR YARD PIPING CONTINUATION.

KEY NOTES:

1. REFER TO DRAWING 91C08 FOR PIPING ELEVATION.
2. PROVIDE 2'-6" WIDE, 2'-6" LONG AND 16" THICK CONCRETE FOOTING WITH #5@12" EACH WAY EACH FACE.

KEY TAGS:

1. PMP-91100 PAU PUMP NO.1

REV	DATE	BY	DESCRIPTION
1	06-02-23	JKN	ADDENDUM 3

CONFORMED DOCUMENTS

DESIGNED CA
DRAWN AL
CHECKED JM
DATE JULY 2023

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CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

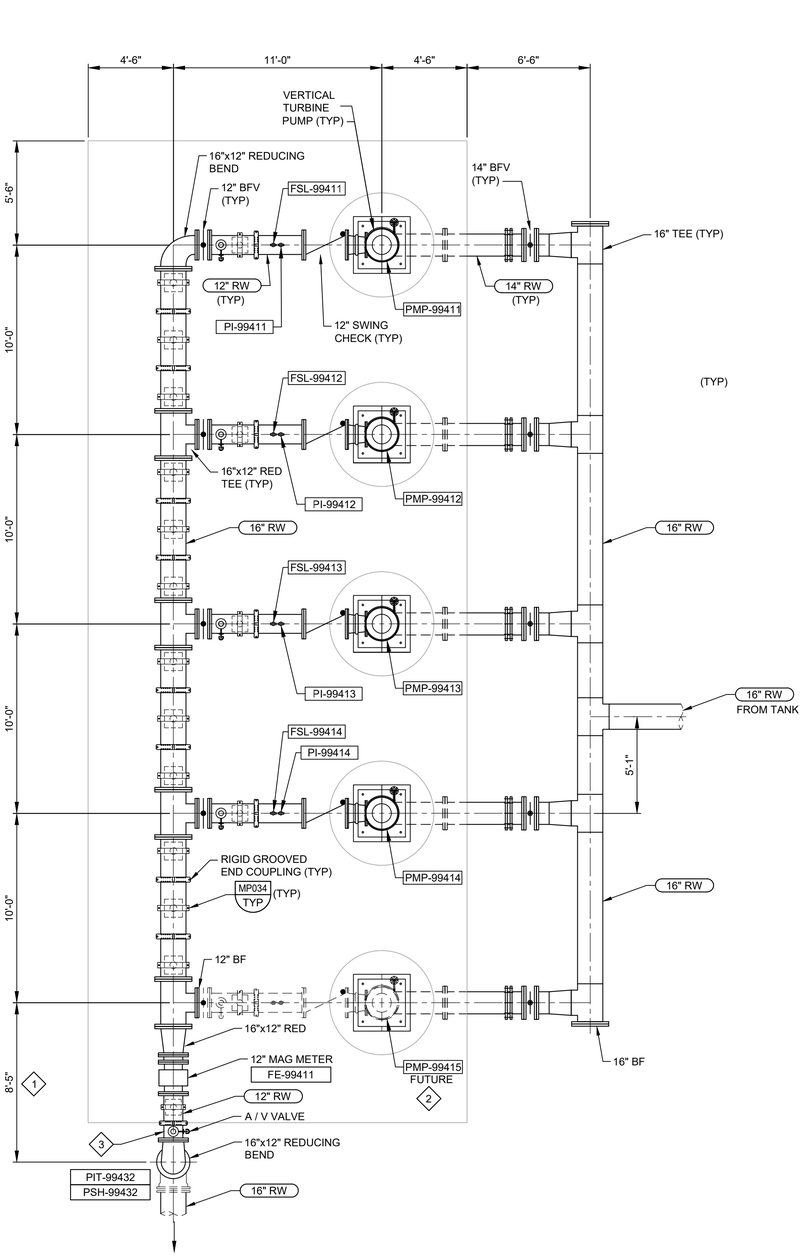
MECHANICAL

PAU PUMP STATION
PLAN AND SECTION

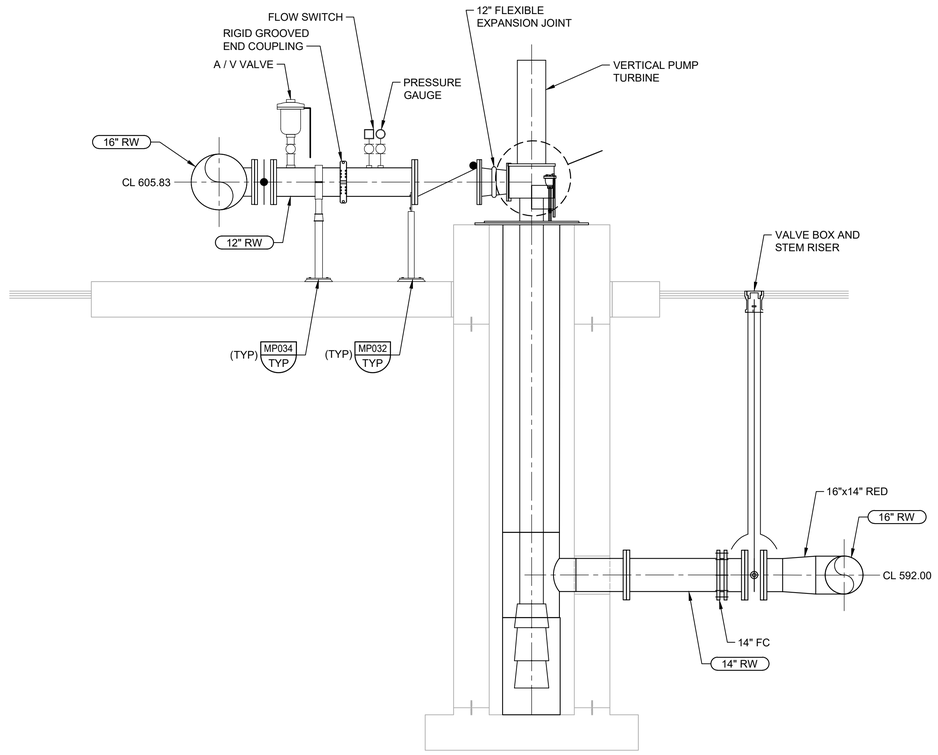
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JOB NO. 8660F.10
DRAWING NO. 91M01
SHEET NO. 82 OF 200

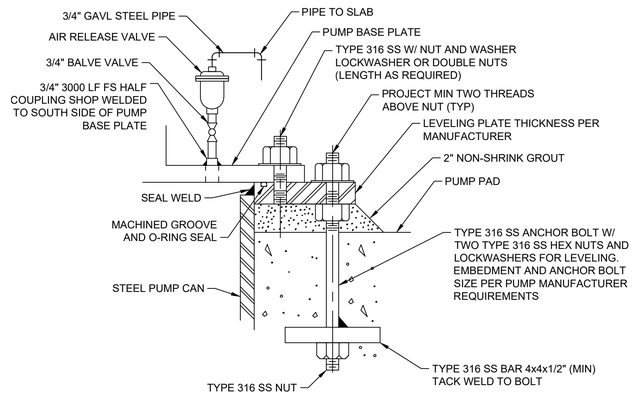
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Model: Layout1
LAST SAVED BY: JGarretty



A 99C19 PLAN
SCALE: 1/4" = 1'-0"
FILE: 8660F1000M100



B - SECTION
SCALE: 3/8" = 1'-0"
FILE: 8660F1000M100



VERTICAL PUMP MOUNTING

1 - DETAIL
SCALE: NO SCALE
FILE: -

GENERAL NOTES:

1. ALL GROOVED END COUPLINGS TO BE RIGID UNLESS NOTED OTHERWISE.

KEY NOTES:

1. FINAL DIMENSIONS SHALL BE COORDINATED BY THE CONTRACTOR TO SUIT THE EQUIPMENT SUPPLIED.
2. INSTALL UPSTREAM PIPING AND PUMP CAN FOR FUTURE PUMP INSTALLATION. INSTALL BLIND FLANGE ON PUMP CAN.
3. SIDE MOUNT PRESSURE INDICATOR WITH HMI. PROVIDE PROTECTIVE COVER.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CA
DRAWN BB
CHECKED JM
DATE JULY 2023

** ORIGINAL SEALED BY REACE P. FISHER 4/7/2023 CA PE NO. 81261 **

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City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
MECHANICAL
RECYCLED WATER PUMP STATION PLAN, SECTION AND DETAIL

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

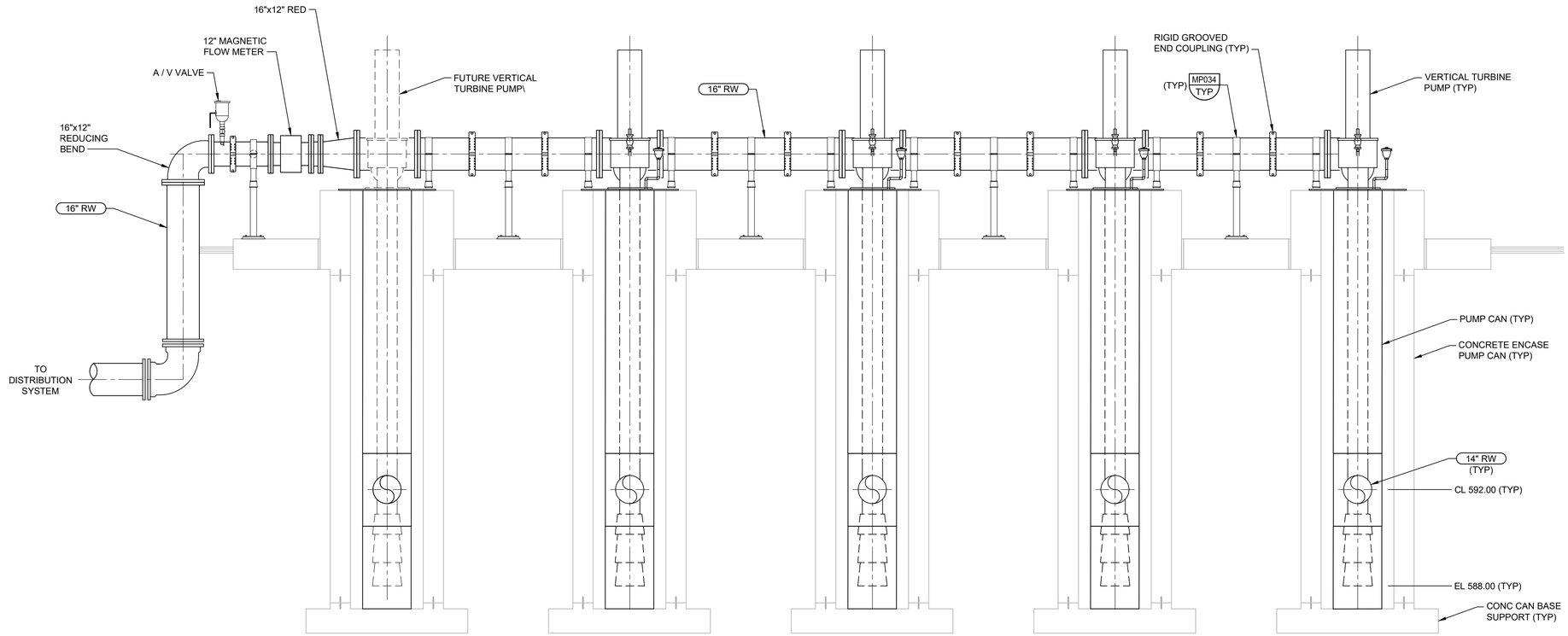
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DRAWING NO. 99M01
SHEET NO. 83 OF 200

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LAST SAVED BY: eparker

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PROJECT NO. 8660F10
LAST SAVED BY: eparker

GENERAL NOTES:

1. ALL GROOVED END COUPLINGS TO BE RIGID UNLESS NOTED OTHERWISE.



C SECTION

99M01

SCALE: 3/8" = 1'-0"
FILE: 8660F1000M100

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CA
DRAWN BB
CHECKED JD
DATE JULY 2023

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City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

MECHANICAL

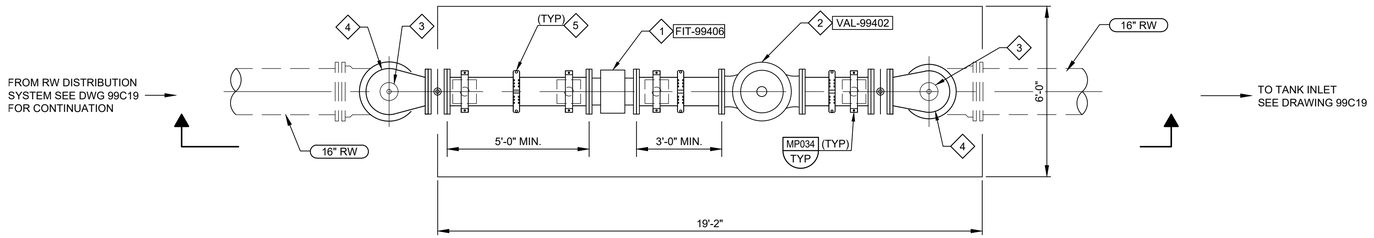
RECYCLED WATER PUMP STATION SECTION

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
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JOB NO. 8660F.10
DRAWING NO. 99M02
SHEET NO. 84 OF 200

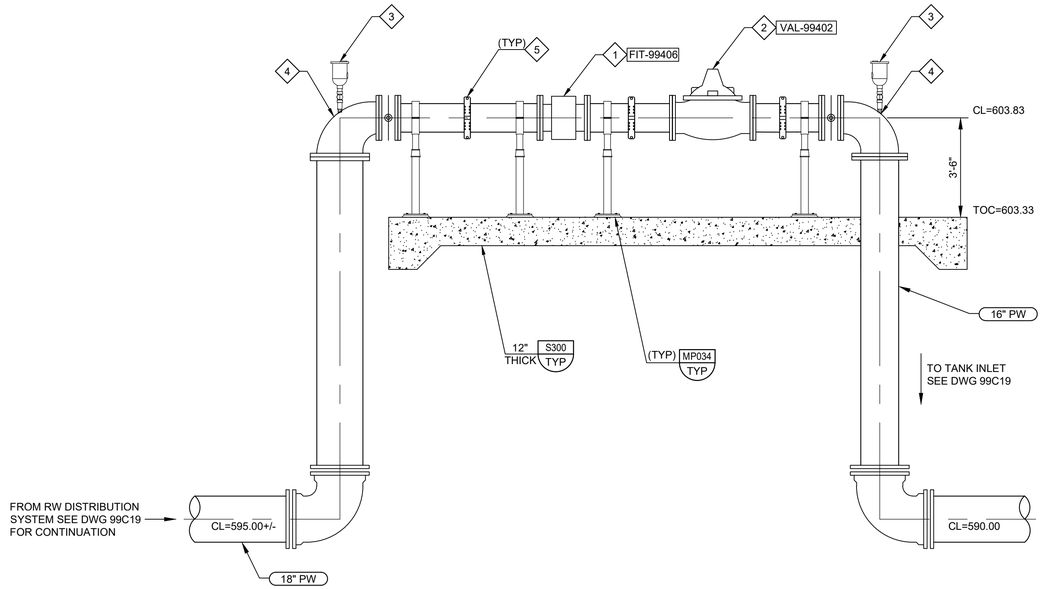
KEY NOTES:

1. 12" MAGNETIC FLOW METER
2. 12" TANK FILL VALVE PER SPECIFICATION SECTION 15117
3. A / V VALVE (TYP)
4. 12"X16" REDUCING BEND
5. RIGID GROOVED END COUPLING



D 99C19 METER & CONTROL VALVE PLAN

SCALE: 3/8=1'-0"
FILE: 8660F10M03



E - METER & CONTROL VALVE SECTION

SCALE: 3/8=1'-0"
FILE: 8660F10M03

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED RPF
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CHECKED JM
DATE JULY 2023

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City of Ukiah

CITY OF UKIAH

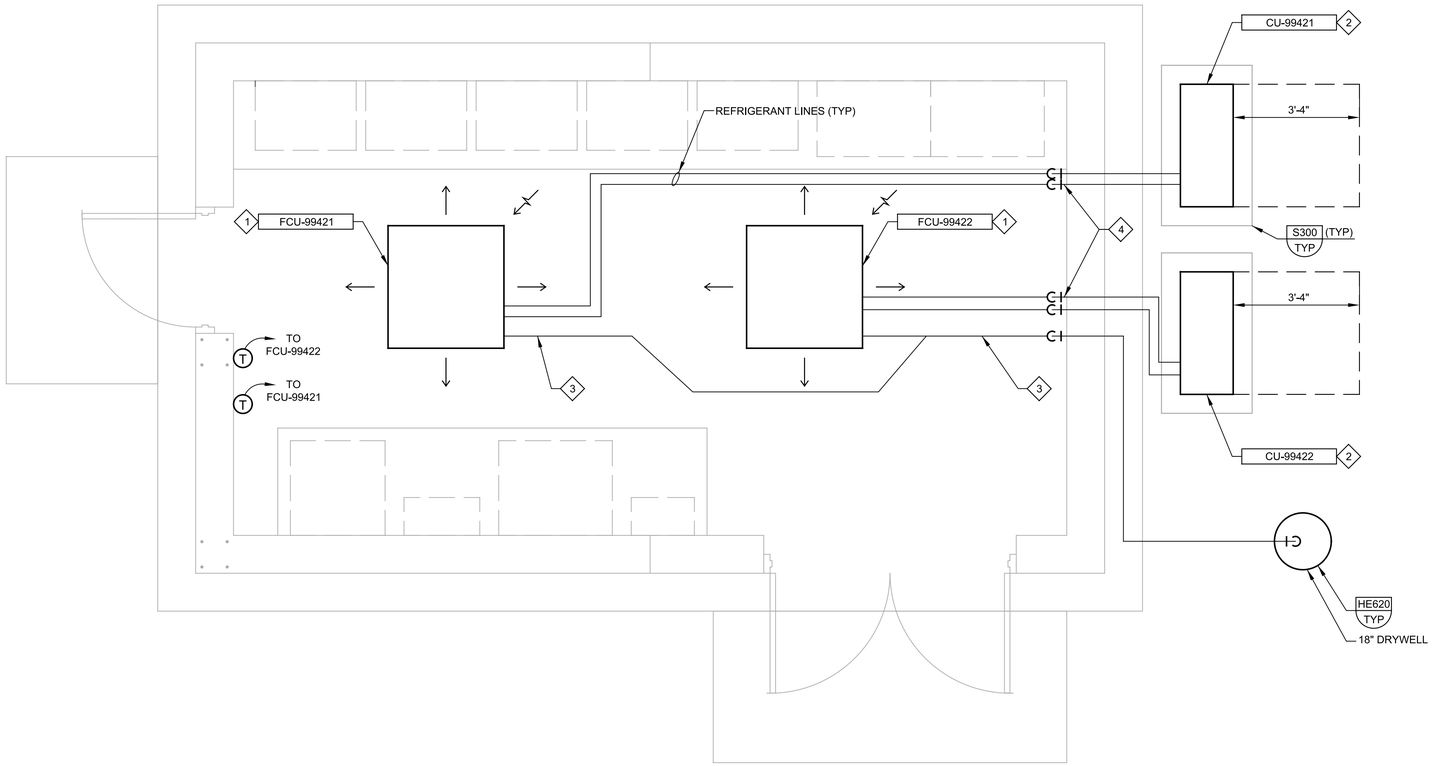
RECYCLED WATER PROJECT - PHASE 4

MECHANICAL

METER AND CONTROL VALVE PLAN AND SECTION

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99M03
SHEET NO. 85 OF 200



F PLAN

SCALE: 1/2" = 1'-0"
FILE: 8660F1000H0101

GENERAL NOTES:

1. MOUNT THERMOSTATS AT 48" AFF AND LABEL WITH ITS CONTROLLING DEVICE.
2. REFRIGERANT AND CONDENSATE DRAIN PIPING SHALL NOT BE ROUTED ABOVE ELECTRICAL EQUIPMENT. REFRIGERANT PIPING SHALL BE INSULATED PER SPECIFICATION 15000.
3. PIPE SUPPORTS SHALL BE INSTALLED PER DETAIL MP132/TYP, MP218/TYP, AND MP215/TYP. INSTALL WALL PENETRATIONS PER DETAIL MP302/TYP.

KEY NOTES:

1 MINI-SPLIT FAN COIL UNIT SUSPENDED FROM CEILING. BOTTOM OF UNIT AT 10'-0 AFF.

2 OUTDOOR CONDENSER UNIT. MOUNT UNIT ON EQUIPMENT PAD PER S300/TYP.

3 1" SCHEDULE 40 PVC CONDENSATE DRAIN ROUTED TO 18" DRYWELL. SLOPE LINES AT A MINIMUM OF 2% SLOPE.

4 ROUTE REFRIGERANT LINES DOWN INTERIOR SIDE OF WALL.

AIR CONDITIONING / CONDENSER UNIT SCHEDULE

EQUIPMENT TAG	AREA SERVED	AIRFLOW (CFM)	WEIGHT (LB)	COOLING DATA				FILTER DATA		ELECTRICAL DATA			BASIS OF DESIGN	NOTES
				OA DB (°F)	EAT DB/WB (°F)	LAT DB/WB (°F)	TOTAL / SENSIBLE CAPACITY (MBH)	MERV RATING	THICKNESS (IN.)	VOLTAGE	PHASE	MCA (AMPS)		
FCU-99421	ELECTRICAL BUILDING	1200	56	-	80/67	PER MNFR	42 / 33.2	MERV 13	2	208	1	2	MITSUBISHI TP\A0A042	1, 2, 3, 4, 5
FCU-99422	ELECTRICAL BUILDING	1200	56	-	80/67	PER MNFR	42 / 33.2	MERV 13	2	208	1	2	MITSUBISHI TP\A0A042	1, 2, 3, 4, 5
CU-99421	ELECTRICAL BUILDING	-	211	95	-	-	-	-	-	208	1	25	MITSUBISHI TRUYA042	5, 6
CU-99422	ELECTRICAL BUILDING	-	211	95	-	-	-	-	-	208	1	25	MITSUBISHI TRUYA042	5, 6

NOTES:
1 SIDE SUPPLY/BOTTOM RETURN CONNECTION
2 PROVIDE 24 VOLT CONTROL VOLTAGE.
3 WIRED THERMOSTAT PROVIDED BY MANUFACTURER.
4 PROVIDE CONDENSING UNIT SIZED PER AIR HANDLER MANUFACTURER TO PROVIDE COOLING REQUIREMENTS AS INDICATED FOR ASSOCIATED AIR HANDLER.
5 CONTROL SYSTEM SPECIFIED IN SECTION 23_09_13 - INSTRUMENTATION AND CONTROL DEVICES FOR HVAC.
6 FLOOR/GRADE MOUNTED MINI SPLIT SYSTEM CONDENSER.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED TCW
DRAWN AMT
CHECKED JM
DATE JULY 2023

** ORIGINAL SEALED BY MATTHEW C. KALLEVANT 4/7/2023 CA PE NO. 84405 **

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City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
MECHANICAL
ELECTRICAL BUILDING
HVAC FLOOR PLAN AND SCHEDULE

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99M04
SHEET NO. 86 OF 200

ELECTRICAL PLAN SYMBOLS

IDENTIFICATION SYMBOLS

EQUIP # — EQUIPMENT AND INSTRUMENT IDENTIFICATION

EQUIPMENT/INSTRUMENT LOCATOR

LUMINAIRE IDENTIFICATION
a = CIRCUIT DESIGNATION
b = DEVICE SWITCHED FROM
c = MOUNTING HEIGHT IN FEET TO BOTTOM OF FIXTURE

XXXX — CONDUIT IDENTIFICATION
XXXX = CONDUIT NUMBER,
REFER TO CONDUIT SCHEDULE
UNLESS OTHERWISE NOTED, GROUPED CONDUITS ARE LABELED LEFT TO RIGHT OR TOP TO BOTTOM.

X — INDICATES KEYNOTE X
(PERTAINS ONLY TO SHEET WHERE NOTE IS FOUND)

DISCONNECT SWITCH

LUMINAIRES

LINEAR FIXTURE

2' X 2' LAY-IN TROFFER

2' X 4' LAY-IN TROFFER

LUMINAIRE POLE MOUNTED

R H — GO/NO-GO PANEL - STROBE AND HORN
R = RED LIGHT
G = GREEN LIGHT
H = HORN

R G — GO/NO-GO PANEL - SOLID

R — GO/NO-GO PANEL - STROBE

LUMINAIRE, EMERGENCY BATTERY-POWERED

LUMINAIRE, EMERGENCY/EXIT BATTERY-POWERED

LUMINAIRE, EMERGENCY BATTERY-POWERED REMOTE

LUMINAIRE, SURFACE OR PENDANT MOUNTED

LUMINAIRE, WALL MOUNTED

LUMINAIRE, FLOOD/SPOT

LUMINAIRE, EXIT ONE OR TWO FACES AS INDICATED. ARROW POINTS IN DIRECTION OF EGRESS.

LUMINAIRE, WALL WASHER

SWITCHES/RECEPTACLES

SINGLE POLE SWITCH
a = CIRCUIT DESIGNATION
b = DEVICE SWITCHED DESIGNATION
c = TYPE
2 = DOUBLE POLE SWITCH
3 = THREE-WAY SWITCH
3P = THREE POSITION SWITCH
4 = FOUR-WAY SWITCH
K = KEY OPERATED SWITCH
F = SWITCH AND FUSESTAT HOLDER
P = SWITCH AND PILOT LIGHT
T = THERMOSTAT
D = DIMMER SWITCH
L = LOW VOLTAGE LIGHT SWITCH
M = MANUAL MOTOR STARTER
N = NETWORKED SINGLE OR MULTIPLE SWITCH LOCATIONS

REFER TO ABBREVIATIONS LEGEND FOR ALL OTHER DESIGNATIONS.

OCCUPANCY SENSOR
X = REFERENCE LIGHTING CONTROL COMPONENT SCHEDULE
a = CIRCUIT DESIGNATION
b = DEVICE SWITCHED DESIGNATION
c = MOUNTING HEIGHT IN FEET TO BOTTOM OF SENSOR

PE — PHOTOCELL

SWITCH AND SINGLE RECEPTACLE
a = CIRCUIT DESIGNATION
b = DEVICE TYPE DESIGNATION

DUPLEX RECEPTACLE

QUADRUPLEX RECEPTACLE

IN FLOOR DUPLEX RECEPTACLE

IN FLOOR QUADRUPLEX RECEPTACLE

DUPLEX RECEPTACLE w/SPLIT WIRE

APPLIANCE RECEPTACLE

SPECIAL PURPOSE RECEPTACLE

WELDING RECEPTACLE
a = CIRCUIT DESIGNATION
b = DISCONNECT TYPE

TWIST LOCK RECEPTACLE
a = AMP RATING

TELEPHONE OUTLET
a = CIRCUIT DESIGNATION
b = MOUNTING HEIGHT

DATA COMMUNICATIONS OUTLET
a = CIRCUIT DESIGNATION
b = MOUNTING HEIGHT

FIRE ALARM

SMOKE DETECTOR
a = TYPE
I = IONIZATION
P = PHOTOELECTRIC
d = DUCT DETECTOR

FACP — FIRE ALARM CONTROL PANEL

F — FIRE ALARM PULL STATION

F — FIRE ALARM HORN/STROBE COMBINATION

F — FIRE ALARM STROBE

F — FIRE SPRINKLER
F = FLOW SWITCH
T = TAMPER SWITCH

RACEWAY

EXPOSED CONDUIT

BREAK AND CONTINUATION IN CONDUIT RUN

EXPOSED CONDUIT HIDDEN BEHIND WALLS, FLOORS OR OTHER STRUCTURES

UNDERGROUND CONDUIT, DIRECT BURIED OR IN DUCT BANK

CONDUIT IN SLAB

CONDUIT VERTICAL CHANGE IN DIRECTION

CONDUIT CAP

J — JUNCTION BOX

CONDUIT SEAL

CONDUIT TEE

DUCT BANK
APPROXIMATE DIMENSIONS SHOWN ON DUCT BANK SECTIONS

CONDUIT SIZE AND CONDUCTORS

INDIVIDUAL CONDUCTORS

W"C-(3-X (Ø), 1-Y (N) & 1-Z (G))

W"C (WHERE INDICATED): W = CONDUIT TRADE SIZE

3-X (Ø):
3 = QUANTITY
X = SIZE OF CONDUCTORS
(Ø) = DESIGNATES PHASE CONDUCTORS

1-Y (N)(WHERE INDICATED):
1 = QUANTITY
Y = SIZE OF CONDUCTORS
(N) = DESIGNATES NEUTRAL CONDUCTORS

1-Z (G)(WHERE INDICATED):
1 = QUANTITY
Z = SIZE OF CONDUCTORS
(G) = DESIGNATES GROUND CONDUCTORS

U{3-X (Ø) & 1-X (G)}
U = NUMBER OF PARALLEL RUNS

MULTI CONDUCTOR CABLES

K/2/C#16S
K (WHERE INDICATED) = NUMBER OF PAIRS
2/C#16S = TWO CONDUCTOR, 16 GAUGE, TWISTED SHIELDED PAIR

K/3/C#16S
K (WHERE INDICATED) = NUMBER OF TRIPLETS
3/C#16S = THREE CONDUCTOR, 16 GAUGE, TWISTED SHIELDED TRIPLETS

N/CX
N = NUMBER OF CONDUCTORS IN THE CABLE
X = SIZE OF CONDUCTORS

FIBER OPTIC CABLES

FO/N
N = NUMBER OF INDIVIDUAL FIBERS

GROUNDING

UNDERGROUND GROUND CABLE #4/0 SDBC UNLESS OTHERWISE NOTED

GROUND ROD

GROUND ROD AND GROUND WELL

ELECTRICAL ONE-LINE SYMBOLS

MEDIUM VOLTAGE

52 — CIRCUIT BREAKER, MEDIUM VOLTAGE
a = CIRCUIT BREAKER NUMBER
b = FRAME SIZE

ANSI RELAY DEVICE
a = ANSI DEVICE FUNCTION
b = QUANTITY

MEDIUM VOLTAGE DISCONNECT SWITCH NON-FUSED CUT OUT

MEDIUM VOLTAGE DISCONNECTING FUSE SINGLE FUSE CUT OUT

MEDIUM VOLTAGE DISCONNECTING FUSE DOUBLE FUSE CUT OUT

MEDIUM VOLTAGE SINGLE FUSE

MEDIUM VOLTAGE DOUBLE FUSE

MEDIUM VOLTAGE LIVE FRONT TERMINATOR

MEDIUM VOLTAGE ELBOW

MEDIUM VOLTAGE TEE

MEDIUM VOLTAGE CONTACTOR

MEDIUM VOLTAGE STARTER

MOV-ELBOW ARRESTER

LOW VOLTAGE

LOW VOLTAGE CIRCUIT BREAKER
a = TYPE
MCP = MOTOR CIRCUIT PROTECTOR
TM = THERMAL MAGNETIC
SS = SOLID STATE
b = FRAME SIZE (MANUFACTURER TO DETERMINE FRAME SIZE UNLESS INDICATED)
c = NUMBER OF POLES
d = TRIP SETTING (AT = AMP TRIP) (AC = MCP CONTINUOUS RATING)
e = DESIGNATION
f = INTERRUPTING RATING

LOW VOLTAGE CIRCUIT BREAKER AUXILIARY OPERATOR
* = S = SHUNT TRIP
= G = GROUND FAULT INTERRUPTER
= V = SOLENOID KEY RELEASE

A — DISCONNECT SWITCH
A = TYPE, REFER TO DISCONNECT SCHEDULE

B — FUSED DISCONNECT SWITCH
B = TYPE, REFER TO DISCONNECT SCHEDULE
b = FUSE RATING

FUSE

COMBINATION STARTER WITH CONTROL POWER TRANSFORMER
a = CIRCUIT BREAKER DISCONNECT, TYPE AS NOTED
b = STARTER TYPE
c = NEMA STARTER SIZE
d = OVERLOAD

MOTOR STARTER/DRIVES:
a = DEVICE TYPE
VFD-6 = 6-PULSE VFD
VFD-18 = 18-PULSE VFD
VFD-RH = REDUCED HARMONIC VFD
RVSS = REDUCED VOLTAGE SOLID STATE STARTER
RVAT = REDUCED VOLTAGE AUTO TRANSFORMER
a/B = DEVICE WITH BYPASS STARTER. REFER TO THE SPECIFICATIONS

b = INPUT OPTIONS
LL = LINE REACTOR
PHF = PASSIVE HARMONIC FILTER

c = OUTPUT OPTIONS
LR = LOAD REACTOR
DV/DT = Dv/dt FILTER
SWF = SINE WAVE FILTER

EQUIPMENT ENCLOSURE

MISCELLANEOUS

HP — MOTOR
HP = HORSEPOWER RATING
FULL LOAD AMPS AS NOTED

PACKAGED EQUIPMENT
LOAD RATING AS INDICATED
a = RATED LOAD
b = UNIT(HP, KW, KVA) AS INDICATED

TRANSFORMER
a = DEVICE I.D.
b = KVA RATING
c = NUMBER OF PHASES
d = PRIMARY VOLTAGE
e = SECONDARY VOLTAGE
f,g = CONNECTION TYPE SYMBOL
h = IMPEDANCE

GROUNDED WYE CONNECTION

DELTA CONNECTION

G — ENGINE-GENERATOR RATINGS AS INDICATED ON THE DRAWINGS
a = KVA/KW
b = VOLTAGE/CONNECTION
c = PHASE
d = WIRE
e = PF

CURRENT TRANSFORMER WITH SHORTING TERMINAL BLOCK
a = QUANTITY
b = RATIO

POTENTIAL TRANSFORMER
a = QUANTITY
b = RATIO
c,d = CONNECTION TYPE SYMBOL

SSM — SOLID STATE MULTIFUNCTION METER

ATP — AMPERE TEST POINT

VTP — VOLTAGE TEST POINT

UTILITY METER

LIGHTNING ARRESTER

SPD — SURGE PROTECTIVE DEVICE

DRAWOUT CONNECTION

GROUND

CAPACITOR

BATTERY

K — KIRK KEY INTERLOCK

LOAD BANK

REV	DATE	BY	DESCRIPTION
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CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
LEGEND

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JOB NO. 8660F.10
DRAWING NO. 00GE01
SHEET NO. 87 OF 200

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Model: Layout1
LAST SAVED BY: avates

PROJECT NO. 8660F10 FILE NAME: 8660F1000GE01.dgn

ABBREVIATIONS

A	AMP
ABS	ABSOLUTE
AC	ALTERNATING CURRENT
ACK	ACKNOWLEDGE
ACTR	ACTUATOR
AF	AMP FRAME
AFC	AUTOMATIC FREQUENCY CONTROL
AIC	AMP INTERRUPTING CAPACITY
AM	AMMETER
ANN	ANNUNCIATOR
ANT	ANTENNA
APU	AUXILIARY POWER UNIT
ARM	ARMORED CABLE
AS	AMMETER SWITCH
ASYM	ASYMMETRICAL
AT	AMP TRIP
ATO	AUTOMATIC THROW OVER
ATP	AMMETER TEST POINT
ATS	AUTOMATIC TRANSFER SWITCH
AUTO XFMR	AUTOMATIC TRANSFORMER
AUX	AUXILIARY
AWG	AMERICAN WIRE GAGE
B	BELL
BAT	BATTERY
BFG	BELOW FINISHED GRADE
BHP	BRAKE HORSEPOWER
BKR	BREAKER
BRF	BELOW RAISED FLOOR
C	CONDUIT / CONTINUOUS LOAD
CB	CIRCUIT BREAKER
CCTV	CLOSED CIRCUIT TELEVISION
CCW	COUNTER CLOCKWISE
CKT	CIRCUIT
COAX	COAXIAL CABLE
COM	COMMON
COMM	COMMUNICATION
CPT	CONTROL POWER TRANSFORMER
CR	CONTROLLED RECEPTACLE
CS	CONTROL SWITCH
CT	CURRENT TRANSFORMER
CV	CONTROL VALVE
CW	CLOCKWISE / COOL WHITE
DC	DIRECT CURRENT
DCS	DISTRIBUTED CONTROL SYSTEM
DCU - X	DISTRIBUTED CONTROL UNIT NO. X
DEMO	DEMOLITION
DISC	DISCONNECT SWITCH
DM	DEMAND METER
DPDT	DOUBLE POLE DOUBLE THROW
DPST	DOUBLE POLE SINGLE THROW
DS	DOOR SWITCH
E/G	EMERGENCY GENERATOR
EM	EMERGENCY
EMT	ELECTRICAL METALLIC TUBING
ENCL	ENCLOSURE
ENG	ENGINE
ENT	ELECTRICAL NON-METALLIC TUBING
EP	EXPLOSION PROOF
ETM	ELAPSED TIME METER
F	SUB-FED
FA	FIRE ALARM
FACP	FIRE ALARM CONTROL PANEL
FDR	FEEDER
FLA	FULL LOAD AMPS
FLX	FLEXIBLE CONDUIT
FO	FIBER OPTIC
FRC	FIBERGLASS RIGID CONDUIT
FREQ	FREQUENCY
FU	FUSE
FU	SW FUSED SWITCH
FVNR	FULL VOLTAGE NON-REVERSING
FVR	FULL VOLTAGE REVERSING
FWD	FORWARD
G	GROUND / EQUIPMENT GROUND / GROUND FAULT
GEN	GENERATOR
GRC	GALVANIZED STEEL RIGID CONDUIT
GFCI	GROUND FAULT CIRCUIT INTERRUPTER (RECEPTACLE)
GFI	GROUND FAULT INTERRUPTER (BREAKER)
GFR	GROUND FAULT RELAY
H	HOT-LEG
HF	HIGH FREQUENCY
HP	HORSEPOWER
HPS	HIGH PRESSURE SODIUM
HR	HOUR
HSTAT	HUMIDISTAT
HV	HIGH VOLTAGE
HVAC	HEATING/VENTILATION/AIR CONDITIONING
HZ	HERTZ
I	INSTANTANEOUS / INTERMITTENT LOAD
IC	INTERRUPTING CAPACITY
IJB	INSTRUMENT JUNCTION BOX
IMC	INTERMEDIATE METAL CONDUIT
INST	INSTANTANEOUS
INT	INTERLOCK
INTERCOM	INTERCOMMUNICATION
J	JUNCTION BOX
K	KEY INTERLOCK
KA	KILOAMP
KV	KILOVOLT
KVA	KILOVOLT AMPERE
KVAR	KILOVAR (REACTANCE)
KW	KILOWATT
KWD	KILOWATT DEMAND
KWH	KILOWATT HOUR
L	LONG-TIME
L-B	LINE-BUS
L-G	LINE-GROUND
LA	LIGHTNING ARRESTOR
LBL	LABEL
LC	LIGHTING CONTACT OR
LCP- X	LOCAL CONTROL PANEL NO. X
LL	LEAD-LAG LOAD REACTOR
LP	LIGHT POLE
LP - X	LIGHTING PANEL NO. X
LTG	LIGHTING
LV	LOW VOLTAGE
LVL	LEVEL
M-X	MOTOR CONTROLLER NO. X
MA	MILLIAMPERE
MCA	MOTOR CIRCUIT AMPS
MCC - X	MOTOR CONTROL CENTER NO. X
MCP	MOTOR CIRCUIT PROTECTOR
MH	MANHOLE / MOUNTING HEIGHT
MLO	MAIN LUGS ONLY
MOD	MOTOR OPERATED DAMPER
MOV	METAL OXIDE VARISTOR
MPR	MOTOR PROTECTION RELAY
MS-X	MOTOR STARTER NO. X
MSP	MOTOR STARTING PANEL
MTO	MANUAL THROW OVER
MTR-X	MOTOR NO. X
MTS	MANUAL TRANSFER SWITCH
MV	MEGAVOLT
MVA	MEGAVOLT-AMPERES
MVS	MEDIUM VOLTAGE SWITCH
MW	MEGAWATT
N	NEUTRAL
NC	NORMALLY CLOSED
NEC	NATIONAL ELECTRICAL CODE
NFC	NONMETALLIC FLEXIBLE CONDUIT
NL	NIGHT LIGHT
NO	NORMALLY OPEN
NP	NAMEPLATE
O	OPEN OR OPENED
OH	OVERHEAD
OL	OVERLOAD RELAY
P	POLE
PA	PUBLIC ADDRESS
PB	PUSHBUTTON / PULL BOX
PCS	PVC COATED GALVANIZED STEEL CONDUIT
PCM	PROCESS CONTROL MODULE
PE	PHOTOCELL
PF	POWER FACTOR
PFCC	POWER FACTOR CORRECTION CAPACITOR
PFR	PHASE FAILURE RELAY
PH	PHASE
PNL	PANEL
PPX	POWER PANEL NO. X
PRI	PRIMARY
PT	POTENTIAL TRANSFORMER
PVC	POLYVINYL CHLORIDE RIGID PLASTIC CONDUIT
PWR	POWER
RAC	RIGID ALUMINUM CONDUIT
RECPT	RECEPTACLE
REV	REVERSE
RF	RADIO FREQUENCY
RMS	ROOT MEAN SQUARED
RVAT	REDUCED VOLTAGE AUTO TRANSFORMER
RVNR	REDUCED VOLTAGE NON-REVERSING
RVSS	REDUCED VOLTAGE SOLID STATE
S	SHIELD / SHORT-TIME
SA	SURGE ARRESTER
SC	SHORT CIRCUIT
SDBC	SOFT DRAWN BARE COPPER
SFL	SUB FEED LUGS
SLT	SEALTIGHT LIQUIDTIGHT FLEXIBLE CONDUIT
SM	SURFACE MOUNTED
SP	SINGLE POLE
SPD	SURGE PROTECTIVE DEVICE
SPDT	SINGLE POLE DOUBLE THROW
SPST	SINGLE POLE SINGLE THROW
SPKR	SPEAKER
SS	SOLID STATE
STB	SHORTING TERMINAL BLOCK
SW	SWITCH
SWBD	SWITCHBOARD
SWGR	SWITCHGEAR
SYM	SYMMETRICAL
TACH	TACHOMETER
TB - X	TERMINAL BLOCK - UNIT X
TC	THERMOCOUPLE / TIME CLOCK / TRAY CABLE
TD	TEMPERATURE DETECTOR RELAY
TE	TOTALLY ENCLOSED
TEFC	TOTALLY ENCLOSED FAN COOLED
TENV	TOTALLY ENCLOSED NON-VENTILATED
TERM	TERMINAL
TJB	TERMINAL JUNCTION BOX
TM	THERMAL MAGNETIC
TP	TWISTED PAIR
TS	TEMPERATURE SWITCH
TS1W	TWO SPEED CONSEQUENT POLE, ONE WINDING
TS2W	TWO SPEED SEPARATE WINDING
TSTAT	THERMOSTAT
UHF	ULTRA HIGH FREQUENCY
UNG	UNGROUNDED
UPS	UNINTERRUPTIBLE POWER SUPPLY
UVR	UNDER VOLTAGE RELAY
V	VOLT
VA	VOLT AMPERE
VAR	VARMETER
VCP	VENDOR CONTROL PANEL
VFD	VARIABLE FREQUENCY DRIVE
VHF	VERY HIGH FREQUENCY
VM	VOLTMETER
VP	VAPORPROOF
VR	VOLTAGE REGULATOR
VS	VOLTAGE SWITCH
VT	VOLTAGE TRANSFORMER
VTP	VOLTAGE TEST POINT
W	WATT / WEST
WT	WATER TIGHT
WP	WEATHER PROOF
XFMR	TRANSFORMER

NOTES:

1. REFER TO SPECIFICATIONS AND OTHER DRAWINGS FOR ADDITIONAL ABBREVIATIONS.

POWER DEVICE FUNCTION NUMBERS

1	MASTER ELEMENT
2	TIME-DELAY STARTING OR CLOSING RELAY
3	CHECKING OR INTERLOCKING RELAY
4	MASTER CONTACTOR
5	STOPPING DEVICE
6	STARTING CIRCUIT BREAKER
7	ANODE CIRCUIT BREAKER
8	CONTROL POWER DISCONNECTING DEVICE
9	REVERSING DEVICE
10	UNIT SEQUENCE SWITCH
11	MULTIFUNCTION DEVICE
12	OVER-SPEED DEVICE
13	SYNCHRONOUS-SPEED DEVICE
14	UNDER-SPEED DEVICE
15	SPEED OR FREQUENCY MATCHING DEVICE
16	DATA COMMUNICATIONS DEVICE
17	SHUNTING OR DISCHARGE SWITCH
18	ACCELERATING OR DECELERATING DEVICE
19	STARTING-TO-RUNNING TRANSITION CONTACTOR
20	ELECTRICALLY OPERATED VALVE
21	DISTANCE RELAY
22	EQUALIZER CIRCUIT BREAKER
23	TEMPERATURE CONTROL DEVICE
24	VOLTS PER HERTZ RELAY
25	SYNCHRONIZING OR SYNCHRONISM-CHECK DEVICE
26	APPARATUS THERMAL DEVICE
27	UNDERVOLTAGE RELAY
27N	GROUND FAULT UNDERVOLTAGE RELAY
28	FLAME DETECTOR
29	ISOLATING CONTACTOR
30	ANNUNCIATOR RELAY
31	SEPARATE EXCITATION DEVICE
32	DIRECTIONAL POWER RELAY
33	POSITION SWITCH
34	MASTER SEQUENCE DEVICE
35	BRUSH-OPERATING OR SLIP-RING SHORT-CIRCUITING DEVICE
36	POLARITY DEVICE
37	UNDERCURRENT OR UNDERPOWER RELAY
38	BEARING PROTECTIVE DEVICE
39	MECHANICAL CONDITION MONITOR
40	FIELD RELAY
41	FIELD CIRCUIT BREAKER
42	RUNNING CIRCUIT BREAKER
43	MANUAL TRANSFER OR SELECTOR DEVICE
44	UNIT SEQUENCE STARTING RELAY
45	ABNORMAL ATMOSPHERIC CONDITION MONITOR
46	REVERSE-PHASE OR BALANCE CURRENT RELAY
47	PHASE-BALANCE OR PHASE-SEQUENCE VOLTAGE RELAY
48	INCOMPLETE SEQUENCE RELAY
49	MACHINE OR TRANSFORMER THERMAL RELAY
50	INSTANTANEOUS OVERCURRENT RELAY
51	AC TIME OVERCURRENT RELAY
52	AC CIRCUIT BREAKER
53	FIELD EXCITATION RELAY
54	TURNING GEAR ENGAGING DEVICE
55	POWER FACTOR RELAY
56	FIELD APPLICATION RELAY
57	SHORT-CIRCUITING OR GROUNDING DEVICE
58	RECTIFICATION FAILURE RELAY
59	OVERVOLTAGE RELAY
60	VOLTAGE OR CURRENT BALANCE RELAY
61	DENSITY SWITCH OR SENSOR
62	TIME-DELAY STOPPING OR OPENING RELAY
63	PRESSURE SWITCH
64	GROUND DETECTOR RELAY
65	GOVERNOR
66	NOTCHING OR JOGGING DEVICE
67	AC DIRECTIONAL OVERCURRENT RELAY
68	BLOCKING OR OUT OF STEP RELAY
69	PERMISSIVE CONTROL DEVICE
70	RHEOSTAT
71	LIQUID LEVEL SWITCH
72	DC CIRCUIT BREAKER
73	LOAD-RESISTOR CONTACTOR
74	ALARM RELAY
75	POSITION CHANGING MECHANISM
76	DC OVERCURRENT RELAY
77	TELEMETERING DEVICE
78	PHASE-ANGLE MEASURING RELAY
79	AC RECLOSING RELAY
80	FLOW SWITCH
81	FREQUENCY RELAY
82	DC LOAD MEASURING RECLOSING RELAY
83	AUTOMATIC SELECTIVE CONTROL OR TRANSFER RELAY
84	OPERATING MECHANISM
85	PILOT COMMUNICATIONS, CARRIER OR PILOT-WIRE RELAY
86	LOCKOUT RELAY
87	DIFFERENTIAL PROTECTIVE RELAY
88	AUXILIARY MOTOR OR MOTOR GENERATOR
89	LINE SWITCH
90	REGULATING DEVICE
91	VOLTAGE DIRECTIONAL RELAY
92	VOLTAGE AND POWER DIRECTIONAL RELAY
93	FIELD-CHANGING CONTACTOR
94	TRIPPING OR TRIP-FREE RELAY

COMMONLY USED SUFFIX LETTERS APPLIED TO POWER DEVICE FUNCTION NUMBERS

A	ALARM ONLY
B	BUS PROTECTION
G	GROUND FAULT PROTECTION (RELAY CT IN A SYSTEM NEUTRAL CIRCUIT OR GENERATOR PROTECTION)
GS	GROUND FAULT PROTECTION (RELAY CT IN TOROIDAL OR GROUND SENSOR TYPE)
L	LINE PROTECTION
M	MOTOR PROTECTION
N	GROUND FAULT PROTECTION (RELAY COIL CONNECTED IN RESIDUAL CT CIRCUIT)
T	TRANSFORMER PROTECTION
V	VOLTAGE
P	PHASE PROTECTION

ABBREVIATIONS

AFD	- ARC FLASH DETECTOR
CLK	- CLOCK OR TIMING SOURCE
DDR	- DYNAMIC DISTURBANCE RECORDER
DFR	- DIGITAL FAULT RECORDER
ENV	- ENVIRONMENTAL DATA
HIZ	- HIGH IMPEDANCE FAULT DETECTOR
HMI	- HUMAN MACHINE INTERFACE
HST	- HISTORIAN
LGC	- SCHEME LOGIC
MET	- SUBSTATION METERING
PDC	- PHASOR DATA CONCENTRATOR
PMU	- PHASOR MEASUREMENT UNIT
PQM	- POWER QUALITY MONITOR
RIO	- REMOTE I/O DEVICE
RTU	- REMOTE TELEMETRY UNIT/REMOTE TERMINAL UNIT
SER	- SEQUENCE OF EVENTS RECORDER
TCM	- TRIP CIRCUIT MONITOR

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

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CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

ELECTRICAL

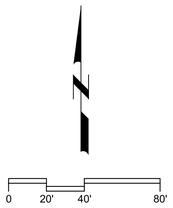
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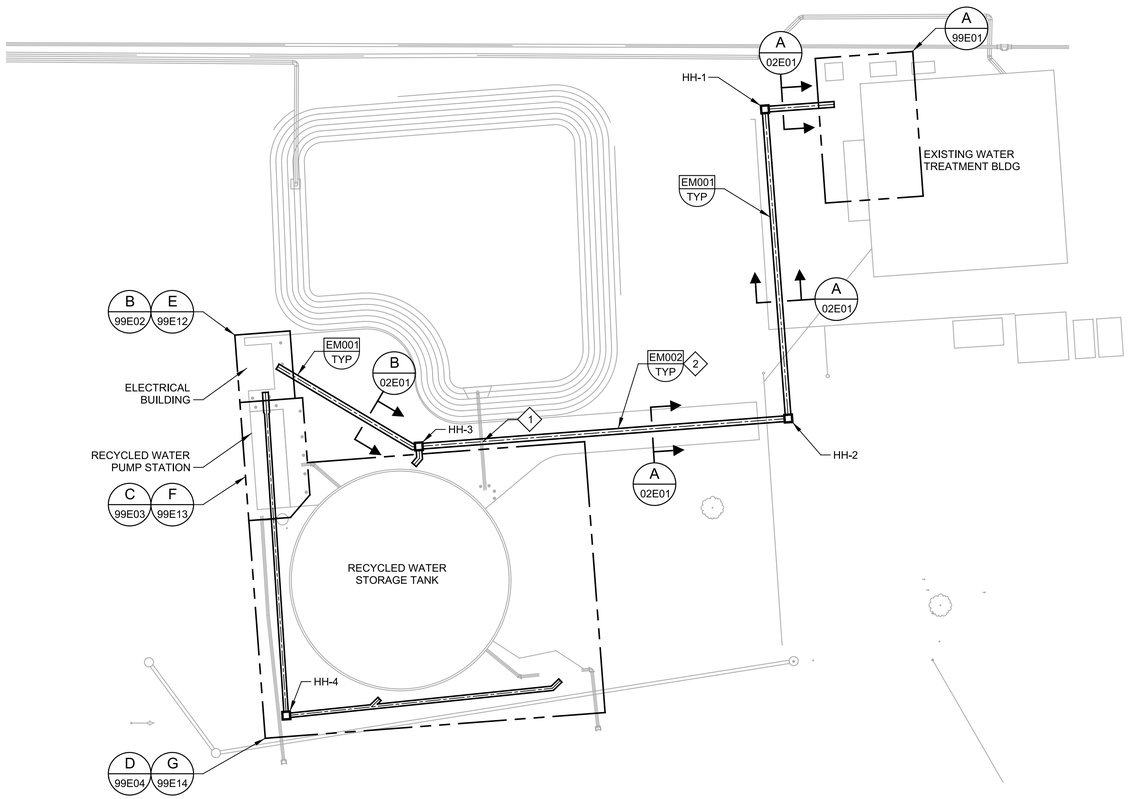
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DRAWING NO. 00GE02
SHEET NO. 88 OF 200

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 # KEY NOTES:

1. DUCT BANK CROSSES OVER YARD PIPE. DEPTH FOR BOTTOM OF DUCT BANK AT THIS LOCATION SHALL NOT EXCEED 3'-6" BELOW FINISHED GRADE.
2. DUCT BANK SEGMENT BETWEEN HH-2 AND HH-3 SHALL BE BUILT AS REDUCED DEPTH DUCT BANK TO ACCOMMODATE YARD PIPE CROSSING UNDER THE DUCT BANK.

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WTP PUMP STATION AND STORAGE SITE PLAN

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JOB NO. 8660F.10
DRAWING NO. 01E01
SHEET NO. 89 OF 200

0 10' 20' 30' 60'

A 89E01 / B 89E02

A 60E01

CAROUSEL PUMP STATION

DE-CHLORINATION STRUCTURE

MV (E)

LV (E)

L 02E02

2 Z 01E03

I 02E01

J 02E02

1 01E03

MV (E)

MV (N)

FIT-88101

FIT-88102

MV (E) 1

2 01E03

L-88-101 / S-88-101 4

L-88-102 / S-88-102 4

A 70E01

H 02E01

K 02E02

DAFT EQUIP. BLDG.

COUED-4 3

PROPOSED PAU PUMP STATION

M 02E03

HH-20

HH-21

M 02E03

5 Q 02E03

SLUDGE DE-WATERING FACILITY 1

M 02E03

A 87E01

P 02E03

A 91E01 / B 91E01

A 80E01

CHLORINATION FACILITY

AWT FACILITY

R 02E03

A 85E01

Z 01E03 2

POWER GENERATION BUILDING

A 12E01

PED-983

GENERAL NOTES:

1. EXISTING UNDERGROUND DUCT BANK AND CONDUIT ROUTING MAY NOT REFLECT ACTUAL FIELD CONDITION. CONTRACTOR SHALL VERIFY BEFORE EXCAVATION FOR NEW INSTALLATION.

KEY NOTES:

1. AFTER EXISTING 12KV CONDUCTORS BETWEEN TRANSFORMER TRF-3E AND PEDESTAL PD-983 ARE REMOVED BY COUED, DEMOLISH EXISTING UNDERGROUND 12KV CONDUITS WHERE NEEDED TO ACCOMMODATE CONSTRUCTION OF NEW STRUCTURES OR UNDERGROUND EQUIPEMENT.
2. INSTALL UNDERGROUND 12KV CONDUITS ACCORDING TO TRENCH SECTION. NEW 12KV ROUTING PROVIDED HERE IS APPROXIMATE. CONTRACTOR SHALL MEET ON SITE AND COORDINATE EXACT UNDERGROUND 12KV CONDUIT ROUTING WITH CITY OF UKIAH ELECTRIC DEPARTMENT (COUED).
3. CONTRACTOR TO PROVIDE MV VAULT ACCORDING TO CITY OF UKIAH ELECTRIC DEPARTMENT (COUED) MV VAULT CONSTRUCTION DETAIL. REFER TO SPECIFICATION SETCTION 16210 FOR UTILITY CONSTRUCTION DETAILS. COORDINATE THE EXACT VAULT LOCATION WITH COUED.
4. INSTALL CONDUITS ADJACENT TO HAND RAILS ACCORDING TO TYPICAL DETAIL EM104/TYP.
5. INSTALL CONDUITS UNDERGROUND ACCORDING TO TYPICAL DETAIL EM015/TYP.

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WWTP AND STORAGE POND PARTIAL SITE PLAN

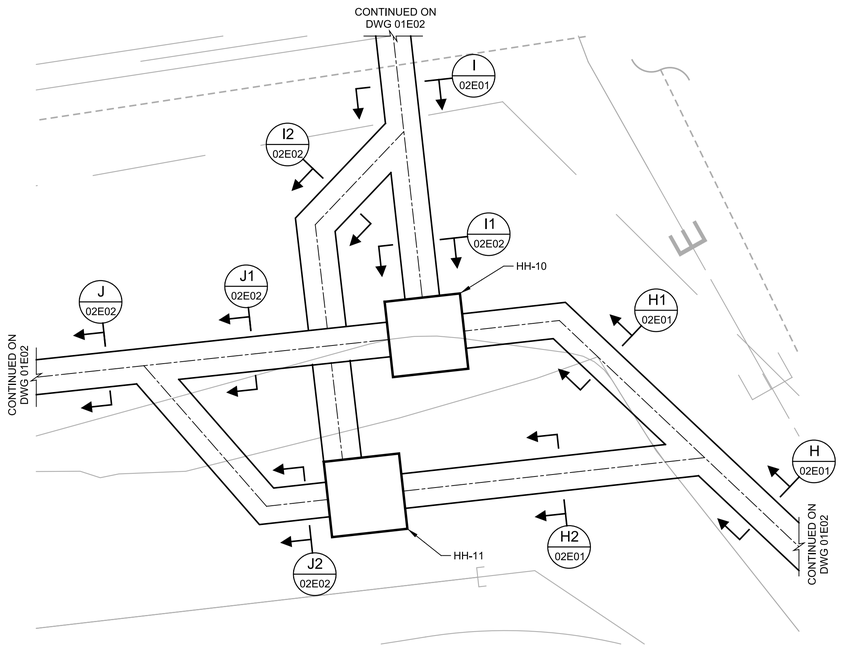
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SHEET NO. 90 OF 200

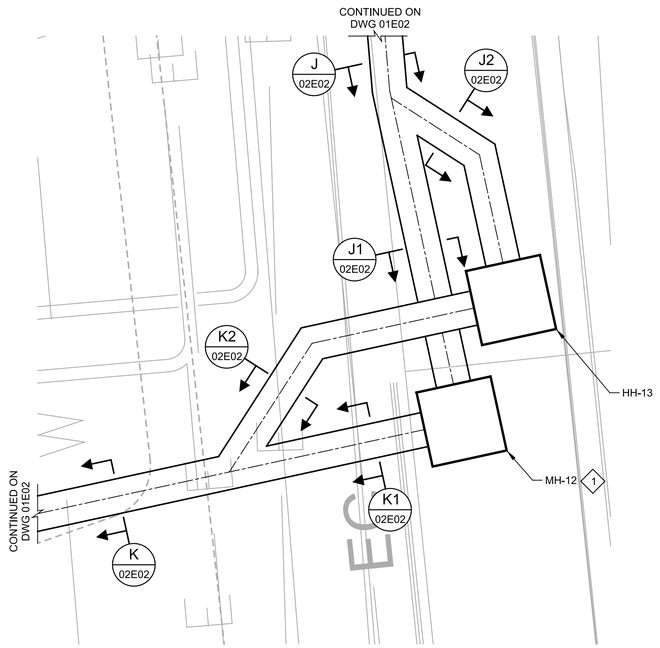
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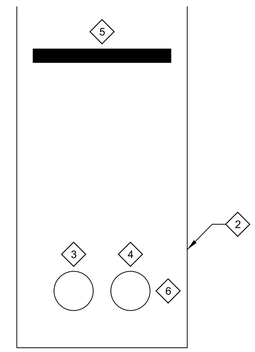
1. SLOPE DUCT BANKS TOWARD THIS MANHOLE TO PROVIDE PROPER DUCT BANK DRAINAGE.
2. REFER TO UTILITY CONSTRUCTION DETAILS PROVIDED IN SPCIFICATION SECTION 16210 FOR TRENCH DEPTH, SPACING AND FILL. PROVIDED SECTION IS SCHEMATIC ONLY.
3. 4" CONDUIT FOR COUED 12KV SPARE.
4. 4" CONDUIT FOR COUED 12KV LINE.
5. 2" CONCRETE COVER AT 12" BFG WHERE TRENCH IS UNDER DRIVEWAY.
6. MINIMUM CLEARANCE BETWEEN 12KV CONDUITS AND OTHER UNDERGROUND UTILITIES SHALL BE MINIMUM 12".



1 DETAIL
01E02 SCALE: 1/4" = 1'-0"
FILE: 8660F1001E0101



2 DETAIL
01E02 SCALE: 1/4" = 1'-0"
FILE: 8660F1001E0101



Z SECTION
01E02 SCALE: NO SCALE
FILE: 8660F1003E001

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City of Ukiah

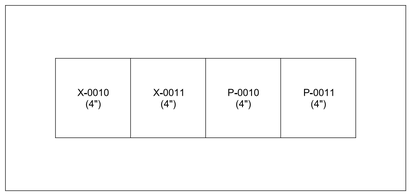
CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
WWTP AND STORAGE POND SITE
PLAN DETAILS AND TRENCH SECTION

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 01E03
SHEET NO. 91 OF 200

GENERAL NOTES:

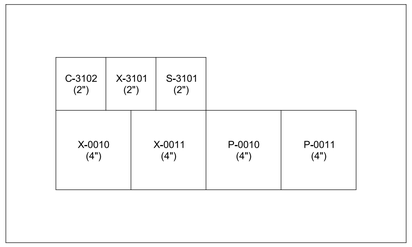
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Height: 1'-7"

A DUCT BANK SECTION

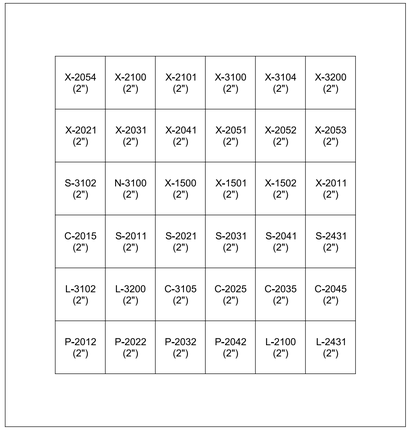
01E01, 01E01, 01E01, 99E01, 99E02, 99E12



Width: 3'-0"
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B DUCT BANK SECTION

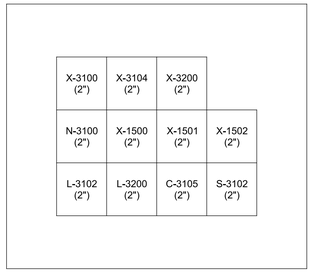
01E01



Width: 3'-1"
Height: 3'-3"

C DUCT BANK SECTION

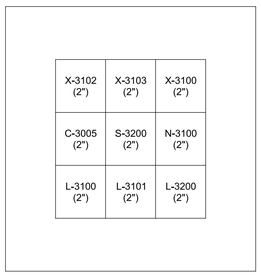
99E02, 99E03, 99E12, 99E13



Width: 2'-4"
Height: 2'-2"

D DUCT BANK SECTION

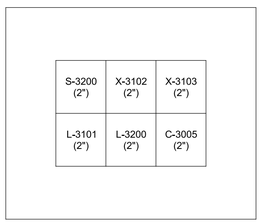
99E03, 99E13, 99E14



Width: 1'-11"
Height: 2'-2"

E DUCT BANK SECTION

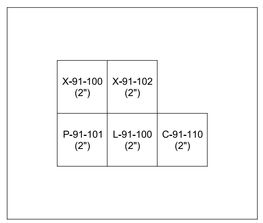
99E14



Width: 1'-11"
Height: 1'-9"

F DUCT BANK SECTION

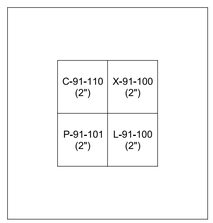
99E14



Width: 1'-11"
Height: 1'-9"

H DUCT BANK SECTION

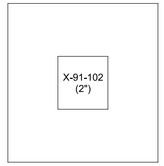
01E02, 01E03, 91E01, 91E01



Width: 1'-7"
Height: 1'-9"

H1 DUCT BANK SECTION

01E03



Width: 1'-2"
Height: 1'-5"

H2 DUCT BANK SECTION

01E03

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN PLK
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

ELECTRICAL

DUCT BANK SECTIONS 1

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

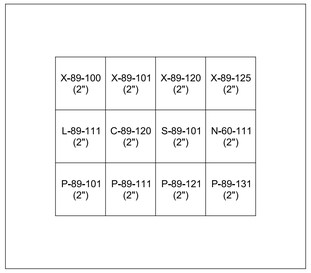
JOB NO. 8660F.10
DRAWING NO. 02E01
SHEET NO. 92 OF 200

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LAST SAVED BY: bshepard

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GENERAL NOTES:

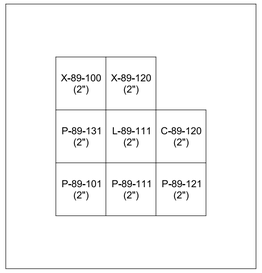
1. CONSTRUCT DUCT BANK IN ACCORDANCE WITH DETAIL EM001/TYP UNLESS OTHERWISE INDICATED.



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I DUCT BANK SECTION

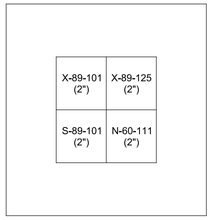
NO MATCHING REF DWGS FOUND



Width: 1'-11"
Height: 2'-2"

I1 DUCT BANK SECTION

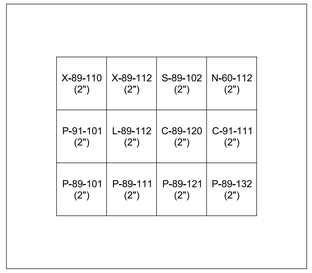
01E03



Width: 1'-7"
Height: 1'-9"

I2 DUCT BANK SECTION

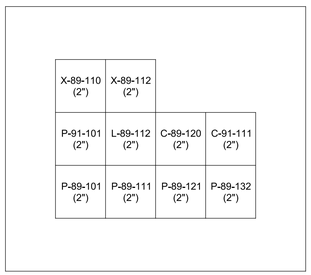
01E03



Width: 2'-4"
Height: 2'-2"

J DUCT BANK SECTION

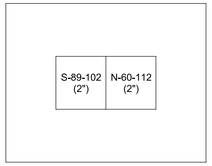
01E02, 01E03, 01E03



Width: 2'-4"
Height: 2'-2"

J1 DUCT BANK SECTION

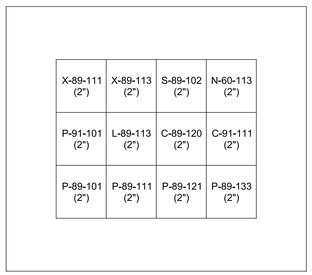
01E03, 01E03



Width: 1'-7"
Height: 1'-5"

J2 DUCT BANK SECTION

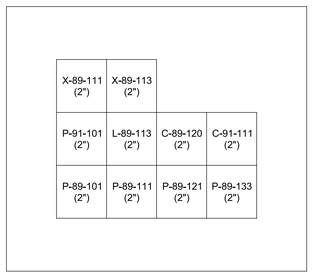
01E03, 01E03



Width: 2'-4"
Height: 2'-2"

K DUCT BANK SECTION

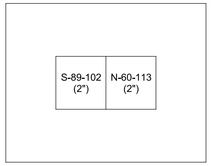
01E02, 01E03, 70E01



Width: 2'-4"
Height: 2'-2"

K1 DUCT BANK SECTION

01E03



Width: 1'-7"
Height: 1'-5"

K2 DUCT BANK SECTION

01E03

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED AH
DRAWN NS
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

ELECTRICAL

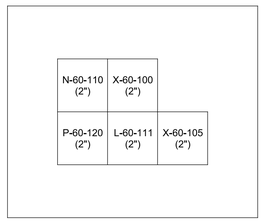
DUCT BANK SECTIONS 2

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 02E02
SHEET NO. 93 OF 200

GENERAL NOTES:

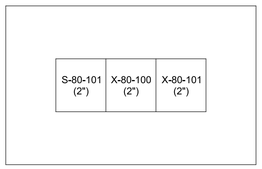
1. CONSTRUCT DUCT BANK IN ACCORDANCE WITH DETAIL EM001/TYP UNLESS OTHERWISE INDICATED.



Width: 1'-11"
Height: 1'-9"

L DUCT BANK SECTION

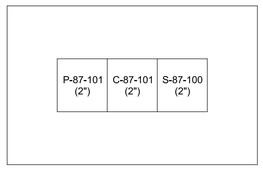
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Width: 1'-11"
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M DUCT BANK SECTION

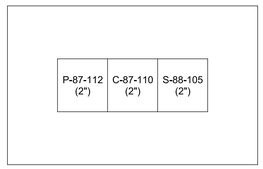
01E02, 01E02, 01E02, 70E01, 80E01



Width: 1'-11"
Height: 1'-5"

P DUCT BANK SECTION

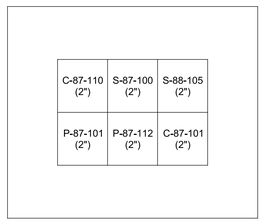
01E02, 87E01



Width: 1'-11"
Height: 1'-5"

Q DUCT BANK SECTION

01E02, 87E01



Width: 1'-11"
Height: 1'-9"

R DUCT BANK SECTION

01E02, 85E03

CONFORMED DOCUMENTS

REV	DATE	BY	DESCRIPTION

DESIGNED AH
DRAWN NS
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

carollo

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

ELECTRICAL

DUCT BANK SECTIONS 3

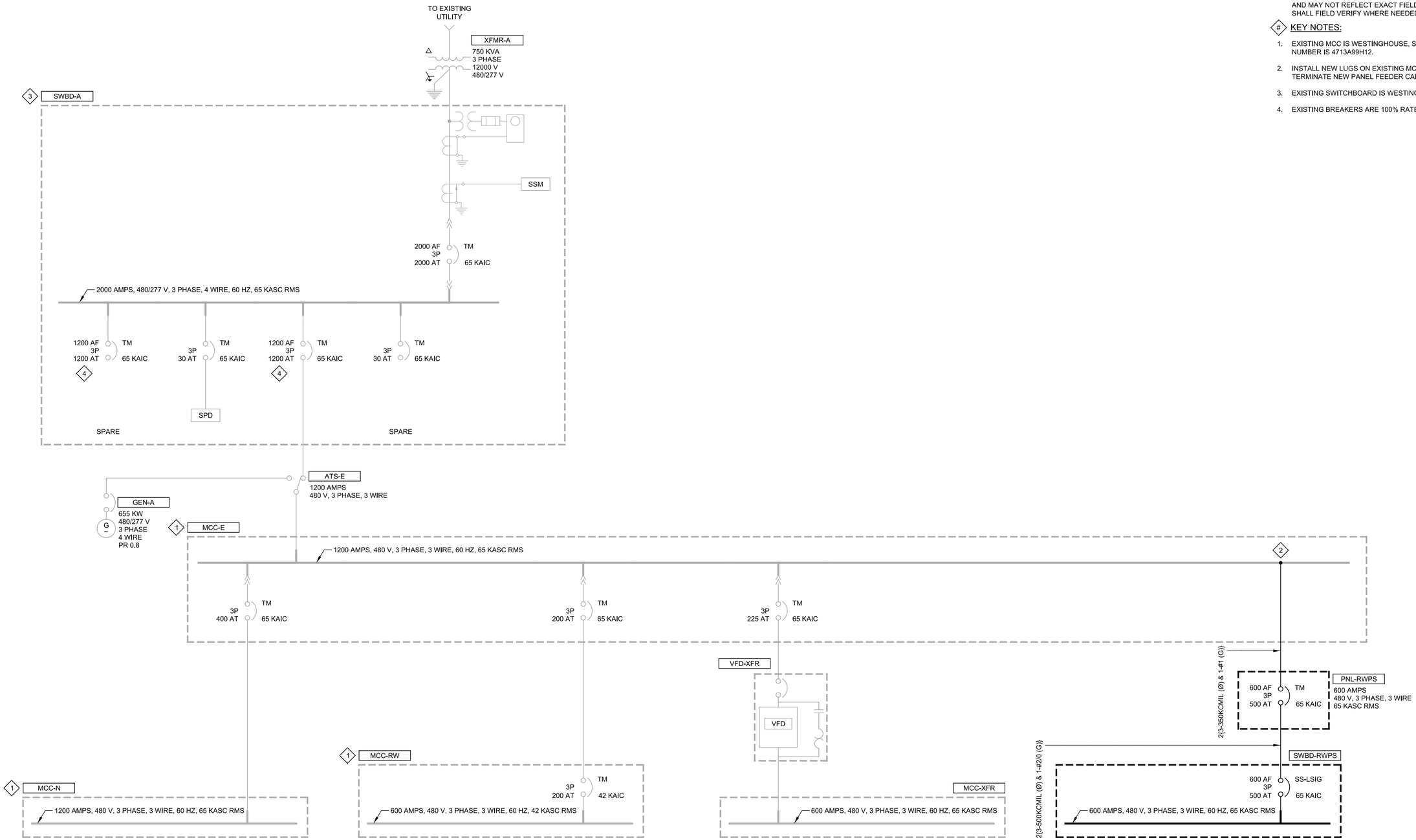
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 02E03
SHEET NO. 94 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1002E03.dgn

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Plot Date: 12-JUL-2023 12:47:00 PM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: avates



GENERAL NOTES:

1. EXISTING EQUIPMENT INFORMATION ARE FROM RECORD DRAWINGS AND MAY NOT REFLECT EXACT FIELD CONDITION. CONTRACTOR SHALL FIELD VERIFY WHERE NEEDED.

KEY NOTES:

1. EXISTING MCC IS WESTINGHOUSE, SERIES 2100. MCC SERIAL NUMBER IS 4713A99H12.
2. INSTALL NEW LUGS ON EXISTING MCC HORIZONTAL BUS AND TERMINATE NEW PANEL FEEDER CABLES ON NEW LUGS.
3. EXISTING SWITCHBOARD IS WESTINGHOUSE, SERIES POW-R-LINE.
4. EXISTING BREAKERS ARE 100% RATED BREAKER.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN CLH
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

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City of Ukiah

CITY OF UKIAH

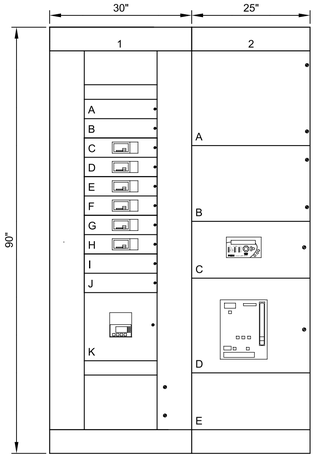
RECYCLED WATER PROJECT - PHASE 4

ELECTRICAL

WTP MODIFIED OVERALL ONE-LINE DIAGRAM

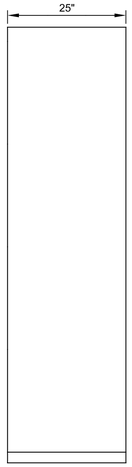
VERIFY SCALES
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0 1"
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JOB NO. 8660F.10
DRAWING NO. 03E01
SHEET NO. 95 OF 200



FRONT VIEW

SCALE: 3/4" = 1'-0"
FILE: 8660F1003E0611



SIDE VIEW

SCALE: 3/4" = 1'-0"
FILE: 8660F1003E0611

1A- SPACE

2A- SPACE

1B- SPACE

2B- SPACE

1C- VFD-99411 RECYCLED WATER PUMP #1

2C- PQM-99400 POWER METERING

1D- VFD-99412 RECYCLED WATER PUMP #2

2D- MAIN BREAKER

1E- VFD-99413 RECYCLED WATER PUMP #3

2E- INCOMING LINE

1F- VFD-99414 RECYCLED WATER PUMP #4

1G- VFD-99415 RECYCLED WATER PUMP #5 (FUTURE)

1H- XFMR-RWPS-L RWPS LIGHTING TRANSFORMER

1I- SPACE

1J- SPACE

1K- SPD

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN CLH
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

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City of Ukiah

CITY OF UKIAH

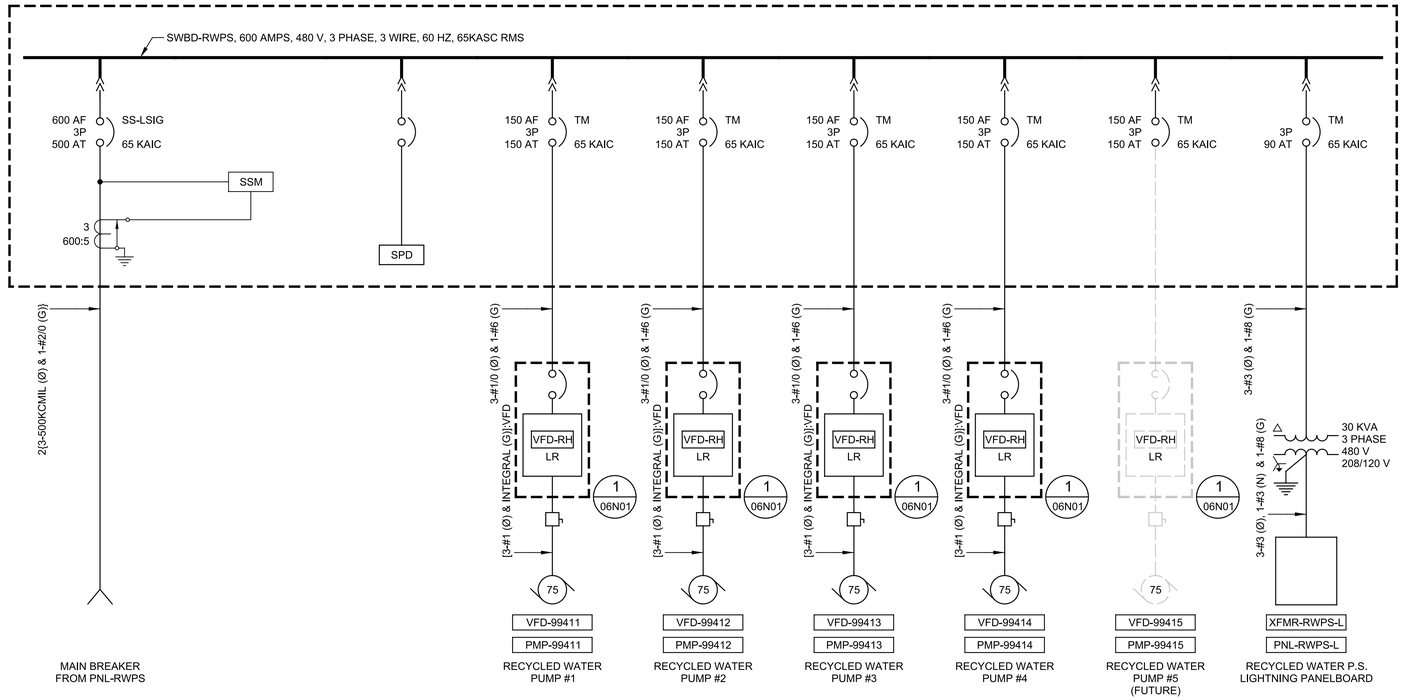
RECYCLED WATER PROJECT - PHASE 4

ELECTRICAL

SWBD-RWPS ELEVATION

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 03E02
SHEET NO. 96 OF 200



REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN CLH
CHECKED JGB
DATE JULY 2023

**
ORIGINAL
SEALED BY
ERIK M. BAHNEMAN
4/7/2023
CA PE NO. 19683
**

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

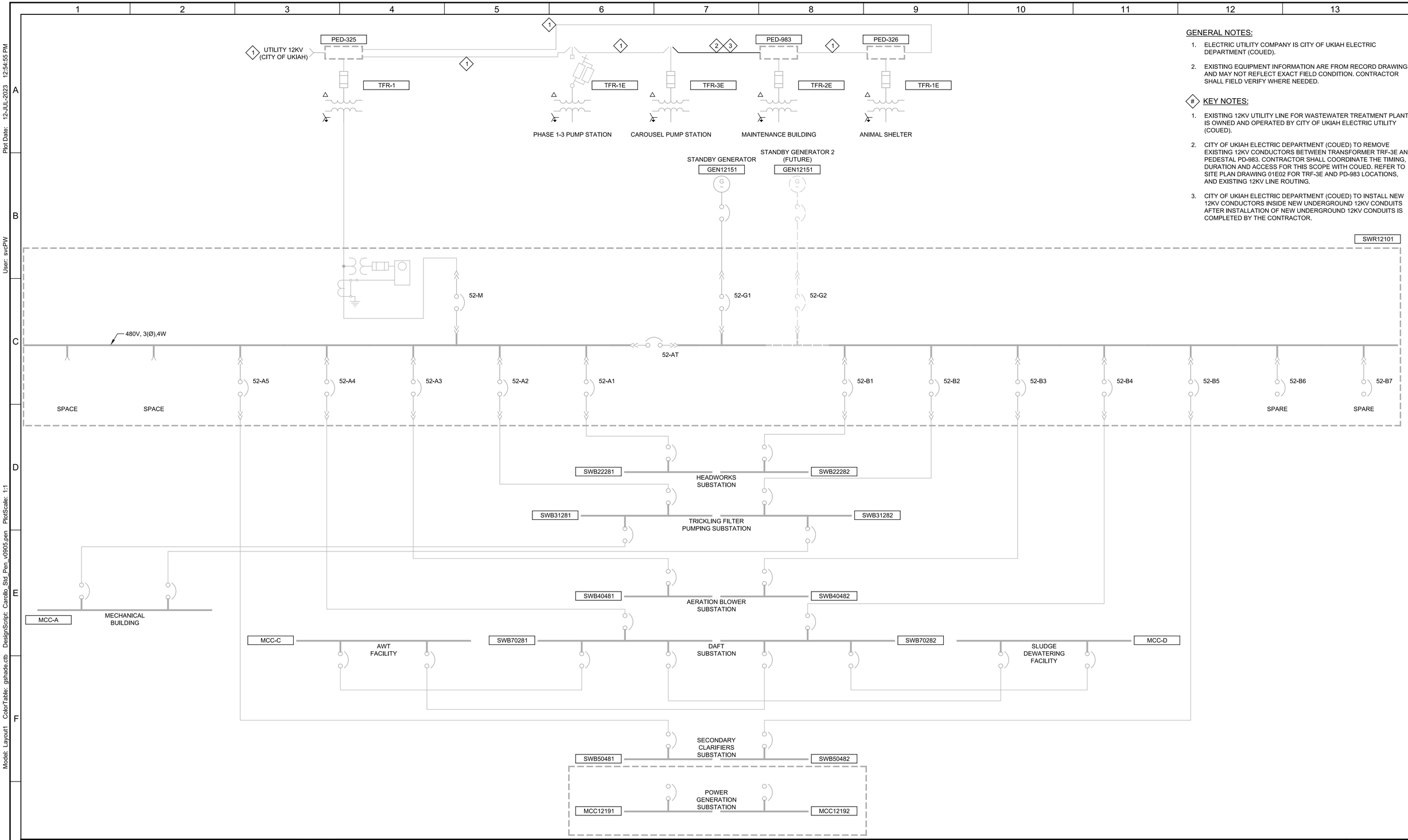
ELECTRICAL

SWBD-RWPS ONE-LINE DIAGRAM

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 03E03
SHEET NO. 97 OF 200

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User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: avates



GENERAL NOTES:

1. ELECTRIC UTILITY COMPANY IS CITY OF UKIAH ELECTRIC DEPARTMENT (COUED).
2. EXISTING EQUIPMENT INFORMATION ARE FROM RECORD DRAWINGS AND MAY NOT REFLECT EXACT FIELD CONDITION. CONTRACTOR SHALL FIELD VERIFY WHERE NEEDED.

◇# KEY NOTES:

1. EXISTING 12KV UTILITY LINE FOR WASTEWATER TREATMENT PLANT IS OWNED AND OPERATED BY CITY OF UKIAH ELECTRIC UTILITY (COUED).
2. CITY OF UKIAH ELECTRIC DEPARTMENT (COUED) TO REMOVE EXISTING 12KV CONDUCTORS BETWEEN TRANSFORMER TRF-3E AND PEDESTAL PD-983. CONTRACTOR SHALL COORDINATE THE TIMING, DURATION AND ACCESS FOR THIS SCOPE WITH COUED. REFER TO SITE PLAN DRAWING 01E02 FOR TRF-3E AND PD-983 LOCATIONS, AND EXISTING 12KV LINE ROUTING.
3. CITY OF UKIAH ELECTRIC DEPARTMENT (COUED) TO INSTALL NEW 12KV CONDUCTORS INSIDE NEW UNDERGROUND 12KV CONDUITS AFTER INSTALLATION OF NEW UNDERGROUND 12KV CONDUITS IS COMPLETED BY THE CONTRACTOR.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN BLS
CHECKED JGB
DATE JULY 2023

**
ORIGINAL
SEALED BY
ERIK M. BAHNEMAN
4/7/2023
CA PE NO. 19683
**

carollo®

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

ELECTRICAL

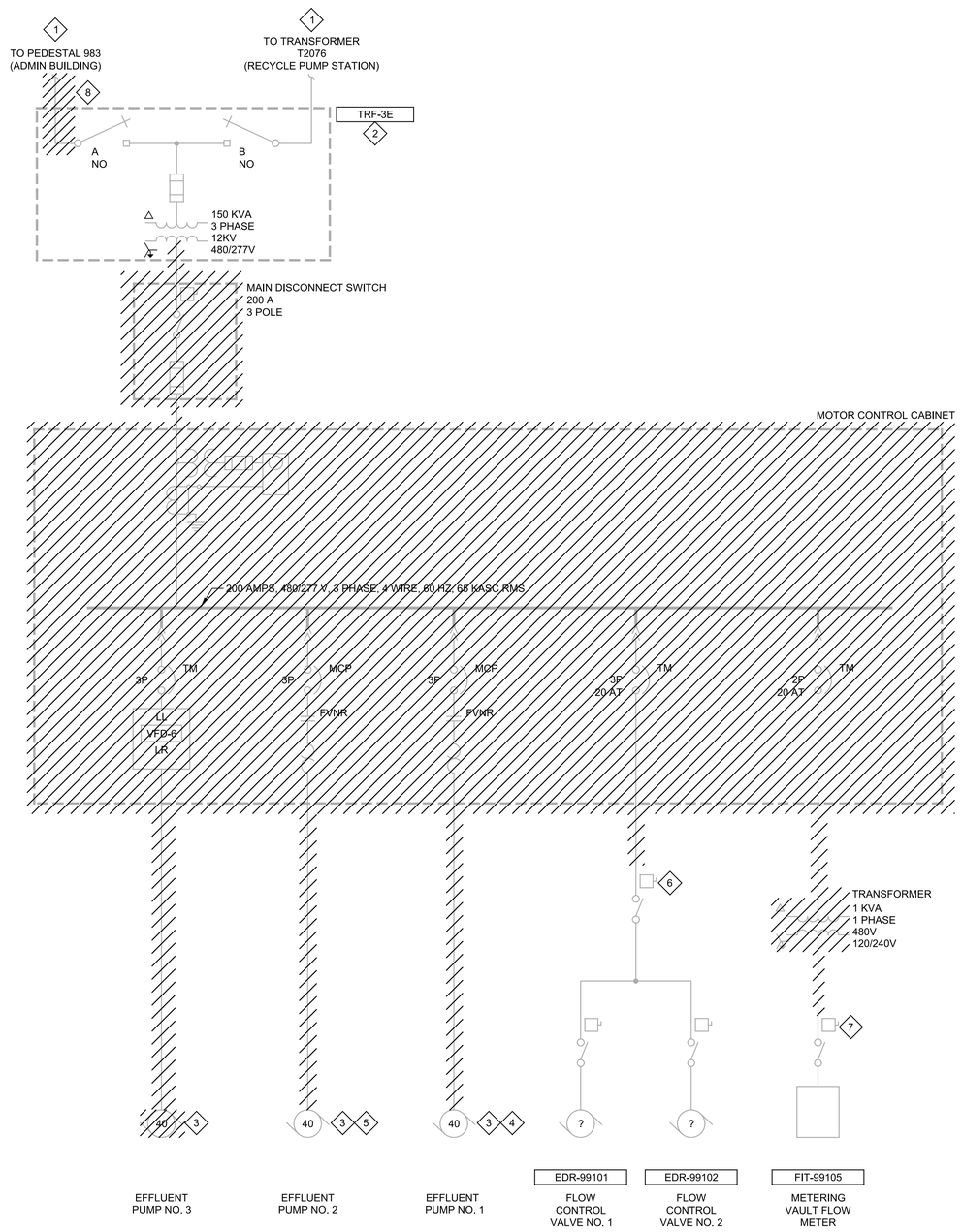
WWTP MODIFIED OVERALL
ONE-LINE DIAGRAM

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 03E04
SHEET NO. 98 OF 200

PROJECT NO. 8660F10
FILE NAME: 8660F1003E04.dgn

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PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: avales



GENERAL NOTES:

1. ELECTRIC UTILITY IS CITY OF UKIAH ELECTRIC DEPARTMENT (COUED).
2. DEMOLISH EXPOSED CONDUIT, AND ALL CABLES FOR CIRCUITS WHICH ARE MARKED ON THIS DRAWING FOR DEMOLITION. UNDERGROUND AND CONCRETE EMBEDDED CONDUITS SHALL REMAIN IN PLACE. REFER TO DRAWING 00D01 GENERAL NOTES FOR ADDITIONAL DEMOLITION REQUIREMENTS.

KEY NOTES:

1. EXISTING 12KV UTILITY LINE FOR WASTEWATER TREATMENT PLANT. IS OWNED AND OPERATED BY CITY OF UKIAH ELECTRIC DEPARTMENT (COUED).
2. PROTECT CAROUSEL PUMP STATION EXISTING TRANSFORMER IN PLACE. DEMOLISH SECONDARY CONDUCTORS. VERIFY WITH PLANT OPERATOR AND CITY OF UKIAH ELECTRIC DEPARTMENT (COUED), AND PLACE BOTH A AND B SWITCHES IN OPEN POSITION. IF POWER SHUT DOWN IS REQUIRED, THE PROCEDURE SHOULD COMPLY WITH SPECIFICATION SECTION 01140.
3. REMOVE EXISTING PUMP MOTOR FROM EXISTING EFFLUENT PUMP. PROTECT PUMP IN PLACE. REFER TO SPEC 11312D FOR MOTOR REQUIREMENTS.
4. EXISTING PUMP WITH NEW MOTOR TO BE RECONNECTED TO MCC70291, AND REDESIGNATED AS A CAROUSEL PUMP.
5. EXISTING PUMP WITH NEW MOTOR TO BE RECONNECTED TO MCC70292, AND REDESIGNED AS A CAROUSEL PUMP.
6. EXISTING DISCONNECT SWITCH TO BE RECONNECTED TO MCC70293.
7. EXISTING FLOW METER DISCONNECT SWITCH TO BE RECONNECTED TO PNL70271.
8. SEE DRAWING 03E04 FOR DEMO NOTES.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN SMB
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

ELECTRICAL

CAROUSEL PUMP STATION
DEMO ONE-LINE DIAGRAM

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 03E05
SHEET NO. 99 OF 200

Plot Date: 12-JUL-2023 12:52:15 PM
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ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: ggraham

PROJECT NO. 8660F10 FILE NAME: 8660F1003E05.dgn



GENERAL NOTES:

1. EXISTING SWITCHBOARD IS SQUARE D TYPE QED.
2. EXISTING BREAKERS TYPE, RATINGS, FRAME SIZES, BREAKER STATUS (OPEN/CLOSE), AND TRIP SETTINGS ARE FROM RECORD DRAWINGS AND MAY NOT REFLECT ACTUAL FIELD INFORMATION. CONTRACTOR SHALL FIELD VERIFY WHERE NEEDED.
3. EXISTING EQUIPMENT INFORMATION ARE FROM RECORD DRAWINGS AND MAY NOT REFLECT EXACT FIELD CONDITION. CONTRACTOR SHALL FIELD VERIFY WHERE NEEDED.

KEY NOTES:

1. EXISTING SWITCH GEAR IS LOCATED INSIDE POWER GENERATION BUILDING.
2. EXISTING SWITCHBOARD IS LOCATED INSIDE DAFT ELECTRICAL BUILDING.
3. ONE-LINE DIAGRAM FOR THIS EQUIPMENT IS PARTIAL AND ONLY SHOWS SELECTIVE LOADS AND CONNECTIONS. FIELD VERIFY WHERE NEEDED, OR REFER TO OWNER'S RECORD DRAWING FOR COMPLETE ONE-LINE DIAGRAM.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HR
DRAWN SMB
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

carollo

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

ELECTRICAL

SWBD70281 AND SWBD70282
ONE-LINE DIAGRAM

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 03E06
SHEET NO. 100 OF 200

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Plot Date: 12-JUL-2023 12:55:02 PM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: bshepard



FRONT VIEW

SCALE: 3/4" = 1'-0"
FILE: 8660F1003E9621



SIDE VIEW

SCALE: 3/4" = 1'-0"
FILE: 8660F1003E9621

GENERAL NOTES:

1. EXISTING MCC IS WESTINGHOUSE, SERIES 2100.

(#) KEY NOTES:

1. REMOVE AND DISPOSE OF EXISTING ELECTRICAL EQUIPMENT INSIDE MCC BUCKET.
2. REMOVE AND DISPOSE OF EXISTING MCC BUCKET COVER.

1A- SPACE

1C- AWT PUMP NO. 1

1F- AWT PUMP NO. 2

1I- HWCP-5 HOT WATER PUMP

1K- RAPID MIX PUMP

2A- SPACE

2C- AWT PUMP NO. 3

2F- AIR WASH BLOWER NO. 1

2I- SPACE

2K- SPACE

3A- SPACE

3C- AIR WASH BLOWER NO. 2

3F- FILTER BACKWASH PUMP NO. 1

3JL- UH-9 UNIT HEATER

3JR- ROLL UP DOOR

3L- SPACE

4A- SPACE

4C- FILTER BACKWASH PUMP NO. 2

4G- AIR COMPRESSOR

4I- WASHWATER RETURN PUMP

4KL- XFMR-A PNL-A LIGHTING PANELBOARD

4KR- DP1 DISTRIBUTION PANEL 1

5A- FILTER SURFACE WASH PUMP

5C- WASHWATER SLUDGE PUMP

5E- DP1 DISTRIBUTION PANEL 1

6A- METERING

6C- MAIN BREAKER 1

6H- MAIN BREAKER 2

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN SMB
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

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City of Ukiah

CITY OF UKIAH

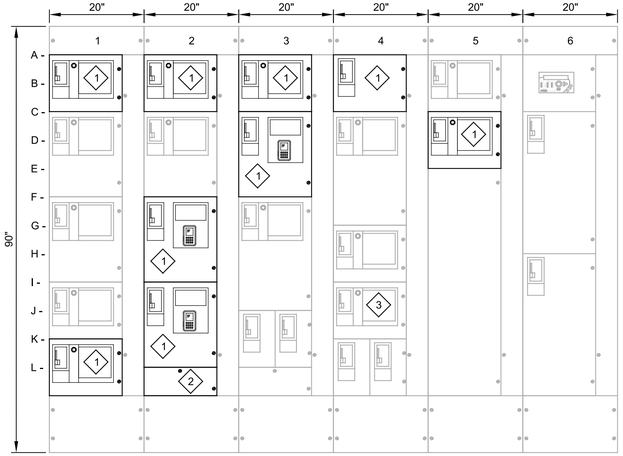
RECYCLED WATER PROJECT - PHASE 4

ELECTRICAL

MCC-C DEMO ELEVATION

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 03E09
SHEET NO. 101 OF 200



FRONT VIEW

SCALE: 3/4" = 1'-0"
FILE: 8660F1003E0621



SIDE VIEW

SCALE: 3/4" = 1'-0"
FILE: 8660F1003E0621

GENERAL NOTES:

1. EXISTING MCC IS WESTINGHOUSE, SERIES 2100.
2. EXISTING MCC OVERALL DIMENSIONS MAY NOT REFLECT THE ACTUAL EQUIPMENT DIMENSIONS IN THE FIELD.
3. PROVIDE COVERS FOR MCC AS NEEDED WHERE NEW UNITS DO NOT COMPLETELY FILL SPACE OF REMOVED UNIT.

(#) KEY NOTES:

1. PROVIDE NEW BREAKER, MOTOR STARTERS AND ALL THE NECESSARY EQUIPMENT ACCORDING TO ONE-LINE DIAGRAMS, CONTROL SCHEMATICS, AND SPECIFICATIONS.
2. PROVIDE NEW COVER.
3. RELABEL EXISTING MCC BUCKET ACCORDING TO MCC ELEVATION TABLE.

1A- FAN-85109 AIR WASH BLOWER FAN NO. 1	2A- FAN-85110 AIR WASH BLOWER FAN NO. 2	3A- FAN-85111 AIR WASH BLOWER FAN NO. 3	4A- DP2 DISTRIBUTION PANEL 2	5A- FILTER SURFACE WASH PUMP	6A- METERING
1C- AWT PUMP NO. 1	2C- AWT PUMP NO. 3	3C- BLO-85107 AIR WASH BLOWER NO. 2	4C- FILTER BACKWASH PUMP NO. 2	5C- PMP-87134 BACKWASH CHLORINE SAMPLE PUMP	6C- MAIN BREAKER A
1F- AWT PUMP NO. 2	2F- BLO-85106 AIR WASH BLOWER NO. 1	3F- FILTER BACKWASH PUMP NO. 1	4G- AIR COMPRESSOR	5E- DP1 DISTRIBUTION PANEL 1	6H- MAIN BREAKER B
1I- HWCP-5 HOT WATER PUMP	2I- BLO-85108 AIR WASH BLOWER NO. 3	3JL- UH-9 UNIT HEATER	4I- SPARE NEMA 2		
		3JR- _____ ROLL UP DOOR			
1K- PMP-85104 RAPID MIX PUMP	2L- SPACE	3L- SPACE	4KL- XFMR-A PNL-A LIGHTING PANELBOARD		
			4KR - _____ DP1 DISTRIBUTION PANEL 1 BREAKER		

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN SMB
CHECKED JGB
DATE JULY 2023

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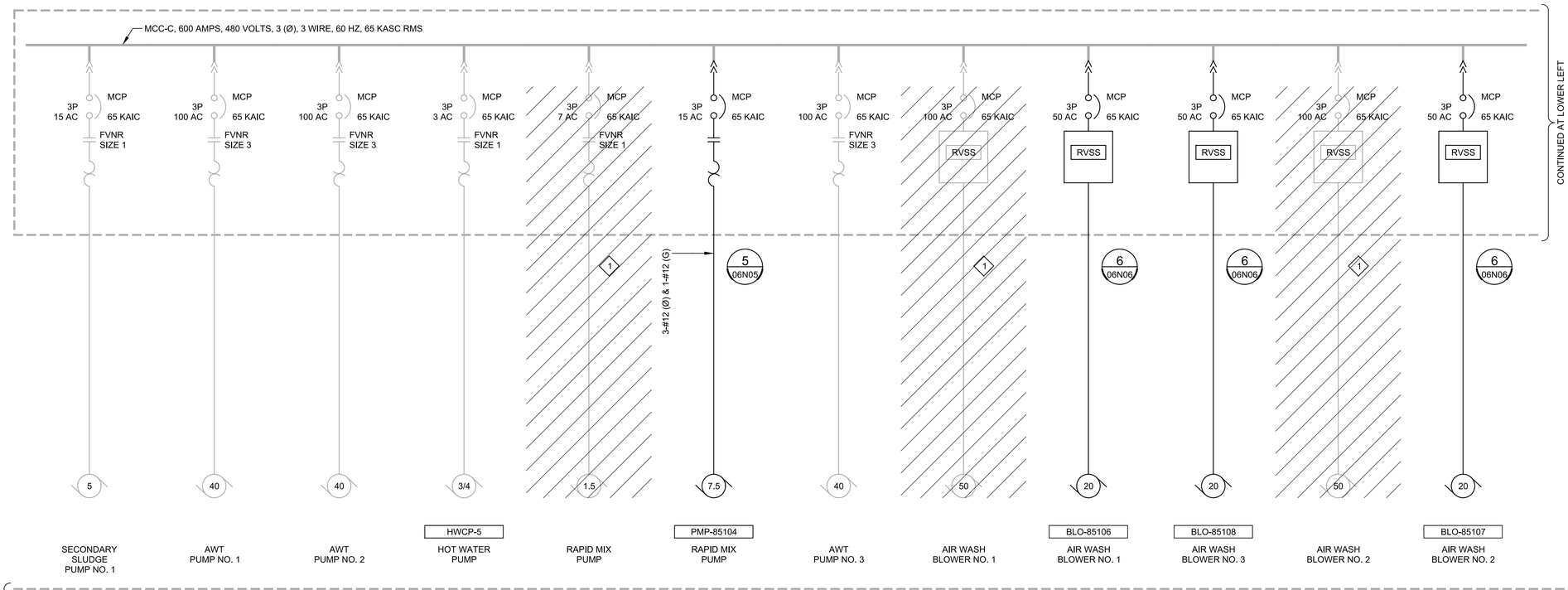
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
MCC-C MODIFIED ELEVATION

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 03E10
SHEET NO. 102 OF 200

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User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: bshepard



KEY NOTES:

1. DEMOLISH EXPOSED CONDUITS, AND ALL CABLES FOR CIRCUITS WHICH ARE MARKED ON THIS DRAWING FOR DEMOLITION. UNDERGROUND AND CONCRETE EMBEDDED CONDUITS SHALL REMAIN IN PLACE.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN SMB
CHECKED JGB
DATE JULY 2023

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City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

ELECTRICAL

MCC-C MODIFIED ONE-LINE DIAGRAM 1

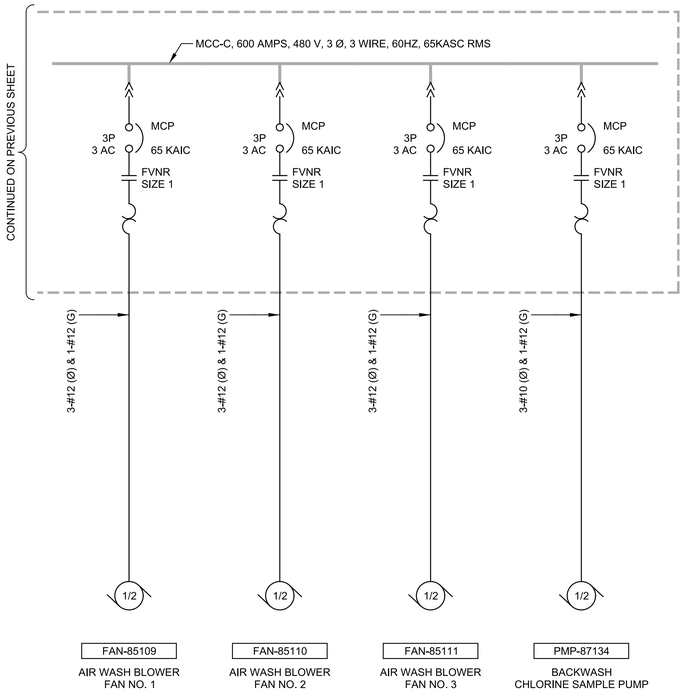
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 03E11
SHEET NO. 103 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1003E11.dgn

Plot Date: 12-JUL-2023 12:48:53 PM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: bshepard

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User: svcPW
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ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: ggraham



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			CONFORMED DOCUMENTS

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DATE JULY 2023

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ORIGINAL
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ERIK M. BAHNEMAN
4/7/2023
CA PE NO. 19683
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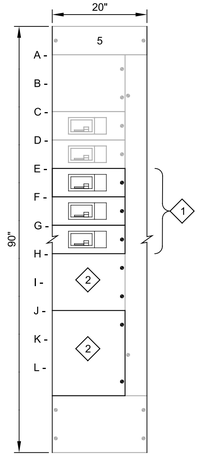
RECYCLED WATER PROJECT - PHASE 4

ELECTRICAL

MCC-C MODIFIED
ONE-LINE DIAGRAM 2

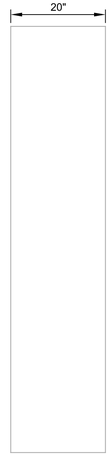
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 03E12
SHEET NO. 104 OF 200



FRONT VIEW

SCALE: 3/4" = 1'-0"
FILE: 8660F1003E0622



SIDE VIEW

SCALE: 3/4" = 1'-0"
FILE: 8660F1003E0622

GENERAL NOTES:

1. EXISTING MCC IS SQUARE D MODEL 6.

KEY NOTES:

1. PROVIDE NEW BREAKER, DRIVES AND ALL THE NECESSARY EQUIPMENT ACCORDING TO ONE-LINE DIAGRAMS, CONTROL SCHEMATICS, AND SPECIFICATIONS.
2. PROVIDE NEW COVER.

5A- SPACE

5C- GDR75112
SLUDGE
GRINDER
DIGESTER 1

5D- P97101
DRAINAGE
PUMP 1

5E- PMP-89100
CAROUSEL
PUMP NO. 1

5F- FV-60100
DCL
STRUCTURE
VALVE 1

5G- FV-60102
DCL
STRUCTURE
VALVE 2

5H- SPACE

5J- SPACE

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN EYJ
CHECKED JGB
DATE JULY 2023

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City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

ELECTRICAL

MCC70291 PARTIAL ELEVATION

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 03E18
SHEET NO. 105 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1003E18.dgn

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PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: ggraham

MCC70291, 600 AMPS, 480 VOLTS, 3 (Ø), 3 WIRE, 60 HZ, 65 KASC RMS

CONTINUED AT LOWER LEFT

SSM
3
MLO

SWB70281

3P 15 AT TM 65 KAIC	3P 15 AT TM 65 KAIC FVNR SIZE 1	3P 20 AT TM 65 KAIC	3P 15 AT MCP 65 KAIC VFD	3P 3 AC MCP 65 KAIC FVNR SIZE 1	3P 20 AT TM 65 KAIC VFD	3P 100 AC MCP 65 KAIC FVNR SIZE 3	3P 15 AC MCP 65 KAIC FVNR SIZE 1	3P 50 AC MCP 65 KAIC FVNR SIZE 2	3P 35 AT TM 65 KAIC	3P 20 AT TM 65 KAIC
VFD-6					VFD					
3/4	1.5	10 HP	7.5	1/2	7.5	40	5	20	20 HP	1 AMP
COL70121A	COL70121B	LCP70201	MX75101	P60211	VFD70131 P70131	P70221	P75111	P80111	P97101	PNL70251
DAFT 1 FLOAT COLLECTOR	DAFT 1 SLUDGE COLLECTOR	DAFT AIR COMPRESSOR 1	DIGESTER 1 MIXER	CHLORINE RESIDUAL SAMPLE PUMP 1	THICKENED SLUDGE PUMP 1	PRESSURIZATION PUMP 1	DIGESTER 1 CIRCULATION PUMP	RECLAIMED WATER FILTER FEED PUMP 1	DRAINAGE PUMP 1	POLYMER BLENDING UNIT 1

CONTINUED AT UPPER RIGHT

SPD

15 KVA
3 PHASE
480V
208/120V

3-#6 (Ø) & 1-#8 (G)

[3-#4 (Ø) & INTEGRAL (G)]:VFD

3-#10 (Ø) & 1-#10 (G)

3-#10 (Ø) & 1-#10 (G)

3-#10 (Ø) & 1-#10 (G)

3-#10 (Ø) & 1-#10 (G)

3
06N03

LL
VFD-6
DV/DT

1
40

3
HP

5
HP

5
HP

SSM
3
MLO

3P 15 AT TM 65 KAIC	3P 45 AT TM 65 KAIC	3P 80 AT TM 65 KAIC	3P 15 AT MCP 65 KAIC FVNR SIZE 1	3P 20 AT TM 65 KAIC	3P 15 AT TM 65 KAIC	3P 15 AT TM 65 KAIC			
3 HP		VFD-89100			5 HP	5 HP			
GDR75112	XFMR70271	PNL70271	PMP-89100	SPARE	SPARE	FV-60100	FV-60102	SWB70282	
SLUDGE GRINDER DIGESTER 1			CAROUSEL PUMP NO. 1			DCL STRUCTURE VALVE 1	DCL STRUCTURE VALVE 2		

GENERAL NOTES:

1. EXISTING MCC IS SQUARE D MODEL 6.

KEY NOTES:

1. REPLACE EXISTING MOTOR FOR THE EXISTING PUMP WITH NEW VFD DUTY RATED MOTOR. MOTOR SELECTION SHALL BE COORDINATED WITH THE EXISTING PUMP MANUFACTURER, AND SPECIFICATION SECTIONS 16222 AND 16262. EXISTING MOTOR IS MADE BY NIDEC MOTOR CORPORATION, MODEL# BF48A, AND CATALOG#: H040S2BLG.

CONFORMED DOCUMENTS

REV	DATE	BY	DESCRIPTION

DESIGNED HQR
DRAWN EYJ
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

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City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

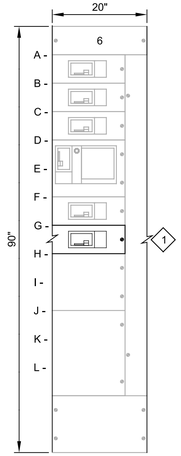
ELECTRICAL

MCC70291 ONE-LINE DIAGRAM

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

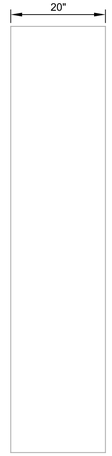
JOB NO. 8660F.10
DRAWING NO. 03E19
SHEET NO. 106 OF 200

Plot Date: 12-JUL-2023 12:52:28 PM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: avates



FRONT VIEW

SCALE: 3/4" = 1'-0"
FILE: 8660F1003E0623



SIDE VIEW

SCALE: 3/4" = 1'-0"
FILE: 8660F1003E0623

GENERAL NOTES:

1. EXISTING MCC IS SQUARE D MODEL 6.

KEY NOTES:

1. PROVIDE NEW BREAKER AND ALL THE NECESSARY EQUIPMENT ACCORDING TO ONE-LINE DIAGRAMS, CONTROL SCHEMATICS, AND SPECIFICATIONS.

6A- POLYMER
BLENDING UNIT 2
PNL70272

6B- 20A SPARE
BREAKER

6C- LCP70202
DAFT AIR COMP 2

6D- SPARE
STARTER - SIZE 1

6F- GDR75122
DIGESTER 2
SLUDGE GRINDER

6G- PMP-89101
CAROUSEL PUMP NO. 2

6H- SPACE

6J- SWB70282

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN EYJ
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

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City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
MCC70292 PARTIAL ELEVATION

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 03E20
SHEET NO. 107 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1003E20.dgn

Plot Date: 12-JUL-2023 12:49:28 PM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: ggraham

MCC70292, 600 AMPS, 480 VOLTS, 3 (Ø), 3 WIRE, 60 HZ, 65 KASC RMS

SSM
3
MLO

CONTINUED AT LOWER LEFT

	3P TM	3P 7 AC MCP 65 KAIC FVNR SIZE 1	3P 20 AT TM 65 KAIC	3P 3 AC MCP 65 KAIC FVNR SIZE 1	3P 3 AC MCP 65 KAIC FVNR SIZE 1	3P 15 AT TM 65 KAIC	3P 20 AT TM 65 KAIC VFD	3P 3 AC MCP 65 KAIC FVNR SIZE 1	3P 20 AT TM 65 KAIC	3P 100 AC MCP 65 KAIC FVNR SIZE 3	3P 15 AC MCP 65 KAIC FVNR SIZE 1	
VFD									VFD			
HP	1.5	10 HP	1/2	1/2	1 HP	7.5	1/2	7.5	40	7.5		
SWB70281	COL70122A DAFT 2 FLOAT COLLECTOR	COL70122B DAFT 2 SLUDGE COLLECTOR	LCP70202 DAFT AIR COMPRESSOR 2	MME60202 SODIUM HYPOCHLORITE INDUCTION UNIT	MME60401 SODIUM BISULFITE INDUCTION UNIT	MME70252 POLYMER BLENDING UNIT 2	MX75102 DIGESTER 2 MIXER	P60213 CHLORINE RESIDUAL SAMPLE PUMP 2	P70132 THICKENED SLUDGE PUMP 2	P70222 PRESSURIZATION PUMP 2	P75121 DIGESTER 2 CIRCULATION PUMP	

CONTINUED AT UPPER RIGHT

	3P 20 AT TM 65 KAIC	3P 15 AC MCP 65 KAIC FVNR SIZE 1	3P 50 AC MCP 65 KAIC FVNR SIZE 2	3P 15 AT TM 65 KAIC	SPD	3P 45 AT TM 65 KAIC 15 KVA 3 PHASE 480 V 120/2080 V		3P 80 AT TM 65 KAIC		SSM 3 MLO		
3-#6 (Ø) & 1-#8 (G)								3-#4 (Ø) & INTEGRAL (G)				
								LL VFD-6 DV/DT	3 06N03			
								1	40			
			20	3 HP				VFD-89101				
SPARE	SPARE	P80112 RECLAIMED WATER FILTER FEED PUMP 2	PNL75122 DIGESTER 2 SLUDGE GRINDER	XFMR70272	PNL-70272	PMP-89101 CAROUSEL PUMP NO. 2	SWB70282					

GENERAL NOTES:

1. EXISTING MCC IS SQUARE D MODEL 6.

KEY NOTES:

1. REPLACE EXISTING MOTOR FOR THE EXISTING PUMP WITH NEW VFD DUTY RATED MOTOR. MOTOR SELECTION SHALL BE COORDINATED WITH THE EXISTING PUMP MANUFACTURER, AND SPECIFICATION SECTIONS 16222 AND 16262. EXISTING MOTOR IS MADE BY NIDEC MOTOR CORPORATION, MODEL# BF48A, AND CATALOG#: H040S2BLG.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN EYJ
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

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City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

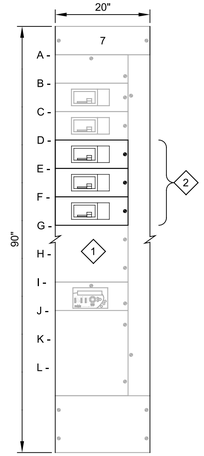
ELECTRICAL

MCC70292 ONE-LINE DIAGRAM

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

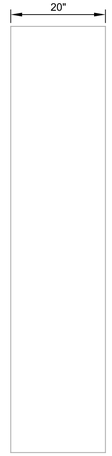
JOB NO. 8660F.10
DRAWING NO. 03E21
SHEET NO. 108 OF 200

Plot Date: 12-JUL-2023 12:50:43 PM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
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FRONT VIEW

SCALE: 3/4" = 1'-0"
FILE: 8660F1003E0624



SIDE VIEW

SCALE: 3/4" = 1'-0"
FILE: 8660F1003E0624

GENERAL NOTES:

1. EXISTING MCC IS SQUARE D MODEL 6.

KEY NOTES:

1. PROVIDE NEW BREAKER AND ALL THE NECESSARY EQUIPMENT ACCORDING TO SINGLE LINE DIAGRAMS AND SPECIFICATIONS.
2. PROVIDE NEW COVER.

7A- SPACE

7B- 30A SPARE
BREAKER

7C- UH70244
DAFT EQUIP. ROOM
UNIT HEATER

7D- EDR-99101
EDR-99102
FLOW CONTROL
VALVES NO. 1 AND NO. 2

7E- PMP-89102
CAROUSEL PUMP NO. 3

7F- PMP-91100
PAU PUMP NO. 1

7G- SPACE

7I- METERING

7J- 600A MLO

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN EYJ
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

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City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
MCC70293 PARTIAL ELEVATION

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 03E22
SHEET NO. 109 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1003E22.dgn

MCC70293, 600 AMPS, 480 VOLTS, 3 (Ø), 3 WIRE, 60 HZ, 65 KASC RMS

CONTINUED AT LOWER LEFT

CONTINUED AT UPPER RIGHT

GENERAL NOTES:

1. EXISTING MCC IS SQUARE D MODEL 6.

3P 20 AT	3P 50 AC	3P 15 AT	3P 15 AT	3P 20 AT	3P 3 AC	3P 3 AC	3P 3 AC	3P 15 AT	3P 100 AC	3P 50 AC	3P 35 AT	3P 15 AT	3P 15 AT	3P
TM 65 KAIC	MCP 65 KAIC	TM 65 KAIC	TM 65 KAIC	TM 65 KAIC	MCP 65 KAIC	MCP 65 KAIC	MCP 65 KAIC	TM 65 KAIC	MCP 65 KAIC	MCP 65 KAIC	TM 65 KAIC	TM 65 KAIC	TM 65 KAIC	TM 65 KAIC
	FVNR SIZE 2	VFD			FVNR SIZE 1	FVNR SIZE 1	FVNR SIZE 1	VFD	FVNR SIZE 3	FVNR SIZE 2			SPD	
SSM, 3, MLO														
10 KW	20	3/4	1.5 HP	10 HP	1/2	1/2	1/2	7.5	40	20	20 HP	1 HP	5 KVA	VCP-SD, 2, 2
SWB70281	AHU70246 DAFT BUILDING AIR HANDLING UNIT	B60221 CHLORINATION AERATION BLOWER	FUTURE DAFT 3 FLOAT COLLECTOR	FUTURE DAFT 3 SLUDGE COLLECTOR	LCP70203 DAFT AIR COMPRESSOR 3	MME60201 SODIUM HYPOCHLORITE INDUCTION UNIT 1	P60215 CHLORINE RESIDUAL SAMPLE PUMP 3	P60411 CHLORINE RESIDUAL SAMPLE PUMP 4	P70133 THICKENED SLUDGE PUMP	P70223 PRESSURIZATION PUMP 3	P80113 RECLAIMED WATER FILTER FEED PUMP 3	P97102 DRAINAGE PUMP 2	PLC70299 FUTURE POLYMER BLENDING UNIT 3	PNL80114 RECLAIMED WATER FILTER CONTROL PANEL	STORM DRAIN PUMP 1 / STORM DRAIN PUMP 2

3P 25 AT, TM 65 KAIC → 3-#10 (Ø) & 1-#10 (G) → 4 / 06N04 → LL, VFD-6, DV/DT → [3-#8 (Ø) & INTEGRAL (G)] VFD → 10 HP → VFD-91100 / PMP-91100 → PAU PUMP NO. 1

3P 45 AT, TM 65 KAIC → 15 KVA, 3 PHASE, 480 V, 120/208 V → XFMR70273 → PNL70273

3P 80 AT, TM 65 KAIC → 3-#6 (Ø) & 1-#8 (G) → 3 / 06N04 → LL, VFD-6, DV/DT → [3-#4 (Ø) & INTEGRAL (G)] VFD → 40 HP → VFD-89102 / PMP-89102 → CAROUSEL PUMP NO. 3

3P 20 AT, TM 65 KAIC → RIVER DISCHARGE CONTROL VALVE

3P 15 AT, TM 65 KAIC → 3-#10 (Ø) & 1-#10 (G) → HP, HP → EDR-99101 FLOW CONTROL VALVE NO. 1 / EDR-99102 FLOW CONTROL VALVE NO. 2

3P, TM 65 KAIC → SSM, 3, MLO → SWB70282

CONFORMED DOCUMENTS

REV	DATE	BY	DESCRIPTION

DESIGNED HQR
DRAWN EYJ
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CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

ELECTRICAL

MCC70293 ONE-LINE DIAGRAM

VERIFY SCALES
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JOB NO. 8660F.10
DRAWING NO. 03E23
SHEET NO. 110 OF 200

PANEL PNL-RWPS-L

3/6/2023

LI RWPS

LOCATION:	RECYCLED WATER PUMP STATION ELECTRICAL BUILDING	NEMA:	1	PH A WEIGHTED VA	6195
VOLTS:	208/120	FEED:	BOTTOM	PH B WEIGHTED VA	4035
PHASE & WIRE:	3 PH 4W	MTG.	SURFACE	PH C WEIGHTED VA	7613
INTERRUPT:	10 KAIC	BUS RATING:	100		
OPTIONS:	SPD	MAIN:	CB	EQUIP SIZING VA	22838
		MAIN RATING:	125 AF 100 AT	PANEL AMPS	63.4

I/C/S	DESCRIPTION	LOAD (VA)	BKR	CIR	Ø	CIR	BKR	LOAD (VA)	DESCRIPTION	I/C/S
C	RECYCLED WATER ELECTRICAL BUILDING LIGHTING	280	20A-1P	1	A	2	20A-1P	720	RECYCLED WATER ELECTRICAL BUILDING RECEPTACLES	I
I	RECYCLED WATER ELECTRICAL BUILDING RECEPTACLES	360	20A-1P	3	B	4	20A-1P	340	RECYCLED WATER PUMP STATION LIGHTING	C
I	RECYCLED WATER PUMP STATION RECEPTACLES	900	20A-1P	5	C	6	35A-2P	2600	CU-99422 - OUTDOOR CONDENSER UNIT NO. 2	C
C	PCM-99400 POWER FEED NO. 1	1500	20A-1P	7	A	8		2600	FCU-99422	C
S	PCM-99400 POWER FEED NO. 2	1500	20A-1P	9	B	10	35A-2P	2600	CU-99421 - OUTDOOR CONDENSER UNIT NO. 1	C
C	RECYCLED WATER STORAGE LIGHTING	170	20A-1P	11	C	12		2600	FCU-99421	C
	SPARE		20A-1P	13	A	14	20A-1P		SPARE	
	SPARE		20A-1P	15	B	16	20A-1P		SPARE	
	SPARE		20A-1P	17	C	18	20A-1P		SPARE	
	SPARE		20A-1P	19	A	20	20A-1P		SPARE	
	SPARE		20A-1P	21	B	22	20A-1P		SPARE	
	SPARE		20A-1P	23	C	24	20A-1P		SPARE	
	SPARE		20A-1P	25	A	26	20A-1P		SPARE	
	SPARE		20A-1P	27	B	28	20A-1P		SPARE	
	SPARE		20A-1P	29	C	30	20A-1P		SPARE	

PANEL DP2

3/30/2023

LOCATION:	ADVANCE WATER TREATMENT (AWT)	NEMA:	1	PH A WEIGHTED VA	13334
VOLTS:	480	FEED:	TOP	PH B WEIGHTED VA	13334
PHASE & WIRE:	3 PH 3W	MTG.	SURFACE	PH C WEIGHTED VA	13334
INTERRUPT:	65 KAIC	BUS RATING:	100		
OPTIONS:	SPD	MAIN:	CB	EQUIP SIZING VA	40002
		MAIN RATING:	100 AF 100 AT	PANEL AMPS	48.1

I/C/S	DESCRIPTION	LOAD (VA)	BKR	CIR	Ø	CIR	BKR	LOAD (VA)	DESCRIPTION	I/C/S
I		1469		1	A	2		1719		I
I	FCV-85211 & FV-85212 & FV-85214 - FILTER 1 INFLUENT & AIR VALVES AND WASTE GATE	1469	15A-3P	3	B	4	15A-3P	1719	FV-85217 & FCV-85218 & FV-85219 - FILTER 1 BACKWASH & EFFLUENT & AIR SCOUR VALVES	I
I		1469		5	C	6		1719		I
I		1469		7	A	8		1719		I
I	FCV-85221 & FV-85222 & FV-85224 - FILTER 2 INFLUENT & AIR VALVES AND WASTE GATE	1469	15A-3P	9	B	10	15A-3P	1719	FV-85227 & FCV-85228 & FV-85229 - FILTER 2 BACKWASH & EFFLUENT & AIR SCOUR VALVES	I
I		1469		11	C	12		1719		I
I		1469		13	A	14		1719		I
I	FCV-85231 & FV-85232 & FV-85234 - FILTER 3 INFLUENT & AIR VALVES AND WASTE GATE	1469	15A-3P	15	B	16	15A-3P	1719	FV-85237 & FCV-85238 & FV-85239 - FILTER 3 BACKWASH & EFFLUENT & AIR SCOUR VALVES	I
I		1469		17	C	18		1719		I
I		1469		19	A	20		1719		I
I	FCV-85241 & FV-85242 & FV-85244 - FILTER 4 INFLUENT & AIR VALVES AND WASTE GATE	1469	15A-3P	21	B	22	15A-3P	1719	FV-85247 & FCV-85248 & FV-85249 - FILTER 4 BACKWASH & EFFLUENT & AIR SCOUR VALVES	I
I		1469		23	C	24		1719		I
I		582		25	A	26				
I	FV-87130 - HIGH RATE BACKWASH VALVE	582	15A-3P	27	B	28	15A-3P		SPARE	
I		582		29	C	30				
				31	A	32				
	SPARE		15A-3P	33	B	34	15A-3P		SPARE	
				35	C	36				
				37	A	38				
	SPARE		15A-3P	39	B	40	15A-3P		SPARE	
				41	C	42				

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN ASH
CHECKED JGB
DATE JULY 2023

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CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

ELECTRICAL

PANELBOARD SCHEDULES 1

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 04E01
SHEET NO. 111 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1004E01.dgn

Plot Date: 12-JUL-2023 12:47:53 PM User: svcPW PlotScale: 1:1 DesignScript: Carollo_Std_Pen_v0905.pen ColorTable: gshade.ctb Model: Layout1 LAST SAVED BY: avates

PA PNL-A

3/9/2023

LOCATION:	AWT BUILDING	NEMA:	1	PH A WEIGHTED VA	8863				
VOLTS:	208/120	FEED:	TOP	PH B WEIGHTED VA	9933				
PHASE & WIRE:	3 PH 4W	MTG.	SURFACE	PH C WEIGHTED VA	9496				
INTERRUPT:	10 KAIC	BUS RATING:	100						
OPTIONS:	SPD	MAIN:	CB	EQUIP SIZING VA	29798				
		MAIN RATING:	100 AF 100 AT	PANEL AMPS	82.7				

I/C/S	DESCRIPTION	LOAD (VA)	BKR	CIR	Ø	CIR	BKR	LOAD (VA)	DESCRIPTION	I/C/S
C	LTS-CONTROL/BLOWER ROOM	500	20A-1P	1	A	2	20A-1P	700	RCPT-CONTROL/BLOWER ROOM	I
C	LTS-CHEMICAL FEED ROOM	1000	20A-1P	3	B	4	20A-1P	800	RCPT-CHEMICAL FEED ROOM	I
C	LTS-AWT CLARIFIER/FILTER	1000	20A-1P	5	C	6	20A-1P	800	RCPT - AWT CLARIFIER/FILTER	I
C	LTS-EXTERIOR	300	20A-1P	7	A	8	20A-1P	500	RCPT - AWT CLARIFIER/FILTER	I
C	EF-5 CHEMICAL FEED	670	20A-1P	9	B	10	20A-1P	450	UH-6, UH-7, UH-8	C
C	EF-6 CHEMICAL FEED	670	20A-1P	11	C	12	20A-1P		SPARE	
C	EF-7 CONTROL ROOM	670	20A-1P	13	A	14	15A-1P	1000	EWH-1	C
C	EF-8 BLOWER ROOM	670	20A-1P	15	B	16	20A-1P	1100	COAGULANT AID POLYMER FEEDER #1	C
C	AWT BUILDING CONTROL PANEL	1000	20A-1P	17	C	18	20A-1P	1100	COAGULANT AID POLYMER FEEDER #2	S
C	CAUSTIC LEAK PANEL	500	20A-1P	19	A	20	20A-1P	830	FILTER AID POLYMER FEEDER	C
C	COAGULANT LEAK PANEL	500	20A-1P	21	B	22	20A-1P	1186	VCP-85183 - COAGULANT FEED CONTROL PANEL NO. 3	C
C	AIT-108/ AIT-109	200	20A-1P	23	C	24	20A-1P	1186	VCP-85182 - COAGULANT FEED CONTROL PANEL NO. 2	S
C	AIT-110/ AIT-111	200	20A-1P	25	A	26	20A-1P	1186	VCP-85181 - COAGULANT FEED CONTROL PANEL NO. 1	S
	SPARE		20A-1P	27	B	28	20A-1P	1100	CAUSTIC FEED PUMP #2	S
C	VCP-3 - AWT CLARIFIER/FILTER CONTROL PANEL	1000	20A-1P	29	C	30	20A-1P	1100	CAUSTIC FEED PUMP #1	C
I	LTG & RCPT AWT & BACKWASH PS	500	20A-1P	31	A	32	20A-1P	300	HEAT TAPE	C
C	SAMPLE PUMP NO. 1	1130	20A-1P	33	B	34	20A-1P	300	HEAT TAPE	C
C	SAMPLE PUMP NO. 2	1587	20A-1P	35	C	36	20A-1P	300	HEAT TAPE	C
C	SAMPLE PUMP NO. 3	1130	20A-1P	37	A	38	20A-1P	300	HEAT TAPE	C
	SPARE		20A-1P	39	B	40	20A-1P	300	HEAT TAPE	C
	SPARE		20A-1P	41	C	42	15A-1P	100	BINKLEY ALARM	C

PANEL PNL70271

4/4/2023

LOCATION:	DAFT BUILDING - MCC70271	NEMA:	1	PH A WEIGHTED VA	4568				
VOLTS:	208/120	FEED:	BOTTOM	PH B WEIGHTED VA	4173				
PHASE & WIRE:	3 PH 4W	MTG.	MCC	PH C WEIGHTED VA	3721				
INTERRUPT:	10 KAIC	BUS RATING:	100						
OPTIONS:	SPD	MAIN:	CB	EQUIP SIZING VA	13703				
		MAIN RATING:	100 AF 60 AT	PANEL AMPS	38.0				

I/C/S	DESCRIPTION	LOAD (VA)	BKR	CIR	Ø	CIR	BKR	LOAD (VA)	DESCRIPTION	I/C/S
C	P60321 (PNL60321)	600	20A-1P	1	A	2	20A-1P	100	FIT7521	C
C	P60341 (PNL60341)	100	20A-1P	3	B	4	20A-1P	100	FIT7025	C
C	LTG-DIGESTERS	173	20A-1P	5	C	6	20A-1P	100	FIT7041	C
C	RECPT-DIGESTERS	180	20A-1P	7	A	8	20A-1P	248	DAFT DECK LIGHTNING	C
C	FIT6031	100	20A-1P	9	B	10	20A-1P	850	DAFT TANK LIGHTNING	C
C	LIT6011	100	20A-1P	11	C	12	20A-1P	360	DAFT TANK RECEPTACLE	I
C	PNL60301	600	20A-1P	13	A	14	20A-1P	650	DAFT BLDG INTERIOR LTG	C
C	PNL60331	600	20A-1P	15	B	16	20A-1P	650	DAFT BLDG INTERIOR LTG	C
C	FIT8001	100	20A-1P	17	C	18	20A-1P	720	DAFT BLDG INTERIOR RECEP	I
C	FIT8002	100	20A-1P	19	A	20	20A-1P	720	DAFT BLDG INTERIOR RECEP	I
C	MME60212 (AIT6004)	100	20A-1P	21	B	22	20A-1P	500	RESTROOM MINI WATER HTR	C
C	NJB-60001 - ETHERNET SWITCH	100	15A-1P	23	C	24	20A-1P	100	LCP70272	C
C	FIT-99105 - METERING VAULT FLOW METER	100	20A-1P	25	A	26	20A-1P	500	PNL70241	C
I	CAROUSEL AND PAU RECEPTACLES	360	20A-1P	27	B	28	20A-1P	50	CV70261	C
C	CAROUSEL AND PAU LIGHTING	360	20A-1P	29	C	30	20A-1P	1080	PLC70299	C

KEY NOTES:

1. RENAME THIS CIRCUIT IN THE PANEL CIRCUIT SCHEDULE. RELOCATE CIRCUIT BREAKERS AS NEEDED TO MATCH PROVIDED PANEL BOARD SCHEDULE.
2. PROVIDE NEW CIRCUIT FOR THE NEW LOADS. REFLECT CHANGES TO PANEL CIRCUIT SCHEDULE IN THE FIELD ACCORDINGLY.
3. EXISTING PANELBOARD IS SQUARE D TYPE NQOD.
4. EXISTING PANELBOARD IS SQUARE D TYPE NQOD.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN ASH
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
PANELBOARD SCHEDULES 2

VERIFY SCALES
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0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 04E02
SHEET NO. 112 OF 200

Plot Date: 12-JUL-2023 12:51:39 PM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: avates

LUMINAIRE SCHEDULE

3/8/2023

ITEM	DESCRIPTION	MOUNTING METHOD	LAMP QUANTITY	LAMP TYPE	LUMINAIRE SPECIFICATIONS MANUFACTURER	CATALOG	VOLTS	VA
A ◇1	AUTOBAHN SERIES ATBM POLE LIGHT, ROADWAY TYPE III DISTRIBUTION FOUR-BOLT MAST ARM MOUNT FOR 1.25 TO 2 INCH OD POLE w/ROUND TAPERED POLE WITH MOUNTING ARM PROVIDE MOUNTING FOR TWO HEADS/ARMS ON A SINGLE POLE WHERE SHOWN COLOR TO MATCH EXISTING LIGHT POLES AND ANODIZED ALUMINUM, 12'-0" HIGH, 4" DIA 7 PIN INTEGRAL PHOTOCELL SENSOR AND CONTROL WITH DIMMABLE DRIVE PROVIDE EMBEDDED GFCI RECEPTACLE WITH WEATHER PROOFING COVER WHERE SHOWN	POLE MOUNT	N/A	LED 4000 CCT 10,675 LUMENS	AMERICAN ELECTRIC LIGHTING	ATBM P10 MVOLT R3 4B UMR-XX P7	120	81
B	SEALED, AND GASKETED LED LUMINAIRE, CLEAR POLYCARBONATE LENS 80 CRI, SUITABLE FOR WET LOCATIONS, w/ HIGH EFFICIENCY LEDs FOR AMBIENT TEMPERATURES -29 TO 40 DEG C, L80 AT 75,000 HOURS CALIFORNIA ENERGY CODE COMPLIANT BUILT-IN EMERGENCY BACKUP WHERE SHOWN	CEILING MOUNT OR SUSPENDED AS NEEDED	N/A	LED 4000K CCT 6,643 LUMENS	HOLOPHANE	EVT4 6000LM PCL WD MVOLT 40K 80	120	71
C	DELEON TL SINGLE FACE EXIT SIGN, UL WET LOCATION LISTED, SELF DIAGNOSTICS AMBIENT TEMPERATURES -40 TO 45 DEG C DUAL VOLTAGE 120/277 w/GREEN EXIT LETTERS SELF-CONTAINED, SEALED MAINTENANCE FREE NICKEL CADMIUM BATTERIES	WALL OR CEILING MOUNT	N/A	LED	HOLOPHANE	LNTLL NC W SG S	120	4.8
D	BUILDING-MOUNTED LUMINAIRE WITH ALUMINUM HOUSING SEALED AGAINST MOISTURE AND ENVIRONMENTAL CONTAMINANTS 70 CRI, TYPE IV LIGHT DISTRIBUTION, HIGH EFFICIENCY LEDs w/ MOTION/AMBIENT LIGHT SENSOR, DARK BRONZE WITH BATTERY PACK	WALL MOUNT	N/A	LED 4000K CCT 2,000 LUMENS	LITHONIA	MRW LED P1 40K SR4 MVOLT PIR DDBXD E20WC	120	28.8

◇# KEY NOTES:

1. LUMINAIRE SHALL BE FACTORY LABELED PER 2019 BUILDING EFFICIENCY STANDARD SECTION 130.0(c).

ELECTRICAL HANDHOLE AND MANHOLE SCHEDULE

4/3/2023

TAG NO	MINIMUM INTERIOR DIMENSIONS (INCHES) WIDTH	LENGTH	DEPTH	CONSTRUCTION	TYPICAL DETAIL	SURFACE LOADING	COMMENTS
COUED-4	60	60	48	60" ROUND PRECAST		ROADWAY	COUED "504" CUSTOM CONSTRUCTION FOR MV VAULT
HH-1	60	60	60	PRECAST CONCRETE	EM056	ROADWAY	
HH-2	60	60	60	PRECAST CONCRETE	EM056	ROADWAY	
HH-3	60	60	60	PRECAST CONCRETE	EM056	ROADWAY	
HH-4	52	52	62	PRECAST CONCRETE	EM056	SIDEWALK	
HH-10	52	52	62	PRECAST CONCRETE	EM056	ROADWAY	
HH-11	44	44	54	PRECAST CONCRETE	EM056	ROADWAY	
MH-12	60	60	84	PRECAST CONCRETE	EM062	ROADWAY	
HH-13	44	44	54	PRECAST CONCRETE	EM056	ROADWAY	
HH-20	48	48	54	PRECAST CONCRETE	EM056	ROADWAY	
HH-21	48	48	54	PRECAST CONCRETE	EM056	ROADWAY	

NOTES:
1. SEE SPECIFICATION 02581 FOR PRECAST ELECTRICAL HANDHOLES AND MANHOLES.
2. ALTERNATES: PROVIDE PER TYPICAL DETAIL EM062 IF INDICATED UNDER "COMMENTS".

DISCONNECT SCHEDULE

11/17/2022

TAG	VOLTAGE	POLES	AMPS	NEMA TYPE	TYPE	HORSEPOWER	FUSE SIZE	BREAKER AF/AT	ACCESSORIES
B	600 VAC	3P	30A	4X-SS	NON-FUSED				
E	600 VAC	3P	60A	4X-SS	NON-FUSED				4
S	600 VAC	3P	200A	4X-SS	NON-FUSED				4
T	600 VAC	2P	60A	4X-SS	NON-FUSED				

ACCESSORIES
1= "B" TYPE ELECTRICAL INTERLOCK FOR POSITION INDICATION
2= INSULATED GROUNDABLE NEUTRAL KIT
3= DRAIN AND BREATHER KIT WHEN OUTDOORS
4= EARLY BREAK AUXILIARY CONTACT

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN CLH
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

carollo®

City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
LUMINAIRE, MANHOLE/HANDHOLE, AND DISCONNECT SCHEDULES

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 05E01
SHEET NO. 113 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1005E01.dgn

Plot Date: 12-JUL-2023 12:50:28 PM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
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STATE OF CALIFORNIA
Outdoor Lighting CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE		NRCC-LTO-E
Project Name:	Ukiah WTP - 2023	Report Page: (Page 1 of 8)
Project Address:		Date Prepared: 2023-03-22T19:54:39-04:00

This document is used to demonstrate compliance with requirements in 110.9, 130.0, 130.2, 140.7, and 141.0(b)2L for outdoor lighting scopes using the prescriptive path for nonresidential and hotel/motel occupancies. It is also used to document compliance with requirements in 160.5, 170.2(e)6, 180.1(a) and 180.2(b)4Bv for outdoor lighting scopes using the prescriptive path for multifamily and mixed-use occupancies. Multifamily includes dormitory and senior living facilities.

A. GENERAL INFORMATION

01	Project Location (city)	935 River St, Ukiah, CA	04	Total Illuminated Hardscape Area (ft²)	12500
02	Climate Zone	2			
03	Outdoor Lighting Zone per Title 24 Part 1 10.114 or as designated by Authority Having Jurisdiction (AHJ):				
☐	LZ-0: Very Low - Undeveloped Parkland	☐ LZ-2: Moderate - Urban Clusters	☐	LZ-4: High - Must be reviewed by CA Energy Commission for Approval	
☐	LZ-1: Low - Rural Areas	☒ LZ-3: Moderately High - Urban Areas			
05	Occupancy Types within Project				
•	All Other Occupancies				

B. PROJECT SCOPE

This table includes outdoor lighting systems that are within the scope of the permit application and are demonstrating compliance using the prescriptive path outlined in 140.7 / 170.2(e)6 or 141.0(b)2I, / 180.2(b)4Bv for alterations.

My Project Consists of:

01	02
☒ New Lighting System	Must Comply with Allowances from 140.7 / 170.2(e)6
☐ Altered Lighting System	Is your alteration increasing the connected lighting load (Watts)? ◯ Yes ◯ No

03	04	05
% of Existing Luminaires Being Altered[1]	Sum Total of Luminaires Being Added or Altered	Calculation Method
☐ < 10% ☐ >= 10% and < 50% ☐ >= 50%		

Please proceed to Table F. Outdoor Lighting Fixture Schedule to define the project's luminaires.

[1] *FOOTNOTES: % of Existing Luminaires Being Altered = (Sum Total of Luminaires Being Added or Altered / Existing Luminaires within the Scope of the Permit Application) x 100.*

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STATE OF CALIFORNIA
Outdoor Lighting CALIFORNIA ENERGY COMMISSION

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Project Name:	Ukiah WTP - 2023	Report Page: (Page 2 of 8)
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C. COMPLIANCE RESULTS

Results in this table are automatically calculated from data input and calculations in Tables F through N. Note: If any cell on this table says "COMPLIES with Exceptional Conditions" refer to Table D. Exceptional Conditions for guidance or see applicable Table referenced below.

Calculations of Total Allowed Lighting Power (Watts) 140.7 / 170.2(e)6 or 141.0(b)2L / 180.2(b)4Bv											Compliance Results		
01		02		03		04		05	OR	06		07	08	09
General Hardscape Allowance 140.7(d)1 / 170.2(e)6 (See Table I)	+	Per Application 140.7(d)2 / 170.2(e)6 (See Table J)	+	Sales Frontage 140.7(d)2 (See Table K)	+	Ornamental 140.7(d)2 / 170.2(e)6 (See Table L)	+	Per Specific Area 140.7(d)2 / 170.2(e)6 (See Table M)	OR	Existing Power Allowance 141.0(b)2I1 / 180.2(b)4Bv (See Table N)	=	**Total Allowed** (Watts)	≥	**Total Actual** (Watts)	**07 must be >= 08**
734.9	+	----	+	----	+	----	+	----	OR	----	=	734.9	≥	510	COMPLIES
Shielding Compliance (See Table G for Details)															COMPLIES
Controls Compliance (See Table H for Details)															COMPLIES

D. EXCEPTIONAL CONDITIONS

This table is auto-filled with uneditable comments because of selections made or data entered in tables throughout the form.

E. ADDITIONAL REMARKS

This table includes remarks made by the permit applicant to the Authority Having Jurisdiction.

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F. OUTDOOR LIGHTING FIXTURE SCHEDULE

For new or altered lighting systems demonstrating compliance with 140.7 / 170.2(e)6 all new luminaires being installed and any existing luminaires remaining or being moved within the spaces covered by the permit application are included in the Table below. For altered lighting systems using the Existing Power method per 141.0(b)2L only new luminaires being installed and replacement luminaires being installed as part of the project scope are included (ie, existing luminaires remaining or existing luminaires being moved are not included). Outdoor lighting attached to multifamily buildings and controlled from the inside of a dwelling unit are included in Table H. and are not included here. All other multifamily outdoor lighting is included here.

Designed Wattage:

01	02	03	04	05	06	07	08	09	10	
Name or Item Tag	Complete Luminaire Description	Watts per luminaire[1, 2]	How is Wattage determined	Total Number Luminaires [2]	Luminaire Status[3]	Excluded per 140.7(a) / 170.2(e)6A	Design Watts	Cutoff Req. > 6,200 initial lumen output - 130.2(b) / 160.5(c)1[4]	Field Inspector	
									Pass	Fail
A	AMERICAN ELECTRIC LIGHTING - ATBM P10 ☐ Linear	85	Mfr. Spec	6	New	☐	510	Provided	☐	☐
						Total Design Watts:	510			

* NOTES: Selections with a * require a note in the space below explaining how compliance is achieved.
EX: Luminaire is lighting a statue; EXCEPTION 2 to 130.2(b)

[1] *FOOTNOTES: Authority Having Jurisdiction may ask for Luminaire cut sheets to confirm wattage used for compliance per 130.0(c) / 160.5(b)*
[2] *For linear luminaires, wattage should be indicated as W/ft instead of Watts/luminaire. Total linear feet should be indicated in column 05 instead of number of luminaires.*
[3] *Select "New" for new luminaires in a new outdoor lighting project, or for added luminaires in an alteration. Select "Altered" for replacement luminaires in an alteration. Select "Existing to Remain" for existing luminaires within the project scope that are not being altered and are remaining. Select "Existing Reinstalled" for existing luminaires which are being removed and reinstalled as part of the project scope.*
[4] *Compliance with mandatory shielding requirements is required for luminaires with initial lumen output >= 6,200 unless exempted by 130.2(b)/ 160.5(c)*

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G. SHIELDING REQUIREMENTS (BUG)

This table includes fixtures of >=6,200 initial lumens indicated on Table F as needing to comply with Shielding Requirements. Maximum lumens can be found in Title 24, Part 11, Section 5.106.8.

01	02	03		04	05	06	07	08	09	10	11	12	
Name or Item Tag	Complete Luminaire Description	Backlight Rating[2]			Uplight Rating[2]			Glare Rating (Lumens)[2]				Field Inspector	
		Mounting Height[1]	Max Allowable Backlight Rating[3]	Backlight Rating Per Design	Lighting type	Max Allowable Uplight Rating[3]	Uplight Rating Per Design	Mounting Height[1]	Max Allowable Glare Rating[3]	Glare Rating Per Design	Pass	Fail
A	AMERICAN ELECTRIC LIGHTING - ATBM P10	2 MH from property line	No Limit	B2	Area Lighting	U0	U0	2 MH from property line	G3	G3	☐	☐

[1] *FOOTNOTES: Mounting Height is labeled MH in this table.*
[2] *Authority Having Jurisdiction may ask for Luminaire cut sheets or other documentation to confirm luminaire type, uplight ratings and glare ratings used for compliance per 130.2(b)/ 160.5(c)*
[3] *BUG ratings with a lower number than the 'Max Allowable' are compliant. Ex. If Max Allowable is Bug Rating B4, then B0, B1, B2 and B3 are all compliant.*

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H. OUTDOOR LIGHTING CONTROLS

This table demonstrates compliance with controls requirements for all new or altered luminaires installed as part of the permit application. For alteration projects, luminaires which are existing to remain (ie untouched) and luminaires which are removed and reinstalled (wiring only) do not need to be included in this table even if they are within the spaces covered by the permit application.
Outdoor lighting for nonresidential buildings, parking garages and common service areas in multifamily buildings must be documented separately from outdoor lighting attached to multifamily buildings and controlled from the inside of a dwelling unit

Mandatory Controls for Nonresidential Occupancies, Parking Garages & Common Areas in Multifamily Buildings

01	02	03	04	05	
Area Description	Shut-Off 130.2(c)1 / 160.5(c)	Auto-Schedule 130.2(c)2 / 160.5(c)	Motion Sensor 130.2(c)3 / 160.5(c)	Field Inspector	
				Pass	Fail
Pump Station and Recycled Water Storage: "A"	Astronomical Timer	NA: Not permitted by H&LS	NA: Industrial Sites Lighting	☐	☐

[1] *FOOTNOTE: Text has been abbreviated, please refer to Table 160.5-A to confirm compliance with the specific light source technologies listed.*
[2] *Authority having jurisdiction may ask for cutsheets or other documentation to confirm compliance of light source.*
[3] *Recessed luminaires marked for use in fire-rated installations, and recessed luminaires installed in non-insulated ceilings are excepted from ii and iii.*

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I. LIGHTING POWER ALLOWANCE (per 140.7 / 170.2(e))

This table includes areas using allowance calculations per 140.7 / 170.2(e). General Hardscape Allowance is per Table 140.7-A/Table 170.2-A while "Use it or lose it" Allowances are per Table 140.7-B /Table 170.2-S. Indicate which allowances are being used to expand sections for user input. Luminaires that qualify for one of the "Use it or lose it" allowances shall not qualify for another "Use it or lose it" allowance.
Outdoor lighting attached to multifamily buildings and controlled from the inside of a dwelling unit are included in Table H. and are not included here. All other multifamily outdoor lighting is included here.

	01				
		"Use it or lose it" Allowance (select all that apply) (select all that apply)			
☒ General Hardscape Allowance Table I (below)	☐ Per Application Table J	☐ Sales Frontage Table K	☐ Ornamental Table L	☐ Per Specific Area Table M

Calculated General Hardscape Lighting Power Allowance per Table 140.7-A for Nonresidential & Hotel/Motel

02	03	04	05	06	07	08	09
Area Description	Area Wattage Allowance (AWA)			Linear Wattage Allowance (LWA)			Total General AWA + LWA (Watts)
	Illuminated Area (ft²)	Allowed Density (W/ft²)	Area Allowance (Watts)	Perimeter Length (lf)	Allowed Density (W/lf)	Linear Allowance (Watts)	
Pump Station and Recycled Water Storage	12500	0.021	262.5	1112	0.2	222.4	484.9
Initial Wattage Allowance for Entire Site (Watts):							250
Instances of Initial Wattage Allowance (LZ 0 only)[1]							
Total General Hardscape Allowance (Watts):							734.9

J. LIGHTING ALLOWANCE: PER APPLICATION

This section does not apply to this project.

K. LIGHTING ALLOWANCE: SALES FRONTAGE

This section does not apply to this project.

L. LIGHTING ALLOWANCE: ORNAMENTAL

This section does not apply to this project.

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M. LIGHTING ALLOWANCE: PER SPECIFIC AREA

This section does not apply to this project.

N. EXISTING CONDITIONS POWER ALLOWANCE (alterations only)

This section does not apply to this project.

O. DECLARATION OF REQUIRED CERTIFICATES OF INSTALLATION

Form/Title
NRCI-LTO-E - Must be submitted for all buildings

P. DECLARATION OF REQUIRED CERTIFICATES OF ACCEPTANCE

Form/Title	Systems/Spaces To Be Field Verified
NRCA-LTO-02-A - Must be submitted for all outdoor lighting controls except for alterations where controls are added to <= 20 luminaires.	Pump Station and Recycled Water Storage: "A"

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CERTIFICATE OF COMPLIANCE		NRCC-LTO-E
Project Name:	Ukiah WTP - 2023	Report Page: (Page 8 of 8)
Project Address:	935 River St, Ukiah, CA 95482	Date Prepared: 2023-03-22T19:54:39-04:00

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT

I certify that this Certificate of Compliance documentation is accurate and complete.

Documentation Author Name: Hadi Rismanchi	Documentation Author Signature:
Company: Carollo Engineers	Signature Date: March 22, 2023
Address: 2795 Mitchell Drive	CEA/ HERS Certification Identification (if applicable):
City/State/Zip: Walnut Creek, CA 94598	Phone: 925-977-3112

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:
1. The information provided on this Certificate of Compliance is true and correct.
2. I am eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design or system design identified on this Certificate of Compliance (responsible designer)
3. The energy features and performance specifications, materials, components, and manufactured devices for the building design or system design identified on this Certificate of Compliance conform to the requirements of Title 24, Part 1 and Part 6 of the California Code of Regulations.
4. The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.
5. I will ensure that a completed signed copy of this Certificate of Compliance shall be made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a completed signed copy of this Certificate of Compliance is required to be included with the documentation the builder provides to the building owner at occupancy.

Responsible Designer Name: Erik Bahnemann	Responsible Designer Signature:
Company: Carollo Engineers	Date Signed: March 22, 2023
Address: 2795 Mitchell Drive	License: E-19683
City/State/Zip: Walnut Creek, CA 94598	Phone: 925 979 8710

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REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN PLK
CHECKED JGB
DATE JULY 2023

**
ORIGINAL
SEALED BY
ERIK M. BAHNEMAN
4/7/2023
CA PE NO. 19683
**

carollo®

City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
TITLE 24 COMPLIANCE SHEETS 1

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 05E02
SHEET NO. 114 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1005E02.dgn

STATE OF CALIFORNIA
Indoor Lighting
CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE			NRCC-LTI-E
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This document is used to demonstrate compliance with requirements in 110.9, 110.12(c), 130.0, 130.1, 140.6 and 141.0(b)2 for indoor lighting scopes using the prescriptive path for nonresidential and hotel/motel occupancies. It is also used to document compliance with requirements in 160.5, 170.2(e) and 180.2(b)4 for indoor lighting scopes using the prescriptive path for multifamily occupancies. Multifamily includes dormitory and senior living facilities.

A. GENERAL INFORMATION

01	Project Location (city)	935 River St, Ukiah, CA	04	Total Conditioned Floor Area (ft²)	273
02	Climate Zone	2	05	Total Unconditioned Floor Area (ft²)	0
03	Occupancy Types Within Project (select all that apply):		06	# of Stories (Habitable Above Grade)	1

● All Other Occupancies

B. PROJECT SCOPE

This table includes any lighting systems that are within the scope of the permit application and are demonstrating compliance using the prescriptive path outlined in 140.6 / 170.2(e) or 141.0(b)2 / 180.2(b)4 for alterations.

Scope of Work	Conditioned Spaces		Unconditioned Spaces	
01	02	03	04	05
My Project Consists of (check all that apply):	Calculation Method	Area (ft²)	Calculation Method	Area (ft²)
☒ New Lighting System	Area Category Method	273	N/A	0
☐ New Lighting System - Parking Garage	N/A	0	N/A	0
Total Area of Work (ft²)	273			

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C. COMPLIANCE RESULTS

If any cell on this table says "DOES NOT COMPLY" or "COMPLIES with Exceptional Conditions" refer to Table D. for guidance.

Lighting in conditioned and unconditioned spaces must not be combined for compliance per 140.6(b)1 / 170.2(e)	Allowed Lighting Power per 140.6(b) / 170.2(e) (Watts)						Adjusted Lighting Power per 140.6(a) / 170.2(e) (Watts)				Compliance Results
	01	02	03	04	05		06	07		08	09
	Complete Building 140.6(c)1	Area Category 140.6(c)2 / 170.2(e)4A	Area Category Additional 140.6(c)2G / 170.2(e)4Av (+)	Tailored 140.6(c)3 / 170.2(e)4B (+)	**Total Allowed** (Watts)		Total Designed (Watts)	Adjustments PAF Lighting Control Credits) 140.6(a)2 / 170.2(e)1B (-)	=	**Total Adjusted** (Watts) *Includes Adjustments	**05 must be >= 08 140.6 / 170.2(e)**
	(See Table I)	(See Table I)	(See Table J)	(See Table K)			(See Table F)	(See Table P)			
Conditioned		163.8	54.6		= 218.4	≥	213		=	213	COMPLIES
Unconditioned					=	≥			=		
Controls Compliance (See Table H for Details)											COMPLIES
Rated Power Reduction Compliance (See Table Q for Details)											

D. EXCEPTIONAL CONDITIONS

This table is auto-filled with uneditable comments because of selections made or data entered in tables throughout the form.

E. ADDITIONAL REMARKS

This table includes remarks made by the permit applicant to the Authority Having Jurisdiction.

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F. INDOOR LIGHTING FIXTURE SCHEDULE

This table includes all planned permanent and portable lighting other than dwelling unit/ hotel/ motel room lighting. Multifamily dwelling unit and hotel/motel room lighting is documented in Table T. If using Table T to document lighting in multifamily common use areas providing shared provisions for living, eating, cooking or sanitation, those luminaires are not included here.

Designed Wattage: Conditioned Spaces

01	02	03	04	05	06	07	08	09	10	
Name or Item Tag	Complete Luminaire Description	Modular (Track) Fixture	Small Aperture & Color Change[1]	Watts per luminaire[2]	How is Wattage determined	Total Number of Luminaires	Excluded per 140.6(a)3 / 170.2(e)2C	Design Watts	Field Inspector	
									Pass	Fail
B	HOLOPHANE , EVT4 6000LM PCL	No	NA	71	Mfr. Spec	3	No	213	☐	☐
Total Designed Watts: CONDITIONED SPACES								213		

[1]*FOOTNOTE: Design Watts for small aperture and color changing luminaires which qualify per 140.6(a)4B / 170.2(e)2D is adjusted to be 75% /80% of their rated wattage. Table F automatically makes this adjustment, the permit applicant should enter full rated wattage in column 05.*

[2]*Authority Having Jurisdiction may ask for Luminaire cut sheets to confirm wattage used for compliance per 130.0(c) / 160.5(b). Wattage used must be the maximum rated for the luminaire, not the lamp.*

G. MODULAR LIGHTING SYSTEMS

This section does not apply to this project.

H. INDOOR LIGHTING CONTROLS (Not including PAFs)

This table includes lighting controls for conditioned and unconditioned spaces.

Building Level Controls

01	02	03	
		Field Inspector	
Mandatory Demand Response 110.12(c)	Shut-off controls 130.1(c) / 160.5(b)4C	Pass	Fail
NA < 4,000W subject to multilevel	See Area/Space Level Controls	☐	☐

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H. INDOOR LIGHTING CONTROLS (Not including PAFs)

Area Level Controls

04	05	06	07	08	09	10	11	12	
Area Description	Complete Building or Area Category Primary Function Area	Manual Area Controls 130.1(a) / 160.5(b)4A	Multi-Level Controls 130.1(b) / 160.5(b)4B	Shut-Off Controls 130.1(c) // 160.5(b)4C	Primary/Sky lit Daylighting 130.1(d) / 160.5(b)4D	Secondary Daylighting 130.1(d) / 160.5(b)4D	Interlocked Systems 140.6(a)1/ 170.2(e)2A	Field Inspector	
								Pass	Fail
Pump Station Electrical & Control Building	General Commercial Industrial Work AreaLow Bay	Readily Accessible	Dimmer	NA: Elec. equip. rm	NA: Not daylit zone	NA: Not daylit zone	No	☐	☐
							13		
							Plan Sheet Showing Daylit Zones:		

I. LIGHTING POWER ALLOWANCE: COMPLETE BUILDING OR AREA CATEGORY METHODS

Each area complying using the Complete Building or Area Category Methods per 140.6(b) are included in this table. Column 06 indicates if additional lighting power allowances per 140.6(c) or adjustments per 140.6(a) are being used .

Conditioned Spaces

01	02	03	04	05	06	
Area Description	Complete Building or Area Category Primary Function Area	Allowed Density (W/ft²)	Area (ft²)	Allowed Wattage (Watts)	Additional Allowance / Adjustment	
					Area Category	PAF
Pump Station Electrical & Control Building	General Commercial Industrial Work AreaLow Bay	0.6	273	163.8	Yes	No
		TOTALS:	273	163.8	See Tables J, or P for detail	

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J. ADDITIONAL ALLOWANCE: AREA CATEGORY METHOD QUALIFYING LIGHTING SYSTEM

All areas indicated in Table I as using an additional allowance using the Area Category Method have been included in this table to calculate the additional allowance per Table 140.6-C /170.2-M

Conditioned Spaces

01	02	03	04	05	06	07	08	09	10
Area Description	Primary Function Area	Applicable Qualifying Lighting System from Table 140.6-C	Allowed Density (W/ft² or W/Lm/ft)	Ltg Area, Length or ATM/Mirror (ft², lf or #)	Extra Allowance (Watts)	Luminaire Name or Item Tag	Watts per Luminaire	Number of Luminaires	Total Design Watts
Pump Station Electrical & Control Building	General Commercial Industrial Work AreaLow Bay	DetailedTaskA	0.2	273	54.6	B	71	3	213

Total Design Watts	Calculated Allowance (Watts):	Total Additional Allowance for this area:
213	54.6	54.6
11		
Total Additional Allowance (Watts) CONDITIONED SPACES		54.6

K. TAILORED METHOD GENERAL LIGHTING POWER ALLOWANCE

This section does not apply to this project.

L. ADDITIONAL LIGHTING ALLOWANCE: TAILORED WALL DISPLAY

This section does not apply to this project.

M. ADDITIONAL LIGHTING ALLOWANCE: TAILORED FLOOR AND TASK LIGHTING

This section does not apply to this project.

Registration Number:
CA Building Energy Efficiency Standards - 2022 Nonresidential Compliance
Generated Date/Time:
Report Version: 2022.0.000
Schema Version: rev 20220101
Documentation Software: Energy Code Ace
Compliance ID: 95607-0323-0002
Report Generated: 2023-03-22 16:33:52

STATE OF CALIFORNIA
Indoor Lighting
CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE			NRCC-LTI-E
Project Name:	Ukiah WTP - 2023	Report Page:	(Page 6 of 8)
		Date Prepared:	2023-03-22T19:33:49-04:00

N. ADDITIONAL LIGHTING ALLOWANCE: TAILORED DECORATIVE /SPECIAL EFFECTS

This section does not apply to this project.

O. ADDITIONAL LIGHTING ALLOWANCE: TAILORED VERY VALUABLE MERCHANDISE

This section does not apply to this project.

P. POWER ADJUSTMENT: LIGHTING CONTROL CREDIT (POWER ADJUSTMENT FACTOR (PAF))

This section does not apply to this project.

Q. RATED POWER REDUCTION COMPLIANCE FOR ONE-FOR-ONE ALTERATIONS

This section does not apply to this project.

R. 80% LIGHTING POWER FOR ALL ALTERATIONS - CONTROLS EXCEPTIONS

This section does not apply to this project.

S. DAYLIGHT DESIGN POWER ADJUSTMENT FACTOR (PAF)

This section does not apply to this project.

T. DWELLING UNIT LIGHTING

This section does not apply to this project.

Registration Number:
CA Building Energy Efficiency Standards - 2022 Nonresidential Compliance
Generated Date/Time:
Report Version: 2022.0.000
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Documentation Software: Energy Code Ace
Compliance ID: 95607-0323-0002
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STATE OF CALIFORNIA
Indoor Lighting
CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE			NRCC-LTI-E
Project Name:	Ukiah WTP - 2023	Report Page:	(Page 7 of 8)
		Date Prepared:	2023-03-22T19:33:49-04:00

U. DECLARATION OF REQUIRED CERTIFICATES OF INSTALLATION

Form/Title
NRCI-LTI-E - Must be submitted for all buildings

V. DECLARATION OF REQUIRED CERTIFICATES OF ACCEPTANCE

There are no NRCA forms required for this project.

Registration Number:
CA Building Energy Efficiency Standards - 2022 Nonresidential Compliance
Generated Date/Time:
Report Version: 2022.0.000
Schema Version: rev 20220101
Documentation Software: Energy Code Ace
Compliance ID: 95607-0323-0002
Report Generated: 2023-03-22 16:33:52

STATE OF CALIFORNIA
Indoor Lighting
CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE			NRCC-LTI-E
Project Name:	Ukiah WTP - 2023	Report Page:	(Page 8 of 8)
Project Address:	935 River St, Ukiah, CA 95482	Date Prepared:	2023-03-22T19:33:49-04:00

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT

I certify that this Certificate of Compliance documentation is accurate and complete.

Documentation Author Name: Hadi Rismanchi	Documentation Author Signature:
Company: Carollo Engineers	Signature Date: March 22, 2023
Address: 2795 Mitchell Drive	CEA/ HERS Certification Identification (if applicable):
City/State/Zip: Walnut Creek, CA 94598	Phone: 925-977-3112

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Compliance is true and correct.
2. I am eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design or system design identified on this Certificate of Compliance (responsible designer)
3. The energy features and performance specifications, materials, components, and manufactured devices for the building design or system design identified on this Certificate of Compliance conform to the requirements of Title 24, Part 1 and Part 6 of the California Code of Regulations.
4. The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.
5. I will ensure that a completed signed copy of this Certificate of Compliance shall be made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a completed signed copy of this Certificate of Compliance is required to be included with the documentation the builder provides to the building owner at occupancy.

Responsible Designer Name: Erik Bahnemen	Responsible Designer Signature:
Company: Carollo Engineers	Date Signed: March 22, 2023
Address: 2795 Mitchell Drive	License: E-19683
City/State/Zip: Walnut Creek, CA 94598	Phone: 925 979 8710

Registration Number:
CA Building Energy Efficiency Standards - 2022 Nonresidential Compliance
Generated Date/Time:
Report Version: 2022.0.000
Schema Version: rev 20220101
Documentation Software: Energy Code Ace
Compliance ID: 95607-0323-0002
Report Generated: 2023-03-22 16:33:52

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN PLK
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

carollo®

City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
TITLE 24 COMPLIANCE SHEETS 2

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 05E03
SHEET NO. 115 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1005E03.dgn

STATE OF CALIFORNIA
Outdoor Lighting CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE		NRCC-LTO-E
Project Name:	Ukiah WWTP - 2023	Report Page: (Page 1 of 7)
Project Address:		Date Prepared: 2023-03-22T19:27:20-04:00

A. GENERAL INFORMATION

01	Project Location (city)	300 Plant Rd, Ukiah, CA	04	Total Illuminated Hardscape Area (ft²)	8431
02	Climate Zone	2			
03	Outdoor Lighting Zone per Title 24 Part 1 10.114 or as designated by Authority Having Jurisdiction (AHJ):				
☐	LZ-0: Very Low - Undeveloped Parkland	☐ LZ-2: Moderate - Urban Clusters	☐ LZ-4: High - Must be reviewed by CA Energy Commission for Approval		
☐	LZ-1: Low - Rural Areas	☒ LZ-3: Moderately High - Urban Areas			
05	Occupancy Types within Project				
• All Other Occupancies					

B. PROJECT SCOPE

This table includes outdoor lighting systems that are within the scope of the permit application and are demonstrating compliance using the prescriptive path outlined in 140.7 / 170.2(e)6i or 141.0(b)2i. / 180.2(b)4iBv for alterations.

My Project Consists of:

01	07		
☒ New Lighting System	Must Comply with Allowances from 140.7 / 170.2(e)6		
☐ Altered Lighting System	Is your alteration increasing the connected lighting load (Watts)?	Yes	No
03	04	05	
% of Existing Luminaires Being Altered[1]	Sum Total of Luminaires Being Added or Altered	Calculation Method	
☐ < 10% ☐ >= 10% and < 50% ☐ >= 50%			

Please proceed to Table F. Outdoor Lighting Fixture Schedule to define the project's luminaires.

[1] *FOOTNOTES: % of Existing Luminaires Being Altered = (Sum Total of Luminaires Being Added or Altered / Existing Luminaires within the Scope of the Permit Application) x 100.*

Registration Number: | Generated Date/Time: | Documentation Software: Energy Code Ace
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STATE OF CALIFORNIA
Outdoor Lighting CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE		NRCC-LTO-E
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C. COMPLIANCE RESULTS

Results in this table are automatically calculated from data input and calculations in Tables F through N. Note: If any cell on this table says "COMPLIES with Exceptional Conditions" refer to Table D. Exceptional Conditions for guidance or see applicable Table referenced below.

Calculations of Total Allowed Lighting Power (Watts) 140.7 / 170.2(e)6 or 141.0(b)2L / 180.2(b)4Bv											Compliance Results		
01		02		03		04		05		06	07	08	09
General Hardscape Allowance 140.7(d)1 / 170.2(e)6i (See Table I)	+	Per Application 140.7(d)2 / 170.2(e)6i (See Table J)	+	Sales Frontage 140.7(d)2 (See Table K)	+	Ornamental 140.7(d)2 / 170.2(e)6i (See Table L)	+	Per Specific Area 140.7(d)2 / 170.2(e)6i (See Table M)	OR	Existing Power Allowance 141.0(b)2L / 180.2(b)4Bv (See Table N)	= **Total Allowed** (Watts)	≥ **Total Actual** (Watts)	**07 must be >= 08**
524.85	+	----	+	----	+	----	+	----	OR	----	= 524.85	≥ 0	COMPLIES
Shielding Compliance (See Table G for Details)													COMPLIES
Controls Compliance (See Table H for Details)													COMPLIES

D. EXCEPTIONAL CONDITIONS

This table is auto-filled with uneditable comments because of selections made or data entered in tables throughout the form.

E. ADDITIONAL REMARKS

This table includes remarks made by the permit applicant to the Authority Having Jurisdiction.

Registration Number: | Generated Date/Time: | Documentation Software: Energy Code Ace
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STATE OF CALIFORNIA
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CERTIFICATE OF COMPLIANCE		NRCC-LTO-E
Project Name:	Ukiah WWTP - 2023	Report Page: (Page 3 of 7)
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F. OUTDOOR LIGHTING FIXTURE SCHEDULE

For new or altered lighting systems demonstrating compliance with 140.7 / 170.2(e)6 all new luminaires being installed and any existing luminaires remaining or being moved within the spaces covered by the permit application are included in the Table below. For altered lighting systems using the Existing Power method per 141.0(b)2L only new luminaires being installed and replacement luminaires being installed as part of the project scope are included (ie, existing luminaires remaining or existing luminaires being moved are not included). Outdoor lighting attached to multifamily buildings and controlled from the inside of a dwelling unit are included in Table H. and are not included here. All other multifamily outdoor lighting is included here.

Designed Wattage:

01	02		03	04	05	06	07	08	09	10	
Name or Item Tag	Complete Luminaire Description		Watts per luminaire[1, 2]	How is Wattage determined	Total Number Luminaires[2]	Luminaire Status[3]	Excluded per 140.7(a) / 170.2(e)6iA	Design Watts	Cutoff Req. > 6,200 initial lumen output 130.2(b) / 160.5(c)1[4]	Field Inspector	
										Pass	Fail
A	AMERICAN ELECTRIC LIGHTING - ATBM P10	☐ Linear	85	Mfr. Spec	4	New	☒	---	Provided	☐	☐
							Total Design Watts:	0			

* NOTES: Selections with a * require a note in the space below explaining how compliance is achieved.
EX: Luminaire is lighting a statue; EXCEPTION 2 to 130.2(b)

[1] *FOOTNOTES: Authority Having Jurisdiction may ask for Luminaire cut sheets to confirm wattage used for compliance per 130.0(c) / 160.5(b)*
[2] *For linear luminaires, wattage should be indicated as W/ft instead of Watts/luminaire. Total linear feet should be indicated in column 05 instead of number of luminaires.*
[3] *Select "New" for new luminaires in a new outdoor lighting project, or for added luminaires in an alteration. Select "Altered" for replacement luminaires in an alteration. Select "Existing to Remain" for existing luminaires within the project scope that are not being altered and are remaining. Select "Existing Reinstalled" for existing luminaires which are being removed and reinstalled as part of the project scope.*
[4] *Compliance with mandatory shielding requirements is required for luminaires with initial lumen output >= 6,200 unless exempted by 130.2(b)/ 160.5(c)*

G. SHIELDING REQUIREMENTS (BUG)

This section does not apply to this project.

Registration Number: | Generated Date/Time: | Documentation Software: Energy Code Ace
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STATE OF CALIFORNIA
Outdoor Lighting CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE		NRCC-LTO-E
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H. OUTDOOR LIGHTING CONTROLS

This table demonstrates compliance with controls requirements for all new or altered luminaires installed as part of the permit application. For alteration projects, luminaires which are existing to remain (ie untouched) and luminaires which are removed and reinstalled (wiring only) do not need to be included in this table even if they are within the spaces covered by the permit application.
Outdoor lighting for nonresidential buildings, parking garages and common service areas in multifamily buildings must be documented separately from outdoor lighting attached to multifamily buildings and controlled from the inside of a dwelling unit

Mandatory Controls for Nonresidential Occupancies, Parking Garages & Common Areas in Multifamily Buildings

01	02	03	04	05	
Area Description	Shut-Off 130.2(c)1 / 160.5(c)	Auto-Schedule 130.2(c)2 / 160.5(c)	Motion Sensor 130.2(c)3 / 160.5(c)	Field Inspector	
				Pass	Fail
PAU Pump Station: "A"	Astronomical Timer	NA: Not permitted by H&LS	NA: Industrial Sites Lighting	☐	☐
PAU Pump Station: "A"	Astronomical Timer	NA: Not permitted by H&LS	NA: Industrial Sites Lighting	☐	☐

[1] *FOOTNOTE: Text has been abbreviated, please refer to Table 160.5-A to confirm compliance with the specific light source technologies listed.*
[2] *Authority having jurisdiction may ask for cutsheets or other documentation to confirm compliance of light source.*
[3] *Recessed luminaires marked for use in fire-rated installations, and recessed luminaires installed in non-insulated ceilings are excepted from ii and iii.*

Registration Number: | Generated Date/Time: | Documentation Software: Energy Code Ace
CA Building Energy Efficiency Standards - 2022 Nonresidential Compliance | Report Version: 2022.0.000 Schema Version: rev 20220101 | Compliance ID: 95576-0323-0002 Report Generated: 2023-03-22 16:27:22

STATE OF CALIFORNIA
Outdoor Lighting CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE		NRCC-LTO-E
Project Name:	Ukiah WWTP - 2023	Report Page: (Page 5 of 7)
		Date Prepared: 2023-03-22T19:27:20-04:00

I. LIGHTING POWER ALLOWANCE (per 140.7 / 170.2(e))

This table includes areas using allowance calculations per 140.7 / 170.2(e). General Hardscape Allowance is per Table 140.7-A/Table 170.2-R while "Use it or lose it" Allowances are per Table 140.7-B /Table 170.2-S. Indicate which allowances are being used to expand sections for user input. Luminaires that qualify for one of the "Use it or lose it" allowances shall not qualify for another "Use it or lose it" allowance. Outdoor lighting attached to multifamily buildings and controlled from the inside of a dwelling unit are included in Table H. and are not included here. All other multifamily outdoor lighting is included here.

01					
	"Use it or lose it" Allowance (select all that apply) (select all that apply)				
☒ General Hardscape Allowance Table I (below)	☐ Per Application Table J	☐ Sales Frontage Table K	☐ Ornamental Table L	☐ Per Specific Area Table M	

Calculated General Hardscape Lighting Power Allowance per Table 140.7-A for Nonresidential & Hotel/Motel

02	03	04	05	06	07	08	09
Area Description	Area Wattage Allowance (AWA)			Linear Wattage Allowance (LWA)			Total General AWA + LWA (Watts)
	Illuminated Area (ft²)	Allowed Density (W/ft²)	Area Allowance (Watts)	Perimeter Length (lf)	Allowed Density (W/lf)	Linear Allowance (Watts)	
PAU Pump Station	1310	0.021	27.51	145	0.2	29	56.51
Carousel Pump Station	7121	0.021	149.54	344	0.2	68.8	218.34
						Initial Wattage Allowance for Entire Site (Watts):	250
						Instances of Initial Wattage Allowance (LZ 0 only)[1]	
						Total General Hardscape Allowance (Watts):	524.85

J. LIGHTING ALLOWANCE: PER APPLICATION

This section does not apply to this project.

K. LIGHTING ALLOWANCE: SALES FRONTAGE

This section does not apply to this project.

L. LIGHTING ALLOWANCE: ORNAMENTAL

This section does not apply to this project.

Registration Number: | Generated Date/Time: | Documentation Software: Energy Code Ace
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STATE OF CALIFORNIA
Outdoor Lighting CALIFORNIA ENERGY COMMISSION

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M. LIGHTING ALLOWANCE: PER SPECIFIC AREA

This section does not apply to this project.

N. EXISTING CONDITIONS POWER ALLOWANCE (alterations only)

This section does not apply to this project.

O. DECLARATION OF REQUIRED CERTIFICATES OF INSTALLATION

Form/Title
NRCI-LTO-E - Must be submitted for all buildings

P. DECLARATION OF REQUIRED CERTIFICATES OF ACCEPTANCE

Form/Title	Systems/Spaces To Be Field Verified
NRCA-LTO-02-A - Must be submitted for all outdoor lighting controls except for alterations where controls are added to <= 20 luminaires.	PAU Pump Station: "A"; PAU Pump Station: "A"

Registration Number: | Generated Date/Time: | Documentation Software: Energy Code Ace
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STATE OF CALIFORNIA
Outdoor Lighting CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE		NRCC-LTO-E
Project Name:	Ukiah WWTP - 2023	Report Page: (Page 7 of 7)
Project Address: 300 Plant Rd, Ukiah, CA 95482		Date Prepared: 2023-03-22T19:27:20-04:00

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT

I certify that this Certificate of Compliance documentation is accurate and complete.

Documentation Author Name:	Documentation Author Signature:
Hadi Rismanchi	
Company: Carollo Engineers	Signature Date: March 22, 2023
Address: 2795 Mitchell Drive	CEA/ HERS Certification Identification (if applicable):
City/State/Zip: Walnut Creek, CA 94598	Phone: 925-977-3152

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Compliance is true and correct.
2. I am eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design or system design identified on this Certificate of Compliance (responsible designer)
3. The energy features and performance specifications, materials, components, and manufactured devices for the building design or system design identified on this Certificate of Compliance conform to the requirements of Title 24, Part 1 and Part 6 of the California Code of Regulations.
4. The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.
5. I will ensure that a completed signed copy of this Certificate of Compliance shall be made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a completed signed copy of this Certificate of Compliance is required to be included with the documentation the builder provides to the building owner at occupancy.

Responsible Designer Name:	Responsible Designer Signature:
Erik Bahneman	
Company: Carollo Engineers	Date Signed: March 22, 2023
Address: 2795 Mitchell Drive	License: E-19683
City/State/Zip: Walnut Creek, CA 94598	Phone: 925 979 8710

Registration Number: | Generated Date/Time: | Documentation Software: Energy Code Ace
CA Building Energy Efficiency Standards - 2022 Nonresidential Compliance | Report Version: 2022.0.000 Schema Version: rev 20220101 | Compliance ID: 95576-0323-0002 Report Generated: 2023-03-22 16:27:22

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN PLK
CHECKED JGB
DATE JULY 2023

**
ORIGINAL
SEALED BY
ERIK M. BAHNEMAN
4/7/2023
CA PE NO. 19683
**

carollo®

City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
TITLE 24 COMPLIANCE SHEETS 3

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

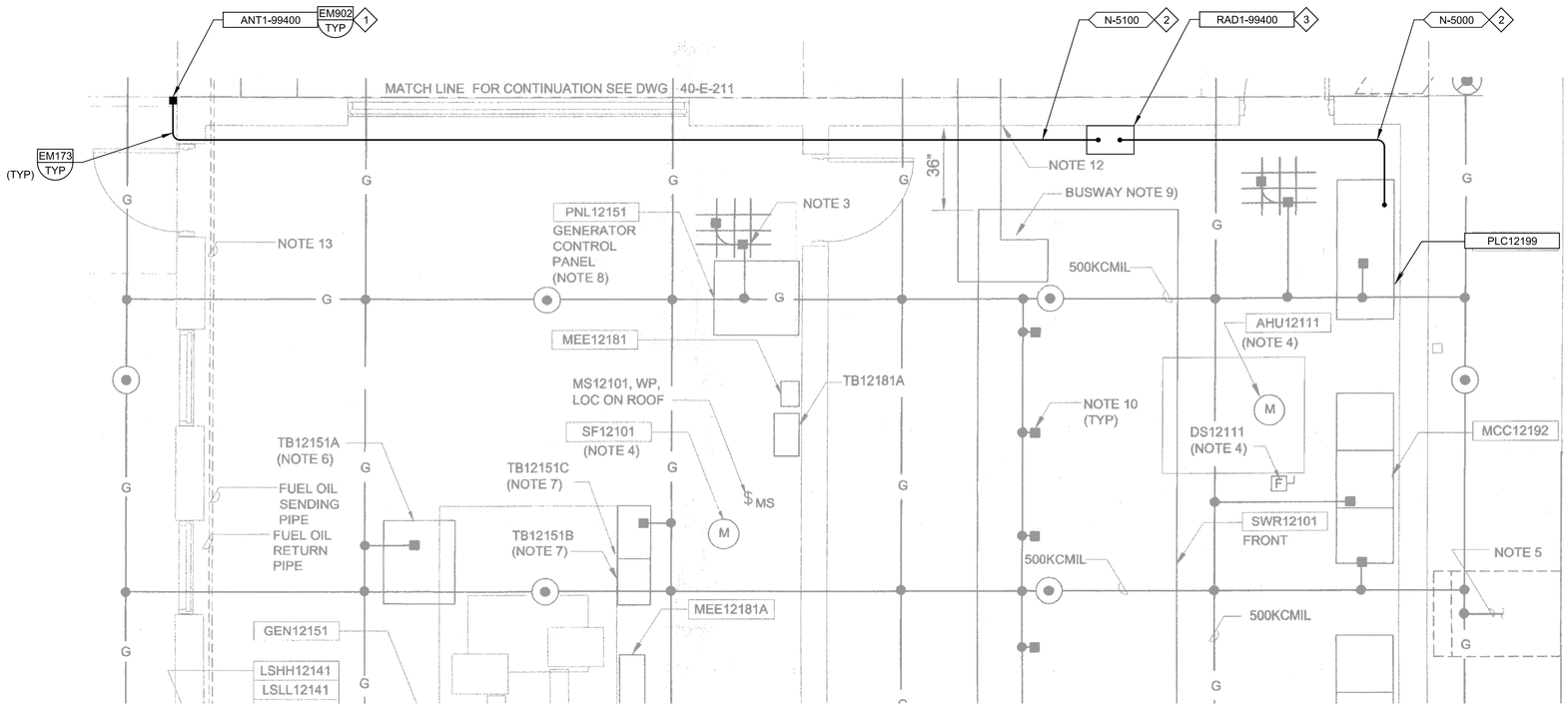
JOB NO. 8660F.10
DRAWING NO. 05E04
SHEET NO. 116 OF 200

GENERAL NOTES:

1. EXISTING EQUIPMENT LOCATIONS AND SIZES ARE FROM OWNER RECORD DRAWINGS, AND MAY NOT REFLECT EXACT LOCATIONS AND SIZES FOR EXISTING EQUIPMENT IN FIELD. CONTRACTOR SHALL FIELD VERIFY WHERE NEEDED.
2. REFER TO NETWORK BLOCK DIAGRAM DRAWING 04N01 FOR ADDITIONAL INFORMATION WITH REGARDS TO RADIO EQUIPMENT INSTALLATION.

KEY NOTES:

1. MOUNT ANTENNA MAST POLE ON WALL WITH PREFORMED CHANNEL. WALL ATTACHMENT SHALL BE ACCORDING TO EA080/TYP. PROVIDE MINIMUM TWO POINT OF SUPPORT FOR MAST POLE.
2. SUPPORT CONDUIT ON WALL WITH PREFORMED CHANNEL ACCORDING TO EA080/TYP.
3. COORDINATE THE EXACT LOCATION FOR RADIO PANEL WITH OWNER. SIZE RADIO PANEL ACCORDING TO RADIO EQUIPMENT DIMENSIONS AND MANUFACTURER RECOMMENDATIONS. RADIO PANEL MINIMUM DIMENSIONS SHALL BE 20" H x 20" W x 12" D.



A 01E02 **PLAN**
SCALE:
FILE: 8660F1012E0101

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN PLK
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

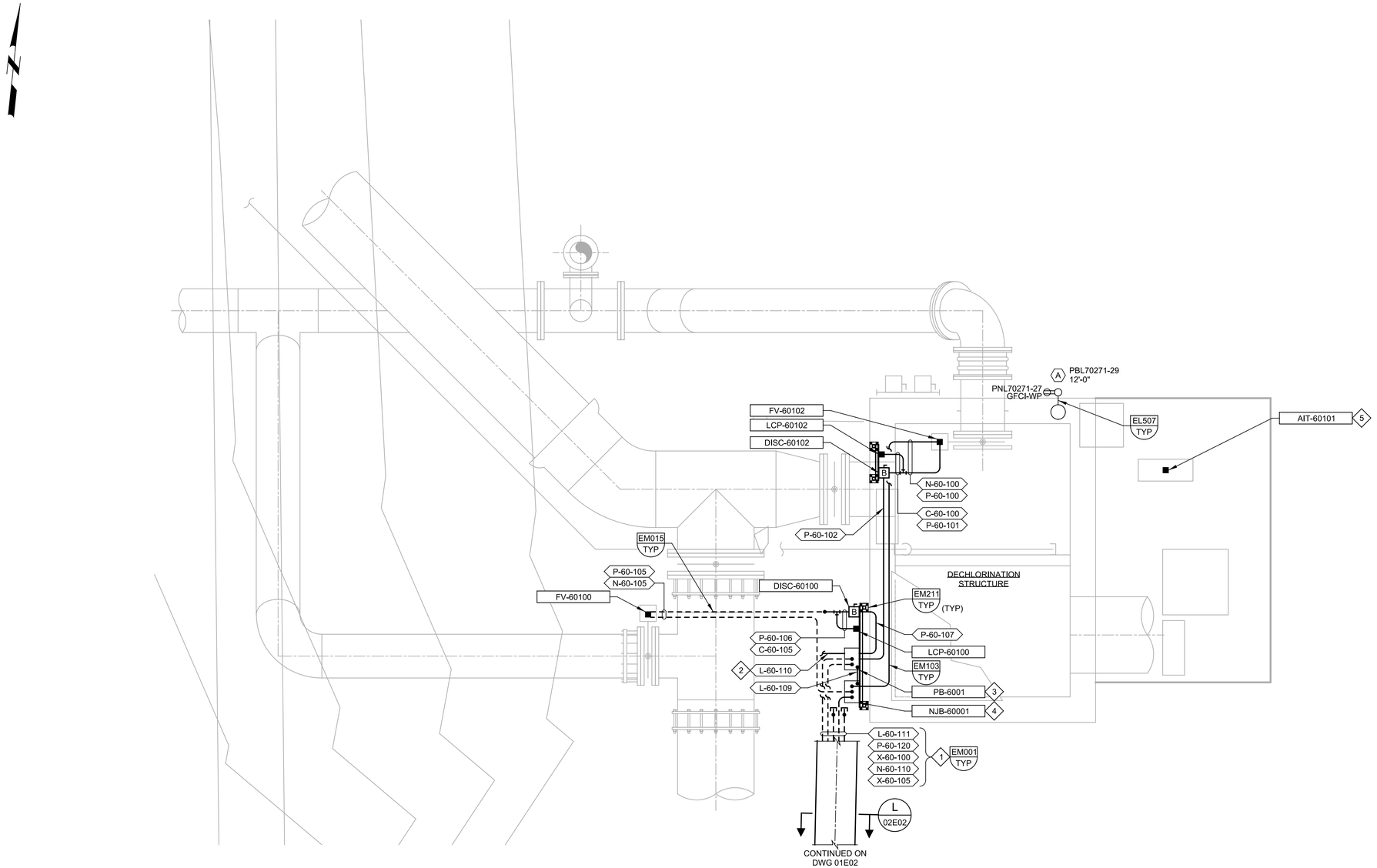
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City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
POWER GENERATION BUILDING
PARTIAL COMMUNICATION PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 12E01
SHEET NO. 117 OF 200



A PLAN
01E02
SCALE: 3/8" = 1'-0"
FILE: 8660F1060E0101

GENERAL NOTES:

1. EXISTING EQUIPMENT LOCATIONS AND SIZES ARE FROM OWNER RECORD DRAWINGS, AND MAY NOT REFLECT EXACT LOCATIONS AND SIZES FOR EXISTING EQUIPMENT IN FIELD. CONTRACTOR SHALL FIELD VERIFY WHERE NEEDED.
2. CONDUIT ROUTING FOR LIGHTING AND RECEPTACLE IS NOT SHOWN. USE THE PROCESS POWER AND CONTROL CONDUIT ROUTING AS A GUIDE TO INSTALL LIGHTING AND RECEPTACLE CONDUITS AND WIRING IN A SIMILAR MANNER.
3. LIGHTING AND RECEPTACLE CONDUITS, AND CONDUIT FITTINGS TYPES SHALL BE THE SAME AS THOSE FOR THE PROCESS POWER AND CONTROL CONDUIT INSTALLATION WITHIN THE SAME AREA.
4. CONDUCTORS FOR LIGHTING AND RECEPTACLE CIRCUITS SHALL BE SIZED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE, AND SHALL BE RATED TO ACCOUNT FOR MULTIPLE CONDUCTORS IN THE SAME RACEWAY FOR VOLTAGE DROP.
5. LIGHTING AND RECEPTACLE CONDUITS SHALL BE SIZED IN ACCORDANCE WITH THE CONDUIT FILL REQUIREMENTS IN THE SPECIFICATIONS. CONDUIT SHALL NOT BE SMALLER THAN 3/4".

(#) KEY NOTES:

1. PROVIDE EXPANSION FITTINGS FOR ALL CONDUITS TRANSITIONING BETWEEN DUCT BANK TO EXPOSED ROUTING ACCORDING TO DETAIL EM219/TYP.
2. TO LIGHTING FIXTURES AND RECEPTACLES.
3. POWER AND CONTROL PULL BOX. SIZE PULL BOX ACCORDING TO NEC. PULL BOX MINIMUM SIZE SHALL BE 12"W X 8"D X 12"H.
4. REFER TO DRAWING 04N03 FOR NETWORK JUNCTION BOX INTERNAL WIRING AND DEVICE INFORMATION. SIZE NETWORK JUNCTION BOX ACCORDING TO NEC.
5. MOUNT NEW ANALYZER UNIT INSIDE THE EXISTING CABINET, ON EQUIPMENT MOUNTING STAND, AND RECONNECT EXISTING POWER AND SIGNAL CIRCUITS TO THE NEW UNIT.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN ASH
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

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City of Ukiah

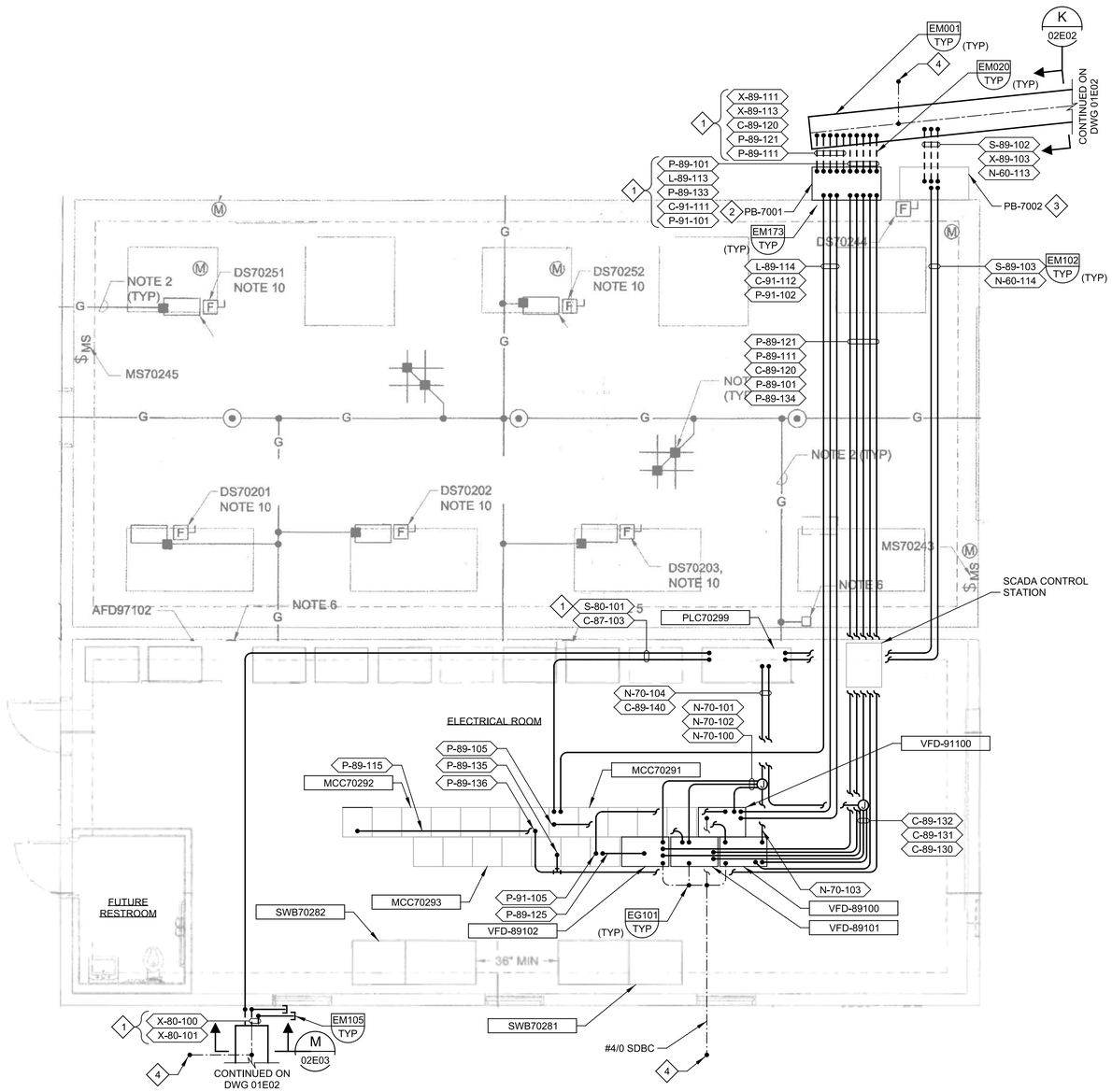
CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
DECHLORINATION STRUCTURE
POWER, CONTROL AND LIGHTING PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 60E01
SHEET NO. 118 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1060E01.dgn

Plot Date: 12-JUL-2023 12:49:57 PM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: avates



A PLAN
01E02
SCALE: 1/4" = 1'-0"
FILE: 8660F1001E0101

GENERAL NOTES:

1. EXISTING EQUIPMENT LOCATIONS AND SIZES ARE FROM OWNER RECORD DRAWINGS, AND MAY NOT REFLECT EXACT LOCATIONS AND SIZES FOR EXISTING EQUIPMENT IN FIELD. CONTRACTOR SHALL FIELD VERIFY WHERE NEEDED.
2. PROVIDE EQUIPMENT HOUSEKEEPING PAD FOR NEW FLOOR MOUNTED ELECTRICAL EQUIPMENT ACCORDING TO DETAIL S350/TYP.

KEY NOTES:

1. PROVIDE EXPANSION FITTINGS FOR ALL CONDUITS TRANSITIONING BETWEEN DUCT BANK TO EXPOSED ROUTING ACCORDING TO DETAIL EM219/TYP.
2. POWER AND CONTROL PULL BOX. SIZE PULL BOX ACCORDING TO NEC. PULL BOX MINIMUM SIZE SHALL BE 36"W X 26"D X 36"H. MOUNT PULL BOX ON THE EXTERIOR WALL OF THE DAFT BUILDING.
3. EXISTING SIGNAL AND COMMUNICATION PULL BOX. PROTECT EXISTING CIRCUITS IN PLACE DURING NEW CONDUITS AND CONDUCTORS INSTALLATION.
4. FIELD VERIFY AND LOCATE EXISTING GROUNDING ELECTRODE RING AND BOND NEW EQUIPMENT TO IT. VERIFY EXISTING CABLE CONNECTION TYPE AND FOLLOW IT TO MAKE THE NEW CONNECTIONS. COMPRESSION CONNECTION SHALL BE PER DETAIL EG101/TYP AND EXOTHERMIC CONNECTION SHALL BE PER DETAIL EG152/TYP.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED AB
DRAWN ASH
CHECKED JGB
DATE JULY 2023

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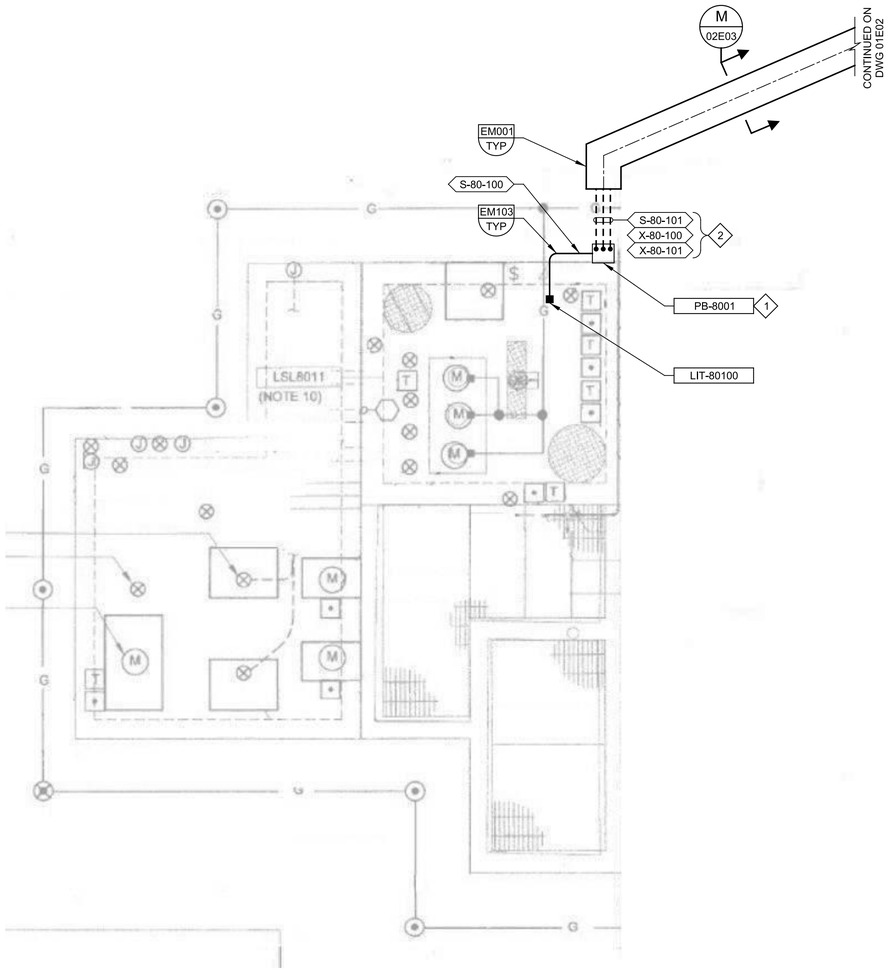
carollo

City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
DAFT BUILDING ELECTRICAL ROOM POWER, CONTROL, AND GROUNDING PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 70E01
SHEET NO. 119 OF 200



A 01E02 **PLAN**
SCALE: NO SCALE
FILE: 8660F1080E0101

GENERAL NOTES:

1. EXISTING EQUIPMENT LOCATIONS AND SIZES ARE FROM OWNER RECORD DRAWINGS, AND MAY NOT REFLECT EXACT LOCATIONS AND SIZES FOR EXISTING EQUIPMENT IN FIELD. CONTRACTOR SHALL FIELD VERIFY WHERE NEEDED.

KEY NOTES:

1. SIGNAL AND COMMUNICATION PULL BOX. SIZE PULL BOX ACCORDING TO NEC. PULL BOX MINIMUM SIZE SHALL BE 18"W X 10"D X 18"H.
2. PROVIDE EXPANSION FITTINGS FOR ALL CONDUITS TRANSITIONING BETWEEN DUCT BANK TO EXPOSED ROUTING ACCORDING TO DETAIL EM219/TYP.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HR
DRAWN SMB
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

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City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
STRUCTURE 80 PLAN

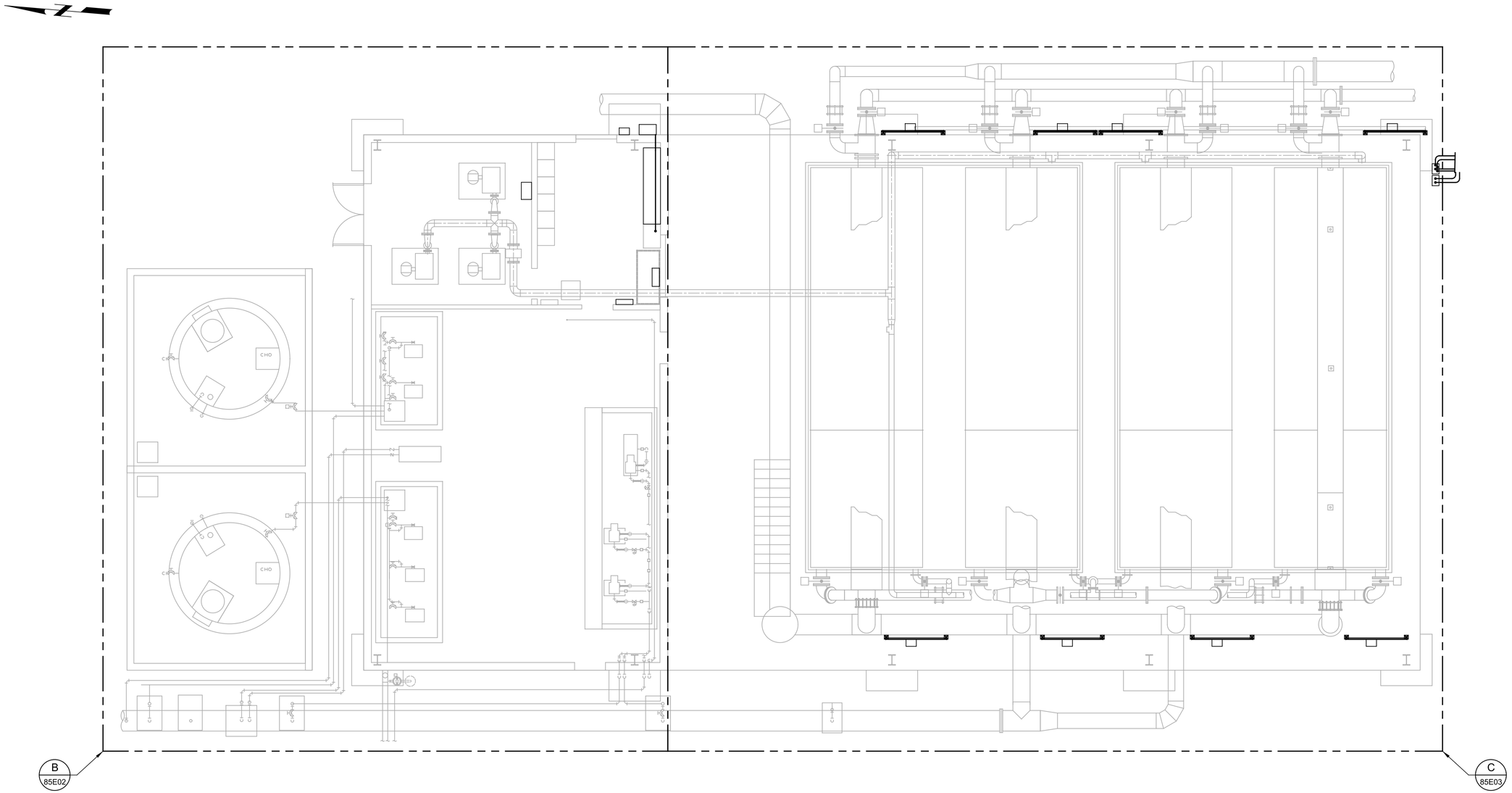
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 80E01
SHEET NO. 120 OF 200

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PROJECT NO. 8660F10 FILE NAME: 8660F1080E01.dgn

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User: svcPW
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ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: avates



B 85E02

C 85E03

A PLAN
01E02
SCALE: 3/16" = 1'-0"
FILE: 8660F1085E0101

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN EYJ
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

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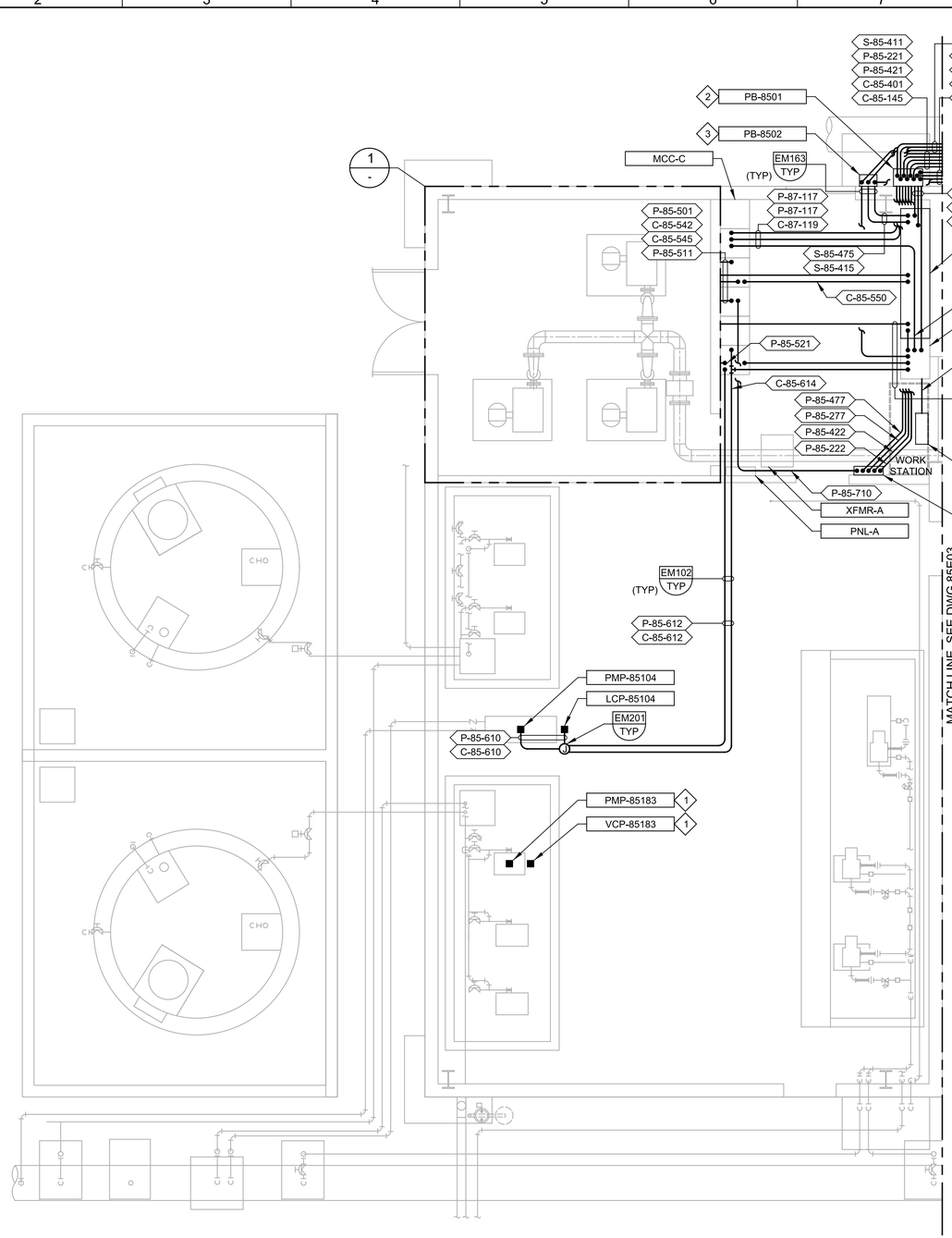
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
AWT BUILDING OVERALL PLAN

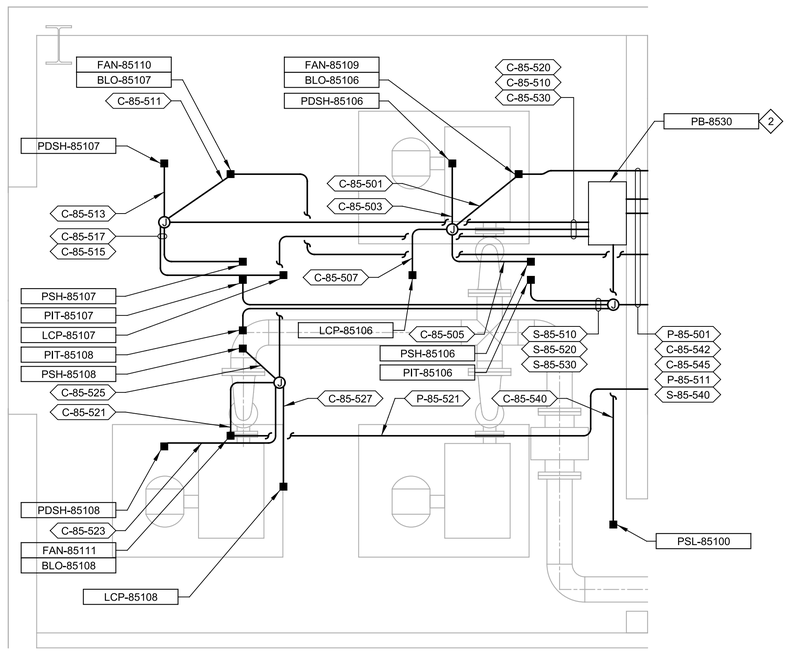
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 85E01
SHEET NO. 121 OF 200

Plot Date: 12-JUL-2023 12:52:41 PM
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LAST SAVED BY: avates



B PLAN
85E01
SCALE: 1/4" = 1'-0"
FILE: 8660F1085E0101



1 DETAIL
-
SCALE: 1/2" = 1'-0"
FILE: 8660F1085E0101

GENERAL NOTES:

1. EXISTING EQUIPMENT AND SIZES ARE FROM OWNER RECORD DRAWINGS, AND MAY NOT REFLECT EXACT LOCATIONS AND SIZES FOR EXISTING EQUIPMENT IN FIELD. CONTRACTOR SHALL FIELD VERIFY WHERE NEEDED.

KEY NOTES:

1. REPLACE EXISTING PUMP LOCATED ON PEDESTAL AND PUMP DRIVE LOCATED INSIDE VENDOR CONTROL PANEL WITH NEW. RECONNECT EXISTING POWER, CONTROL, AND SIGNAL CONDUITS AND CONDUCTORS TO THE NEW EQUIPMENT.
2. POWER AND CONTROL PULL BOX. SIZE PULL BOX ACCORDING TO NEC. PULL BOX MINIMUM SIZE SHALL BE 20"W X 12"D X 20"H.
3. SIGNAL AND COMMUNICATION PULL BOX. SIZE PULL BOX ACCORDING TO NEC. PULL BOX MINIMUM SIZE SHALL BE 12"W X 8"D X 12"H.
4. RELOCATE EXISTING LIGHTING SWITCH TO MAKE ROOM FOR NEW PANELBOARD. PROVIDE ALL THE NECESSARY EQUIPMENT SUCH AS CONDUIT, CONDUCTORS, AND SWITCH BOXES TO COMPLETE THE WORK.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN EYJ
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

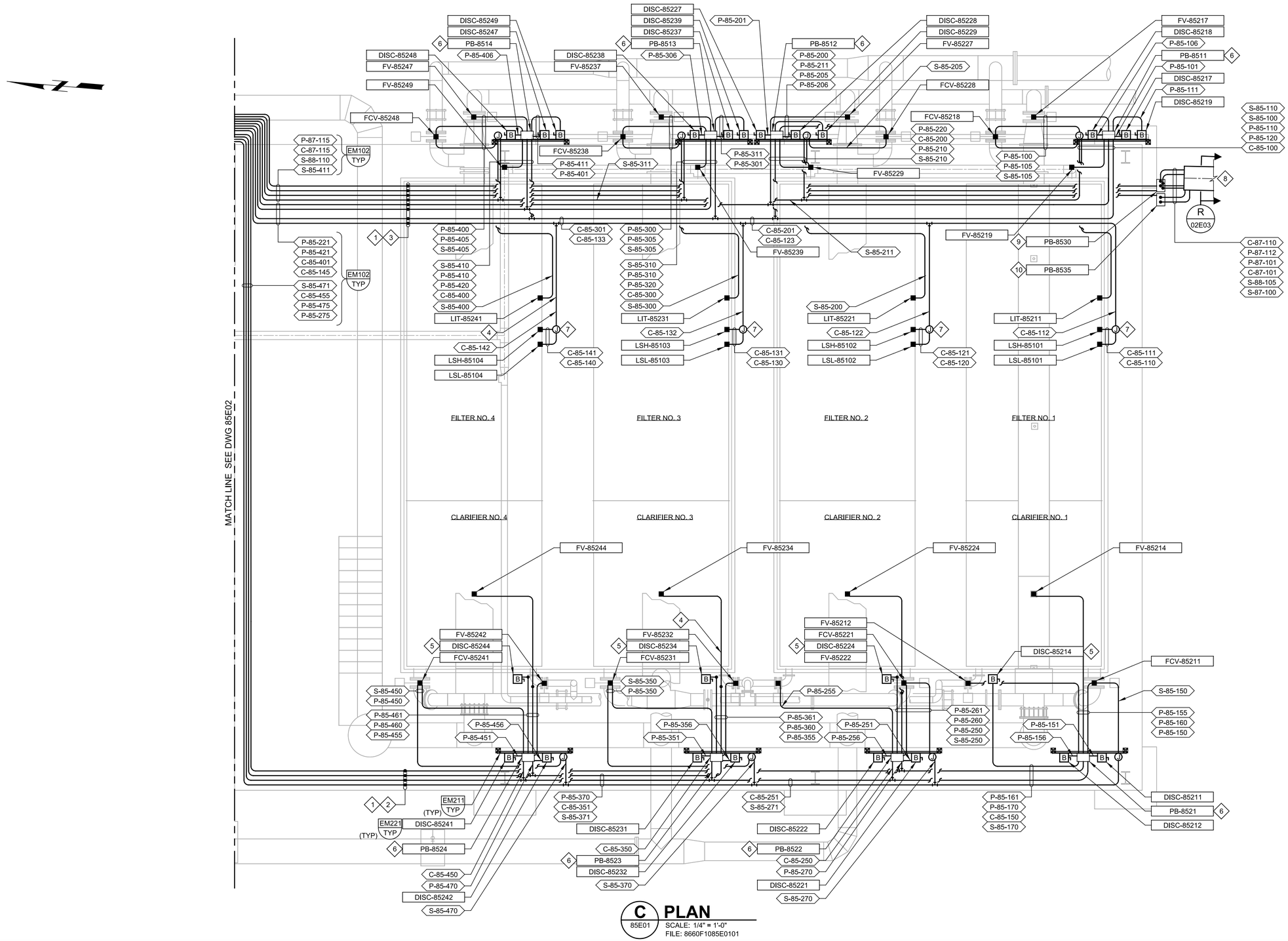
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City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
AWT BUILDING POWER AND CONTROL PLAN 1

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 85E02
SHEET NO. 122 OF 200



GENERAL NOTES:

1. EXISTING EQUIPMENT AND SIZES ARE FROM OWNER RECORD DRAWINGS, AND MAY NOT REFLECT EXACT LOCATIONS AND SIZES FOR EXISTING EQUIPMENT IN FIELD. CONTRACTOR SHALL FIELD VERIFY WHERE NEEDED.
2. COORDINATE EQUIPMENT MOUNTING STAND LOCATIONS WITH THE OWNER AND ENSURE ADEQUATE SPACE FOR MAINTENANCE AND REPAIR IS PROVIDED AROUND AWT FILTER ELECTRICAL AND PROCESS EQUIPMENT.

KEY NOTES:

1. CONDUITS FROM THE WEST SIDE OF TANK SHALL RISE TO CEILING LEVEL.
2. CONDUIT ROUTING ON THE WEST SIDE OF FILTERS SHALL BE SUPPORTED UNDER THE PLATFORM WITH PREFORMED CHANNEL ACCORDING TO DETAIL EA060/TYP.
3. CONDUIT ROUTING ON THE EAST SIDE OF FILTERS SHALL BE SUPPORTED ON THE GROUND ACCORDING TO DETAIL EM104/TYP. OR SUPPORTED WITH PREFORMED CHANNEL ON THE FILTER EXTERIOR WALL ACCORDING TO DETAIL EA030/TYP.
4. SUPPORT CONDUITS WITH PREFORMED CHANNELS ON THE FILTER EXTERIOR WALLS. THIS IS TYPICAL FOR CONDUITS ASSOCIATED WITH ALL FILTERS, LEVEL INSTRUMENTS, AND WASTE GATES.
5. MOUNT DISCONNECT SWITCH ON THE FILTER EXTERIOR WALL WITH PREFORMED CHANNEL ACCORDING TO DETAIL EA030/TYP.
6. POWER AND CONTROL PULL BOX. SIZE PULL BOX ACCORDING TO NEC. PULL BOX MINIMUM SIZE SHALL BE 12"W X 8"D X 12"H. ACTUATOR POWER FEEDER CIRCUIT COMING FROM PANELBOARD SHALL SPLICE TO THREE DIFFERENT CIRCUITS INSIDE PULL BOX, TO FEED ASSOCIATED ACTUATOR ACCORDING TO PANELBOARD DP2 SCHEDULE.
7. PROVIDE A TERMINATION JUNCTION BOX, MOUNTED AT TOP FILTER WALL. TERMINATE LEVEL FLOAT SWITCH CABLE TO CONTRACTOR PROVIDED CONDUCTORS, USING TERMINAL STRIPS INSIDE THE JUNCTION BOX.
8. DUCT BANKS CONTINUES ONTO DRAWING 01E02.
9. POWER AND CONTROL PULL BOX. SIZE PULL BOX ACCORDING TO NEC. PULL BOX MINIMUM SIZE SHALL BE 12"W X 8"D X 12"H.
10. SIGNAL AND COMMUNICATION PULL BOX. SIZE PULL BOX ACCORDING TO NEC. PULL BOX MINIMUM SIZE SHALL BE 12"W X 8"D X 12"H.

C PLAN
85E01
SCALE: 1/4" = 1'-0"
FILE: 8660F1085E0101

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN EYJ
CHECKED JGB
DATE JULY 2023

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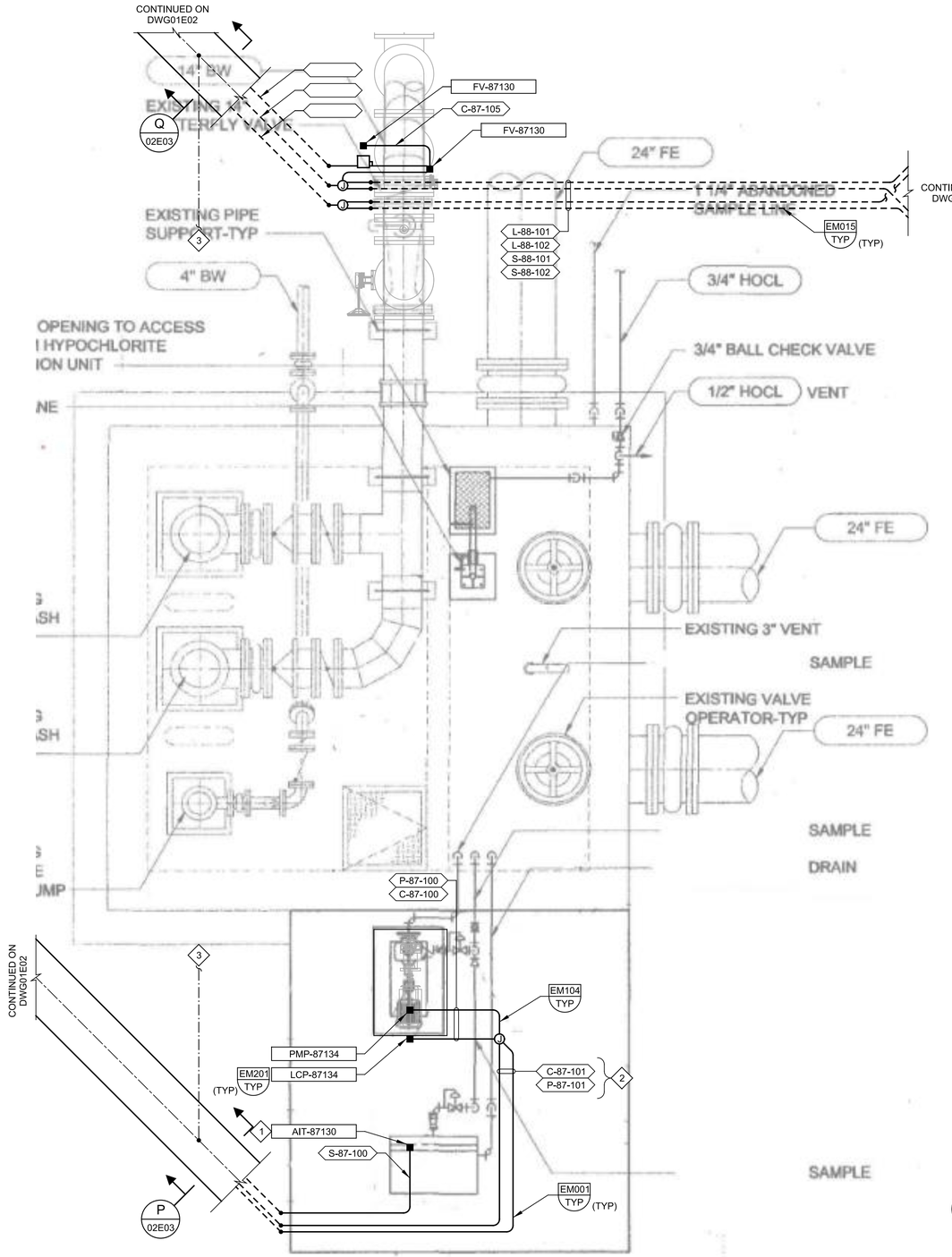
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
AWT BUILDING POWER AND CONTROL PLAN 2

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 85E03
SHEET NO. 123 OF 200

Plot Date: 12-JUL-2023 12:51:30 PM
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ColorTable: gshade.ctb
Model: Layout1
PlotScale: 1:1
LAST SAVED BY: avales



GENERAL NOTES:

1. EXISTING EQUIPMENT AND SIZES ARE FROM OWNER RECORD DRAWINGS, AND MAY NOT REFLECT EXACT LOCATIONS AND SIZES FOR EXISTING EQUIPMENT IN FIELD. CONTRACTOR SHALL FIELD VERIFY WHERE NEEDED.

KEY NOTES:

1. MOUNT NEW ANALYZER UNIT ON THE EXISTING ANALYZER EQUIPMENT MOUNTING STAND, AND RECONNECT EXISTING POWER CIRCUITS TO THE NEW UNIT. EXTEND POWER CONDUITS AND CONDUCTORS AS LONG AS NEEDED TO REACH EQUIPMENT CONDUCTOR TERMINATION POINT.
2. PROVIDE EXPANSION FITTINGS FOR ALL CONDUITS TRANSITIONING BETWEEN DUCT BANK TO EXPOSED ROUTING ACCORDING TO DETAIL EM219/TYP.
3. GROUND NEW DUCT BANK TO EXISTING GROUND RING.

A PLAN
A / 01E02
SCALE: NO SCALE
FILE: 8660F1087E0101

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN ASH
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

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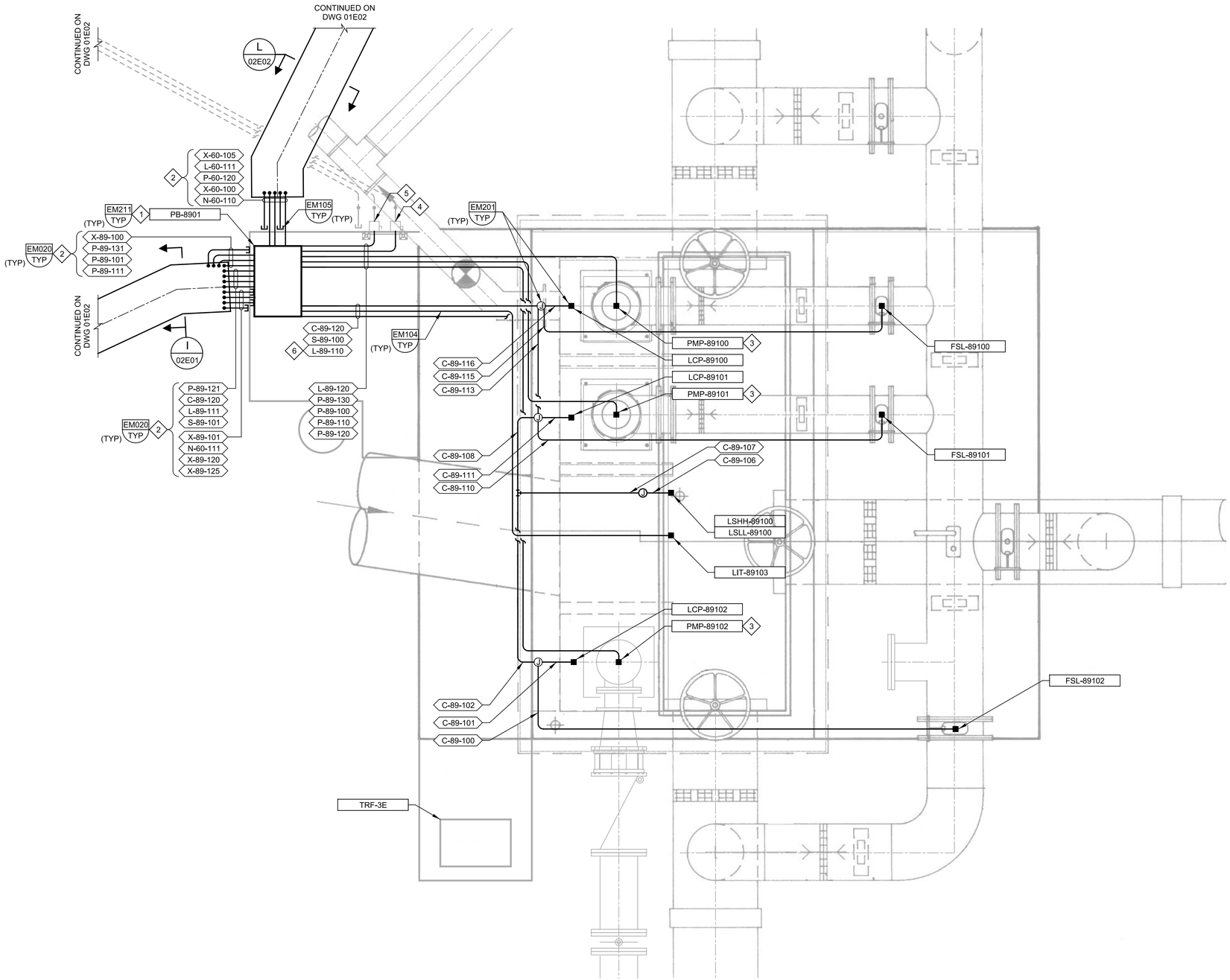
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
BACKWASH PUMP STATION POWER AND CONTROL PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 87E01
SHEET NO. 124 OF 200

Plot Date: 12-JUL-2023 12:53:37 PM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: avates



A 01E02 **PLAN**
SCALE: 1/2"=1'-0"
FILE: 8660F1089E0101

GENERAL NOTES:

1. EXISTING EQUIPMENT LOCATIONS AND SIZES ARE FROM OWNER RECORD DRAWINGS, AND MAY NOT REFLECT EXACT LOCATIONS AND SIZES FOR EXISTING EQUIPMENT IN FIELD. CONTRACTOR SHALL FIELD VERIFY WHERE NEEDED.
2. REFER TO DRAWING 89D01 FOR LOCATION OF FOLLOWING ELECTRICAL EQUIPMENT TO BE DEMOLISHED:
   - MAIN DISCONNECT SWITCH, 200 A, 3-POLE
   - MOTOR CONTROL CABINET
   -1 KVA TRANSFORMER

KEY NOTES:

1. POWER, CONTROL, SIGNAL AND COMMUNICATION PULL BOX. SIZE PULL BOX ACCORDING TO NEC. PULL BOX MINIMUM DIMENSIONS SHALL BE 30"W X 20"D X 30" H. PROVIDE A DIVIDER INSIDE THE PULL BOX WITH SEPARATE ACCESS DOORS AND SEPARATE THE CABLE PULLING SPACE BETWEEN SIGNAL/COMMUNICATION AND POWER/CONTROL CIRCUITS. ACCESS DOORS SHALL BE FACING EAST.
2. PROVIDE EXPANSION FITTINGS FOR ALL CONDUITS TRANSITIONING BETWEEN DUCT BANK TO EXPOSED ROUTING ACCORDING TO DETAIL EM219/TYP.
3. REPLACE EXISTING PUMP MOTOR WITH NEW MOTOR.
4. DISCONNECT SWITCH IS FOR 480V POWER SOURCE TO FLOW DIVERSION METERING VAULT ACTUATED VALVES. TERMINATE CONDUCTORS ON LINE SIDE OF DISCONNECT SWITCH.
5. DISCONNECT SWITCH IS FOR 120V POWER SOURCE TO FLOW DIVERSION METERING VAULT FLOW METER FIT-99105. TERMINATE CONDUCTORS ON LINE SIDE OF DISCONNECT SWITCH.
6. TO LIGHTING FIXTURES AND RECEPTACLES.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN ASH
CHECKED JGB
DATE JULY 2023

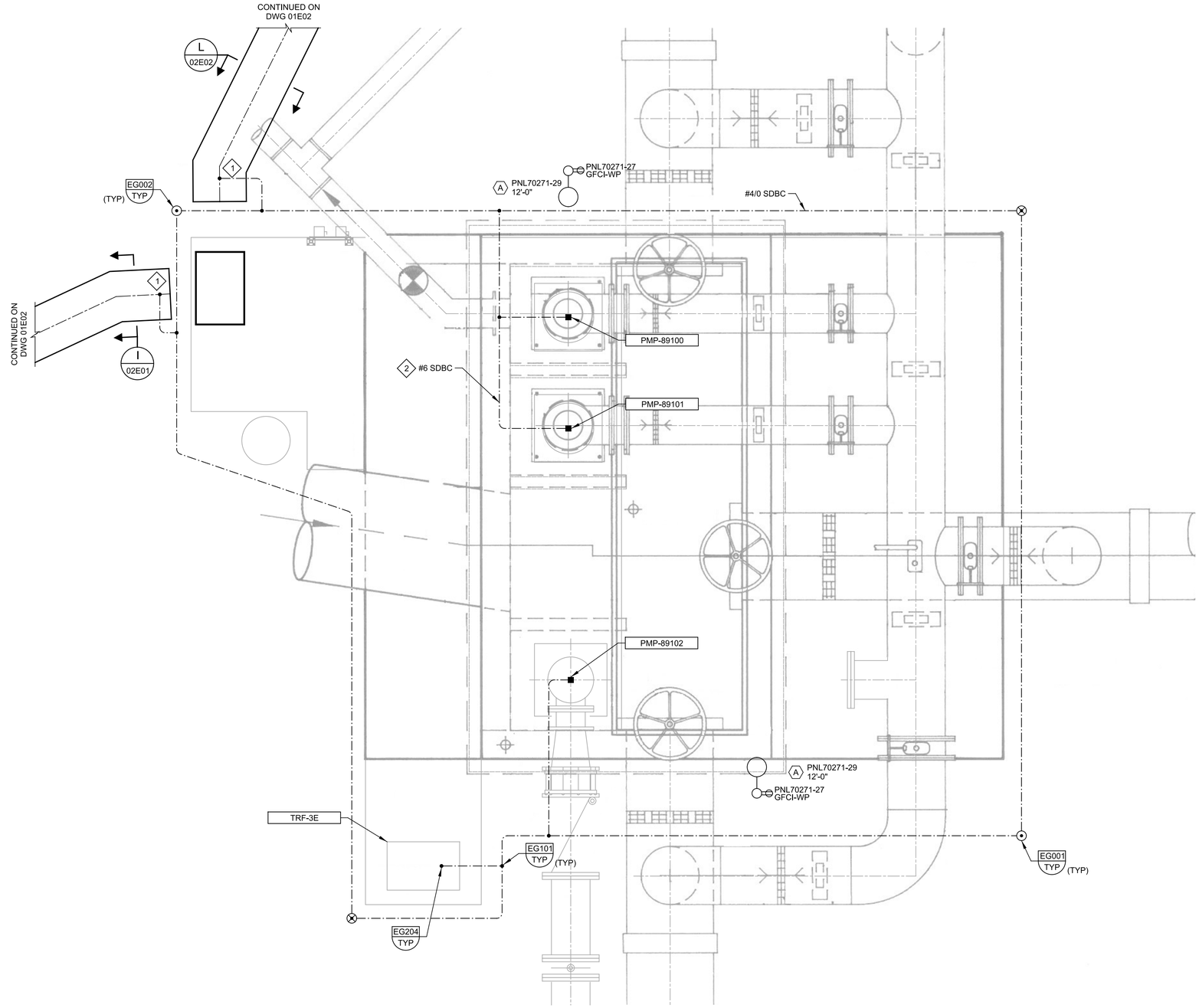
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CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
CAROUSEL PUMP STATION
POWER AND CONTROL PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 89E01
SHEET NO. 125 OF 200

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PROJECT NO. 8660F10
FILE NAME: 8660F1089E01.dgn



B 01E02 **PLAN**
SCALE: 1/2"=1'-0"
FILE: 8660F1089E0201

GENERAL NOTES:

1. CONDUIT ROUTING FOR LIGHTING AND RECEPTACLE IS NOT SHOWN. USE THE PROCESS POWER AND CONTROL CONDUIT ROUTING AS A GUIDE TO INSTALL LIGHTING AND RECEPTACLE CONDUITS AND WIRING IN A SIMILAR MANNER.
2. LIGHTING AND RECEPTACLE CONDUITS, AND CONDUIT FITTINGS TYPES SHALL BE THE SAME AS THOSE FOR THE PROCESS POWER AND CONTROL CONDUIT INSTALLATION WITHIN THE SAME AREA.
3. CONDUCTORS FOR LIGHTING AND RECEPTACLE CIRCUITS SHALL BE SIZED IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE, AND SHALL BE RATED TO ACCOUNT FOR MULTIPLE CONDUCTORS IN THE SAME RACEWAY FOR VOLTAGE DROP.
4. LIGHTING AND RECEPTACLE CONDUITS SHALL BE SIZED IN ACCORDANCE WITH THE CONDUIT FILL REQUIREMENTS IN THE SPECIFICATIONS. CONDUIT SHALL NOT BE SMALLER THAN 0.75 INCHES.
5. FIELD VERIFY CONDITION, LAYOUT AND INTEGRITY OF THE EXISTING GROUND RING ASSOCIATED WITH THE PUMP STATION. REPLACE THE EXISTING GROUND RING AND GROUND RODS IF EXISTING GROUNDING EQUIPMENT ARE NOT IN ADEQUATE CONDITION.

KEY NOTES:

1. BOND DUCT BANK GROUNDING WIRE TO THE GROUND RING CONDUCTOR ACCORDING TO DETAIL EG101/TYP.
2. TYPICAL FOR ALL CAROUSEL PUMP MOTOR.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

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City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
CAROUSEL PUMP STATION LIGHTING, GROUNDING, AND RECEPTACLES PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 89E02
SHEET NO. 126 OF 200

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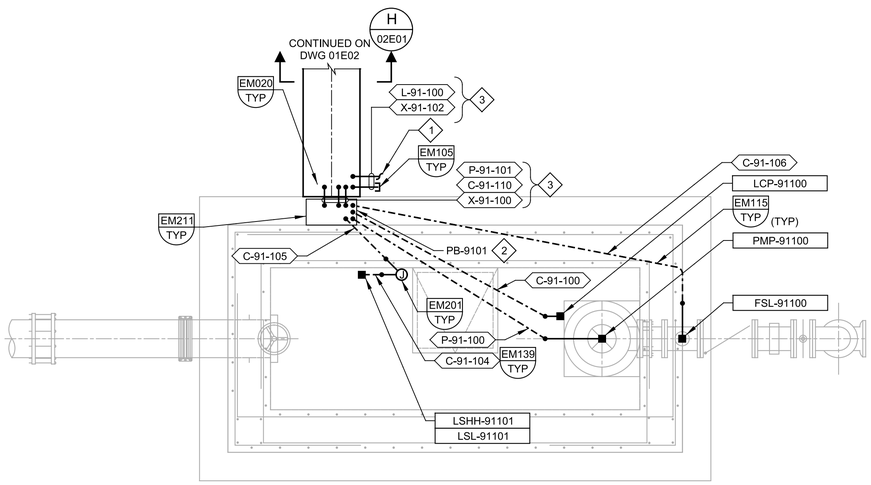
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ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: evandoorn

GENERAL NOTES:

1. CONDUIT ROUTING FOR LIGHTING AND RECEPTACLE IS NOT SHOWN, USE THE PROCESS POWER AND CONTROL CONDUIT ROUTING AS A GUIDE TO INSTALL LIGHTING AND RECEPTACLE CONDUITS AND WIRING IN A SIMILAR MANNER.
2. LIGHTING AND RECEPTACLE CONDUITS, AND CONDUIT FITTINGS TYPES SHALL BE THE SAME AS THOSE FOR THE PROCESS POWER AND CONTROL CONDUIT INSTALLATION WITHIN THE SAME AREA.
3. CONDUCTORS FOR LIGHTING AND RECEPTACLE CIRCUITS SHALL BE SIZED IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE, AND SHALL BE RATED TO ACCOUNT FOR MULTIPLE CONDUCTORS IN THE SAME RACEWAY FOR VOLTAGE DROP.
4. LIGHTING AND RECEPTACLE CONDUITS SHALL BE SIZED IN ACCORDANCE WITH THE CONDUIT FILL REQUIREMENTS IN THE SPECIFICATIONS. CONDUIT SHALL NOT BE SMALLER THE 0.75 INCHES.

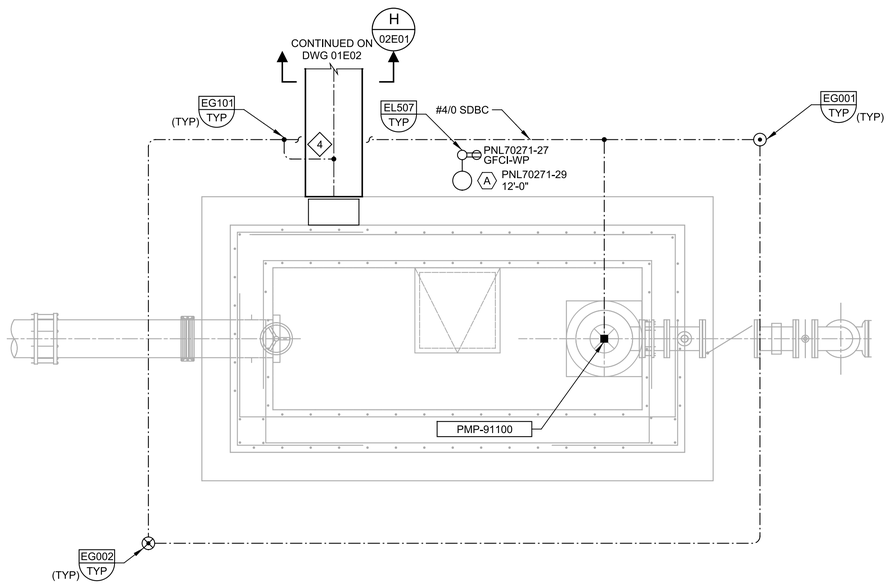
KEY NOTES:

1. TO LIGHTING FIXTURES AND RECEPTACLES.
2. POWER AND CONTROL PULL BOX SIZE PULL BOX ACCORDING TO NEC. PULL BOX MINIMUM SIZE SHALL BE 22"W X 12"D X 22" H.
3. PROVIDE EXPANSION FITTINGS FOR ALL CONDUITS TRANSITIONING BETWEEN DUCT BANK TO EXPOSED ROUTING AS PER DETAIL EM219/TYP.
4. BOND DUCT BANK GROUNDING WIRE TO THE GROUND RING CONDUCTOR AS PER DETAIL EG101/TYP.



POWER AND CONTROL

A PLAN
01E02 SCALE: 3/8"=1'-0"
FILE: 8660F1091E0101



LIGHTING AND GROUNDING

B PLAN
01E02 SCALE: 3/8"=1'-0"
FILE: 8660F1091E0201

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED HQR
DRAWN ASH
CHECKED JGB
DATE JULY 2023

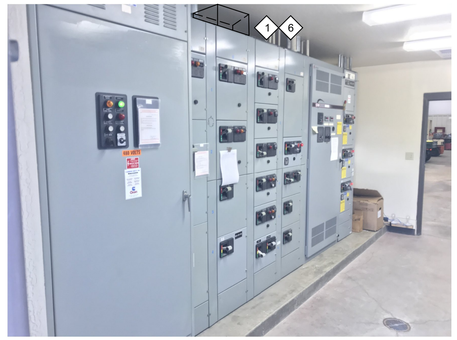
** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19663 **

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
PAU PUMP STATION PLANS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 91E01
SHEET NO. 127 OF 200

Plot Date: 12-JUL-2023 12:52:25 PM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: avates



MCC-E

1 PHOTO
SCALE: NO SCALE
FILE: 8660F1099E01A



PNL-RWPS

2 PHOTO
SCALE: NO SCALE
FILE: 8660F1099E01B



ELECTRICAL ROOM ATTIC

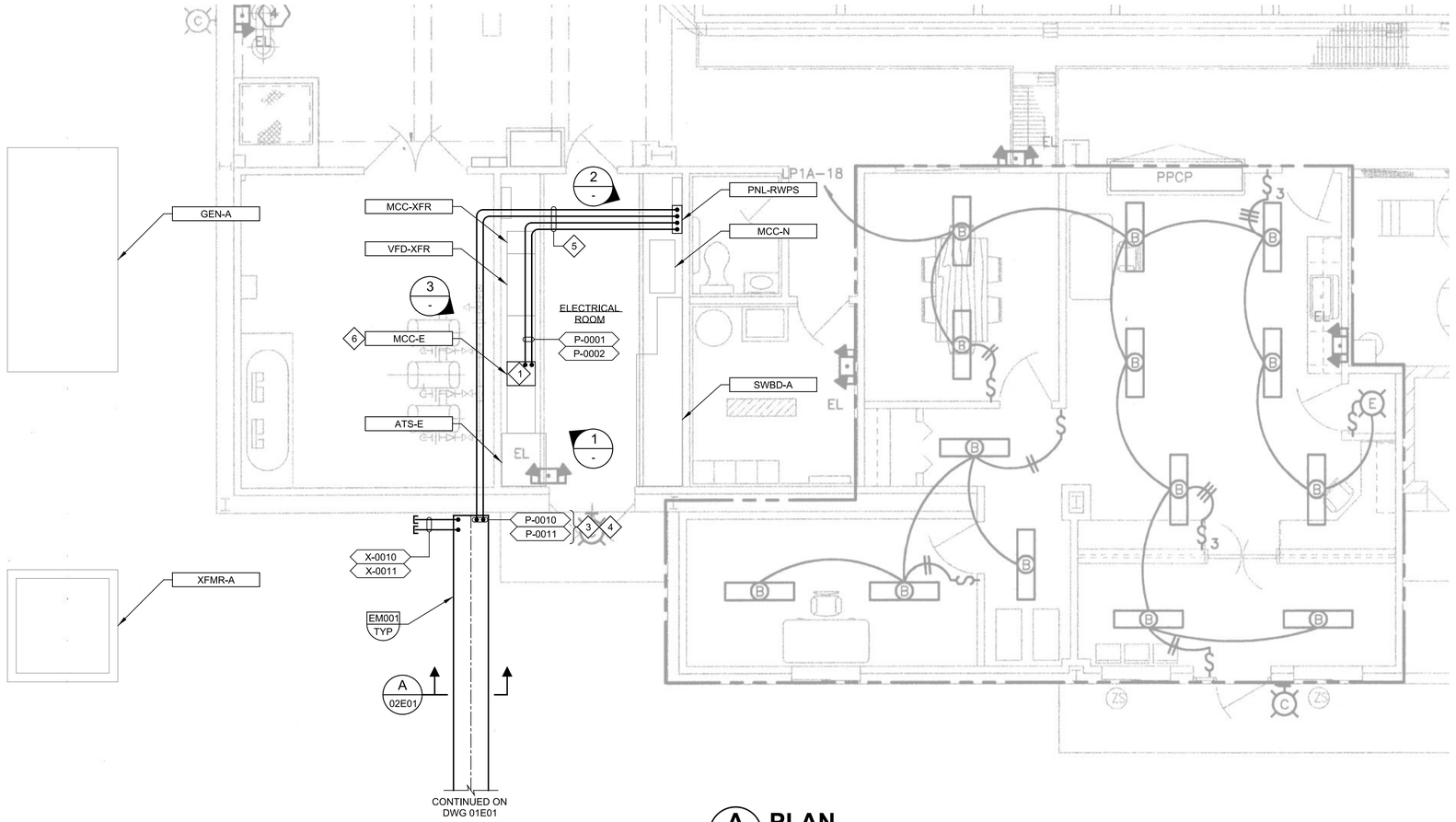
3 PHOTO
SCALE: NO SCALE
FILE: 8660F1099E01C

GENERAL NOTES:

1. EXISTING EQUIPMENT LOCATION AND SIZES ARE FROM OWNER RECORD DRAWINGS, AND MAY NOT REFLECT EXACT LOCATIONS AND SIZES FOR EXISTING EQUIPMENT IN FIELD. CONTRACTOR SHALL FIELD VERIFY WHERE NEEDED.

KEY NOTES:

1. PROVIDE MCC TOP HAT ENCLOSURE TO HOUSE PNL-RWPS POWER. ACCOMMODATE NEW TAP OF EXISTING MCC-E BUS WITH PNL-RWPS POWER CABLES. ENCLOSURE MANUFACTURER AND MODEL SHALL BE THE SAME AS EXISTING MCC-E. PROVIDE ALL THE NECESSARY PARTS AND ACCESSORIES TO COMPLETE CABLE TERMINATION IN MCC-E. CONTRACTOR TO PROVIDE MANUFACTURER FIELD SERVICES TO COMPLETE TOP HAT INSTALLATION. CONTRACTOR SHALL SUBMIT TOP HAT AND TAP DESIGN FOE ENGINEER REVIEW.
2. RELOCATE SPD ENCLOSURE IF NEEDED TO PROVIDE ADEQUATE SPACE FOR PNL-RWPS INSTALLATION.
3. CONDUITS RISE FROM DUCT BANK PER DETAIL EM020/TYP AND EM219/TYP, AND ENTER TO THE BUILDING'S ATTIC SPACE, ABOVE ELECTRICAL BUILDING.
4. SUPPORT CONDUITS ON BUILDING SIDE WALL WITH PREFORMED CHANNELS ACCORDING TO DETAIL EM903/TYP.
5. ROUTE CONDUITS THROUGH ATTIC SPACE ABOVE ELECTRICAL ROOM. SUPPORT CONDUITS IN ATTIC SPACE PER DETAIL EM901/TYP.
6. HEAD SPACE ABOVE MCC IS APPROXIMATELY 8". TOP HAT HIGHER THAN 8" MAY NEED TO BE PARTIALLY PLACED IN CEILING, BETWEEN JOISTS. COORDINATE NEW TOP HAT ENCLOSURE ACTUAL SIZE, CONDUIT ENTRY, AND ACCESS LOCATION WITH EATON. IF IT IS DETERMINED DURING FIELD VERIFICATION THAT ENCLOSURE MOUNTING SPACE IS OBSTRUCTED BY CEILING JOISTS, AND MODIFICATION TO CEILING JOISTS IS NEEDED, CONTACT STRUCTURAL ENGINEER OF RECORD FOR DIRECTION.
7. IF NEEDED FOR TOP HAT CONSTRUCTION, RELOCATE EXISTING CONDUITS. PROTECT EXISTING CABLES AND RE-TERMINATE AFTER CONDUIT WORK. REFER TO SPECIFICATION SECTION 01140 FOR WORK RESTRICTIONS.



A 01E01 PLAN
SCALE: 1/4" = 1'-0"
FILE: 8660F1099E0101

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

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CHECKED JGB
DATE JULY 2023

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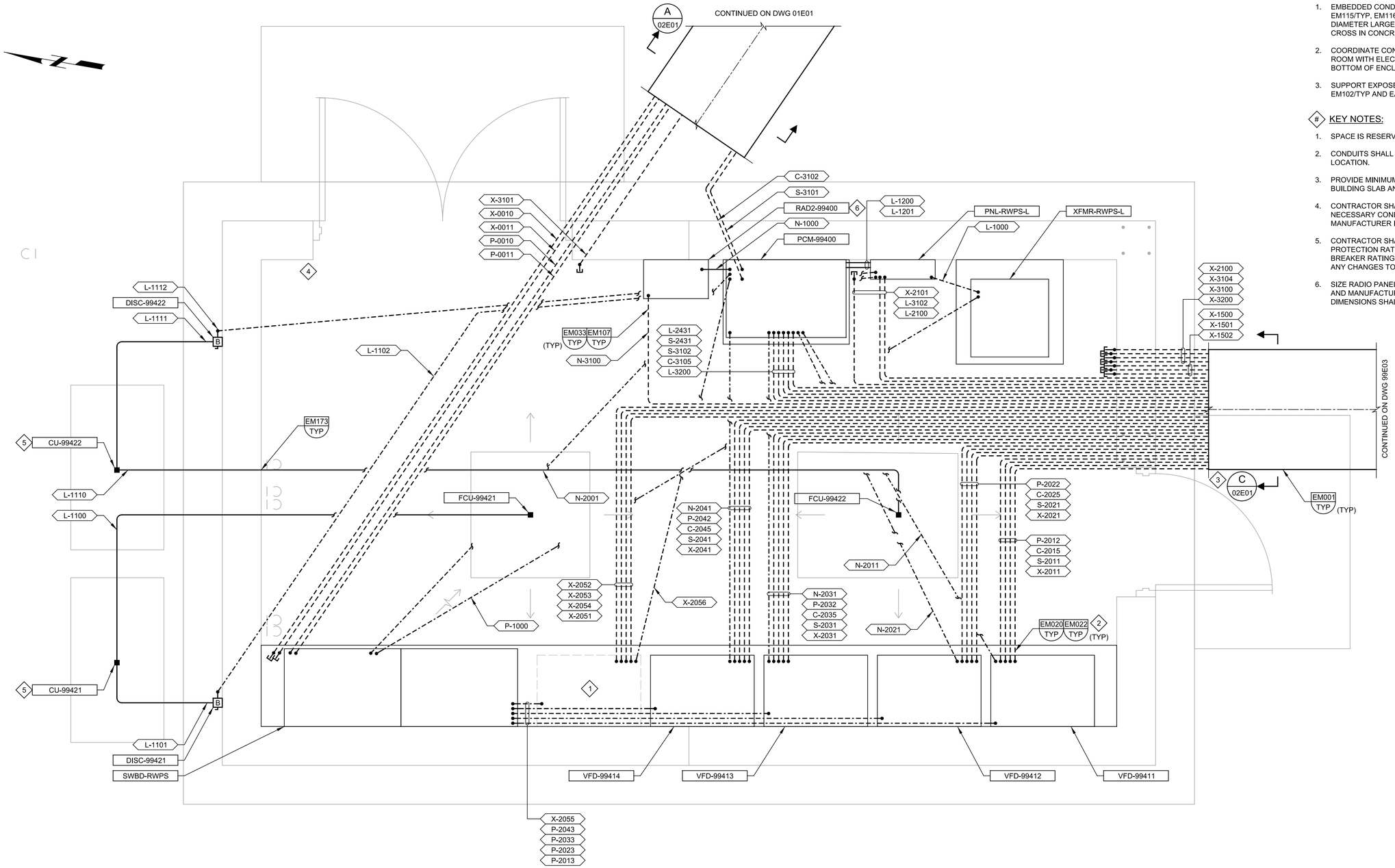
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
EXISTING WATER TREATMENT BUILDING
PARTIAL POWER AND CONTROL PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99E01
SHEET NO. 128 OF 200

Plot Date: 12-JUL-2023 12:47:10 PM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
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Model: Layout1
LAST SAVED BY: avates



GENERAL NOTES:

1. EMBEDDED CONDUIT IN SLAB SHALL BE INSTALLED PER DETAILS EM115/TYP, EM116/TYP, AND EM117/TYP. EMBEDDED CONDUITS WITH DIAMETER LARGER THAN TWO INCHES SHALL NOT STACK OR CROSS IN CONCRETE SLAB.
2. COORDINATE CONDUIT STUB UP LOCATIONS INSIDE ELECTRICAL ROOM WITH ELECTRICAL EQUIPMENT CONDUIT ENTRY OPENING AT BOTTOM OF ENCLOSURE.
3. SUPPORT EXPOSED CONDUITS AS NEEDED ACCORDING TO DETAILS EM102/TYP AND EA030/TYP.

KEY NOTES:

1. SPACE IS RESERVED FOR FUTURE RECYCLED PUMP VFD.
2. CONDUITS SHALL REMAIN ENCASED IN DUCT BANK TO STUB UP LOCATION.
3. PROVIDE MINIMUM OF 6" SPACE BETWEEN BOTTOM OF THE BUILDING SLAB AND TOP OF THE DUCT BANK.
4. CONTRACTOR SHALL INSTALL THERMOSTAT, AND PROVIDE NECESSARY CONDUITS AND CABLES ACCORDING TO MANUFACTURER INSTALLATION REQUIREMENTS.
5. CONTRACTOR SHALL VERIFY MAXIMUM OVER CURRENT PROTECTION RATING FOR HVAC UNIT, AND CHANGE CIRCUIT BREAKER RATING AND CABLE SIZE ACCORDINGLY PER NEC. SUBMIT ANY CHANGES TO ENGINEER FOR REVIEW.
6. SIZE RADIO PANEL ACCORDING TO RADIO EQUIPMENT DIMENSIONS AND MANUFACTURER RECOMMENDATIONS. RADIO PANEL MINIMUM DIMENSIONS SHALL BE 20" H x 20" W x 12" D.

B 01E01 PLAN
SCALE: 3/4" = 1'-0"
FILE: 8660F1099E0101

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			CONFORMED DOCUMENTS

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CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
RECYCLED WATER ELECTRICAL BUILDING POWER AND CONTROL PLAN

VERIFY SCALES
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0 1"
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JOB NO. 8660F.10
DRAWING NO. 99E02
SHEET NO. 129 OF 200

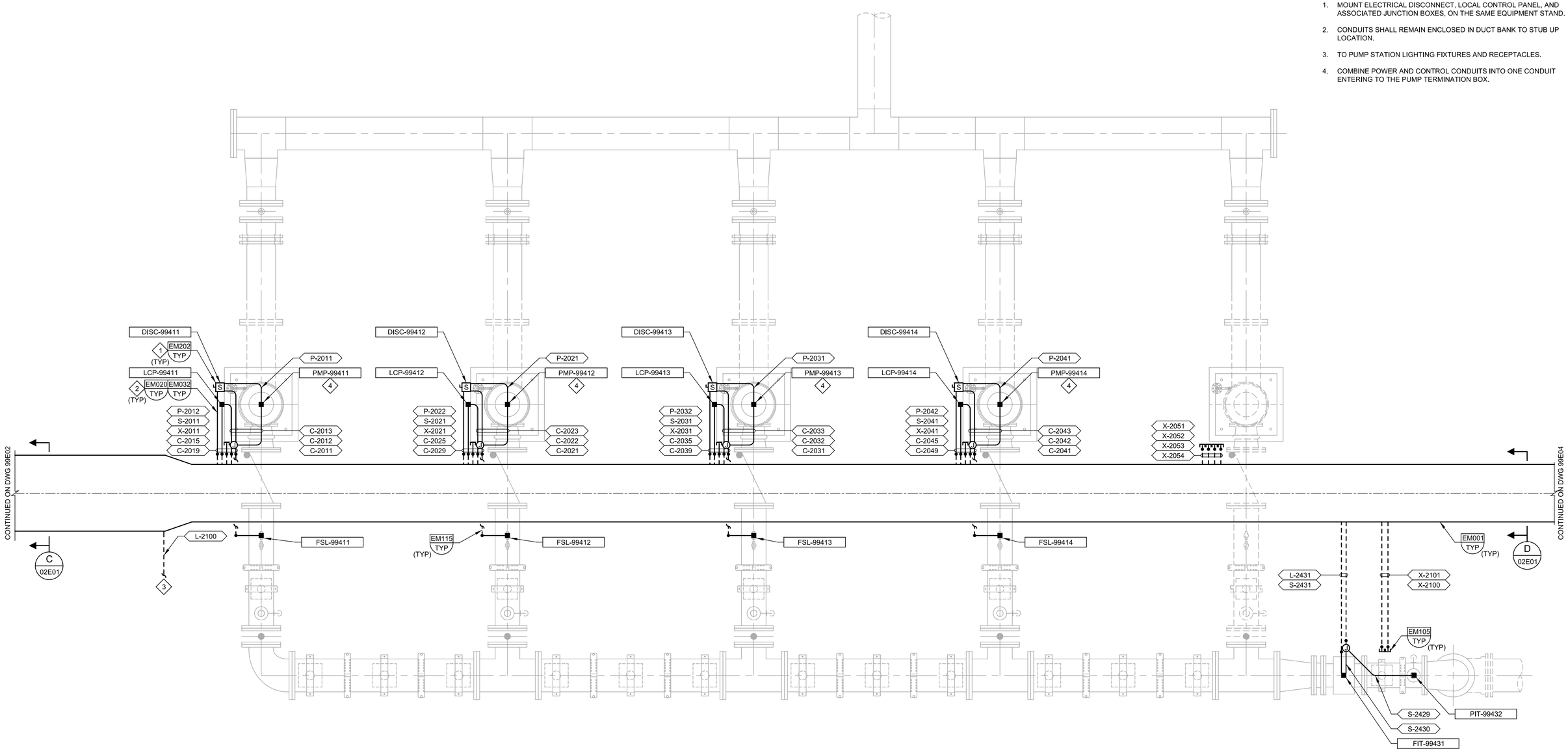
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DesignScript: Carollo_Std_Pen_v9905.pen
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Model: Layout1
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GENERAL NOTES:

1. FINAL CONDUIT CONNECTION TO PUMP MOTOR SHALL BE MADE WITH MAXIMUM 2' OF TYPE LIQUID-TYPE FLEXIBLE CONDUIT.

KEY NOTES:

1. MOUNT ELECTRICAL DISCONNECT, LOCAL CONTROL PANEL, AND ASSOCIATED JUNCTION BOXES, ON THE SAME EQUIPMENT STAND.
2. CONDUITS SHALL REMAIN ENCLOSED IN DUCT BANK TO STUB UP LOCATION.
3. TO PUMP STATION LIGHTING FIXTURES AND RECEPTACLES.
4. COMBINE POWER AND CONTROL CONDUITS INTO ONE CONDUIT ENTERING TO THE PUMP TERMINATION BOX.



C 01E01 PLAN
SCALE: 1/2" = 1'-0"
FILE: 8660F1099E0102

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			CONFORMED DOCUMENTS

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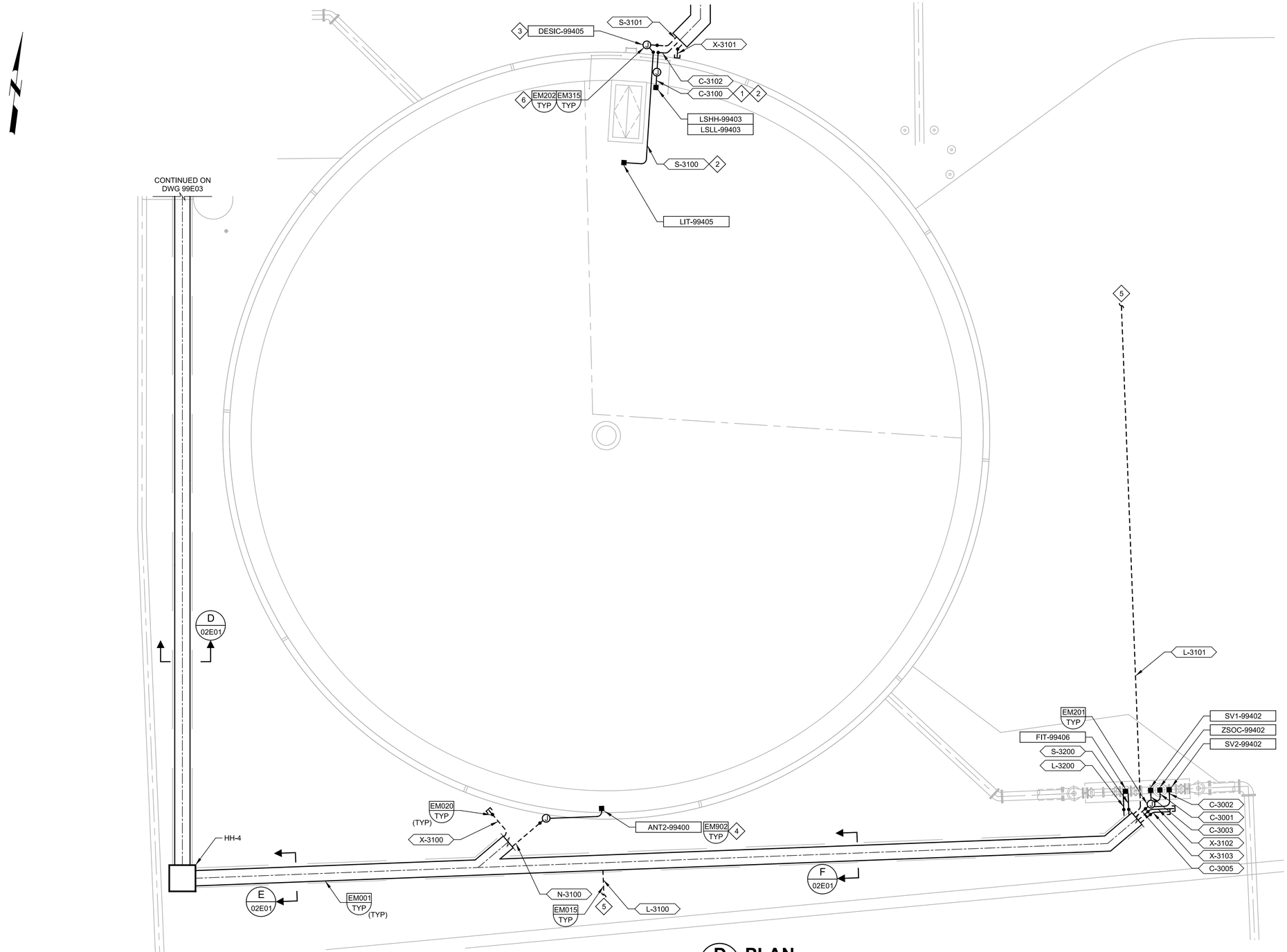
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
RECYCLED WATER PUMP STATION POWER AND CONTROL PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
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JOB NO. 8660F.10
DRAWING NO. 99E03
SHEET NO. 130 OF 200

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Model: Layout1
LAST SAVED BY: avates



D PLAN
01E01 SCALE: 1/8" = 1'-0"
FILE: 8660F1099E0104

KEY NOTES:

1. INSTALL CONDUIT SLEEVE FOR LEVEL INSTRUMENT CABLES.
2. SUPPORT CONDUITS WITH PREFORMED CHANNEL ON TANK EMBEDDED SUPPORT LUGS.
3. DESICCANT JUNCTION BOX MINIMUM SIZE SHALL BE 6" x 6" x 6". PROVIDE SST SUN SHADE FOR THE BOX.
4. SUPPORT ANTENNA MAST POLE ON TANK EMBEDDED SUPPORT LUGS.
5. LIGHTING AND RECEPTACLE CONDUIT CONTINUES ON DRAWING 10E14.
6. MOUNT JUNCTION BOX ON THE ROOF NEAR LEVEL INSTRUMENTS. PROVIDE TERMINAL STRIP INSIDE THE JUNCTION BOX AND TERMINATE LEVEL INSTRUMENT CABLES ON IT.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

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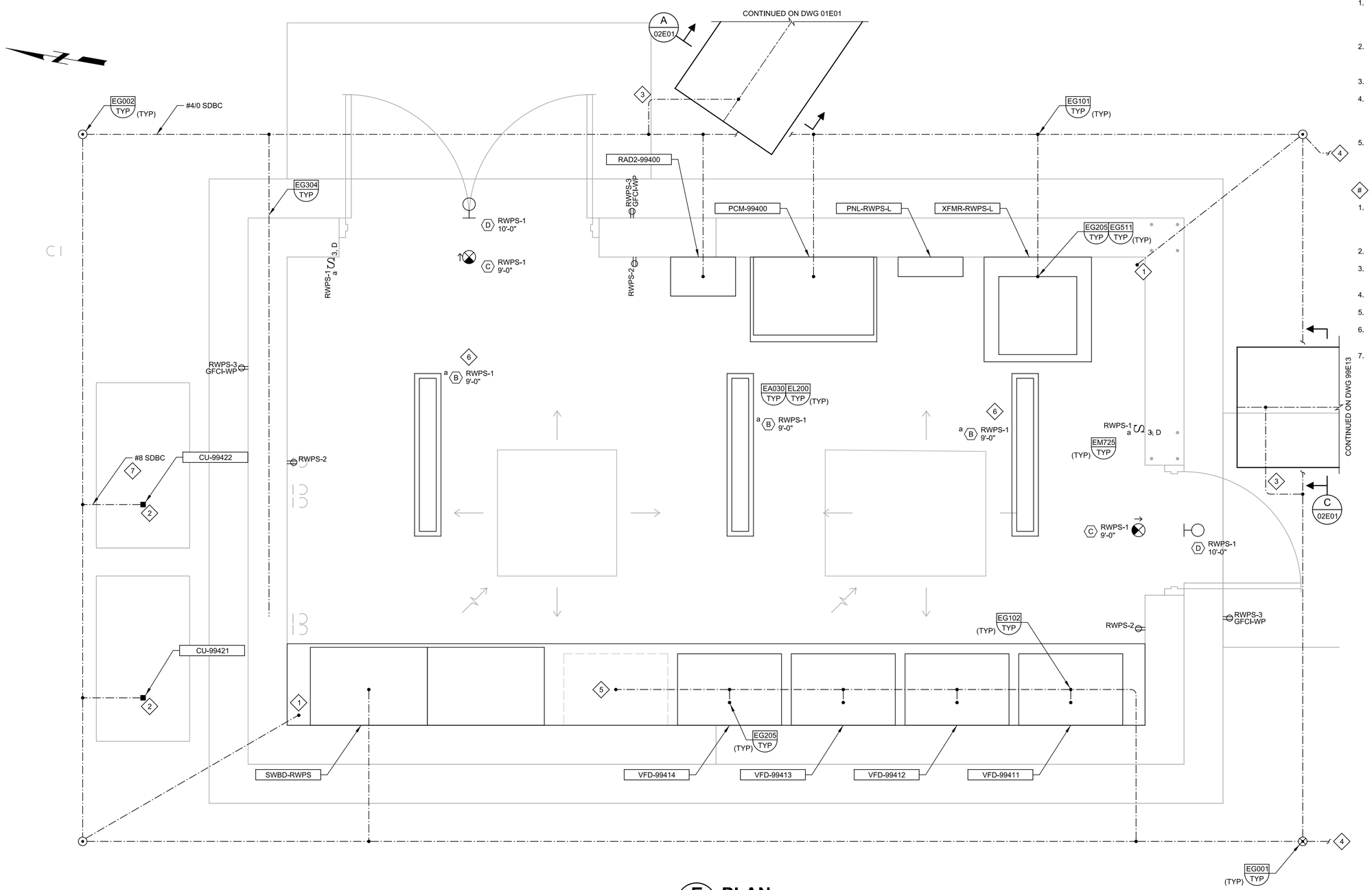
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CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
RECYCLED WATER STORAGE POWER AND CONTROL

VERIFY SCALES
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0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99E04
SHEET NO. 131 OF 200



GENERAL NOTES:

1. CONDUIT ROUTING FOR LIGHTING AND RECEPTACLE IS NOT SHOWN. USE THE PROCESS POWER AND CONTROL CONDUIT ROUTING AS A GUIDE TO INSTALL LIGHTING AND RECEPTACLE CONDUITS AND WIRING IN A SIMILAR MANNER.
2. LIGHTING AND RECEPTACLE CONDUITS, AND CONDUIT FITTINGS TYPES SHALL BE THE SAME AS THOSE FOR THE PROCESS POWER AND CONTROL CONDUIT INSTALLATION WITHIN THE SAME AREA.
3. LIGHTING PANEL PNL-RWPS-L IS ABBREVIATED AS RWPS.
4. CONDUCTORS FOR LIGHTING AND RECEPTACLE CIRCUITS SHALL BE SIZED IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE, AND SHALL BE DE RATED TO ACCOUNT FOR MULTIPLE CONDUCTORS IN THE SAME RACEWAY AND FOR VOLTAGE DROP.
5. LIGHTING AND RECEPTACLE CONDUITS SHALL BE SIZED IN ACCORDANCE WITH THE CONDUIT FILL REQUIREMENTS IN THE SPECIFICATIONS. CONDUITS SHALL NOT BE SMALLER THAN 0.75 INCHES.

KEY NOTES:

1. BOND CEILING METALLIC BEAM TO THE GROUND RING CONDUCTOR WITH COMPRESSION CONNECTION. INSTALL GROUNDING CONDUCTOR INSIDE MINIMUM SIZE 1-1/2" SCHEDULE 80 PVC CONDUIT AT EXPOSED LOCATIONS.
2. BOND HVAC EQUIPMENT TO THE GROUND RING CONDUCTOR.
3. BOND DUCT BANK GROUNDING WIRE TO THE GROUND RING CONDUCTOR ACCORDING TO DETAIL EG101/TYP.
4. CONTINUED ON SHEET 10E13.
5. SPACE IS RESERVED FOR FUTURE RECYCLED PUMP VFD.
6. PROVIDE EMERGENCY BACKUP LIGHTING PACKAGE FOR THIS FIXTURE.
7. TYPICAL FOR HVAC CONDENSER UNIT.

E PLAN
01E01
SCALE: 3/4" = 1'-0"
FILE: 8660F1099E0201

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			CONFORMED DOCUMENTS

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CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
RECYCLED WATER ELECTRICAL BUILDING LIGHTING, GROUNDING AND RECEPTACLES PLAN

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99E12
SHEET NO. 132 OF 200

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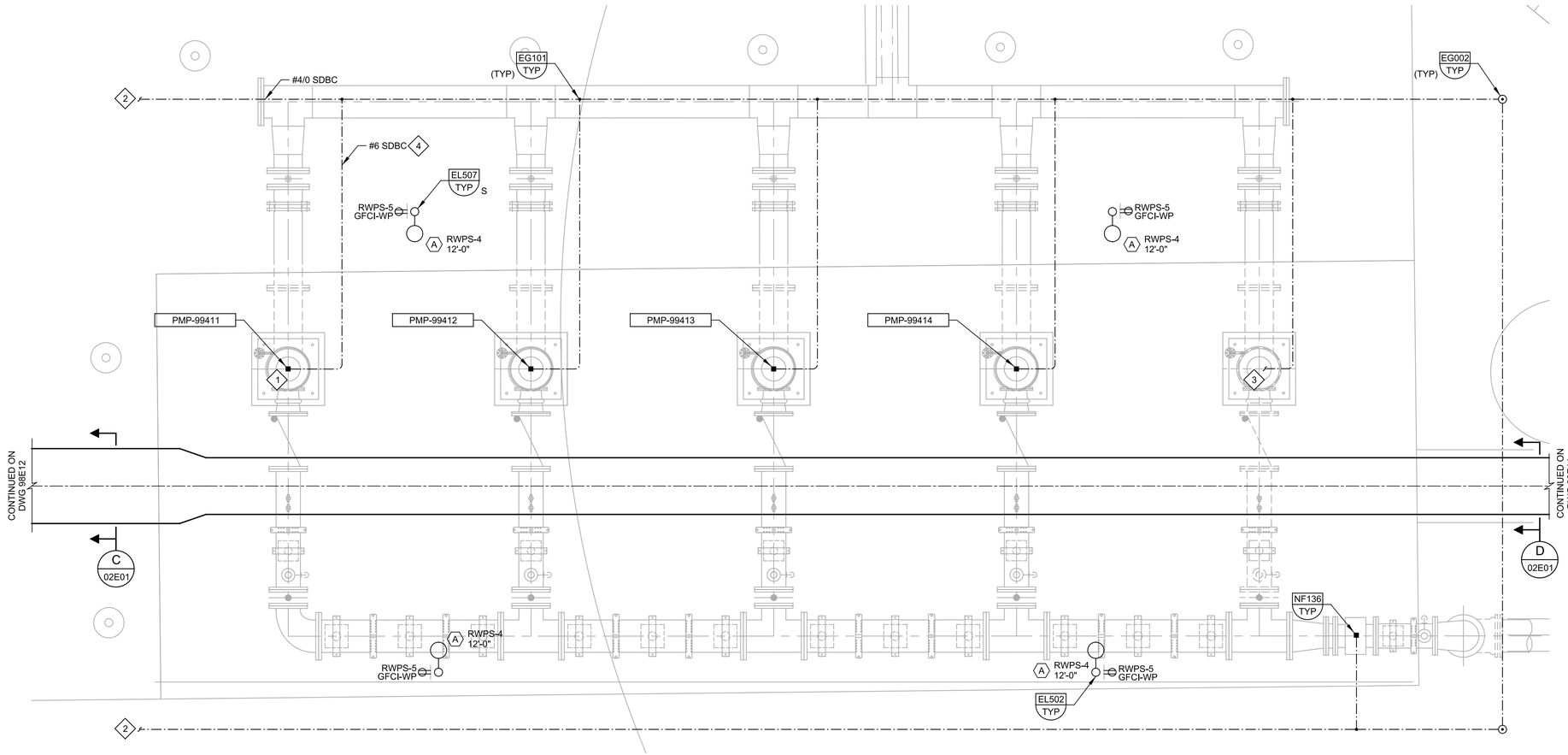
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LAST SAVED BY: avates

GENERAL NOTES:

1. CONDUIT ROUTING FOR LIGHTING AND RECEPTACLE IS NOT SHOWN. USE THE PROCESS POWER AND CONTROL CONDUIT ROUTING AS A GUIDE TO INSTALL LIGHTING AND RECEPTACLE CONDUITS AND WIRING IN A SIMILAR MANNER.
2. LIGHTING AND RECEPTACLE CONDUITS, AND CONDUIT FITTINGS TYPES SHALL BE THE SAME AS THOSE FOR THE PROCESS POWER AND CONTROL CONDUIT INSTALLATION WITHIN THE SAME AREA.
3. CONDUCTORS FOR LIGHTING AND RECEPTACLE CIRCUITS SHALL BE SIZED IN ACCORDANCE WITH THE NATIONAL ELECTRIC CODE, AND SHALL BE RATED TO ACCOUNT FOR MULTIPLE CONDUCTORS IN THE SAME RACEWAY FOR VOLTAGE DROP.
4. LIGHTING AND RECEPTACLE CONDUITS SHALL BE SIZED IN ACCORDANCE WITH THE CONDUIT FILL REQUIREMENTS IN THE SPECIFICATIONS. CONDUIT SHALL NOT BE SMALLER THAN 0.75 INCHES.
5. LIGHTING PANEL PNL-RWPS-L IS ABBREVIATED AS RWPS.

(#) KEY NOTES:

1. BOND MOTOR FRAME ACCORDING TO NEC AND MANUFACTURER INSTALLATION MANUAL. THIS IS TYPICAL FOR ALL RECYCLED WATER PUMP MOTORS.
2. CONTINUED ON SHEET 10E12.
3. FOR FUTURE PUMP INSTALLATION.
4. TYPICAL FOR ALL RECYCLED WATER PUMP MOTOR.



F PLAN
01E01
SCALE: 3/8" = 1'-0"
FILE: 8660F1099E0202

REV	DATE	BY	DESCRIPTION
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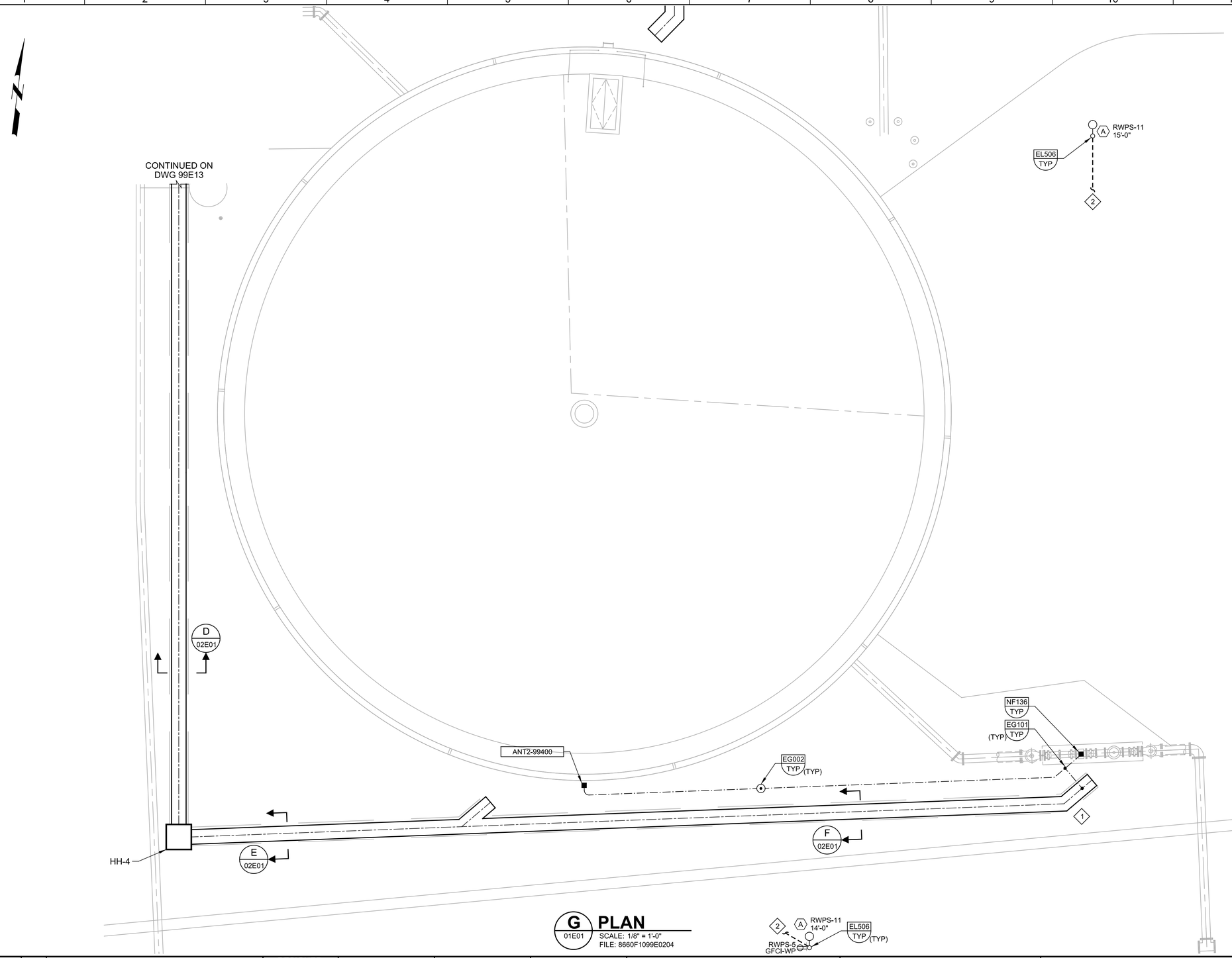
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City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
ELECTRICAL
RECYCLED WATER PUMP STATION
LIGHTING, GROUNDING, AND RECEPTACLES PLAN

VERIFY SCALES
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0 1"
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JOB NO. 8660F.10
DRAWING NO. 99E13
SHEET NO. 133 OF 200



KEY NOTES:

1. BOND DUCT BANK GROUNDING WIRE TO THE GROUND RING CONDUCTOR ACCORDING TO DETAIL EG101/TYP.
2. LIGHTING AND RECEPTACLE CONDUIT CONTINUES ON DRAWING 10E04.

G PLAN
01E01

SCALE: 1/8" = 1'-0"
FILE: 8660F1099E0204

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RECYCLED WATER PROJECT - PHASE 4

ELECTRICAL

RECYCLED WATER STORAGE LIGHTING, GROUNDING, AND RECEPTACLES PLAN

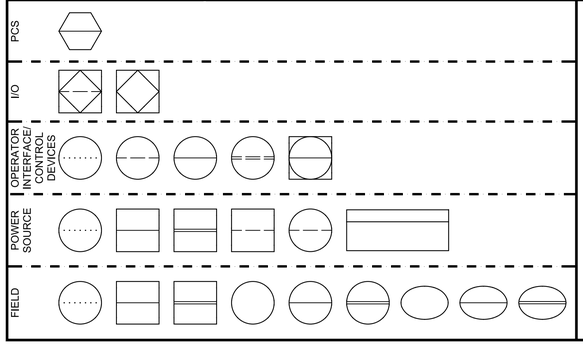
VERIFY SCALES
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0 1"
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JOB NO. 8660F.10
DRAWING NO. 99E14
SHEET NO. 134 OF 200

SYMBOL	DRAWING VISIBLE FIELDS	FIELD - 1	FIELD - 2	FIELD - 3	FIELD - 4	FIELD - 5	FIELD - 6	FIELD - 7	FIELD - 8
HMI/SCADA SYSTEM OPERATOR INTERFACE TERMINAL 	1 - TAG 2 - LOOP NUMBER 3 - FUNCTION 4 - DESCRIPTION 5 - DESCRIPTION 6 - EXISTING/FUTURE	REFER 1 2	REFER 3	ACTION ALARM SP - NUMERIC STATUS - SET POINT TREND	DESCRIPTION 2 5	DESCRIPTION	E - EXISTING F - FUTURE		
HARDWIRED I/O POINT 	1 - TAG 2 - LOOP NUMBER 3 - FUNCTION 4 - DESCRIPTION 5 - LOCATION 6 - EXISTING/FUTURE 7 - IO TABLE	REFER 1 2 4	REFER 3	AI - ANALOG INPUT AO - ANALOG OUTPUT DI - DISCRETE INPUT DO - DISCRETE OUTPUT RTD - RTD INPUT	DESCRIPTION	PAC - PROGRAMMABLE AUTOMATION CONTROLLER NO. PLC - PROGRAMMABLE LOGIC CONTROLLER NO. RIO - REMOTE I/O VCP - VENDOR CONTROL PANEL NO.	E - EXISTING F - FUTURE		
NETWORK / SOFT I/O 	1 - TAG 2 - LOOP NUMBER 3 - PROTOCOL 4 - PANEL 5 - PLC 6 - EXISTING/FUTURE 7 - IO TABLE 8 - SWITCH/SEGMENT	REFER 1 2	REFER 3	COMMUNICATION PROTOCOL CNET - CONTROLNET DNET - DEVICENET EIP - ETHERNET/IP FF - FOUNDATION FIELDBUS HART-I - HART OVER ETHERNET MANF - MFR. PROPRIETARY MBRTU - MODBUS RTU MB+ - MODBUS PLUS MBTCP - MODBUS TCP DP - PROFIBUS DP PA - PROFIBUS PA PNET - PROFINET SNMP - SNMPv3 HTTP - WEB SERVER (TCP/IP)	DESCRIPTION	PAC - PROGRAMMABLE AUTOMATION CONTROLLER NO. PLC - PROGRAMMABLE LOGIC CONTROLLER NO. RIO - REMOTE I/O VCP - VENDOR CONTROL PANEL NO.	E - EXISTING F - FUTURE		
LOCAL OPERATOR INTERFACE 	1 - TAG 2 - LOOP NUMBER 3 - FUNCTION 4 - DESCRIPTION 5 - LOCATION 6 - EXISTING/FUTURE	REFER 1 2	REFER 3	ACTION ALARM SP - NUMERIC STATUS - SET POINT TREND	DESCRIPTION	LOI - LOCAL OPERATOR INTERFACE NO. LCP - LOCAL CONTROL PANEL NO. PCM - PROCESS CONTROL MODULE NO. VCP - VENDOR CONTROL PANEL NO.	E - EXISTING F - FUTURE		
PILOT DEVICE OPERATOR INTERFACE 	1 - TAG 2 - LOOP NUMBER 3 - FUNCTION 4 - DESCRIPTION 5 - LOCATION 6 - EXISTING/FUTURE	REFER 1 2	REFER 3	AM - AUTO/MANUAL BYPASS - BY PASS E-STOP - EMERGENCY STOP FRLR - FIXED RATE/LEVEL RATE HOA - HAND/OFF/AUTO LOR - LOCAL/OFF/REMOTE LOS - LOCK OUT STOP LS - LEAD/STANDBY LSR - LOCAL/STOP/REMOTE NOOT - NO OFFLINE/OFFLINE TRANSITION OC - OPEN/CLOSE OLOL - ON LINE/OFFLINE OO - OFF/ON OSC - OPEN/STOP/CLOSE RST - RESET SAAM - SEMI AUTO/AUTO/MANUAL SEL - SELECT SPD - SPEED SS - START/STOP ST - STOP	DESCRIPTION 2 5	LCP - LOCAL CONTROL PANEL NO. MCC - MOTOR CONTROL CENTER NO. PCM - PROCESS CONTROL MODULE NO. RVS - REDUCED VOLTAGE SOLID STARTER NO. VCP - VENDOR CONTROL PANEL NO. VFD - VARIABLE FREQUENCY DRIVE NO.	E - EXISTING F - FUTURE		
POWER DEVICE PRIMARY FUNCTION OPERATOR ACCESSIBLE 	1 - TAG 2 - LOOP NUMBER 3 - FUNCTION 4 - VOLTAGE-POLE 5 - LOCATION 6 - EXISTING/FUTURE	CB - CIRCUIT BREAKER DISC - DISCONNECT FU - FUSE	REFER 3	TM - THERMAL MAGNETIC CIRCUIT BREAKER	24VDC - 1P 24VDC - 2P 24VAC - 1P 48VDC - 2P 120VAC - 1P 208VAC - 2P 208VAC - 3P 240VAC - 2P 240VAC - 3P 480VAC - 3P 2400VAC - 3P 4160VAC - 3P	DP - DISTRIBUTION PANEL NO. LCP - LOCAL CONTROL PANEL NO. LP - LIGHTING PANEL NO. MCC - MOTOR CONTROL CENTER NO. PCM - PROCESS CONTROL MODULE NO. PP - POWER PANEL NO. VCP - VENDOR CONTROL PANEL NO.	E - EXISTING F - FUTURE		
POWER DEVICE AUXILIARY FUNCTION OPERATOR ACCESSIBLE 	1 - TAG 2 - LOOP NUMBER 3 - DESCRIPTION 4 - DESCRIPTION 5 - DESCRIPTION 6 - EXISTING/FUTURE	DISC - DISCONNECT	REFER 3	DESCRIPTION	DESCRIPTION	DESCRIPTION	E - EXISTING F - FUTURE		
POWER DEVICE PRIMARY FUNCTION OPERATOR INACCESSIBLE 	1 - TAG 2 - LOOP NUMBER 3 - FUNCTION 4 - VOLTAGE-POLE 5 - LOCATION 6 - EXISTING/FUTURE	CB - CIRCUIT BREAKER FU - FUSE	REFER 3	MCP - MOTOR CIRCUIT PROTECTOR SS - SOLID STATE CIRCUIT BREAKER TM - THERMAL MAGNETIC CIRCUIT BREAKER	24VDC - 1P 24VDC - 2P 24VAC - 1P 48VDC - 2P 120VAC - 1P 208VAC - 2P 208VAC - 3P 240VAC - 2P 240VAC - 3P 480VAC - 3P 2400VAC - 3P 4160VAC - 3P	DP - DISTRIBUTION PANEL NO. LCP - LOCAL CONTROL PANEL NO. LP - LIGHTING PANEL NO. MCC - MOTOR CONTROL CENTER NO. PCM - PROCESS CONTROL MODULE NO. PP - POWER PANEL NO. VCP - VENDOR CONTROL PANEL NO.	E - EXISTING F - FUTURE		

SYMBOL	DRAWING VISIBLE FIELDS	FIELD - 1	FIELD - 2	FIELD - 3	FIELD - 4	FIELD - 5	FIELD - 6	FIELD - 7	FIELD - 8
INSTRUMENT PRIMARY ELEMENT 	1 - TAG 2 - LOOP NUMBER 3 - FUNCTION 4 - FURNISHED BY 5 - LOCATION 6 - EXISTING/FUTURE	REFER 1	REFER 3	DESCRIPTION 5	DESCRIPTION 6 7	AREA NO. BUILDING NO. ROOM NO.	E - EXISTING F - FUTURE		
INSTRUMENT/ CONTROL ELEMENT PRIMARY FUNCTION OPERATOR ACCESSIBLE 	1 - TAG 2 - LOOP NUMBER 3 - FUNCTION 4 - FURNISHED BY 5 - DESCRIPTION 6 - EXISTING/FUTURE	REFER 1	REFER 3	DESCRIPTION 5	DESCRIPTION 6 7	DESCRIPTION INT - INTEGRAL REM - REMOTE	E - EXISTING F - FUTURE		OUT - OUTDOOR
INSTRUMENT/ CONTROL ELEMENT AUXILIARY FUNCTION OPERATOR ACCESSIBLE 	1 - TAG 2 - LOOP NUMBER 3 - FUNCTION 4 - FURNISHED BY 5 - LOCATION 6 - EXISTING/FUTURE	REFER 1	REFER 3	DESCRIPTION	DESCRIPTION 6 7	DESCRIPTION	E - EXISTING F - FUTURE		
INSTRUMENT/ CONTROL ELEMENT PRIMARY FUNCTION OPERATOR INACCESSIBLE 	1 - TAG 2 - LOOP NUMBER 3 - FUNCTION 4 - FURNISHED BY 5 - LOCATION 6 - EXISTING/FUTURE	REFER 1 3 XR - PROTECTION RELAY CR - CONTROL RELAY XR - INTERPOSING RELAY	REFER 3	DESCRIPTION	DESCRIPTION 6 7	DESCRIPTION	E - EXISTING F - FUTURE		
INSTRUMENT/ CONTROL ELEMENT AUXILIARY FUNCTION OPERATOR INACCESSIBLE 	1 - TAG 2 - LOOP NUMBER 3 - FUNCTION 4 - FURNISHED BY 5 - LOCATION 6 - EXISTING/FUTURE	REFER 1 3 XR - PROTECTION RELAY CR - CONTROL RELAY XR - INTERPOSING RELAY	REFER 3	DESCRIPTION	DESCRIPTION 6 7	DESCRIPTION	E - EXISTING F - FUTURE		
FIELD EQUIPMENT NON-POWERED 	1 - TAG 2 - LOOP NUMBER 3 - FUNCTION/SIZE 4 - FURNISHED BY 5 - LOCATION 6 - EXISTING/FUTURE	REFER 3	REFER 3	DESCRIPTION	DESCRIPTION 6 7	AREA NO. BUILDING NO. ROOM NO.	E - EXISTING F - FUTURE		
FIELD EQUIPMENT PRIMARY FUNCTION POWERED 	1 - TAG 2 - LOOP NUMBER 3 - FUNCTION 4 - FURNISHED BY 5 - LOCATION 6 - EXISTING/FUTURE	REFER 3	REFER 3	DESCRIPTION	DESCRIPTION 6 7	AREA NO. BUILDING NO. ROOM NO.	E - EXISTING F - FUTURE		
FIELD EQUIPMENT AUXILIARY FUNCTION POWERED 	1 - TAG 2 - LOOP NUMBER 3 - FUNCTION 4 - FURNISHED BY 5 - LOCATION 6 - EXISTING/FUTURE	MWH - MOTOR WINDING HEATER TSH - TEMPERATURE SWITCH XSH - TORQUE SWITCH	REFER 3	DESCRIPTION	DESCRIPTION 6 7	DESCRIPTION	E - EXISTING F - FUTURE		
FIELD EQUIPMENT STARTER/DRIVE CUBICLE/CABINET	1 - TAG 2 - LOOP NUMBER 3 - TYPE 4 - VOLTAGE-POLE 5 - POWER SOURCE 6 - EXISTING/FUTURE	MS - MOTOR STARTER RVAT - REDUCED VOLTAGE AUTO TRANSFORMER STARTER RVSS - REDUCED VOLTAGE SOLID STATE STARTER VFD - VARIABLE FREQUENCY DRIVE	REFER 3	FVNR - FULL VOLTAGE NON-REVERSING STARTER FVR - FULL VOLTAGE REVERSING STARTER PWS - PART-WINDING STARTER RVAT - REDUCED VOLTAGE AUTO RVSS - REDUCED VOLTAGE SOLID STATE STARTER TS1W - TWO SPEED SINGLE WINDING TS2W - TWO SPEED TWO WINDINGS VFD - VARIABLE FREQUENCY DRIVE	120VAC - 1P 208VAC - 2P 208VAC - 3P 240VAC - 2P 240VAC - 3P 480VAC - 3P 2400VAC - 3P 4160VAC - 3P	LCP - LOCAL CONTROL PANEL NO. MCC - MOTOR CONTROL CENTER NO. PCM - PROCESS CONTROL MODULE NO. VCP - VENDOR CONTROL PANEL NO.	E - EXISTING F - FUTURE		

INSTRUMENT BUBBLE LOCATIONS



NOTES

1. INSTRUMENT TAG IDENTIFICATION LETTERS TABLE
2. OPERATOR PILOT DEVICE LEGEND
3. EQUIPMENT TAGGING TABLE
4. I/O TYPE DESIGNATIONS
5. INSTRUMENT TYPE DESIGNATIONS TABLE
6. FURNISHED BY: FBO FURNISHED BY OWNER; FBV FURNISHED BY VENDOR
7. PROVIDED BY: PBO PROVIDED BY OWNER; PBV PROVIDED BY VENDOR

CONFORMED DOCUMENTS

REV	DATE	BY	DESCRIPTION

DESIGNED DB
DRAWN AAW
CHECKED BAL
DATE JULY 2023

** ORIGINAL SEALED BY BRETT A. LEE 4/7/2023 CA PE NO. 22911 **

carollo

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

SYMBOLS AND ABBREVIATIONS 1

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00GN01
SHEET NO. 135 OF 200

Plot Date: 12-JUL-2023 11:50:35 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
jwicks

INSTRUMENT TAG IDENTIFICATION LETTERS

	MEASURED VARIABLE / INSTRUMENT FUNCTION	ELEMENT	TRANSMITTER	INDICATING TRANSMITTER	CONVERTER TRANSDUCER, RELAY SPECIAL DEVICES	INDICATOR	RECORDER	CONTROLLER	INDICATING CONTROLLER	RECORDING CONTROLLER	SWITCH	SWITCH LOW LOW	SWITCH LOW	SWITCH HIGH	SWITCH HIGH HIGH	SWITCH COMBINATION HIGH LOW	ACTION	ALARM LOW LOW	ALARM LOW	ALARM HIGH	ALARM HIGH HIGH	TOTALIZE INDICATOR TRANSMITTER	VALVE	GAUGE	LIGHT	SPEED SETTING
A	ANALYSIS	AE	AT	AIT	AY	AI	AR	AC	AIC	ARC	AS	ASLL	ASL	ASH	ASHH	ASHL		AALL	AAL	AAH	AAHH				AL	
B	BURNER FLAME	BE	BT	BIT	BY	BI	BR	BC	BIC	BRC	BS	BSLL	BSL	BSH	BSHH			BALL	BAL	BAH	BAHH				BL	
C	CONDUCTIVITY	CE	CT	CIT	CY	CI	CR	CC	CIC	CRC	CS	CSLL	CSL	CSH	CSHH	CSHL		CALL	CAL	CAH	CAHH				CL	
D	DENSITY	DE	DT	DIT	DY	DI	DR	DC	DIC	DRC	DS	DSLL	DSL	DSH	DSHH	DSHL		DALL	DAL	DAH	DAHH				DL	
E	VOLTAGE												ESL													
F	FLOW	FE	FT	FIT	FY	FI	FR	FC	FIC	FRC	FS	FSLL	FSL	FSH	FSHH	FSHL		FALL	FAL	FAH	FAHH	FQI	FCV	FG	FL	
FF	FLOW RATIO				FFY	FFI		FFC	FFIC		FFS														FFL	
H	HAND (MANUAL)*							HC			HS*						HA*						HV		HL	HSS
I	CURRENT		IT	IIT	IY	II	IR	IC	IIC	IRC	IS	ISLL	ISL	ISH	ISHH			IALL	IAL	IAH	IAHH				IL	
J	POWER																									
K	TIME				KY	KI	KR	KC	KIC	KRC	KS	KSLL	KSL	KSH	KSHH			KALL	KAL	KAH	KAHH		KV		KL	
L	LEVEL	LE	LT	LIT	LY	LI	LR	LC	LIC	LRC	LS	LSLL	LSL	LSH	LSHH	LSHL		LALL	LAL	LAH	LAHH		LCV	LG	LL	
M	MOISTURE OR HUMIDITY	ME	MT	MIT	MY	MI	MR	MC	MIC	MRC	MS	MSLL	MSL	MSH	MSHH			MALL	MAL	MAH	MAHH				ML	
N	USER'S CHOICE																									
P	PRESSURE OR VACUUM	PE	PT	PIT	PY	PI	PR	PC	PIC	PRC	PS	PSLL	PSL	PSH	PSHH	PSHL		PALL	PAL	PAH	PAHH		PCV		PL	
PD	DIFFERENTIAL PRESSURE		PDT	PDIT	PDY	PDI	PDR	PDC	PDIC	PDRC	PDS	PDSLL	PDSL	PDSH	PDSHH			PDALL	PDAL	PDAH	PDAHH		PDCV		PDL	
Q	QUANTITY	QE	QT	QIT	QY	QI	QR				QS	QSLL	QSL	QSH	QSHH			QALL	QAL	QAH	QAHH					
R	RADIATION																									
S	SPEED	SE	ST	SIT	SY	SI	SR	SC	SIC	SRC	SS	SSLL	SSL	SSH	SSHH			SALL	SAL	SAH	SAHH					
T	TEMPERATURE	TE	TT	TIT	TY	TI	TR	TC	TIC	TRC	TS	TSLL	TSL	TSH	TSHH	TSHL		TALL	TAL	TAH	TAHH		TCV		TL	
TD	DIFFERENTIAL TEMPERATURE		TDT	TDIT	TDY	TDI	TDR	TDC	TDIC	TDRC	TDS	TDSLL	TDSL	TDSH	TDSHH			TDALL	TDAL	TDAH	TDAHH		TDCV		TDL	
U	MULTIVARIABLE					UI	UR	UC	UIC	URC	US														UL	
V	VISCOSITY	VE	VT	VIT	VY	VI	VR	VC	VIC	VRC	VS	VSLL	VSL	VSH	VSHH			VALL	VAL	VAH	VAHH				VL	
W	WEIGHT	WE	WT	WIT	WY	WI	WR				WS	WSLL	WSL	WSH	WSHH			WALL	WAL	WAH	WAHH					
X	UNCLASSIFIED	XE	XT	XIT	XY	XI	XR	XC	XIC	XRC	XS	XSLL	XSL	XSH	XSHH			XALL	XAL	XAH	XAHH		XCV	XG	XL	
XV	VIBRATION	XVE	XVT		XVY	XVI	XVR				XVS			XVSH	XVSHH					XVAH	XVAHH				XVL	
Y	STATUS***					YI																			YL	
Z	POSITION	ZE	ZT	ZIT	ZY	ZI					ZS**												ZV		ZL**	

* REFER TO OPERATOR PILOT DEVICE LEGEND

** LETTER INDICATES POSITION (O=OPEN, C=CLOSED, R=RAISE, L=LOWER, ETC)

OPERATOR PILOT DEVICE LEGEND

DEVICE TYPE / PILOT DEVICE FUNCTION	LOCAL-OFF-REMOTE (LOR)OR LOCAL-STOP-REMOTE (LSR)	STOP(SP)	START (ST)	HAND-OFF-AUTO (HOA)	OFF-ON (OO)	SELECT (SEL)	OPEN-STOP-CLOSE (OSC)	JOG OPEN-HOLD-CLOSE (JOHC)	SEMIAUTO-AUTO-MANUAL (SAAM)	LEAD-LAG-STANDBY (LLGS)	JOG OPEN-JOG CLOSE (JOJC)	ONLINE-OFFLINE (OLOF)	AUTO-MANUAL (AM)	FIXED RATE-LEVEL RATE (FRLR)	OPEN-CLOSE (OC)	NO OFFLINE-OFFLINE TRANSITION (NOOT)	LOW-HIGH (LH)	RESET (RST)	SPEED (SPD)	START-STOP (STSP)	E-STOP (E-SP)	BYPASS (BYP)			SILENCE	POSITION (POS)
PILOT DEVICE TAG (HAND SWITCHES)	HSA*	HSB	HSC	HSD*	HSE	HSF	HSG	HSH	HIS	HSJ*	HSK	HSL*	HSM*	HSN	HSO	HSP	HSQ*	HSR	HSS	HST*	HSU	HSV	HSW	HSX	HSY	HSZ

PLC I/O TAG: * = R (REMOTE), A (AUTO), ETC.

I/O TYPE DESIGNATIONS

AUX1	RUNNING	MSL	MOTOR START LOW
AUX2	FAILED/FAULT	MSM	VALVE MODULATE
AUXF1	RUNNING FORWARD	MSP	MOTOR STOP
AUXH1	RUNNING HIGH	MSR	MOTOR START REVERSE
AUXL1	RUNNING LOW	MST	MOTOR START
AUXR1	RUNNING REVERSE	SS	SPEED SIGNAL
SVC	SOLENOID VALVE CLOSE	ZC	POSITION COMMAND
SVO	SOLENOID VALVE OPEN	ZCC	POSITION COMMAND CLOSE
MS	RUN	ZCO	POSITION COMMAND OPEN
MSF	MOTOR START FORWARD		
MSH	MOTOR START HIGH		

INSTRUMENT TYPE DESIGNATIONS

CGD	COMBUSTIBLE GAS DETECTOR	RTD	RESISTANCE TEMP DETECTOR
COND	CONDUCTIVITY	SB	SLUDGE BLANKET
DO	DISSOLVED OXYGEN	SC	STREAMING CURRENT
FMCW	FREQ. MODULATED CONT. WAVE	SD	SLUDGE DEPTH
IS	INTRINSIC SAFETY BARRIER	SH	SODIUM HYPOCHLORITE
LEL	LOWER EXPLOSIVE LIMIT	SO2	SULFUR DIOXIDE
MLSS	MIXED LIQUOR SUSPENDED SOLIDS	TDR	TIME DOMAIN REFLECTOMETRY
ORP	OXIDATION REDUCTION POTENTIAL	TOC	TOTAL ORGANIC CARBON
P-SUB	PRESSURE SUBMERSIBLE	TSS	TOTAL SUSPENDED SOLIDS
PC	PARTICLE COUNTER	UVI	UV INTENSITY
PTOF	PULSE TIME OF FLIGHT	UVT	UV TRANSMITTANCE

SPECIFIC ABBREVIATIONS

HTR	HEATER
HTU	HEAT TRACE UNIT
MWH	MOTOR WINDING HEATER
SV	SOLENOID VALVE
SPD	SURGE PROTECTIVE DEVICE
UPS	UNINTERRUPTIBLE POWER SUPPLY
YA	STATUS AUTO
YR	STATUS REMOTE
Y1	STATE RUNNING
Y2	ALARM FAILED/FAULT

P&ID LINE SYMBOLS

INSTRUMENT OR CONNECTION TO PROCESS

PNEUMATIC SIGNAL

ELECTRIC SIGNAL

HYDRAULIC SIGNAL

CAPILLARY TUBE

ELECTROMAGNETIC OR SONIC SIGNAL (GUIDED)

ELECTROMAGNETIC OR SONIC SIGNAL (NOT GUIDED)

INTERNAL SYSTEM LINK (SOFTWARE OR DATA LINK)

PROCESS LINE SYMBOLS

PRIMARY PROCESS FLOW IN PIPE

SECONDARY PROCESS FLOW IN PIPE

PRIMARY PROCESS FLOW IN CHANNEL

SECONDARY PROCESS FLOW IN CHANNEL

DESIGNATIONS

EQUIPMENT ENCLOSURE

EXISTING

FUTURE

FUTURE

MISCELLANEOUS P&ID SYMBOLS

PROCESS CONTINUATION — DESC2_ DESC1_ # DWG NO. — UNIQUE IDENTIFIER — CONTINUATION SHEET

SIGNAL CONTINUATION — DESC2_ DESC1_ # DWG NO. — UNIQUE IDENTIFIER — CONTINUATION SHEET

PIPE CALLOUT — PIPE SIZE

SCHEMATIC DETAIL — ? / -

TYPICAL DETAIL — * / TYP — TYPNUM, TYPNUM2, TYPNUM3, TYPNUM4, TYPNUM5, TYPNUM6

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN AAW
CHECKED BAL
DATE JULY 2023

** ORIGINAL SEALED BY BRETT A. LEE 4/7/2023 CA PE NO. 22911 **

carollo

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

SYMBOLS AND ABBREVIATIONS 2

VERIFY SCALES
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0 — 1"
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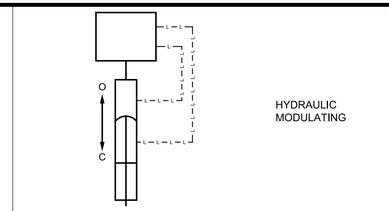
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DRAWING NO. 00GN02
SHEET NO. 136 OF 200

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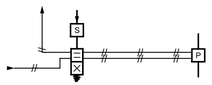
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jwicks

ACTUATORS

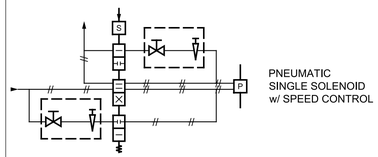
- DIAPHRAGM
- ELECTRIC DISCRETE
- ELECTRIC MODULATING
- ELECTRIC HYDRAULIC
- HAND
- HYDRAULIC
- PNEUMATIC
- SOLENOID



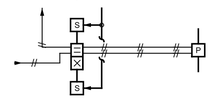
HYDRAULIC MODULATING



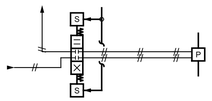
PNEUMATIC SINGLE SOLENOID OPEN/CLOSE



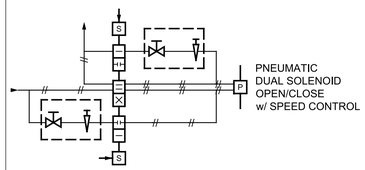
PNEUMATIC SINGLE SOLENOID w/ SPEED CONTROL



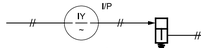
PNEUMATIC DUAL SOLENOID OPEN/CLOSE



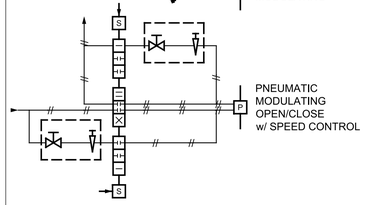
PNEUMATIC DUAL SOLENOID OPEN/HOLD/CLOSE



PNEUMATIC DUAL SOLENOID OPEN/CLOSE w/ SPEED CONTROL



PNEUMATIC MODULATING



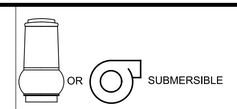
PNEUMATIC MODULATING OPEN/CLOSE w/ SPEED CONTROL

PIPING

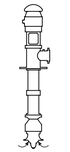
- AIR GAP
- BLIND FLANGE
- CAPPED OR PLUGGED
- CONCENTRIC INCREASER
- CONCENTRIC REDUCER
- DRAIN
- ECCENTRIC INCREASER
- FLANGED CONNECTION
- TEE
- UNION
- ECCENTRIC REDUCER
- EXPANSION COUPLING
- EXPANSION JOINT VIBRATION CENTER
- FLEXIBLE CONNECTION
- QUICK DISCONNECT

PUMPS

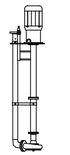
- AIR DRIVEN
- CENTRIFUGAL
- CHEMICAL FEED DIAPHRAGM
- DIAPHRAGM
- GEAR
- PERISTALTIC OR HOSE
- PISTON
- PROGRESSIVE CAVITY



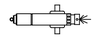
SUBMERSIBLE



VERTICAL TURBINE



VERTICAL CHOPPER



WATER CHAMP

BLOWERS/ COMPRESSORS



CENTRIFUGAL SINGLE STAGE BLOWER



CENTRIFUGAL MULTI STAGE BLOWER



RECIPROCATING COMPRESSOR



SCREW COMPRESSOR



FAN



LIQUID RING COMPRESSOR



ROTARY LOBE BLOWER

CHECK VALVES

- BACK FLOW PREVENTER
- BALL
- DIAPHRAGM CHECK
- DOUBLE FLAP
- FLAPPER
- SPRING LOADED GENERAL
- SPRING LOADED SWING
- SWING

PRESSURE VALVES

- BACKPRESSURE REGULATING SELF CONTAINED
- BACKPRESSURE REGULATING EXTERNAL TAP
- PRESSURE REDUCING SELF CONTAINED
- PRESSURE REDUCING EXTERNAL PRESSURE TAP
- REGULATING
- PRESSURE RELIEF
- VACUUM RELIEF

VALVES

- 3-WAY
- 3-WAY PLUG
- 4-WAY
- AIR-RELIEF
- ANGLE
- BALL
- BALL V-NOTCH
- BUTTERFLY
- BUTTERFLY-BURIED VALVE BOX
- CONE
- DIAPHRAGM
- FLOAT
- GATE
- GATE-BURIED VALVE BOX
- GLOBE
- HOSE
- MUD
- NEEDLE
- PINCH
- PLUG ECCENTRIC
- PLUG ECCENTRIC w-VALVE BOX
- PLUG ECCENTRIC LUBRICATED
- PLUG ECCENTRIC LUBRICATED BURIED VALVE BOX
- PLUG CONCENTRIC
- PLUG CONCENTRIC -BURIED VALVE BOX
- PLUG CONCENTRIC LUBRICATED
- PLUG CONCENTRIC LUBRICATED BURIED VALVE BOX
- PUMP DISCHARGE
- TELESCOPING

VALVE DESIGNATIONS

NO	NORMALLY OPEN
NC	NORMALLY CLOSED
FO	FAIL OPEN
FC	FAIL CLOSE
FLP	FAIL LAST POSITION

MISC

- AIR / CHEMICAL DIFFUSER
- BASKET STRAINER
- BLOW-OFF SILENCER
- CALIBRATION COLUMN
- COALESCER
- DESICCANT DRYER
- EDUCTOR/EJECTOR
- EQUIPMENT/INSTRUMENT LOCATOR
- EXHAUST FAN
- EYEWASH
- FILTER
- FILTER SEPARATOR
- FINE FILTER
- FIRE ALARM/SENSOR
- FLAME ARRESTER
- FLAME ARRESTER w/THERMALLY OPERATED VALVE
- FLOW CONDITIONER
- GAS CANNON
- GRINDER
- HEAT EXCHANGER
- HOIST
- HORIZONTAL MIXER
- HOSE CONNECTION
- INLET STRAINER
- INLINE STATIC MIXER
- INLINE DUCT DAMPER
- LOUVER OR DAMPER
- MATERIAL CHANGE
- MIXER
- MOTOR
- NOZZLE
- ORIFICE RESTRICTION
- PERISTALTIC COMPOSITE SAMPLER
- OR
- PULSATION DAMPENER
- REFRIGERATED DRYER
- RUPTURE DISK
- SAMPLE PORT
- SIGHT TUBE
- SMOKE DETECTOR
- STRAINER - MECHANICALLY CLEANED
- STRAINER WITH BLOW OFF
- STRAINER WYE TYPE
- VAPOR HEATER
- VAPORIZER
- VENT
- VENT TO ATMOSPHERE

CONFORMED DOCUMENTS

REV	DATE	BY	DESCRIPTION

DESIGNED DB
DRAWN AAW
CHECKED BAL
DATE JULY 2023

** ORIGINAL SEALED BY BRETT A. LEE 4/7/2023 CA PE NO. 22911 **

carollo

City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
INSTRUMENTATION
SYMBOLS AND ABBREVIATIONS 3

VERIFY SCALES
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0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00GN03
SHEET NO. 137 OF 200

jwicks

PROJECT NO. 8660F10 FILE NAME: 8660F1000GN03.dwg

FLOW

- BATCH
- CORIOLIS
- MAGNETIC
- ORIFICE
- PADDLE WHEEL
- PISTON
- ANNUBAR
- PITOT TUBE
- POSITIVE-DISPLACEMENT
- PROPELLER-TURBINE
- ROTAMETER
- THERMAL
- ULTRASONIC
- ULTRASONIC BIOGAS
- V-CONE
- VENTURI TUBE OR FLOW NOZZLE
- VORTEX

FLUMES

- LEOPOLD-LAGCO
- PALMER-BOWLUS
- PARSHALL
- REGULAR CUTTHROAT
- TRAPEZOIDAL

GATES

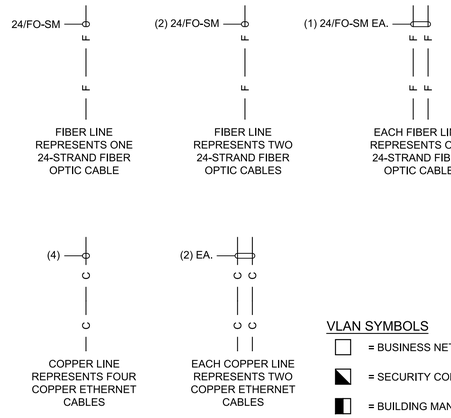
SIDE VIEW	PLAN VIEW
SLIDE	FLAP
SLUICE	KNIFE
STOP	SLIDE
WASTE GATE	SLUICE
	STOP
	WEIR
	BUTTERFLY

LEVEL

- BUBBLER
- CAPACITANCE
- DIFFERENTIAL PRESSURE (TANK)
- ELECTRODE
- FLOAT
- INVERTED COLUMN
- PROBE
- RADAR PTOF
- RADAR (FREQUENCY MODULATED CONTINUOUS WAVE)
- RADAR TDR
- SUSPENDED/ SUBMERSIBLE
- TUNING FORK
- ULTRASONIC

NETWORKS

CABLE CALLOUTS AND ABBREVIATIONS



FIBER ABBREVIATIONS

##/FO-XX
- ## = STRAND COUNT
- FO = FIBER OPTIC

XX = MODE
- SM = SINGLE MODE
- MM = MULTIMODE

NETWORK ABBREVIATIONS

BMS	= BUILDING MANAGEMENT SYSTEM
BSN	= BUSINESS NETWORK
FCN	= FIELD CONTROL NETWORK
MIN	= MAINTENANCE INFORMATION NETWORK
PCN	= PROCESS CONTROL NETWORK
PLCN	= PLC NETWORK
SCN	= SECURITY CONTROL NETWORK
PCN-W	= WIRELESS PROCESS CONTROL NETWORK
NR	= NETWORK RACK
NP	= NETWORK PANEL
ES	= ETHERNET SWITCH
FPP	= FIBER PATCH PANEL

VLAN SYMBOLS

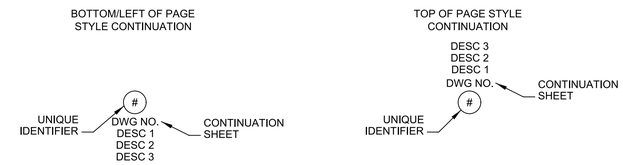
- = BUSINESS NETWORK
- = SECURITY CONTROL NETWORK
- = BUILDING MANAGEMENT SYSTEM
- = PROCESS CONTROL NETWORK
- = WIRELESS PROCESS CONTROL NETWORK
- = MAINTENANCE INFORMATION NETWORK
- = PLC NETWORK
- = FIELD CONTROL NETWORK

NETWORK LINE SYMBOLS

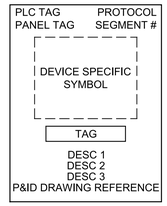
COPPER ETHERNET	C
FIBER OPTIC ETHERNET	F
WIRELESS ETHERNET	W
PROFIBUS DP	PBD
PROFIBUS PA	PBA
SERIAL DATA	o

MISCELLANEOUS NETWORK SYMBOLS

NETWORK CABLE CONTINUATIONS



FIELD NETWORK DEVICE



NETWORK EQUIPMENT CALLOUT



PRESSURE/VACUUM

PRESSURE	DIFFERENTIAL PRESSURE	PRESSURE SEALS
GAUGE	GAUGE DIFFERENTIAL INDICATOR	SEAL ANNULAR
MANOMETER	DIFFERENTIAL PRESSURE SWITCH	SEAL DIAPHRAGM
PRESSURE SWITCH	DIFFERENTIAL PRESSURE TRANSMITTER	SEAL SANITARY
PRESSURE TRANSMITTER		EXAMPLE: PRESSURE SWITCH

TEMPERATURE

- TEMPERATURE w/THERMOWELL
- TEMPERATURE GAUGE
- THERMOMETER

WEIGHT

- HYDRAULIC
- STRAIN GAUGE

WEIRS

SIDE VIEW	PLAN VIEW
RECTANGULAR w/o END CONTRACTIONS	RECTANGULAR w/o END CONTRACTIONS
RECTANGULAR w/ END CONTRACTIONS	RECTANGULAR w/ END CONTRACTIONS
V-NOTCH (TRIANGULAR)	V-NOTCH (TRIANGULAR)
TRAPEZOIDAL (CIPOLLETTI)	TRAPEZOIDAL (CIPOLLETTI)

REV	DATE	BY	DESCRIPTION

CONFORMED DOCUMENTS

DESIGNED DB
DRAWN AAW
CHECKED BAL
DATE JULY 2023

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City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

SYMBOLS AND ABBREVIATIONS 4

VERIFY SCALES
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0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00GN04
SHEET NO. 138 OF 200

PROCESS SWITCHES

- FLOAT SWITCH
  CLOSE ON RISING LEVEL
- FLOAT SWITCH
  OPEN ON RISING LEVEL
- PRESSURE SWITCH
  CLOSE ON RISING PRESSURE
- PRESSURE SWITCH
  OPEN ON RISING PRESSURE
- TEMPERATURE SWITCH
  CLOSE ON RISING TEMPERATURE
- TEMPERATURE SWITCH
  OPEN ON RISING TEMPERATURE
- FLOW SWITCH
  CLOSE ON INCREASE IN FLOW
- FLOW SWITCH
  OPEN ON INCREASE IN FLOW
- VIBRATION SWITCH
  OPEN ON RISING VIBRATION
- VIBRATION SWITCH
  CLOSE ON RISING VIBRATION
- TORQUE SWITCH
  OPEN ON HIGH TORQUE
- TORQUE SWITCH
  CLOSE ON HIGH TORQUE
- NORMALLY CLOSED
  LIMIT SWITCH
- NORMALLY CLOSED
  HELD OPEN LIMIT SWITCH
- NORMALLY OPEN
  LIMIT SWITCH
- NORMALLY OPEN
  HELD CLOSED LIMIT SWITCH

HAND SWITCHES

- NORMALLY OPEN
  MOMENTARY PUSHBUTTON
- NORMALLY CLOSED
  MOMENTARY PUSHBUTTON
- THREE POSITION SELECTOR SWITCH
  x - DENOTES POSITION CONTACTS CLOSED IN
  (xoo)
- TWO POSITION SELECTOR SWITCH
  x - DENOTES POSITION CONTACTS CLOSED IN
  (xo)
- MUSHROOM HEAD PUSHBUTTON
- PUSH-PULL PUSHBUTTON
  MAINTAINED CONTACT
- PADLOCK SWITCH
  x - DENOTES POSITION CONTACTS CLOSED IN
  (xox)
- PULL CORD SWITCH
- STOP-LOCKOUT PUSHBUTTON
- SPRING-RETURN
  x - DENOTES POSITION CONTACTS CLOSED IN
  (xoo)

INDICATORS

- PILOT LIGHT
  a = LENS COLOR
  R = RED
  G = GREEN
  W = WHITE
  A = AMBER
  B = BLUE
  Y = YELLOW
  C = CLEAR
- BEACON
  a = LENS COLOR
  R = RED
  G = GREEN
  W = WHITE
  A = AMBER
  B = BLUE
  M = MAGENTA
  C = CLEAR
- HORN

RELAYS

- RELAY COIL
  a = TYPE
  CR - CONTROL RELAY
  TD - TIME DELAY RELAY
  M - MOTOR STARTER COIL
  L - MOTOR STARTER COIL - LOW SPEED
  H - MOTOR STARTER COIL - HIGH SPEED
  F - MOTOR STARTER COIL - FORWARD
  R - MOTOR STARTER COIL - REVERSE
  b = TDON - TIME DELAY ON ENERGIZATION
  TDOFF - TIME DELAY ON DEENERGIZATION
  c = TIMING RANGE/SETTING
  d = DESCRIPTION
- NORMALLY OPEN
  CONTROL CONTACT
- NORMALLY CLOSED
  CONTROL CONTACT
- NOTC
  TIME DELAY CONTACT
  NORMALLY OPEN
  TIMED CLOSING
- NCTO
  TIME DELAY CONTACT
  NORMALLY CLOSED
  TIMED OPENING
- NOTO
  TIME DELAY CONTACT
  NORMALLY OPEN
  TIMED OPENING
- NCTC
  TIME DELAY CONTACT
  NORMALLY CLOSED
  TIMED CLOSING

TERMINAL BLOCKS

- TERMINAL
  IN PLC/PCM PANEL
- TERMINAL
  IN MOTOR CONTROL CENTER
- TERMINAL
  IN LOCAL STARTER CONTROL PANEL
- TERMINAL
  AT FIELD DEVICE
- TERMINAL
  IN RTU
- TERMINAL
  IN FIELD PANEL
- TERMINAL
  IN (USER CHOICE)
- DIGITAL BUS CONNECTOR
  * = D - DEVICENET
  * = PA - PROFIBUS PA
  * = DP - PROFIBUS DP
  * = H1 - FOUNDATION FIELDBUS H1
  * = H2 - FOUNDATION FIELDBUS H2
  * = E - ETHERNET

I/O

- PLC DISCRETE
  a = INPUT OR OUTPUT AS INDICATED
- PLC ANALOG
  a = INPUT OR OUTPUT AS INDICATED
- DIGITAL BUS

MISC

- SOLENOID
- METER UNIT
  M = TYPE
- MOTOR
- CIRCUIT BREAKER
- DISCONNECT
- FUSE
- TRANSIENT SURGE PROTECTION
- MOTOR WINDING HEATER
  * - MOTOR TAG I.D.
- SPACE HEATER
- VARISTOR
- CAPACITOR
- RESISTOR
- BATTERY
- DIODE
- MOTOR OVERLOAD HEATERS
- OVERLOAD CONTACT
- DRAWOUT CONNECTION
- GROUND
- LIGHTNING ARRESTOR
- CONTROL POWER TRANSFORMER
- ELAPSED TIME METER

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

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DRAWN AAW
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CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
INSTRUMENTATION
SCHEMATIC SYMBOLS

VERIFY SCALES
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DRAWING NO. 00GN05
SHEET NO. 139 OF 200

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ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: awills

MCC-1201

PCM-300

TERMINAL | PANEL | PLC

PMP-210
UTILITY WATER PUMP
MOTOR:
25HP, 480VAC, 3Ø
INV. DUTY, TEFC
TOSHIBA MODEL: XYZ

PUMP
200 GPM @ 20 FT TDH
900-1800 RPM
GOULD MODEL: XYZ

P-01-001 J-BOX P-01-002

H, C — MWH 210 — (MWH210-H/VFD210-33), (MWH210-C/VFD210-X2)

T1, T2, T3 — PMP 210 — (PMP210-T1/VFD210-T1), (PMP210-T2/VFD210-T2), (PMP210-T3/VFD210-T3)

NC, C — TSH 210 — (TSH210-NC/PCM300-CB1300H1), (TSH210-C/PCM300-I001)

C-01-003 J-BOX

C-01-001

PE/PSH-210
UTILITY WATER HIGH PRESSURE
MODEL: XYZ
RANGE: 0-200 PSIG
SETPOINT: 50 PSIG

PE 210 — PSH 210 — 1, 2 — (PSH210-1/PCM300-CB1300H2), (PSH210-2/PCM300-C0001)

L-01-001

FE/FIT/FQT-210
UTILITY WATER FLOW METER
ENDRESS HAUSER
CAT NO.: XYZ
FLOW RANGE: 200-2500 GPM
FLOW TOTAL: 1 PULSE/500 GAL

L, N, G

S-01-001 J-BOX S-01-003

FE 210 — FIT 210 — FQT 210 — 1, 2, 4, 5

S-01-002

LCP-210
HSS 210 — P1, P2, P3 — (LCP210-P1/VFD210-1), (LCP210-P2/VFD210-2), (LCP210-P3/VFD210-3)

C-01-002

HSA 210 — OFF / LOCAL / REMOTE — 1, 2, 3, 4 — xoo, oox — (LCP210-1/VFD210-5), (LCP210-2/VFD210-6)

HSB 210 — STOP — 5, 6 — (LCP210-5/VFD210-7), (LCP210-6/VFD210-8)

HSC 210 — START — 7, 8 — (LCP210-7/VFD210-9), (LCP210-8/VFD210-10)

VFD-210
SECTION - 3
CUBICLE - 2
30HP, 480VAC, 42 AMPS

MWH-210 MOTOR WINDING HEATER: 33, X2

MOTOR CONNECTION: T1, T2, T3

LOCAL SPEED IN: 1, 2, 3, 4

HSAL-210 LOCAL MODE: 5, 6

HSB-210 LOCAL STOP: 7, 8

HSC-210 LOCAL START: 9, 10

SS-210 VFD SPEED OUT: 11, 12 — (VFD210-11,12/PCM300-AQ001)

SB-210 REMOTE SPEED IN: 13, 14 — (VFD210-13,14/PCM300-AI001)

MSP-210 REMOTE STOP: 15, 16 — (VFD210-15/PCM300-Q001A), (VFD210-16/PCM300-Q001B)

E-STOP: 23, 24 — (VFD210-23/PCM300-C0002), (VFD210-24/PCM300-C0003)

MS-210 REMOTE START: 17, 18 — (VFD210-17/PCM300-Q002A), (VFD210-18/PCM300-Q002B)

AUX1-210 RUNNING: 19, 20

AUX2-210 FAIL: 21, 22 — (VFD210-19/PCM300-FU13000H3), (VFD210-20/PCM300-I003), (VFD210-21/PCM300-FU1300H4), (VFD210-22/PCM300-I004)

(PSH210-1/PCM300-C001)

(FIT210-L/PCM300-CB1210H), (FIT210-N/PCM300-CB1210N)

(FIT210-1,2/PCM300-AI002)

(FQT210-4,5/PCM300-FU1300P3; C0004)

(LCP210-3/PCM300-FU1300H5), (LCP210-4/PCM300-I006)

AQ0001+ <BLK-1>
AQ0001- <WHT-1>
SHLD
FU1300-P1
AI001+ <BLK-1>
FU1300-M1 <WHT-1>
SHLD
FU1300-H1
I001 <BLK>
Q001A <BLK>
Q001B <RED>
FU1300-H2
C0002
C0003
C0001
Q002A <BLU>
Q002B
CB1-210H
CB1-210N
GND
FU1300-P2
AI002+ <BLK-2>
FU1300-M2 <WHT-2>
SHLD
FU1300-P3
C0004
SHLD
FU1300-H3
I003 <BLU>
FU1300-H4
I004 <ORG>
FU1300-H5
I006 <YEL>

(C0002), (C0003), (C0001), (CB1300-H6) — PHOENIX MODEL: XYZ 120 VAC — CR1 210 — (CB1-300N1), (I005)

120VAC

(FU1300-M3), (C0004), (CB1300-H7) — CR2 210 — (I002) — PHOENIX MODEL: XYZ 120 VAC

FU1-300M, FU1-300P — 24 VDC

(FU1300-P), (CB1300-H) — CB1-300H — 120 VAC — CB1-300N — (CB1300-N)

PLC:
1, 2 — SS 210 — %AQ001 SPEED OUT — RACK 1 SLOT 2
1, 2 — SB 210 — %AI001 SPEED IN — RACK 1 SLOT 3
1, 2 — TSH 210 — %I001 MTR TEMP — RACK 1 SLOT 4
1, 2 — MSP 210 — %Q001 STOP — RACK 1 SLOT 5
9, 10 — PSH 210 — %I005 HI PRESS — RACK 1 SLOT 4
3, 4 — MS 210 — %Q002 START — RACK 1 SLOT 5
3, 4 — F 210 — %AI002 FLOW — RACK 1 SLOT 2
3, 4 — FQ 210 — %I002 FLOW TOT — RACK 1 SLOT 4
5, 6 — AUX1 210 — %I003 RUNNING — RACK 1 SLOT 4
7, 8 — AUX2 210 — %I004 FAIL — RACK 1 SLOT 4
11, 12 — HSAR 210 — %I006 REMOTE — RACK 1 SLOT 4

THE ABOVE DRAWING IS INCLUDED AS AN EXAMPLE ONLY AND IS NOT PROJECT SPECIFIC. CONTRACTOR SHALL FURNISH LOOP DIAGRAMS FOR THE ENTIRE FACILITY. PRELIMINARY DETAILED LOOP DIAGRAMS TO BE SUBMITTED FOR REVIEW PRIOR TO BEGINNING CONSTRUCTION. THE LOOP DIAGRAM SHOWN ABOVE DISPLAYS THE LEVEL OF EXPECTED DETAIL.

REV	DATE	BY	DESCRIPTION

CONFORMED DOCUMENTS

DESIGNED DB
DRAWN AAW
CHECKED BAL
DATE JULY 2023

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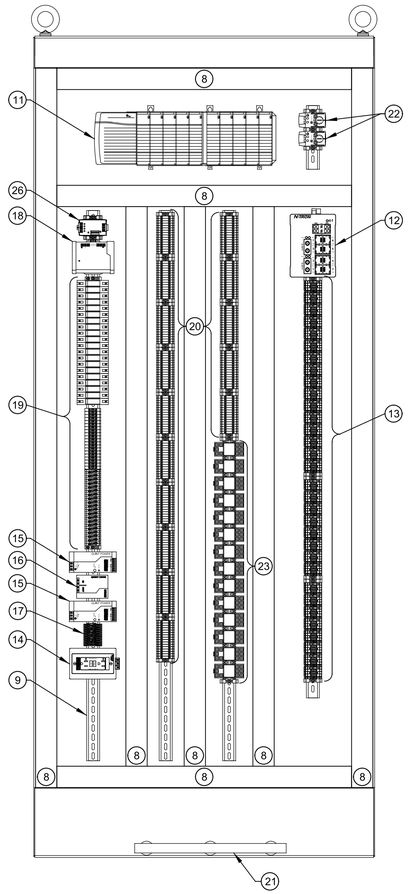
CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
INSTRUMENTATION
SAMPLE LOOP DRAWING

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

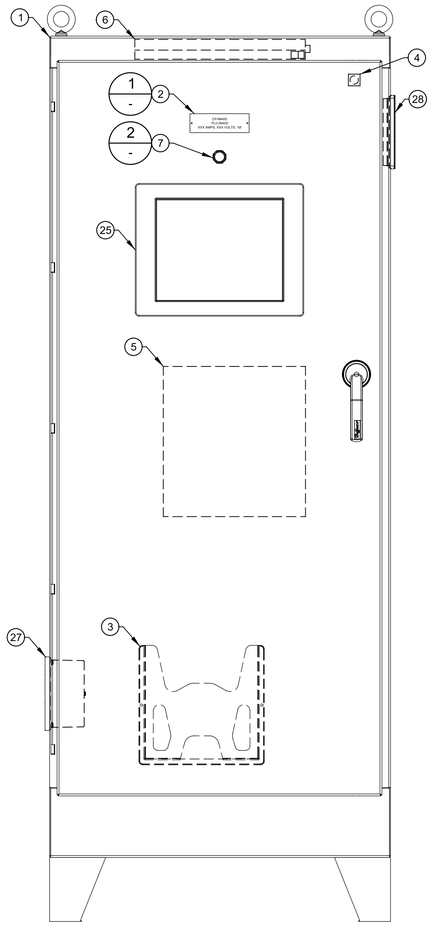
JOB NO. 8660F.10
DRAWING NO. 00GN06
SHEET NO. 140 OF 200

GENERAL NOTES:

1. ENCLOSURE DRAWING REPRESENTS DESIGN INTENT. CONTRACTOR TO SUPPLY AS-BUILT DRAWINGS SHOWING FINAL ENCLOSURE LAYOUT WITH ALL EQUIPMENT, MANUFACTURERS, AND PART NUMBERS.
2. REFER TO ELECTRICAL PLANS FOR LOCATION OF ALL ENCLOSURES.
3. CONSTRUCT PANEL TO MEET THE FULL INTENT OF ARTICLE 409 OF THE NATIONAL ELECTRIC CODE.
4. FOLLOW ALL UL 508 AND 508 SUPPLEMENT 5B TO DETERMINE SHORT CIRCUIT RATINGS.
5. NO 480VAC CIRCUITS SHALL TERMINATE IN OR PASS THROUGH CONTROL CABINETS.
6. ALL CONDUIT PENETRATIONS SHALL BE LOCATED AT THE TOP OR BOTTOM OF THE ENCLOSURE. NO SIDE, FRONT, OR REAR PENETRATIONS ALLOWED.
7. QUANTITY OF COMPONENTS VARY AS REQUIRED FOR EACH CABINET.

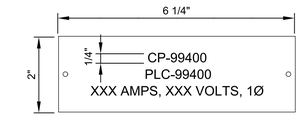


PCM-99400 PANEL ELEVATION INTERIOR



CP-99400 PANEL ELEVATION EXTERIOR

CONTROL PANEL - BILL OF MATERIALS	
ITEM	DESCRIPTION
1	ENCLOSURE
2	NAMEPLATE
3	DATA POCKET
4	INTRUSION DOOR SWITCH
5	INTERNAL FOLDING SHELF
6	CABINET LIGHT WITH DOOR SWITCH
7	POWER PILOT LIGHT
8	WIRE DUCT (AS REQUIRED)
9	DIN RAIL (AS REQUIRED)
10	NOT USED
11	PLC CHASSIS
12	MANAGED ETHERNET SWITCH
13	ANALOG TERMINAL BLOCKS (AS REQUIRED)
14	RECEPTACLE
15	POWER SUPPLY, 24VDC (2 EA.)
16	REDUNDANCY MODULE
17	24VDC POWER DISTRIBUTION TERMINALS
18	120VAC SURGE PROTECTOR
19	CP POWER DISTRIBUTION
20	DISCRETE TERMINAL BLOCKS
21	GROUND BAR
22	TEMPERATURE SWITCH
23	CONTROL RELAYS
24	NOT USED
25	LOCAL OPERATOR INTERFACE (LOI)
26	ELECTRONIC CIRCUIT PROTECTOR
27	COOLING FAN
28	EXHAUST GRILLE



1 - **NAMEPLATE DETAIL**
SCALE: 6' = 1'-0"
FILE: 8660F1000N671.2dm



POWER ON

2 - **PILOT DEVICES DETAIL**
SCALE: 6' = 1'-0"
FILE: 8660F1000N671.2dm

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

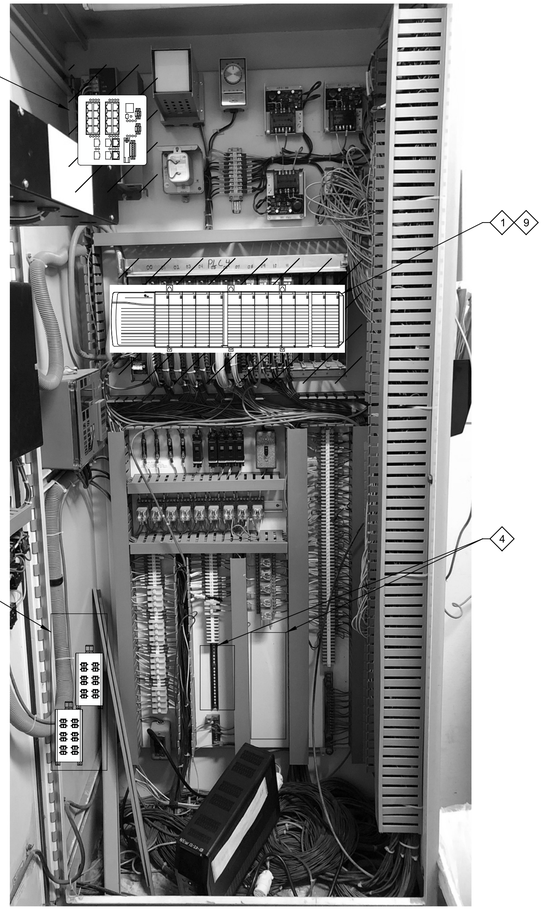
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CHECKED BAL
DATE JULY 2023

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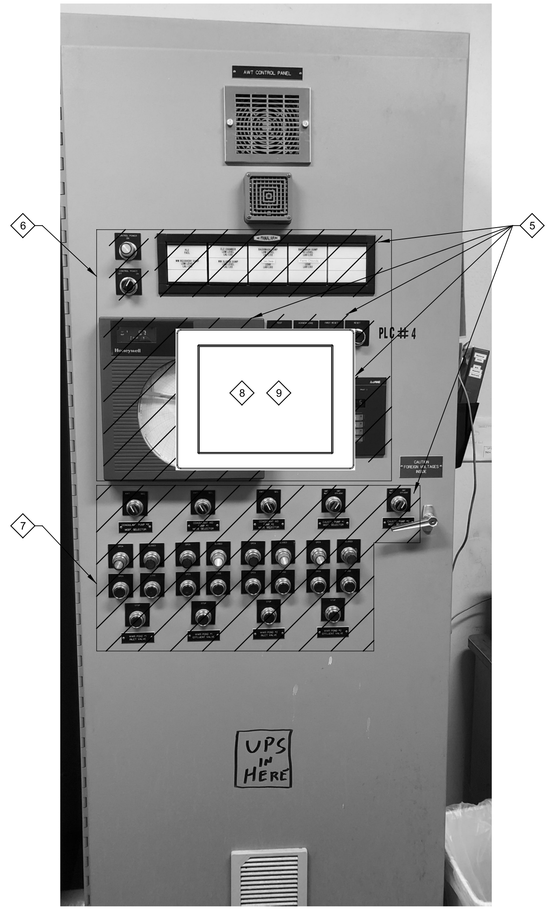
CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
INSTRUMENTATION
PCM-99400 ELEVATION LAYOUT

VERIFY SCALES
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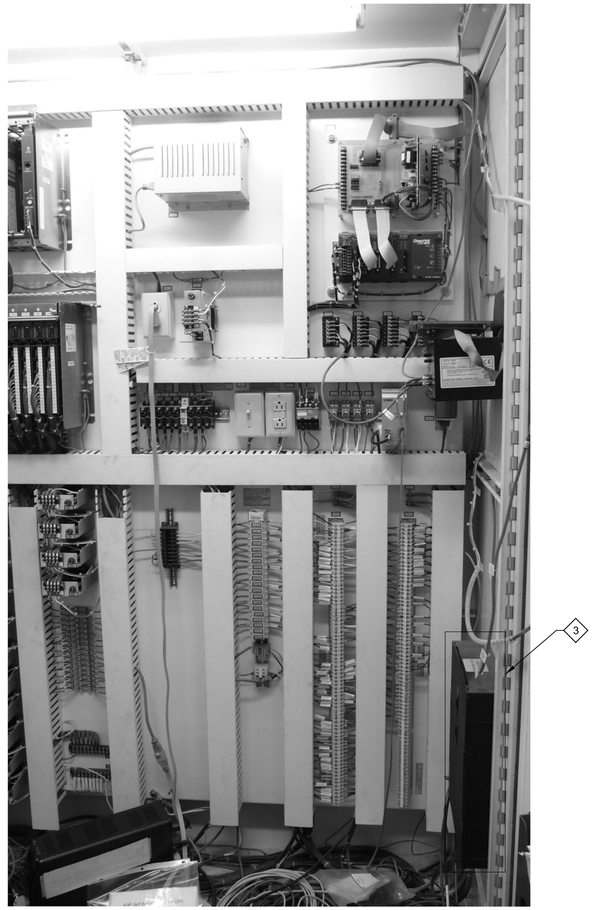
JOB NO. 8660F.10
DRAWING NO. 02N01
SHEET NO. 141 OF 200



PCM-4 PANEL ELEVATION INTERIOR



PCM-4 PANEL ELEVATION EXTERIOR



EXISTING PLC-3 PANEL ELEVATION INTERIOR (NOT SHOWING THE COMPLETE INTERIOR)

KEY NOTES:

1. REMOVE EXISTING PLC RACK AND MODULES AND RETURN TO THE OWNER. PROVIDE AND INSTALL NEW PLC AS SPECIFIED IN CONTRACT DRAWINGS AND SPECIFICATION 17720. TRACE AND FIELD VERIFY ALL EXISTING IO WIRING AND NETWORK CONNECTIONS BEFORE REMOVING WIRES FROM THE EXISTING PLC. WHERE POSSIBLE, TERMINATE EXISTING IO WIRES TO THE NEW PLC IN THE SAME SLOT NUMBER AND IO POINT AS THEY WERE PREVIOUSLY CONNECTED TO THE EXISTING PLC.
2. REMOVE PLC PROCESSOR AND RETURN TO THE OWNER. PROVIDE AND INSTALL ETHERNET SWITCH IN THE SPACE WHERE THE OLD PROCESSOR WAS PREVIOUSLY INSTALLED AS SPECIFIED IN CONTRACT DRAWINGS AND SPECIFICATION 17733. CONNECT NETWORK CONNECTIONS AS SHOWN ON CONTRACT DRAWING 04N02.
3. PROVIDE AND INSTALL NEW FIBER PATCH PANEL IN PLC-4 AS SPECIFIED IN CONTRACT DRAWING AND SPECIFICATION 17733. TRACE AND FIELD VERIFY EXISTING FIBER CONNECTIONS. THE TWO EXISTING FIBER CONNECTIONS COMING FROM PLC-70299 AND PLC-12199 PANELS SHALL BE DISCONNECTED FROM THE EXISTING FIBER PATCH PANEL LOCATED IN PLC-3 AND SHALL BE CONNECTED TO THESE NEW PATCH PANELS AS SHOWN ON 04N02.
4. UTILIZE THE IDENTIFIED EMPTY SPACES AS NEEDED FOR ANY NEW RELAYS, TERMINAL BLOCKS, FUSES AND CIRCUIT BREAKERS THAT MAY BE REQUIRED PER CONTRACT DRAWINGS AND SPECIFICATIONS.
5. REMOVE EXISTING CHART RECORDER, REDIPANEL KEYPAD MODULE, ANNUNCIATOR, PUSH BUTTONS, PILOT LIGHTS, AND SELECTOR SWITCHES AND RETURN TO THE OWNER. EXISTING CHART RECORDER, REDIPANEL KEYPAD MODULE, ANNUNCIATOR, PUSH BUTTONS, PILOT LIGHTS, AND SELECTOR SWITCHES FUNCTIONALITY SHALL BE REPLICATED ON THE NEW LOI AND SCADA AS NEEDED.
6. CUT ONE LARGE SQUARE HOLE IN THE AREA SHOWN. GASKET AND BOLT A PLATE TO COVER THE HOLE. THIS PLATE SHALL BE UTILIZED TO INSTALL THE NEW LOI.
7. USE APPROPRIATE PLUGS TO INDIVIDUALLY COVER THE PILOT LIGHTS, SELECTOR SWITCHES, AND PUSH BUTTONS TO MAINTAIN THE PANEL'S NEMA RATING.
8. PROVIDE AND INSTALL NEW LOCAL OPERATOR INTERFACE AS SPECIFIED IN CONTRACT DRAWINGS AND SPECIFICATION 17721. LOI SHALL BE INSTALLED ON THE PLATE SPECIFIED IN KEY NOTE 6.
9. ALL EXISTING PROGRAMMING SHALL BE REPROGRAMMED IN THE NEW PLC. ADDITIONALLY, THE NEW PLC AND LOI SHALL PROVIDE THE SAME FUNCTIONALITY AS WAS PRESENT INCLUDING THE ITEMS REMOVED PER KEY NOTE 5.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

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DATE JULY 2023

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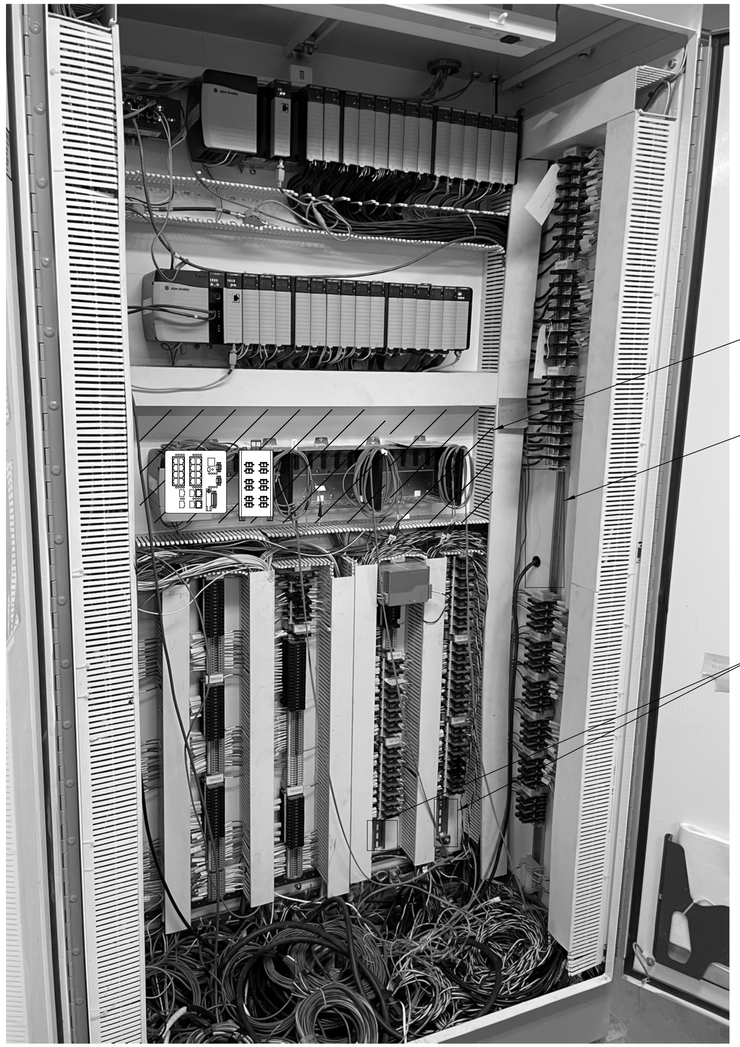
CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
INSTRUMENTATION
PCM-4 PANEL MODIFICATIONS

VERIFY SCALES
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0 1"
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JOB NO. 8660F.10
DRAWING NO. 02N02
SHEET NO. 142 OF 200

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PLC-70299 PANEL ELEVATION INTERIOR

KEY NOTES:

1. REMOVE EXISTING EMPTY PLC RACK AND RETURN TO THE OWNER. PROVIDE AND INSTALL ETHERNET SWITCH AND FIBER PATCH PANEL AS SHOWN ON CONTRACT DRAWING 04N03 AND SPECIFICATION. PROVIDE AND INSTALL DIN RAIL, TERMINAL BLOCKS, FUSES AND RELAYS TO TERMINATE NEW IO POINTS AS REQUIRED. UTILIZE HORIZONTAL SPACE CREATED BY THE SMALLER PLC CHASSIS FOR NEW TERMINAL BLOCKS AND FUSES AS NEEDED.
2. UTILIZE EMPTY AREAS IF ADDITIONAL SPACE IS REQUIRED FOR NEW TERMINAL BLOCKS, FUSES AND RELAYS.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

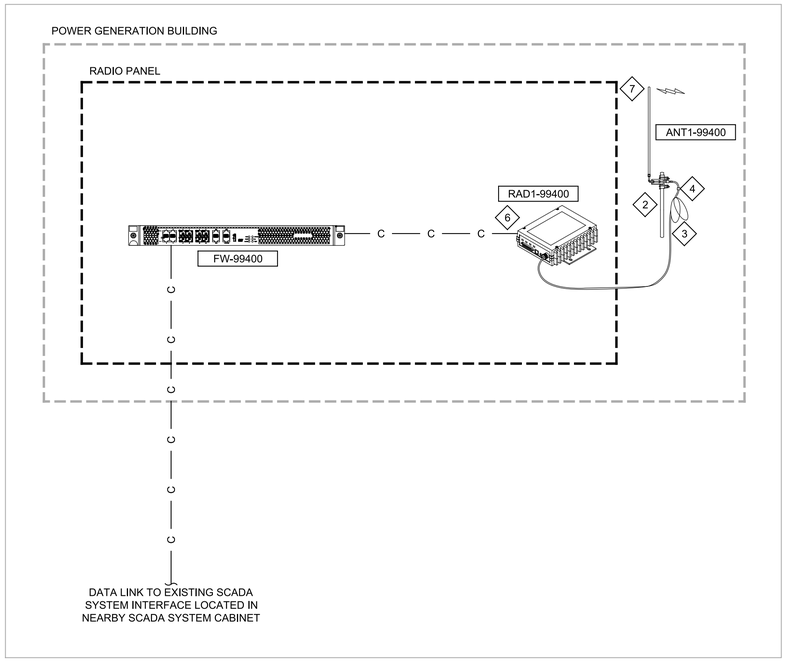
DESIGNED DB
DRAWN LMB
CHECKED BAL
DATE JULY 2023

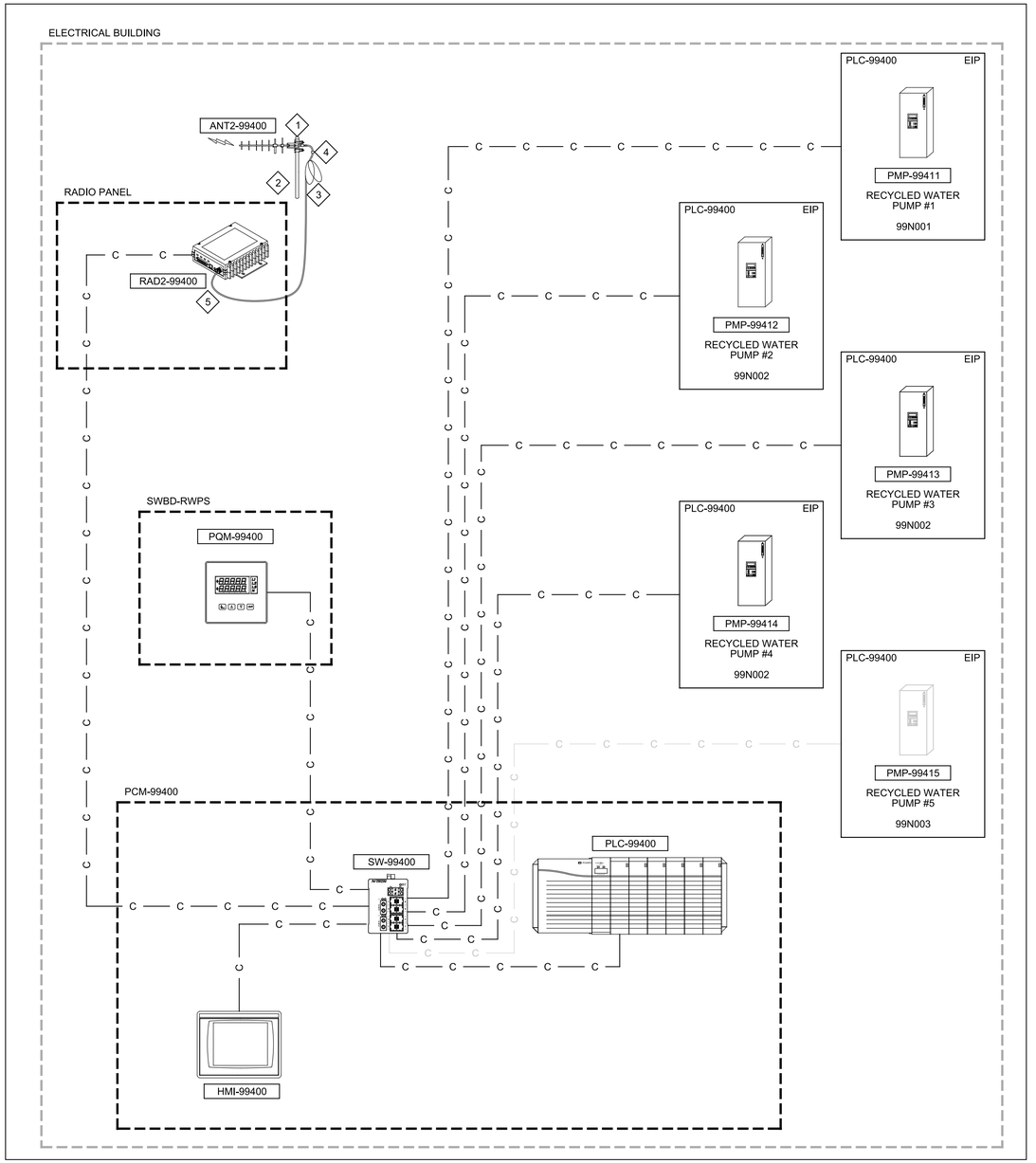
** ORIGINAL SEALED BY BRETT A. LEE 4/7/2023 CA PE NO. 22911 **

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
INSTRUMENTATION
PLC-70299 PANEL MODIFICATIONS

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 02N03
SHEET NO. 143 OF 200





KEY NOTES:

1. HIGH-GAIN YAGI ANTENNA.
2. 10 FT. 2" GRC MAST FOR ANTENNA MOUNTING. CAP MAST BOTH ENDS AGAINST WEATHER.
3. MINIMUM 10 FT. LOOP OF ANTENNA CABLE AT BASE OF ANTENNA MAST.
4. INSTALL COAXIAL CABLE SURGE PROTECTION DEVICE IN THE CONTROL PANEL.
5. COMMUNICATES WITH NEW TRANSCEIVER AT WWTP.
6. COMMUNICATES WITH NEW TRANSCEIVER AT RECYCLED WATER PUMP STATION.
7. OMNIDIRECTIONAL BASE STATION ANTENNA. TO BE INSTALLED ON TOP OF GENERATOR BUILDING.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN AAW
CHECKED BAL
DATE JULY 2023

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CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
INSTRUMENTATION
RECYCLED WATER PUMP STATION NETWORK BLOCK DIAGRAM

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

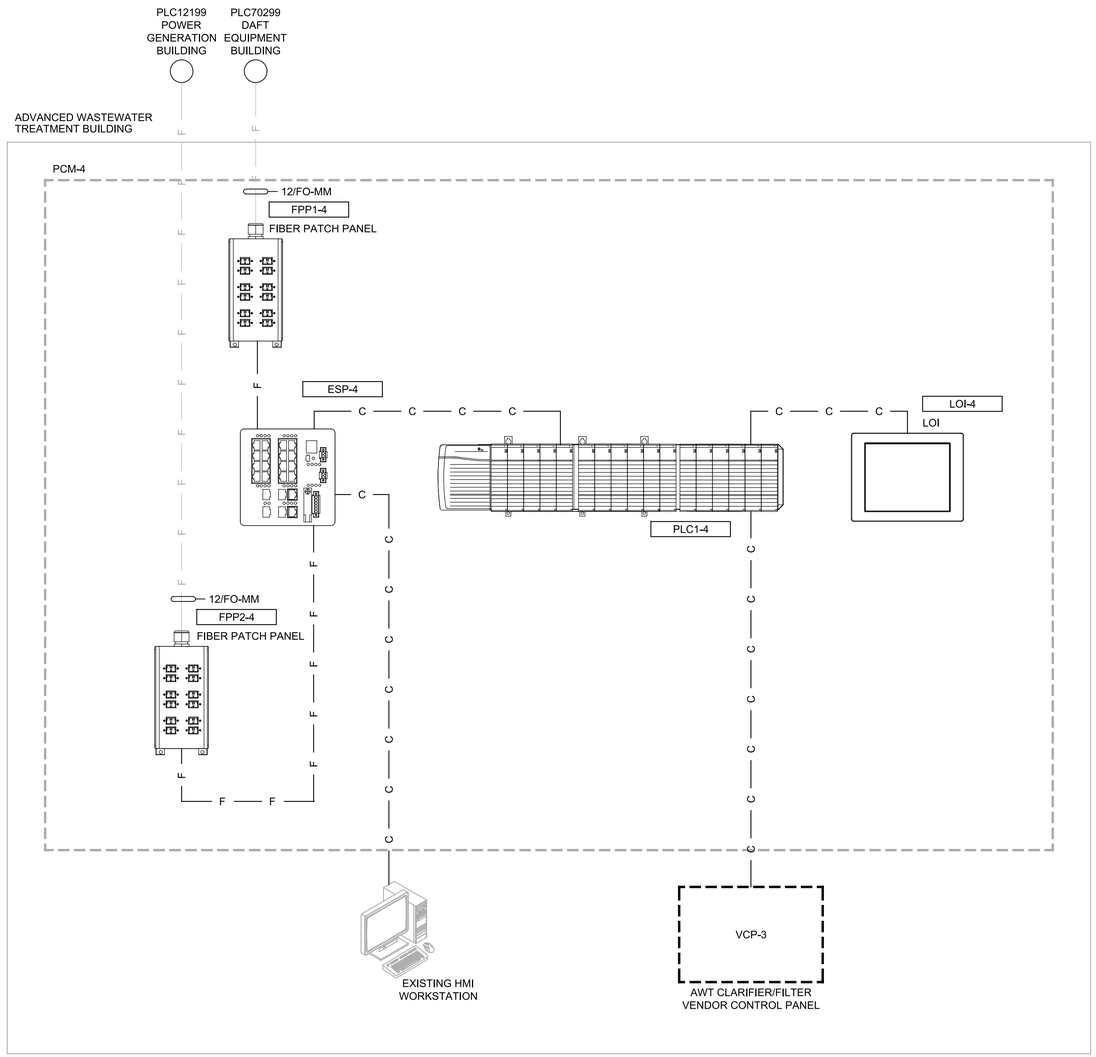
JOB NO. 8660F.10
DRAWING NO. 04N01
SHEET NO. 144 OF 200

Plot Date: 12-JUL-2023 11:49:18 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
jwicks

Plot Date: 12-JUL-2023 11:48:42 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
jwicks

GENERAL NOTES:

1. PROVIDE DUPLEX PATCH CABLES FOR ALL INTERNAL FIBER CONNECTIONS, UNLESS NOTED OTHERWISE.
2. ALL COPPER CONNECTIONS FROM DEVICES EXTERNAL TO THE ENCLOSURE SHALL BE MADE THROUGH COPPER PATCH PANELS (NOT SHOWN FOR CLARITY) OR SURGE PROTECTION DEVICE AND PATCHED THROUGH TO DEVICES AS SHOWN.
3. COMMUNICATION PROTOCOL SHALL BE ETHERNET/IP, UNLESS OTHERWISE NOTED.
4. PROVIDE ADDITIONAL HARDWARE AND CONFIGURATION AS NEEDED FOR A FULLY FUNCTIONAL SYSTEM.



REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN KIK
CHECKED BAL
DATE JULY 2023

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CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

ADVANCED WASTEWATER TREATMENT NETWORK BLOCK DIAGRAM

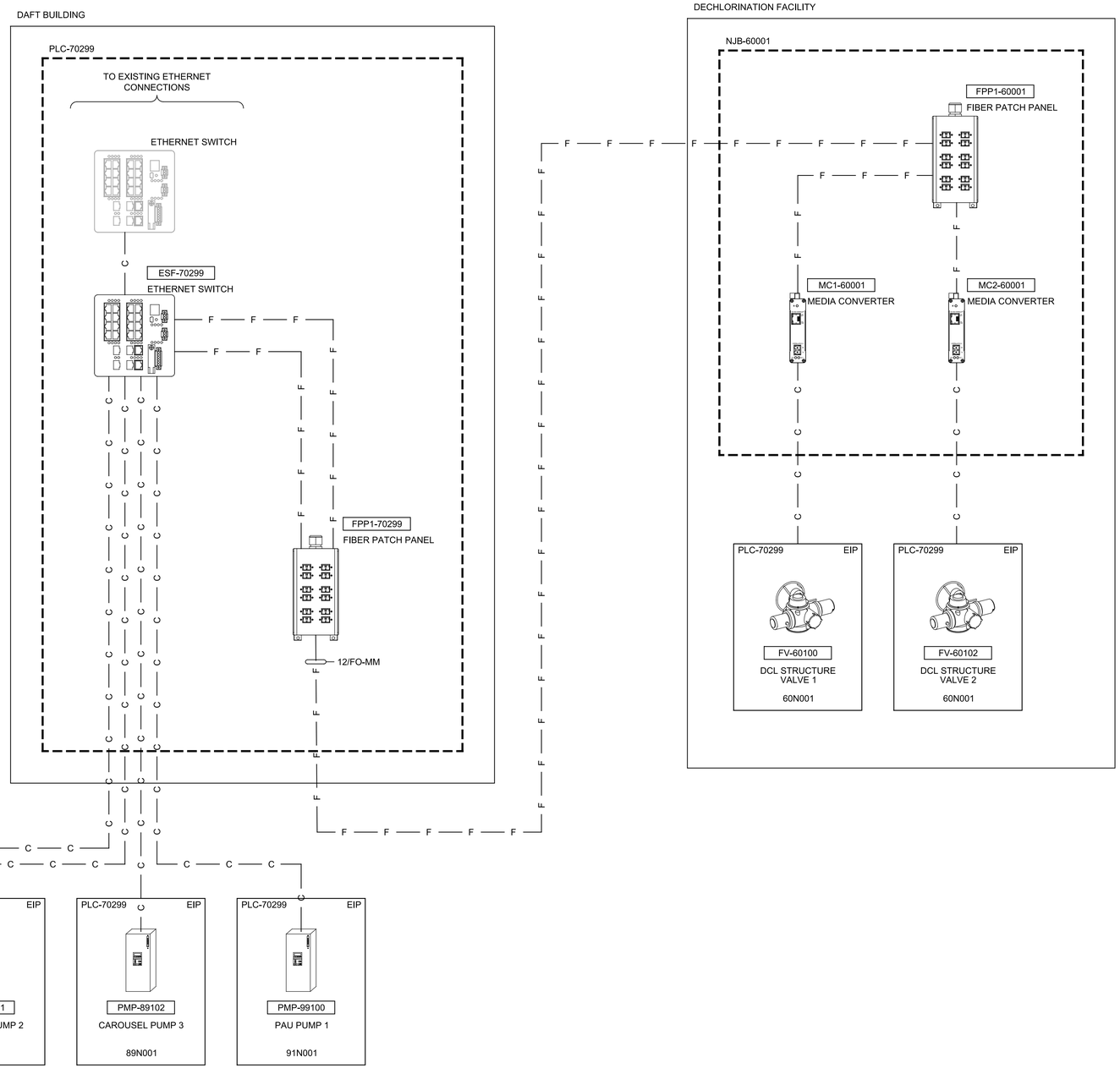
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 04N02
SHEET NO. 145 OF 200

Plot Date: 12-JUL-2023 11:50:52 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
jwicks

GENERAL NOTES:

1. DRAWING REFLECTS NEW SCOPE. EXISTING CONNECTIONS NOT SHOWN.



REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN CGR
CHECKED BAL
DATE JULY 2023

**
ORIGINAL
SEALED BY
BRETT A. LEE
4/7/2023
CA PE NO. 22911
**

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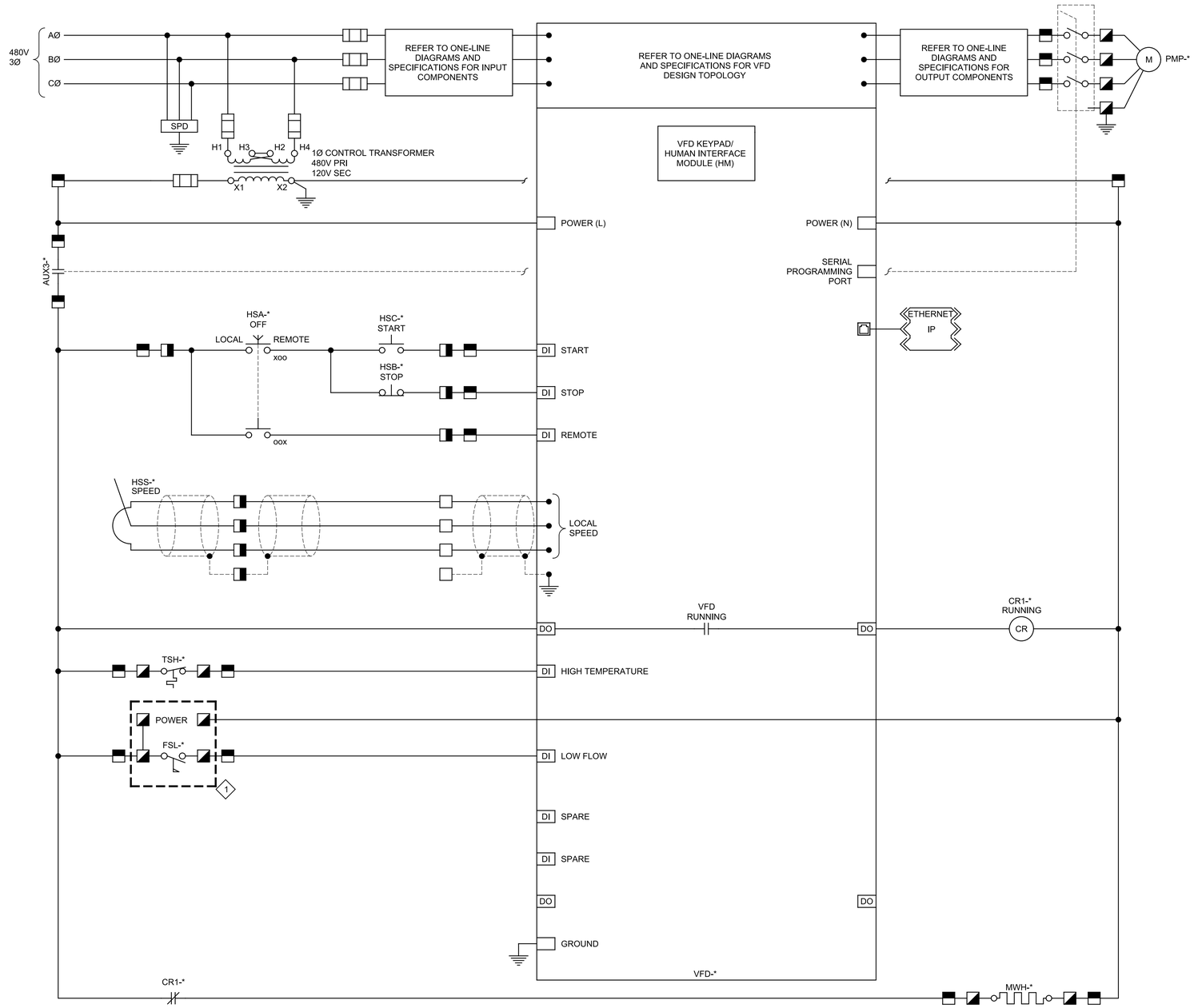
RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

DAFT BUILDING NETWORK BLOCK DIAGRAM

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 04N03
SHEET NO. 146 OF 200



GENERAL NOTES:

1. SCHEMATIC WIRING IS BASED ON ONE OF THE NAMED MANUFACTURERS. REVISE SCHEMATIC AS REQUIRED TO PERFORM THE OPERATION SHOWN HERE AND DESCRIBED IN 17100 AND 17101 BASED ON THE SELECTED MANUFACTURER.
2. SIZE CONTROL POWER TRANSFORMER IN ACCORDANCE WITH ALL INDICATED LOADS.
3. REFER TO SPECIFICATION 17101 FOR CONTROL DESCRIPTIONS.

KEY NOTES:

1. FLOW SWITCH SHALL BE RESET THROUGH THE PCS.

TAG	LOOP	REFERENCE DWG.
* = 99411	PMP - 99411	99N01
* = 99412	PMP - 99412	99N02
* = 99413	PMP - 99413	99N02
* = 99414	PMP - 99414	99N02

1 RECYCLED WATER PUMPS

99N01, 99N02

CONFORMED DOCUMENTS

REV	DATE	BY	DESCRIPTION

DESIGNED DB
DRAWN TCD
CHECKED BAL
DATE JULY 2023

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RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

CONTROL SCHEMATIC 1

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

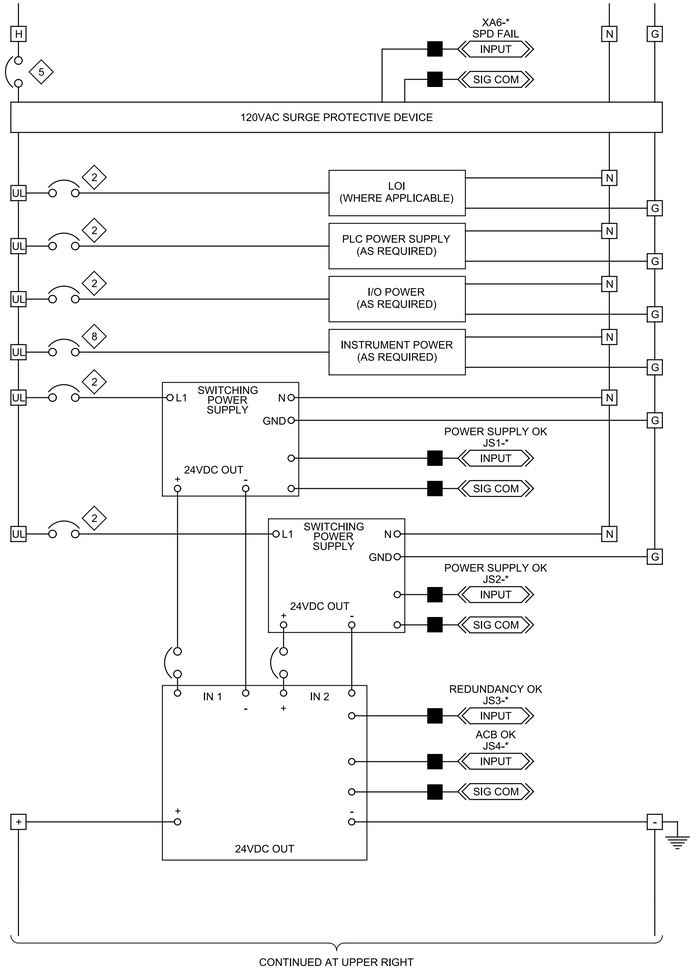
JOB NO. 8660F.10
DRAWING NO. 06N01
SHEET NO. 147 OF 200

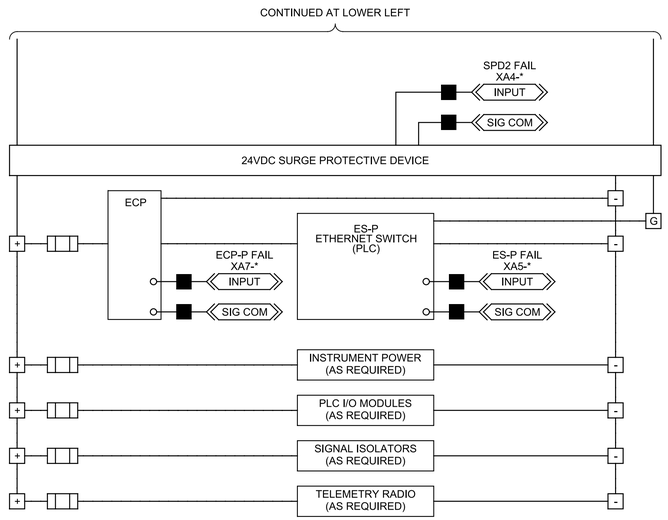
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Model: Layout1
LAST SAVED BY: crollins

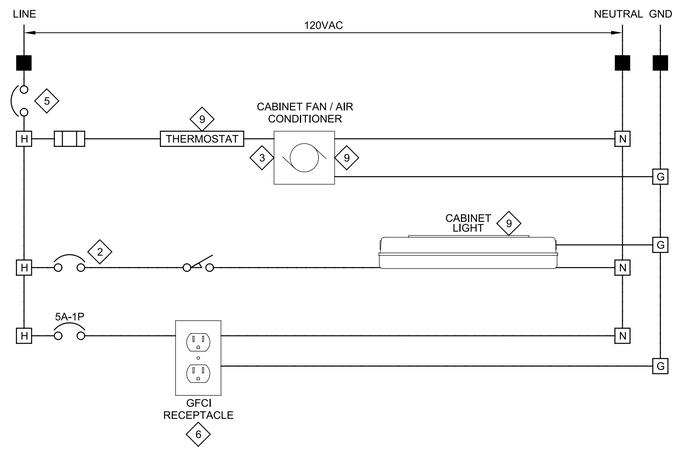
PROJECT NO. 8660F10 FILE NAME: 8660F1006N001.dgn

Plot Date: 12-JUL-2023 11:46:38 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: awills

LOCATED WITHIN PCM CABINET







GENERAL NOTES:

1. SCHEMATIC ILLUSTRATES DESIGN INTENT ONLY. PROVIDE ALL NECESSARY COMPONENTS TO MEET PROJECT REQUIREMENTS.

KEY NOTES:

1. NOT USED.
2. SIZE BASED ON PROTECTION NEEDS.
3. VERIFY LOADS BASED ON TEMPERATURE CALCULATIONS. PROVIDE ADDITIONAL CIRCUIT IF REQUIRED.
4. INSTALL SWITCH ON OUTERMOST DOOR OF OVERLAPPING DOORS. PROVIDE ADDITIONAL SWITCHES, WIRED IN SERIES, FOR NON-OVERLAPPING DOORS.
5. SIZE BASED ON LOAD REQUIREMENT.
6. PROVIDE QUANTITY REQUIRED PER SPECIFICATIONS. SIZE RECEPTACLE FOR LAPTOP.
7. NOT USED.
8. SIZE BASED ON PROTECTION NEEDS. PROVIDE SEPARATE CIRCUIT BREAKERS FOR EACH INSTRUMENT POWERED FROM THE PCM CABINET.
9. PROVIDE QUANTITY REQUIRED PER SPECIFICATIONS.

TERMINAL BLOCK LEGEND

■	PCM
H	120VAC
N	NEUTRAL
G	GROUND
UL	UPS 120VAC
+	24VDC (+)
-	24VDC (-)



TAG ⟷ LOOP
* = 99400 ⟷ PCM-99400

REFERENCE DWG.
99N04

2 PLC AND INSTRUMENT POWER DISCRETE-ANALOG PCM CABINET

99N04

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN TCD
CHECKED BAL
DATE JULY 2023

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CITY OF UKIAH

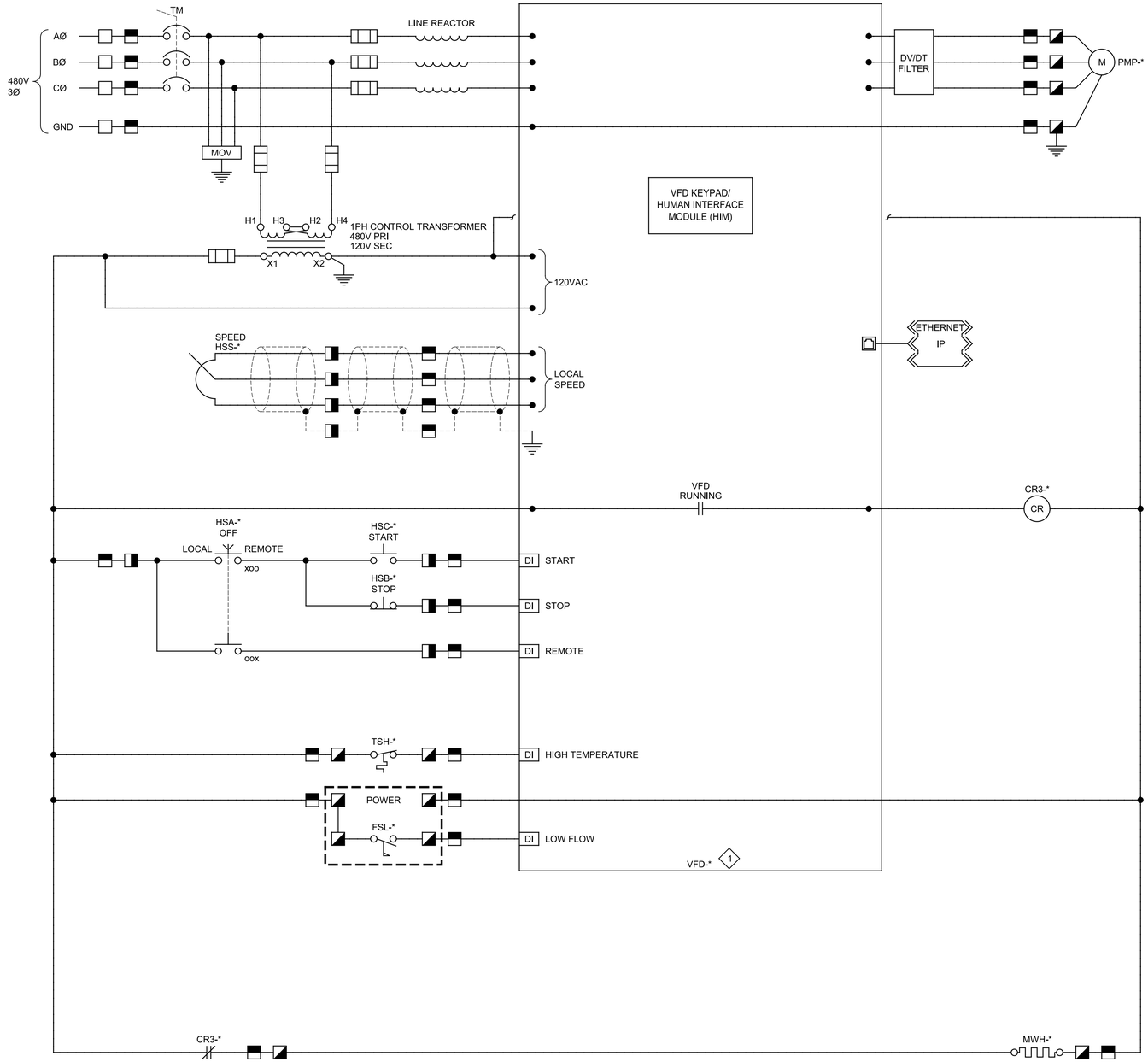
RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

CONTROL SCHEMATIC 2

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 06N02
SHEET NO. 148 OF 200



GENERAL NOTES:

1. SCHEMATIC WIRING IS BASED ON ONE OF THE NAMED MANUFACTURERS. REVISE SCHEMATIC AS REQUIRED TO PERFORM THE OPERATION SHOWN HERE. IF ANOTHER MANUFACTURER IS SELECTED, CONTRACTOR IS RESPONSIBLE FOR PROVIDING FOR NECESSARY DIFFERENCES WITH NO ADDITIONAL COST TO THE OWNER, INCLUDING BUT NOT LIMITED TO DIFFERENCE IN MCC FOOTPRINT, WIRING CHANGES, ADDITIONAL CONTROL RELAYS, ETC.
2. SIZE CONTROL POWER TRANSFORMER IN ACCORDANCE WITH ALL INDICATED LOADS.
3. PROVIDE EXPANSION MODULES AND ANY OTHER APPLICABLE CONVERTER MODULES AS NEEDED FOR FUNCTIONALITY SHOWN.

KEY NOTES:

1. HARDWIRED CONTROLS:
   A. WHEN THE LOCAL-OFF-REMOTE (LOR) SELECTOR SWITCH IS IN THE LOCAL POSITION, AN OPERATOR SHALL START THE EQUIPMENT BY PRESSING START PUSH BUTTON.
   B. WHEN THE LOCAL-OFF-REMOTE (LOR) SELECTOR SWITCH IS IN THE LOCAL POSITION, THE SPEED OF THE EQUIPMENT SHALL BE ADJUSTED USING THE SPEED POTENTIOMETER.
   C. WHEN THE LOCAL-OFF-REMOTE (LOR) SELECTOR SWITCH IS IN THE LOCAL POSITION, AN OPERATOR SHALL STOP THE EQUIPMENT BY PRESSING THE STOP PUSH BUTTON.
   D. WHEN THE LOCAL-OFF-REMOTE (LOR) SELECTOR SWITCH IS IN THE OFF POSITION, THE EQUIPMENT IS PROHIBITED FROM BEING STARTED.
   E. WHEN THE LOCAL-OFF-REMOTE (LOR) SELECTOR SWITCH IS IN THE REMOTE POSITION, SCADA/HMI SHALL CONTROL THE EQUIPMENT.

   HARDWIRED INTERLOCKS/OVERLOAD PROGRAMMED INTERLOCKS:
   A. IN A HIGH MOTOR TEMPERATURE CONDITION, THE EQUIPMENT SHALL SHUT OFF AND A HIGH TEMPERATURE ALARM SIGNAL SHALL BE SENT TO THE PLANT PLC.
   B. IN A LOW DISCHARGE FLOW CONDITION, THE EQUIPMENT SHALL SHUT OFF AFTER AN OPERATOR ADJUSTABLE TIMER AND A LOW FLOW ALARM SIGNAL SHALL BE SENT TO THE PLANT PLC. FLOW SWITCH SHALL BE RESET THROUGH TO PCS.

TAG	LOOP	REFERENCE DWG.
* = 89100	PMP-89100	89N01
* = 89101	PMP-89101	89N01
* = 89102	PMP-89102	89N01

3 CAROUSEL PUMPS

89N01

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN KIK
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DATE JULY 2023

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RECYCLED WATER PROJECT - PHASE 4

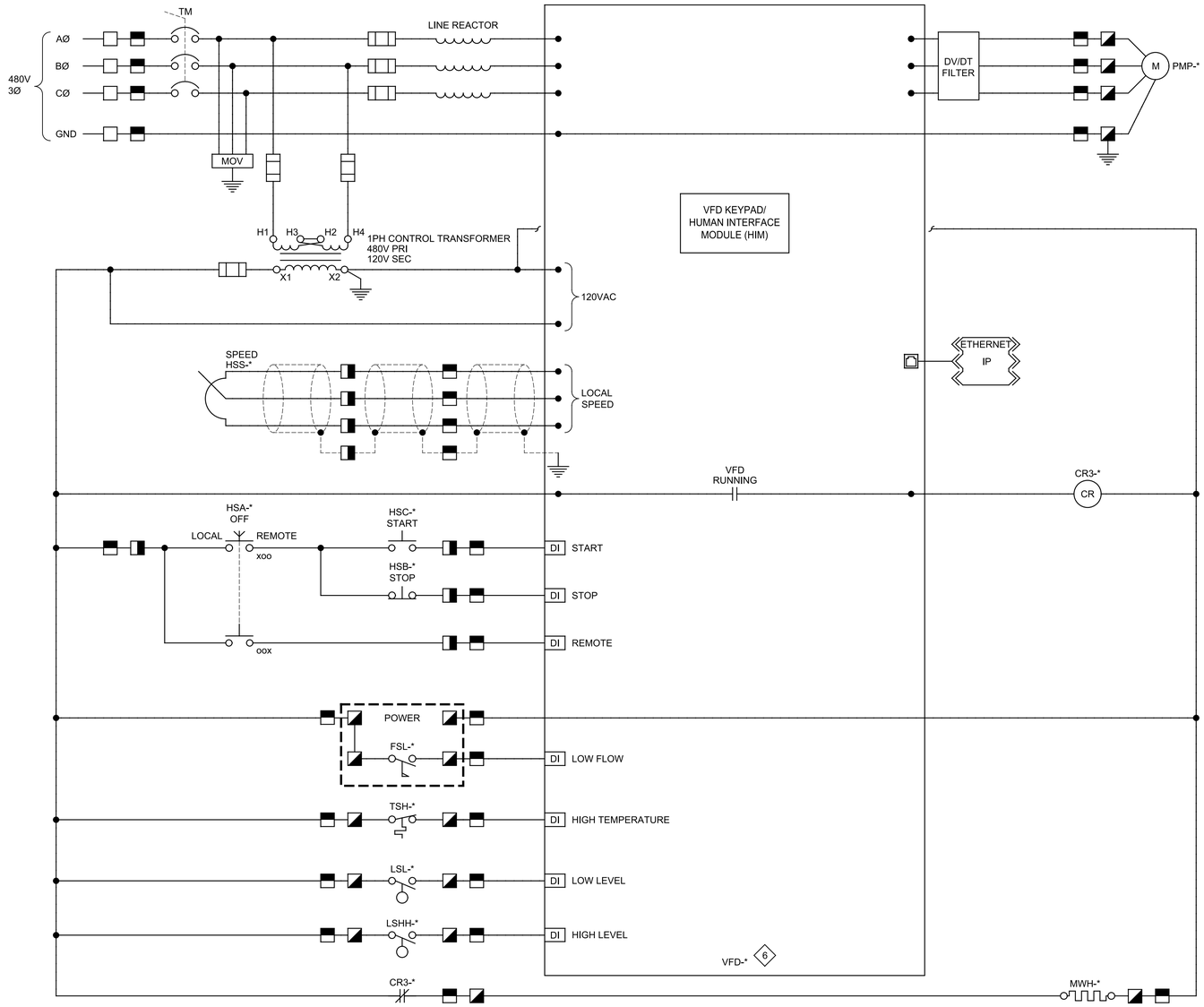
INSTRUMENTATION

CONTROL SCHEMATIC 3

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 06N03
SHEET NO. 149 OF 200

Plot Date: 12-JUL-2023 11:47:04 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: sshepard



TAG ⟷ LOOP
* = 91100 ⟷ PMP-91100

REFERENCE DWG.
91N01

GENERAL NOTES:

1. SCHEMATIC WIRING IS BASED ON ONE OF THE NAMED MANUFACTURERS. REVISE SCHEMATIC AS REQUIRED TO PERFORM THE OPERATION SHOWN HERE. IF ANOTHER MANUFACTURER IS SELECTED, CONTRACTOR IS RESPONSIBLE FOR PROVIDING FOR NECESSARY DIFFERENCES WITH NO ADDITIONAL COST TO THE OWNER, INCLUDING BUT NOT LIMITED TO DIFFERENCE IN MCC FOOTPRINT, WIRING CHANGES, ADDITIONAL CONTROL RELAYS, ETC.
2. SIZE CONTROL POWER TRANSFORMER IN ACCORDANCE WITH ALL INDICATED LOADS.
3. PROVIDE EXPANSION MODULES AND ANY OTHER APPLICABLE CONVERTER MODULES AS NEEDED FOR FUNCTIONALITY SHOWN.

KEY NOTES:

1. HARDWIRED CONTROLS:
   - A. WHEN THE LOCAL-OFF-REMOTE (LOR) SELECTOR SWITCH IS IN THE LOCAL POSITION, AN OPERATOR SHALL START THE EQUIPMENT BY PRESSING START PUSH BUTTON.
   - B. WHEN THE LOCAL-OFF-REMOTE (LOR) SELECTOR SWITCH IS IN THE LOCAL POSITION, THE SPEED OF THE EQUIPMENT SHALL BE ADJUSTED USING THE SPEED POTENTIOMETER.
   - C. WHEN THE LOCAL-OFF-REMOTE (LOR) SELECTOR SWITCH IS IN THE LOCAL POSITION, AN OPERATOR SHALL STOP THE EQUIPMENT BY PRESSING THE STOP PUSH BUTTON.
   - D. WHEN THE LOCAL-OFF-REMOTE (LOR) SELECTOR SWITCH IS IN THE OFF POSITION, THE EQUIPMENT IS PROHIBITED FROM BEING STARTED.
   - E. WHEN THE LOCAL-OFF-REMOTE (LOR) SELECTOR SWITCH IS IN THE REMOTE POSITION, SCADA/HMI SHALL CONTROL THE EQUIPMENT.

   HARDWIRED INTERLOCKS/OVERLOAD PROGRAMMED INTERLOCKS:
   - A. IN A HIGH MOTOR TEMPERATURE CONDITION, THE EQUIPMENT SHALL SHUT OFF AND A HIGH TEMPERATURE ALARM SIGNAL SHALL BE SENT TO THE PLANT PLC.
   - B. IN A LOW DISCHARGE FLOW CONDITION, THE EQUIPMENT SHALL SHUT OFF AFTER AN OPERATOR ADJUSTABLE TIMER AND A LOW FLOW ALARM SIGNAL SHALL BE SENT TO THE PLANT PLC. FLOW SWITCH SHALL BE RESET THROUGH THE PCS.
   - C. IN LOW LEVEL CONDITION, THE EQUIPMENT SHALL SHUT OFF AND A LEVEL LOW SIGNAL SHALL BE SENT TO THE PLC.
   - D. IN HIGH HIGH LEVEL CONDITION, A HIGH HIGH LEVEL ALARM SIGNAL SHALL BE SENT TO THE PLANT PLC TO SHUT DOWN CAROUSEL PUMP NO. 3.

4 PAU PUMP

91N01

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN KIK
CHECKED BAL
DATE JULY 2023

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CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

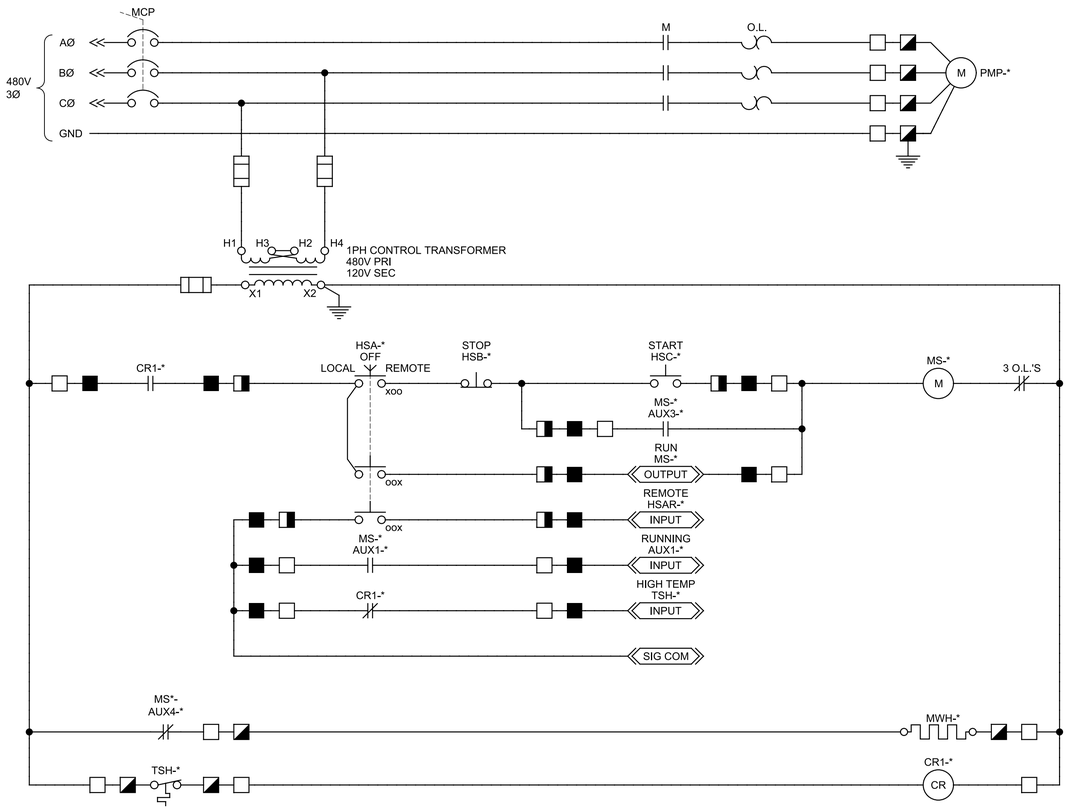
INSTRUMENTATION

CONTROL SCHEMATIC 4

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 06N04
SHEET NO. 150 OF 200

Plot Date: 12-JUL-2023 11:46:51 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: sshepard



TAG	LOOP	REFERENCE DWG.
* = 85104	PMP-85104	85N07
* = 87134	PMP-87134	87N01

5 RAPID MIX PUMP, SAMPLE PUMP

85N07, 87N01

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN KIK
CHECKED BAL
DATE JULY 2023

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RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

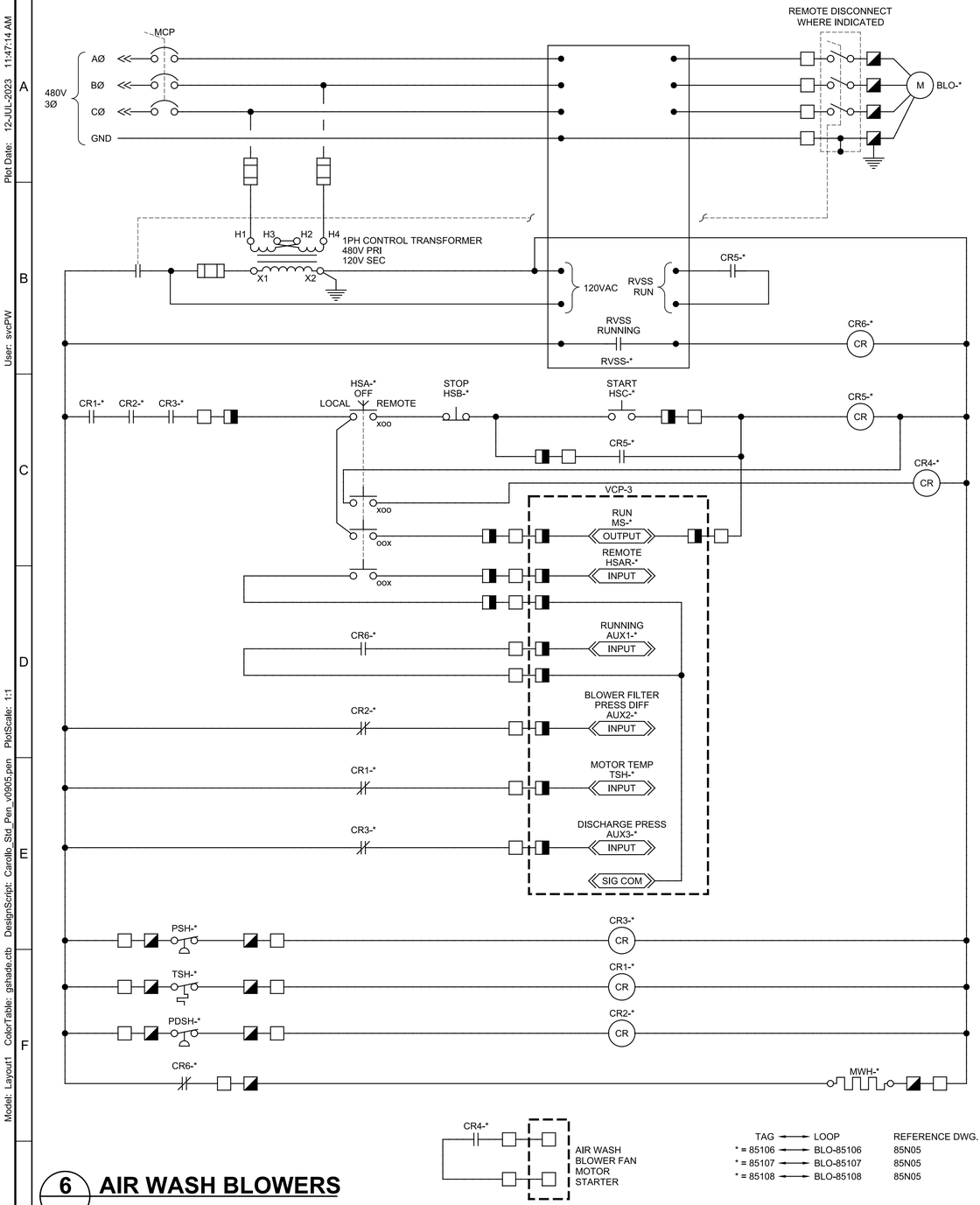
CONTROL SCHEMATIC 5

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 06N05
SHEET NO. 151 OF 200

Plot Date: 12-JUL-2023 11:47:17 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: lbordelon

PROJECT NO. 8660F10 FILE NAME: 8660F1006N005.dgn



TAG		LOOP	REFERENCE DWG.
* = 85106	⟷	BLO-85106	85N05
* = 85107	⟷	BLO-85107	85N05
* = 85108	⟷	BLO-85108	85N05

TAG		LOOP	REFERENCE DWG.
* = 85109, **=85106	⟷	FAN-85109	85N05
* = 85110, **=85107	⟷	FAN-85110	85N05
* = 85111, **=85108	⟷	FAN-85111	85N05

6 AIR WASH BLOWERS

85N05

7 AIR WASH BLOWER FANS

85N05

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN KIK
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DATE JULY 2023

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CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
INSTRUMENTATION
CONTROL SCHEMATIC 6

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 06N06
SHEET NO. 152 OF 200

Plot Date: 12-JUL-2023 11:47:14 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: lbordelon

PROJECT NO. 8660F10 FILE NAME: 8660F1006N006.dgn

RECYCLED_PUMP						
RECYCLED PUMP - VFD						
PROTOCOL: EtherNet/IP						
DESCRIPTION	CONTROL	HISTORIZE	INDICATE	ALARM	TREND	INTERLOCK
LOCAL			✓			
OFF	✓		✓			
REMOTE			✓			
STOP	✓		✓			
START	✓		✓			
SPEED	✓		✓			
SPEED FEEDBACK		✓	✓		✓	
RESET ELAPSED TIME	✓		✓			
RUNNING		✓	✓		✓	
TOTAL STARTS		✓	✓		✓	
DAILY STARTS		✓	✓		✓	
ELAPSED TIME		✓	✓		✓	
DAILY RUN TIME		✓	✓		✓	
A PH V		✓	✓		✓	
B PH V		✓	✓		✓	
C PH V		✓	✓		✓	
A PH CURRENT		✓	✓		✓	
B PH CURRENT		✓	✓		✓	
C PH CURRENT		✓	✓		✓	
AVERAGE 3 PH CURRENT		✓	✓		✓	
POWER KVA		✓	✓		✓	
POWER KW		✓	✓		✓	
POWER FACTOR		✓	✓		✓	
CURRENT ALARM HIGH			✓	✓		✓
OVERLOAD			✓	✓		✓
FAULT		✓	✓	✓		✓
FAIL TO RESPOND		✓	✓	✓		✓
VOLTAGE		✓	✓	✓	✓	
LOW FLOW			✓	✓		✓
HIGH DISCHARGE PRESSURE		✓	✓	✓		✓
HIGH TEMPERATURE DETECTION			✓	✓		✓

CAROUSEL_PUMP						
CAROUSEL PUMP - VFD						
PROTOCOL: EtherNet/IP						
DESCRIPTION	CONTROL	HISTORIZE	INDICATE	ALARM	TREND	INTERLOCK
LOCAL			✓			
OFF	✓		✓			
REMOTE			✓			
STOP	✓		✓			
START	✓		✓			
SPEED	✓		✓			
SPEED FEEDBACK		✓	✓		✓	
RESET ELAPSED TIME	✓		✓			
RUNNING		✓	✓		✓	
TOTAL STARTS		✓	✓			
DAILY STARTS		✓	✓		✓	
ELAPSED TIME		✓	✓			
DAILY RUN TIME		✓	✓		✓	
A PH V		✓	✓		✓	
B PH V		✓	✓		✓	
C PH V		✓	✓		✓	
A PH CURRENT		✓	✓		✓	
B PH CURRENT		✓	✓		✓	
C PH CURRENT		✓	✓		✓	
AVERAGE 3 PH CURRENT		✓	✓		✓	
POWER KVA		✓	✓		✓	
POWER KW		✓	✓		✓	
POWER FACTOR		✓	✓		✓	
CURRENT ALARM HIGH			✓	✓		✓
OVERLOAD			✓	✓		✓
FAULT		✓	✓	✓		✓
FAIL TO RESPOND			✓	✓		✓
VOLTAGE		✓	✓	✓	✓	
LOW FLOW			✓	✓		✓
HIGH TEMPERATURE DETECTION			✓	✓		✓

PAU_PUMP						
PAU PUMP - VFD						
PROTOCOL: EtherNet/IP						
DESCRIPTION	CONTROL	HISTORIZE	INDICATE	ALARM	TREND	INTERLOCK
LOCAL			✓			
OFF	✓		✓			
REMOTE			✓			
STOP	✓		✓			
START	✓		✓			
SPEED	✓		✓			
SPEED FEEDBACK		✓	✓		✓	
RESET ELAPSED TIME	✓		✓			
RUNNING		✓	✓		✓	
TOTAL STARTS		✓	✓		✓	
DAILY STARTS		✓	✓		✓	
ELAPSED TIME		✓	✓		✓	
DAILY RUN TIME		✓	✓		✓	
A PH V		✓	✓		✓	
B PH V		✓	✓		✓	
C PH V		✓	✓		✓	
A PH CURRENT		✓	✓		✓	
B PH CURRENT		✓	✓		✓	
C PH CURRENT		✓	✓		✓	
AVERAGE 3 PH CURRENT		✓	✓		✓	
POWER KVA		✓	✓		✓	
POWER KW		✓	✓		✓	
POWER FACTOR		✓	✓		✓	
CURRENT ALARM HIGH			✓	✓		✓
OVERLOAD			✓	✓		✓
FAULT		✓	✓	✓		✓
FAIL TO RESPOND			✓	✓		✓
VOLTAGE		✓	✓	✓	✓	
LOW FLOW			✓	✓		✓
LOW LEVEL			✓	✓		✓
HIGH MOISTURE DETECTION			✓	✓		✓
HIGH TEMPERATURE DETECTION			✓	✓		✓

DCL_STRUCTURE_VALVE						
MULTI-TURN ACTUATOR						
PROTOCOL: EtherNet/IP						
DESCRIPTION	CONTROL	HISTORIZE	INDICATE	ALARM	TREND	INTERLOCK
MOTOR CURRENT		✓		✓	✓	
LOCAL			✓			
OFF		✓	✓			
REMOTE			✓			
OPEN	✓		✓			
CLOSE	✓		✓			
STOP	✓		✓			
RUNNING CLOSE			✓			
RUNNING OPEN			✓			
CLOSE LIMIT		✓	✓		✓	
OPEN LIMIT		✓	✓		✓	
INSTANTANEOUS TORQUE		✓	✓	✓	✓	
TORQUE ALARM		✓	✓	✓		
HIGH MOTOR TEMPERATURE		✓	✓	✓		
WATCHDOG TIMER				✓		
BATTERY LOW				✓		

POWER_QUALITY_METER						
POWER QUALITY METER POWER MONITOR M500 (PM500)						
PROTOCOL: EtherNet/IP						
DESCRIPTION	CONTROL	HISTORIZE	INDICATE	ALARM	TREND	INTERLOCK
A PH V		✓	✓		✓	
B PH V		✓	✓		✓	
C PH V		✓	✓		✓	
A PH CURRENT		✓	✓		✓	
B PH CURRENT		✓	✓		✓	
C PH CURRENT		✓	✓		✓	
A PH DEMAND CURRENT		✓	✓			
B PH DEMAND CURRENT		✓	✓			
C PH DEMAND CURRENT		✓	✓			
3 PH AVG DEMAND CURRENT		✓	✓		✓	
WATTS		✓	✓		✓	
VARS		✓	✓		✓	
VA		✓	✓		✓	
VA DEMAND		✓	✓		✓	
W DEMAND		✓	✓		✓	
ENERGY		✓	✓		✓	
FREQUENCY		✓	✓			
POWER FACTOR		✓	✓		✓	

AWT_CLARIFIER_FILTER						
VCP-3						
PROTOCOL: EtherNet/IP						
DESCRIPTION	CONTROL	HISTORIZE	INDICATE	ALARM	TREND	INTERLOCK
HANDSHAKING	✓		✓			
ALL SETPOINTS	✓		✓			
AWT CLARIFIER/FILTER 1 READY			✓			
AWT CLARIFIER/FILTER 2 READY			✓			
AWT CLARIFIER/FILTER 3 READY			✓			
AWT CLARIFIER/FILTER 4 READY			✓			
BACKWASH IN PROGRESS			✓			
FLUSH IN PROGRESS			✓			
AIR WASH BLOWER 1 MODE AUTO	✓		✓			
AIR WASH BLOWER 1 MOTOR STATUS STOPPED		✓	✓			
AIR WASH BLOWER 1 MOTOR STATUS RUNNING		✓	✓			
AIR WASH BLOWER 2 MODE AUTO	✓		✓			
AIR WASH BLOWER 2 MOTOR STATUS STOPPED		✓	✓			
AIR WASH BLOWER 2 MOTOR STATUS RUNNING		✓	✓			
AIR WASH BLOWER 3 MODE AUTO	✓		✓			
AIR WASH BLOWER 3 MOTOR STATUS STOPPED		✓	✓			
COAGULANT PUMP 1 STATUS RUNNING OUTPUT	✓		✓			
COAGULANT PUMP 2 STATUS RUNNING OUTPUT	✓		✓			
COAGULANT PUMP 3 STATUS RUNNING OUTPUT	✓		✓			
WASTE GATE VALVE 1 MODE AUTO	✓		✓			
WASTE GATE VALVE 1 MODE POSITION	✓		✓			
BACKWASH VALVE 1 MODE AUTO	✓		✓			
BACKWASH VALVE 1 MODE POSITION	✓		✓			
AC AIR SCOUR VALVE 1 MODE AUTO	✓		✓			
AC AIR SCOUR VALVE 1 MODE POSITION	✓		✓			
WASTE GATE VALVE 2 MODE POSITION	✓		✓			
BACKWASH VALVE 2 MODE POSITION	✓		✓			
AC AIR SCOUR VALVE 2 MODE POSITION	✓		✓			
EFFLUENT VALVE 2 MODE AUTO	✓		✓			
EFFLUENT VALVE 2 MODE POSITION	✓		✓			
AWT CLARIFIER/FILTER 3 MODE AUTO	✓		✓			
AWT CLARIFIER/FILTER 3 MODE STATUS	✓		✓			
INFLUENT VALVE 3 MODE AUTO	✓		✓			
AIR VALVE 3 MODE AUTO	✓		✓			
WASTE GATE VALVE 3 MODE AUTO	✓		✓			
AWT CLARIFIER/FILTER 4 MODE SEMI-AUTO	✓		✓			
EFFLUENT VALVE 1 MODE POSITION	✓		✓			
AWT CLARIFIER/FILTER 4 MODE AUTO	✓		✓			
AWT CLARIFIER/FILTER 4 MODE STATUS		✓	✓			
INFLUENT VALVE 4 MODE AUTO	✓		✓			
INFLUENT VALVE 4 MODE POSITION	✓		✓			
AIR VALVE 4 MODE AUTO	✓		✓			
AIR VALVE 4 MODE POSITION	✓		✓			
WASTE GATE VALVE 4 MODE AUTO	✓		✓			
WASTE GATE VALVE 4 MODE POSITION	✓		✓			
BACKWASH VALVE 4 MODE AUTO	✓		✓			
AC AIR SCOUR VALVE 4 MODE AUTO	✓		✓			
AC AIR SCOUR VALVE 4 MODE POSITION	✓		✓			
EFFLUENT VALVE 4 MODE AUTO	✓		✓			
EFFLUENT VALVE 4 MODE POSITION	✓		✓			
AWT CLARIFIER/FILTER 1 CALL RUN COMMAND	✓					
AWT CLARIFIER/FILTER 2 CALL RUN COMMAND	✓					
AWT CLARIFIER/FILTER 4 CALL RUN COMMAND	✓					
AWT CLARIFIER/FILTER 4 INLET FLOW		✓	✓	✓	✓	
COAGULANT FEED PUMP 1 COMMAND SPEED	✓					
COAGULANT FEED PUMP 2 COMMAND SPEED	✓					
COAGULANT FEED PUMP 3 COMMAND SPEED	✓					
AWT CLARIFIER/FILTER 3 INLET FLOW		✓	✓	✓	✓	
INFLUENT VALVE 3 MODE POSITION	✓		✓			
WASTE GATE VALVE 3 MODE POSITION	✓		✓			
BACKWASH VALVE 3 MODE AUTO	✓		✓			
EFFLUENT VALVE 3 MODE POSITION	✓		✓			
BACKWASH VALVE 4 MODE POSITION	✓		✓			
AWT CLARIFIER/FILTER 1 MODE SEMI-AUTO	✓		✓			
AWT CLARIFIER/FILTER 1 MODE AUTO	✓		✓			
AWT CLARIFIER/FILTER 1 MODE STATUS		✓	✓			
INFLUENT VALVE 1 MODE AUTO	✓		✓			
INFLUENT VALVE 1 MODE POSITION	✓		✓			
AIR VALVE 1 MODE AUTO	✓		✓			
AIR VALVE 1 MODE POSITION	✓		✓			
EFFLUENT VALVE 1 MODE AUTO	✓		✓			
INFLUENT VALVE 2 MODE POSITION	✓		✓			
BACKWASH VALVE 3 MODE POSITION	✓		✓			
AC AIR SCOUR VALVE 3 MODE AUTO	✓		✓			
AC AIR SCOUR VALVE 3 MODE POSITION	✓		✓			
EFFLUENT VALVE 3 MODE AUTO	✓		✓			
AWT CLARIFIER/FILTER 2 MODE SEMI-AUTO	✓		✓			
AWT CLARIFIER/FILTER 2 MODE AUTO	✓		✓			
AWT CLARIFIER/FILTER 2 MODE STATUS		✓	✓			
INFLUENT VALVE 2 MODE AUTO	✓		✓			
AIR VALVE 2 MODE AUTO	✓		✓			
AIR VALVE 2 MODE POSITION	✓		✓			
WASTE GATE VALVE 2 MODE AUTO	✓		✓			
BACKWASH VALVE 2 MODE AUTO	✓		✓			
AC AIR SCOUR VALVE 2 MODE AUTO	✓		✓			
AWT CLARIFIER/FILTER 3 MODE SEMI-AUTO	✓		✓			
AIR VALVE 3 MODE POSITION	✓		✓			
AWT CLARIFIER/FILTER 3 CALL RUN COMMAND	✓					
BACKWASH STATION LOW LEVEL OUTPUT	✓					
BACKWASH STATION HIGH LEVEL OUTPUT	✓					
AWT CLARIFIER/FILTER 1 INLET FLOW		✓	✓	✓	✓	
AWT CLARIFIER/FILTER 2 INLET FLOW		✓	✓	✓	✓	
AIR WASH BLOWER 3 MOTOR STATUS RUNNING		✓	✓			

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN DKI
CHECKED BAL
DATE JULY 2023

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CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

PCS I/O TABLES

VERIFY SCALES
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0 1"
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JOB NO. 8660F.10
DRAWING NO. 09N01
SHEET NO. 153 OF 200

Plot Date: 12-JUL-2023 11:46:31 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
LAST SAVED BY: MHood

PROJECT NO. 8660F10 FILE NAME: 8660F1009N001.dgn

KEY NOTES:

1. ETHERNET CONNECTION SHALL BE CONNECTED TO THE EXISTING ETHERNET SWITCH IN PANEL PLC-70299.
2. THE NEW ANALYZER SHALL REPLACE THE EXISTING ANALYZER AND BE INSTALLED IN THE EXISTING ENCLOSURE.

I/O

POWER SOURCE

FIELD

DCL_STRUCTURE_VALVE
EIP
FVC 60100 (1)
PLC-70299

TM 480VAC-3P
CB 60100
MCC70291

LSR
HSA 60100
OSC
HSG 60100
ZSOC 60100
FV 60100
DISC 60100
LSR
HSA 60100
OSC
HSG 60100
LCP 60100

E DO OPEN ZCO 60009 PLC-70299
E DO CLOSE ZCC 60009 PLC-70299
E DI OPENED ZSO 60009 PLC-70299
E DI CLOSED ZSC 60009 PLC-70299
E DI REMOTE HSAR 60009 PLC-70299

E TM 480VAC-3P CB 60009 MCC70291
E LSR HSA 60009
E OSC HSG 60009
E ZSOC 60009
E FCV 60009
E DISC 60009
E LSR HSA 60009
E OSC HSG 60009
E LCP 60009

E TM 120VAC-1P CB 60101 PCM-70299

E AI CL A 60101 PLC-70299

AIT 60101 (2)
AE 60101
CHLORINE
REAGENT DRAIN

DCL_STRUCTURE_VALVE
EIP
FVC 60102 (1)
PLC-70299

TM 480VAC-3P
CB 60102
MCC70291

LSR
HSA 60102
OSC
HSG 60102
ZSOC 60102
FV 60102
DISC 60102
LSR
HSA 60102
OSC
HSG 60102
LCP 60102

E PMP 60135

E PMP 60101

PRESSURE
PI 60101
CHLORINE
FI 60101

CHLORINE BASIN
M
M
E D
E VAL 60009
PROCESS DRAIN
PROCESS DRAIN

FROM CHLORINATION FACILITY
EX- 42" RCP
EX- 30" WSP
TO CAROUSEL PUMP STATION

E D
VAL 60100

FROM SODIUM BISULFATE INJECTION STRUCTURE
EX- 24" FE
E D
VAL 60102
EX- 42"
TO RUSSIAN RIVER

FV-60100
DCL STRUCTURE VALVE 1
5HP 480VAC 3PH

PMP-60135
CHLORINE BASIN SAMPLE PUMP

PMP-60101
DCL CHLORINE SAMPLE PUMP

FCV-60009
DCL STRUCT CHLORINE VALVE

AE-60101
CHLORINE ANALYZER 4
0-10 MG/L

NA090 (* TYP)

PI-60101
PRESSURE INDICATOR
0-30 PSI

FV-60102
DCL STRUCTURE VALVE 2
5HP 480VAC 3PH

FI-60101
CHLORINE SAMPLE FLOW INDICATOR
0-500 ML/MIN

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

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INSTRUMENTATION

DECHLORINATION STRUCTURE P&ID

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JOB NO. 8660F.10
DRAWING NO. 60N01
SHEET NO. 154 OF 200

I/O

POWER SOURCE

FIELD

AI
L 80100
PLC–70299

E CB 80002 TM 120VAC–1P PCM

E LSL 80011 / E LE 80011 FLOAT

E LSL 80012 / E LE 80012 FLOAT

E LSL 80013 / E LE 80013 FLOAT

E FIT 80002 / E FE 80002 MAGNETIC

LIT 80100 / LE 80100 ULTRASONIC

8" RCW

MM

TO RECLAIMED WATER FILTER

E PMP 80111 — 6" RCW

E PMP 80112 — 6" RCW

E PMP 80113 — 6" RCW

FROM CHLORINE CONTACT PIPE - SEGMENT 2

96" SE

16" RW

FROM PAU PUMP STATION 91N01 80N01 17

42" SE

TO CAROUSEL PUMP STATION

30" FE

TO AWT PUMP STATION

LE–80011 LOW LEVEL SWITCH

LE–80012 LOW LEVEL SWITCH

LE–80013 LOW LEVEL SWITCH

FE–80002 RECLAIMED WATER FLOW TRANSMITTER

PMP–80111 RECLAIMED WATER FILTER FEED PUMP 1

PMP–80112 RECLAIMED WATER FILTER FEED PUMP 2

PMP–80113 RECLAIMED WATER FILTER FEED PUMP 3

LE–80100 STRUCT 80 LEVEL 0–18 FT

* TYP NL175

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

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INSTRUMENTATION

STRUCTURE 80 P&ID

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JOB NO. 8660F.10
DRAWING NO. 80N01
SHEET NO. 155 OF 200

AWT_CLARIFIER_FILTER
CF 3 EIP
PLC-4

I/O

POWER SOURCE

CB 85210 TM 120VAC-1P PNL-A

CB 85212 TM 480VAC-3P DP2

CB 85219 TM 480VAC-3P DP2

FIELD

VCP 3

CONTINUED ON P&ID 85N02

E FIT 85211
E FE 85211 MAGNETIC

HSA 85212 LSR FBV
HSG 85212 OSC FBV
ZSOC 85212 FBV
FV 85212 FBV DISC 85212

ZT 85211 FBV
HSA 85211 LSR FBV
HSG 85211 OSC FBV
ZSOC 85211 FBV
FCV 85211 FBV DISC 85211

E PDIT 85213
E PE 85213 PRESS DIFF

HSA 85214 LSR FBV
HSG 85214 OSC FBV
ZSOC 85214 FBV
FV 85214 FBV DISC 85214

LIT 85211
LE 85211 RADAR PTOF FBV

LSH 85101 FLOAT FBV
LE1 85101 FLOAT FBV
LSL 85101 FLOAT FBV
LE2 85101 FLOAT FBV

E PDIT 85216
E PE 85216 PRESS DIFF

HSA 85219 LSR FBV
HSG 85219 OSC FBV
ZSOC 85219 FBV
FV 85219 FBV DISC 85219

ZT 85218 FBV
HSA 85218 LSR FBV
HSG 85218 OSC FBV
ZSOC 85218 FBV
FCV 85218 FBV DISC 85218

HSA 85217 LSR FBV
HSG 85217 OSC FBV
ZSOC 85217 FBV
FV 85217 FBV DISC 85217

E D FBV

WASHWATER RECOVERY BASINS
20" WW

AWT PUMPS
MM
12" FE
E M FBV
VAL 85211 FBV

E GAT 85214
CLARIFIER

FILTER

15 85N01 85N08
9 85N01 85N02
10 85N01 85N03
11 85N01 85N04

AIR WASH BLOWERS
6" AA
E D FBV
VAL 85212 FBV

TANK NO. 1

20" BW/FE
E D FBV
VAL 85219 FBV

12" FE
E M FBV
VAL 85218 FBV

24" FE
16 85N01 85N08
BACKWASH PUMP STATION
TANK NO. 4 FILTER 85N04 85N01 14
TANK NO. 3 FILTER 85N03 85N01 13
TANK NO. 2 FILTER 85N02 85N01 12
BACKWASH PUMP STATION

12" FE
E D FBV
VAL 85217 FBV
AIR WASH BLOWERS 85N05 85N01 5
8" AA

FE-85211
FLOW TRANSMITTER AWT CLARIFIER/FILTER 1

FV-85212
AIR VALVE NO.1
0.5HP 480VAC 3PH

FCV-85211
INFLUENT VALVE NO.1
1HP 480VAC 3PH

PE-85213
PRESSURE DIFFERENTIAL TRANSMITTER

FV-85214
WASTE GATE VALVE NO.1
1HP 480VAC 3PH

LE-85211
RADAR PTOF
* NL180 TYP

LE1-85101
HIGH LEVEL SWITCH FILTER 1
7.17 FT
* NL101 TYP

LE2-85101
LOW LEVEL SWITCH FILTER 1
6.17 FT
* NL101 TYP

PE-85216
PRESSURE DIFFERENTIAL TRANSMITTER

FV-85219
AC AIR SCOUR VALVE NO. 1
0.5HP 480VAC 3PH

FCV-85218
EFFLUENT VALVE NO.1
1HP 480VAC 3PH

FV-85217
BACKWASH VALVE NO.1
1.5HP 480VAC 3PH

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

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RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

AWT CLARIFIER/FILTER 1 P&ID

VERIFY SCALES
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0 1"
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JOB NO. 8660F.10
DRAWING NO. 85N01
SHEET NO. 156 OF 200

I/O

POWER SOURCE

FIELD

CB 85222 — TM 480VAC–3P — DP2

CB 85229 — TM 480VAC–3P — DP2

CONTINUED ON P&ID 85N01

VCP-3

CONTINUED ON P&ID 85N03

E FIT 85221

E FE 85221 MAGNETIC

HSA 85222 LSR FBV

HSG 85222 OSC FBV

ZSOC 85222 FBV

FV 85222 FBV — DISC 85222

ZT 85221 FBV

HSA 85221 LSR FBV

HSG 85221 OSC FBV

ZSOC 85221 FBV

FCV 85221 FBV — DISC 85221

E PDIT 85223

E PE 85223 PRESS DIFF

HSA 85224 LSR FBV

HSG 85224 OSC FBV

ZSOC 85224 FBV

FV 85224 FBV — DISC 85224

LIT 85221 FBV

LE 85221 RADAR PTOF FBV

LSH 85102 FLOAT FBV

LE1 85102 FLOAT FBV

LSL 85102 FLOAT FBV

LE2 85102 FLOAT FBV

E PDIT 85226

E PE 85226 PRESS DIFF

HSA 85229 LSR FBV

HSG 85229 OSC FBV

ZSOC 85229 FBV

FV 85229 FBV — DISC 85229

ZT 85228 FBV

HSA 85228 LSR FBV

HSG 85228 OSC FBV

ZSOC 85228 FBV

FCV 85228 FBV — DISC 85228

HSA 85227 LSR FBV

HSG 85227 OSC FBV

ZSOC 85227 FBV

FV 85227 FBV — DISC 85227

E/D FBV

E GAT 85224

WASHWATER RECOVERY BASINS — 20" WW

AWT PUMPS 9 — 85N01 85N02 — MM

E/M FBV — VAL 85221 FBV — 12" FE

CLARIFIER

FILTER

12" FE

E/M FBV — VAL 85228 FBV — 12" FE — BACKWASH PUMP STATION 12 — 85N02 85N01

E/D FBV — VAL 85227 FBV — 14" BW — BACKWASH PUMP STATION

AIR WASH BLOWERS — E/D FBV — VAL 85222 FBV — 6" AA

E/D FBV — VAL 85229 FBV — 20" BW/FE

8" AA — AIR WASH BLOWERS 85N05 85N02 6

TANK NO. 2

FE–85221
FLOW TRANSMITTER AWT CLARIFIER/FILTER 2

PE–85223
PRESSURE DIFFERENTIAL TRANSMITTER

PE–85226
PRESSURE DIFFERENTIAL TRANSMITTER

LE–85221 RADAR PTOF * TYP NL180

LE2–85102 LOW LEVEL SWITCH FILTER 2 6.17 FT * TYP NL101

FV–85229
AC AIR SCOUR VALVE NO. 2
0.5HP 480VAC 3PH

FV–85222
AIR VALVE NO.2
0.5HP 480VAC 3PH

FCV–85221
INFLUENT VALVE NO.2
1HP 480VAC 3PH

FV–85224
WASTE GATE VALVE NO.2
1HP 480VAC 3PH

LE1–85102
HIGH LEVEL SWITCH FILTER 2
7.17 FT * TYP NL101

FCV–85228
EFFLUENT VALVE NO.2
1HP 480VAC 3PH

FV–85227
BACKWASH VALVE NO.2
1.5HP 480VAC 3PH

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN KIK
CHECKED BAL
DATE JULY 2023

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RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

AWT CLARIFIER/FILTER 2 P&ID

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 85N02
SHEET NO. 157 OF 200

I/O

POWER SOURCE

FIELD

CB 85232 — TM 480VAC–3P — DP2

CB 85239 — TM 480VAC–3P — DP2

CONTINUED ON P&ID 85N02

VCP-3

CONTINUED ON P&ID 85N04

E FIT 85231

E FE 85231 MAGNETIC

HSA 85232 LSR FBV

HSG 85232 OSC FBV

ZSOC 85232 FBV

FV 85232 FBV — DISC 85232

ZT 85231 FBV

HSA 85231 LSR FBV

HSG 85231 OSC FBV

ZSOC 85231 FBV

FCV 85231 FBV — DISC 85231

E PDIT 85233

E PE 85233 PRESS DIFF

HSA 85234 LSR FBV

HSG 85234 OSC FBV

ZSOC 85234 FBV

FV 85234 FBV — DISC 85234

LIT 85231

LE 85231 RADAR PTOF FBV

LSH 85103 FLOAT FBV

LE1 85103 FLOAT FBV

LSL 85103 FLOAT FBV

LE2 85103 FLOAT FBV

E PDIT 85236

E PE 85236 PRESS DIFF

HSA 85239 LSR FBV

HSG 85239 OSC FBV

ZSOC 85239 FBV

FV 85239 FBV — DISC 85239

ZT 85238 FBV

HSA 85238 LSR FBV

HSG 85238 OSC FBV

ZSOC 85238 FBV

FCV 85238 FBV — DISC 85238

HSA 85237 LSR FBV

HSG 85237 OSC FBV

ZSOC 85237 FBV

FV 85237 FBV — DISC 85237

E D FBV

E GAT 85234

CLARIFIER

FILTER

TANK NO. 3

WASHWATER RECOVERY BASINS — 20" WW

AWT PUMPS 10 — 85N01 85N03 — MM — E M FBV — VAL FBV 85231 — 12" FE

AIR WASH BLOWERS — E D FBV — VAL FBV 85232 — 6" AA

12" FE

20" BW/FE

E M FBV — VAL FBV 85238 — 18" FE — BACKWASH PUMP STATION 13 — 85N03 85N01

E D FBV — VAL FBV 85237 — 14" BW — BACKWASH PUMP STATION

E D FBV — VAL FBV 85239 — 8" AA — AIR WASH BLOWERS 85N05 85N03 7

PE–85236
PRESSURE DIFFERENTIAL TRANSMITTER

FE–85231
FLOW TRANSMITTER AWT CLARIFIER/FILTER 3

PE–85233
PRESSURE DIFFERENTIAL TRANSMITTER

LE–85231 RADAR PTOF — * TYP — NL180

LE2–85103 LOW LEVEL SWITCH FILTER 3 6.17 FT — * TYP — NL101

FV–85239 AC AIR SCOUR VALVE NO. 3 0.5HP 480VAC 3PH

FV–85232
AIR VALVE NO.3
0.5HP 480VAC 3PH

FCV–85231
INFLUENT VALVE NO.3
1HP 480VAC 3PH

FV–85234
WASTE GATE VALVE NO.3
1HP 480VAC 3PH

LE1–85103
HIGH LEVEL SWITCH FILTER 3
7.17 FT

* TYP — NL101

FCV–85238
EFFLUENT VALVE NO.3
1HP 480VAC 3PH

FV–85237
BACKWASH VALVE NO.3
1.5HP 480VAC 3PH

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN KIK
CHECKED BAL
DATE JULY 2023

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City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

AWT CLARIFIER/FILTER 3 P&ID

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 — 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 85N03
SHEET NO. 158 OF 200

I/O

POWER SOURCE

FIELD

CB 85242 — TM 480VAC–3P — DP2

CB 85249 — TM 480VAC–3P — DP2

CONTINUED ON P&ID 85N03

VCP-3

CONTINUED ON P&ID 85N05

E FIT 85241
E FE 85241 MAGNETIC

HSA 85242 LSR FBV
HSG 85242 OSC FBV
ZSOC 85242 FBV
FV 85242 FBV
DISC 85242

ZT 85241 FBV
HSA 85241 LSR FBV
HSG 85241 OSC FBV
ZSOC 85241 FBV
FCV 85241 FBV
DISC 85241

E PDIT 85243
E PE 85243 PRESS DIFF

HSA 85244 LSR FBV
HSG 85244 OSC FBV
ZSOC 85244 FBV
FV 85244 FBV
DISC 85244

LIT 85241 FBV
LE 85241 RADAR PTOF FBV

LSH 85104 FLOAT FBV
LE1 85104 FLOAT FBV
LSL 85104 FLOAT FBV
LE2 85104 FLOAT FBV

E PDIT 85246
E PE 85246 PRESS DIFF

HSA 85249 LSR FBV
HSG 85249 OSC FBV
ZSOC 85249 FBV
FV 85249 FBV
DISC 85249

ZT 85248 FBV
HSA 85248 LSR FBV
HSG 85248 OSC FBV
ZSOC 85248 FBV
FCV 85248 FBV
DISC 85248

HSA 85247 LSR FBV
HSG 85247 OSC FBV
ZSOC 85247 FBV
FV 85247 FBV
DISC 85247

WASHWATER RECOVERY BASINS — 20" WW

AWT PUMPS 11 — 85N01 85N04 — MM — 12" FE

AIR WASH BLOWERS — 6" AA

E GAT 85244 — CLARIFIER

FILTER

TANK NO. 4

12" FE

20" BW/FE

8" AA

14" BW

E/M FBV — VAL 85241 FBV

E/D FBV — VAL 85242 FBV

E/D FBV

E/M FBV — VAL 85248 FBV

E/D FBV — VAL 85249 FBV

E/D FBV — VAL 85247 FBV

BACKWASH PUMP STATION — 14 — 85N04 85N01

BACKWASH PUMP STATION

AIR WASH BLOWERS — 85N05 85N04 — 8

FE–85241
FLOW TRANSMITTER AWT CLARIFIER/FILTER 4

PE–85243
PRESSURE DIFFERENTIAL TRANSMITTER

PE–85246
PRESSURE DIFFERENTIAL TRANSMITTER

LE–85241 RADAR PTOF * TYP NL180

LE2–85104
LOW LEVEL SWITCH FILTER 4
6.17 FT

* TYP NL101

FV–85249
AC AIR SCOUR VALVE NO. 4
0.5HP 480VAC 3PH

FV–85242
AIR VALVE NO.4
0.5HP 480VAC 3PH

FCV–85241
INFLUENT VALVE NO.4
1HP 480VAC 3PH

FV–85244
WASTE GATE VALVE NO.4
1HP 480VAC 3PH

LE1–85104
HIGH LEVEL SWITCH FILTER 4
7.17 FT

* TYP NL101

FCV–85248
EFFLUENT VALVE NO.4
1HP 480VAC 3PH

FV–85247
BACKWASH VALVE NO.4
1.5HP 480VAC 3PH

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN KIK
CHECKED BAL
DATE JULY 2023

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RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

AWT CLARIFIER/FILTER 4 P&ID

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 85N04
SHEET NO. 159 OF 200

I/O

E AI F 85105 PLC–4

POWER SOURCE

MS- 85109 | FVNR | 480VAC-3P | MCC-C

MS- 85110 | FVNR | 480VAC-3P | MCC-C

MS- 85111 | FVNR | 480VAC-3P | MCC-C

PERMISSIVE

RVSS- 85106 | RVSS | 480VAC-3P | MCC-C

RVSS- 85107 | RVSS | 480VAC-3P | MCC-C

RVSS- 85108 | RVSS | 480VAC-3P | MCC-C

RUN, RUNNING

RUN, REMOTE, RUNNING, TEMP, PRESS DIFF, PRESS

FIELD

LOR, STOP, START

HSA 85106, HSB 85106, HSC 85106, LCP 85106

BLO 85106, MWH 85106, TSH 85106, FAN 85109

HSA 85107, HSB 85107, HSC 85107, LCP 85107

BLO 85107, MWH 85107, TSH 85107, FAN 85110

HSA 85108, HSB 85108, HSC 85108, LCP 85108

BLO 85108, MWH 85108, TSH 85108, FAN 85111

CONTINUED FROM 85N04

CONTINUED ON 85N08

VCP-3 CONTINUED

PSH 85106 FBV, PE2 85106 PRESS SW FBV

PIT 85106 FBV, PE3 85106 PRESSURE FBV

PDSH 85106 FBV, PE1 85106 PRESS DIFF FBV

PSH 85107 FBV, PE2 85107 PRESS SW FBV

PIT 85107 FBV, PE3 85107 PRESSURE FBV

PDSH 85107 FBV, PE1 85107 PRESS DIFF FBV

PSH 85108 FBV, PE2 85108 PRESS SW FBV

PIT 85108 FBV, PE3 85108 PRESSURE FBV

PDSH 85108 FBV, PE1 85108 PRESS DIFF FBV

PI 85100 FBV

PSL 85100 FBV, PE 85100 PRESS SW FBV

E SORT FIT 85105

E VENTURI FE 85105

8" AA

FILTER NO. 1 — 5 — 85N05 85N01

FILTER NO. 2 — 6 — 85N05 85N02

FILTER NO. 3 — 7 — 85N05 85N03

FILTER NO. 4 — 8 — 85N05 85N04

OUTSIDE AIR

4" AA

8" AA

EX-6" AA

CLARIFIER NO. 1

CLARIFIER NO. 2

CLARIFIER NO. 3

CLARIFIER NO. 4

PE1–85106 FILTER DIFFERENTIAL PRESSURE 1 — * TYP — NP188

PE2–85106 PRESSURE SWITCH HIGH — * TYP — NP501

PE1–85107 FILTER DIFFERENTIAL PRESSURE 2 — * TYP — NP188

PE2–85107 PRESSURE SWITCH HIGH — * TYP — NP501

PE1–85108 FILTER DIFFERENTIAL PRESSURE 3 — * TYP — NP188

PE2–85108 PRESSURE SWITCH HIGH — * TYP — NP501

PI–85100 PRESSURE INDICATOR

FE–85105 AIR WASH VENTURI FLOWMETER

BLO–85106 AIR WASH BLOWER 1 20HP 480VAC 3PH

6 06N06, 7 06N06 — PE3–85106 PRESSURE TRANSMITTER — * TYP — NP501

BLO–85107 AIR WASH BLOWER 2 20HP 480VAC 3PH

6 06N06, 7 06N06 — PE3–85107 PRESSURE TRANSMITTER — * TYP — NP501

BLO–85108 AIR WASH BLOWER 3 20HP 480VAC 3PH

6 06N06, 7 06N06 — PE3–85108 PRESSURE TRANSMITTER — * TYP — NP501

PE–85100 LOW PRESSURE SWITCH — * TYP — NP501

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

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INSTRUMENTATION

AIR WASH BLOWERS 1, 2 & 3 P&ID

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 85N05
SHEET NO. 160 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1085N005.dwg

Plot Date: 12-JUL-2023 11:48:52 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
jwicks

KEY NOTES:

1. INSTALL NEW DC DRIVE AND ENCODER IN THE EXISTING ENCLOSURE.

I/O

E AI L 85180 PLC–4

E DI AUX1 85181 RUNNING PLC–4
E DI AUX2 85181 E–STOP PLC–4

E AO SS 85181 SPEED OUT PLC–4

E DI AUX1 85182 RUNNING PLC–4
E DI AUX2 85182 E–STOP PLC–4

E AO SS 85182 SPEED OUT PLC–4

E DI AUX1 85183 RUNNING PLC–4
E DI AUX2 85183 E–STOP PLC–4

E AO SS 85183 SPEED OUT PLC–4

POWER SOURCE

E TM CB 85180 120VAC–1P PCM–4

E TM CB 85181 120VAC–1P PNL–A

E TM CB 85182 120VAC–1P PNL–A

E TM CB 85183 120VAC–1P PNL–A

FIELD

E LIT 85180

E ULTRASONIC LE 85180

E VCP 85181 FBV

E VCP 85182 FBV

E VCP 85183 FBV (1)

E PMP 85181 FBV

E PMP 85182 FBV

E PMP 85183 FBV

S

E FI 85181

E FI 85182

E FI 85183

TANK 2
WITH FERRIC CHLORIDE

EX-1 1/2" FC

TO AWT RAPID MIX 18 85N06 85N07

NPW - 2" NPW

FI–85181
ROTAMETER 1
0–5 GPM

FI–85182
ROTAMETER 2
0–5 GPM

FI–85183
ROTAMETER 3
0–5 GPM

LE–85180
TNK 2 LEVEL

PMP–85181
COAGULANT FEED PUMP NO. 1
0.5HP 90VDC

PMP–85182
COAGULANT FEED PUMP NO. 2
0.5HP 90VDC

PMP–85183
COAGULANT FEED PUMP NO. 3
0.5HP 90VDC

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN AAW
CHECKED BAL
DATE JULY 2023

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RECYCLED WATER PROJECT - PHASE 4
INSTRUMENTATION
COAGULANT FEED PUMP P&ID

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 85N06
SHEET NO. 161 OF 200

I/O

POWER SOURCE

FIELD

DI HSAR REMOTE 85104 PLC-4

DO MS RUN 85104 PLC-4

DI TSH HIGH TEMP 85104 PLC-4

DI AUX1 RUNNING 85104 PLC-4

FVNR- 85104
FVNR
480VAC-3P
MCC-C

LOR HSA 85104

STOP HSB 85104

START HSC 85104

LCP 85104

PMP 85104

MWH 85104

TSH 85104

3" FE

FROM COAGULANT FEED
18 85N06 85N07

FROM CHLORINATION FACILITY

EX-24" FE

FLASH MIX ASSEMBLY

CLARIFIER/FILTER UNITS

PMP-85104
RAPID MIX PUMP
7.5HP 480VAC 3PH
5 06N05

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN AAW
CHECKED BAL
DATE JULY 2023

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RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

RAPID MIX PUMP P&ID

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 85N07
SHEET NO. 162 OF 200

Plot Date: 12-JUL-2023 11:51:01 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
jwicks

I/O

POWER SOURCE

FIELD

CONTINUED FROM 85N05

VCP-3

CONTINUED ON SHEET 87N01

RCW

E AIT 85108

E AE 85108 pH

E AIT 85109

E AE 85109 TURBIDITY

TO DRAIN

15 85N01 85N08

TO SAMPLE SINK

RCW

E PMP 85112

M

16 85N01 85N08

E AIT 85110

E AE 85110 pH

E AIT 85111

E AE 85111 TURBIDITY

TO DRAIN

TO SAMPLE SINK

PMP–85112

AE–85108 pH

AE–85109 TURBIDITY

AE–85110 pH

AE–85111 TURBIDITY

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN LMB
CHECKED BAL
DATE JULY 2023

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RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

EXISTING CHLORINATION FACILITY ANALYZERS P&ID

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 85N08
SHEET NO. 163 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1085N008.dwg

KEY NOTES:

1. THE NEW ANALYZER SHALL REPLACE THE EXISTING ANALYZER AND BE INSTALLED IN THE EXISTING ENCLOSURE.

I/O

POWER SOURCE

FIELD

E LSL 87130 DI PLC–4

E LSH 87130 DI PLC–4

HSAR 87134 DI REMOTE
MS 87134 DO RUN
PLC–4

TSH 87134 DI HIGH TEMP
AUX1 87134 DI RUNNING
PLC–4

A 87130 AI CL PLC–4

FVNR- 87134
FVNR
480VAC-3P
MCC-C

CB1 87130 TM 120VAC–1P PCM–4

E LSL 87130

E LE 87130

E LSH 87130

E LE/LSH 87130

LOR
HSA 87134
STOP
HSB 87134
START
HSC 87134
LCP 87134

PMP 87134 MWH 87134 TSH 87134

AIT 87130 1
AE 87130 CL

REACTOR DRAIN

PI 87130 PRESSURE

FI 87130 CHLORINE

M

PROCESS DRAIN

E AUX2 87132 DI FAILED
E MS 87132 DO RUN
PLC–4

E AUX1 87132 DI READY PLC–4

E MS- 87132
FVNR
0VAC-2P
MCC-

E RUN HSC 87132
E OFF HSB 87132
E HOA HSA 87132
E LCP 87132

E PMP 87132 E MWH 87132 E TSH 87132

E AUX2 87133 DI FAILED
E MS 87133 DO RUN
PLC–4

E AUX1 87133 DI READY PLC–4

E MS- 87133
FVNR
480VAC-3P
MCC-

E RUN HSC 87133
E OFF HSB 87133
E HOA HSA 87133
E LCP 87133

E PMP 87133 E MWH 87133 E TSH 87133

CB2 87130 TM 480VAC–3P DP2

CONTINUED FROM 85N08

VCP-3

HSA 87130 LSR FBV
HSG 87130 OSC FBV
ZSOC 87130 FBV
FV 87130 FBV
VCP 87130
DISC 87130

M

VAL 87130 FBV

TO AWT BUILDING

14" BW

8" BW

FROM HOCL

2" CLS

FROM AWT

24" FE

TO CHLORINE CONTACT BASINS
24" FE 19 87N01 88N01

TO CHLORINE CONTACT BASINS
24" FE 20 87N01 88N01

PI–87130
PRESSURE INDICATOR
0–30 PSI

FI–87130
CHLORINE SAMPLE FLOW INDICATOR
0–500 ML/MIN

LE–87130
LOW LEVEL SWITCH

LE/LSH–87130
HIGH LEVEL SWITCH

PMP–87134
BACKWASH CHLORINE SAMPLE PUMP
0.5HP 480VAC 3PH
5 06N05

AE–87130
CHLORINE ANALYZER 3
0–10 MG/L
★ TYP NA090

PMP–87132
BACKWASH PUMP NO. 1

PMP–87133
BACKWASH PUMP 2

FV–87130
HIGH RATE BACKWASH VALVE
1HP 480VAC 3PH

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN AAW
CHECKED BAL
DATE JULY 2023

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RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

BACKWASH PUMP STATION
CHLORINE ANALYZER P&ID

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 87N01
SHEET NO. 164 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1087N001.dwg

Plot Date: 12-JUL-2023 11:51:54 AM
User: svcPW
PlotScale: 1:1
DesignScript: Carollo_Std_Pen_v0905.pen
ColorTable: gshade.ctb
Model: Layout1
jwicks

I/O

POWER SOURCE

FIELD

AI
F
88101
PLC–4

AI
F
88102
PLC–4

TM
120VAC–1P
CB
88101
PCM–4

TM
120VAC–1P
CB
88102
PCM–4

FIT
88101

FIT
88102

LE
88101
ULTRASONIC

LE
88102
ULTRASONIC

BACKWASH PUMPING STATION
19
87N01
88N01
24" FE

BACKWASH PUMPING STATION
20
87N01
88N01
24" FE

CHLORINE CONTACT BASIN 1

CHLORINE CONTACT BASIN 2

24" FE
SODIUM BISULFITE INJECTION STRUCTURE

24" FE
SODIUM BISULFITE INJECTION STRUCTURE

LE–88101
CHLORINE CONTACT BASIN OPEN CHANNEL FLOW METER 1
600–1500 GPM
* TYP
NA901

LE–88102
CHLORINE CONTACT BASIN OPEN CHANNEL FLOW METER 2
600–1500 GPM
* TYP
NA901

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN LMB
CHECKED BAL
DATE JULY 2023

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RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

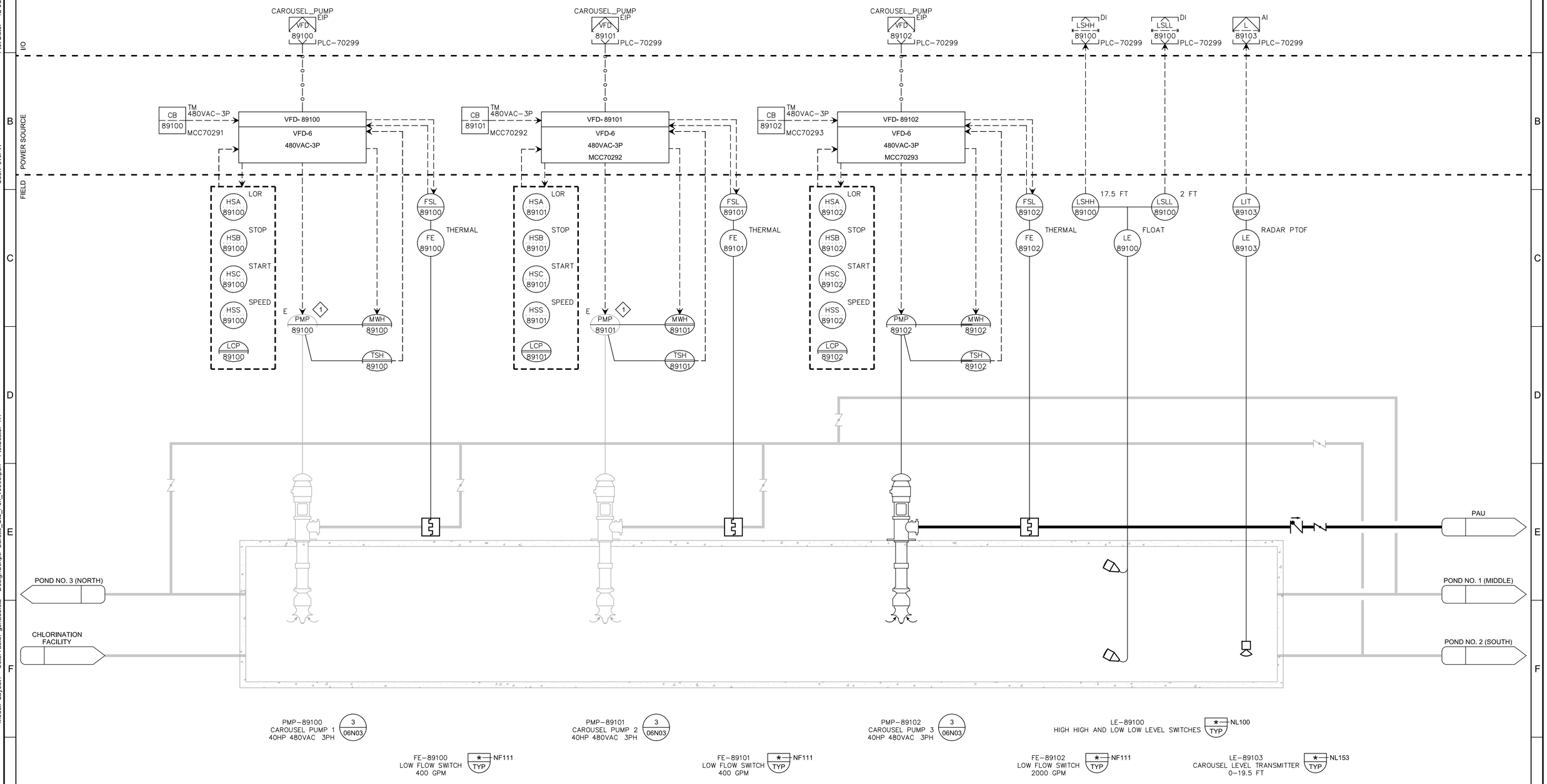
CHLORINE CONTACT BASIN FLOW METERS P&ID

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 88N01
SHEET NO. 165 OF 200

KEY NOTES:

1. EXISTING MOTOR SHALL BE REPLACED WITH NEW ONE. REFER TO ELECTRICAL DRAWINGS FOR FURTHER DETAIL.



PMP-89100 CAROUSEL PUMP 1 40HP 480VAC 3PH (3 / 06N03)

PMP-89101 CAROUSEL PUMP 2 40HP 480VAC 3PH (3 / 06N03)

PMP-89102 CAROUSEL PUMP 3 40HP 480VAC 3PH (3 / 06N03)

LE-89100 HIGH HIGH AND LOW LOW LEVEL SWITCHES (* TYP) NL100

FE-89100 LOW FLOW SWITCH 400 GPM (* TYP) NF111

FE-89101 LOW FLOW SWITCH 400 GPM (* TYP) NF111

FE-89102 LOW FLOW SWITCH 2000 GPM (* TYP) NF111

LE-89103 CAROUSEL LEVEL TRANSMITTER 0-19.5 FT (* TYP) NL153

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN TCD
CHECKED BAL
DATE JULY 2023

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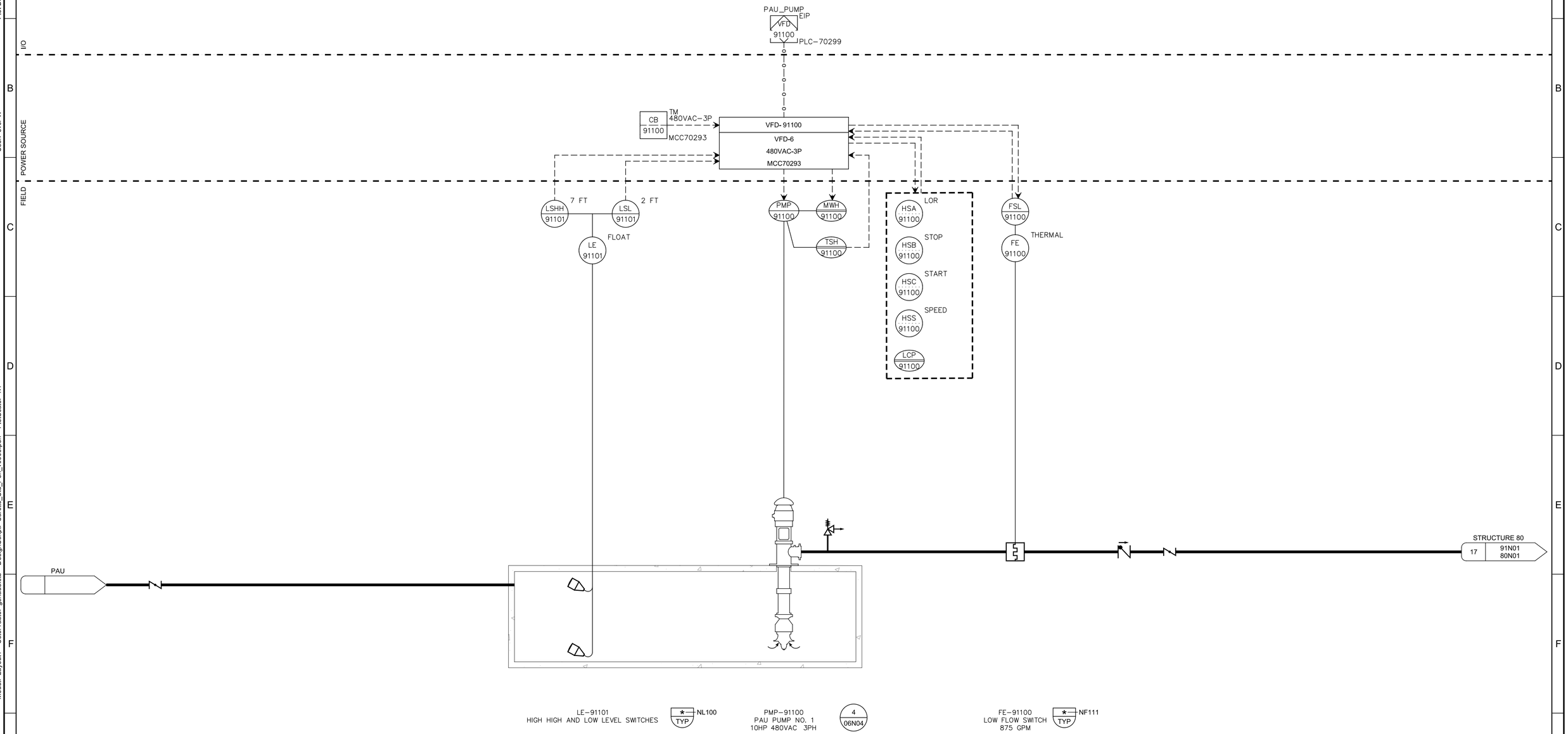
RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

CAROUSEL PUMP & LEVEL CONTROLS P&ID

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 89N01
SHEET NO. 166 OF 200



REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN KIK
CHECKED BAL
DATE JULY 2023

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RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

PAU PUMP STATION P&ID

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 91N01
SHEET NO. 167 OF 200

KEY NOTES:

1. CABLE TERMINATION BOX.

I/O

POWER SOURCE

FIELD

F 99406 AI PLC–99400

ZCC1 99402 DO OPEN PLC–99400

ZCC1 99402 DO CLOSE PLC–99400

ZSO 99402 DI OPENED PLC–99400

ZSC 99402 DI CLOSED PLC–99400

ZCO2 99402 DO OPEN PLC–99400

ZCC2 99402 DO CLOSE PLC–99400

LSLL 99403 DI PLC–99400

LSHH 99403 DI PLC–99400

L 99405 AI PLC–99400

RECYCLED_PUMP VFD 99411 EIP PLC–99400

CB 99406 TM 120VAC–1P PCM–99400

CB 99411 TM 480VAC–3P SWBD–RWPS

VFD- 99411
VFD-RH
480VAC-3P
SWBD-RWPS

FIT 99406

FE 99406 MAGNETIC

SV1 99402

ZSOC 99402

VAL 99402

SV2 99402

LSLL 99403 1 FT

LSHH 99403 25 FT

LE 99403 FLOAT

1 DESICCANT

LIT 99405

LE 99405 P–SUB

LOR STOP
HSA 99411
HSB 99411
LCP 99411
START
HSC 99411
SPEED
HSS 99411

DISC 99411

PMP 99411

MWH 99411

TSH 99411

FSL 99411

FE 99411 THERMAL

S S

H

PHASE 1-3 RECYCLED WATER SYSTEM

16" RW

MM

12" RW

OVERFLOW

25 FT

1 FT

TNK 99401
RECYCLED WATER DISTRIBUTION TANK

HH LEVEL 25 FT

LL LEVEL 1 FT

PI 99411 PRESSURE

16" RW

RECYCLED WATER PUMP STATION 2 99N01 99N02

14" RW

16" RW

16" RW

RECYCLED WATER PUMP STATION 1 99N01 99N02

FE–99406 FLOW METER 500–4000 GPM 12" * TYP NF130 NF136

VAL–99402 TANK FILL VALVE

LE–99403 LEVEL FLOAT SWITCHES * TYP NL108

LE–99405 LEVEL TRANSMITTER 0–25 FT * TYP NL132 NL133

PMP–99411 RECYCLED WATER PUMP #1 75HP 480VAC 3PH 1 06N01

PI–99411 PRESSURE INDICATOR 0–150 PSIG * TYP NP502

FE–99411 THERMAL LOW FLOW SWITCH 450 GPM * TYP NF111

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN AAW
CHECKED BAL
DATE JULY 2023

** ORIGINAL SEALED BY BRETT A. LEE 4/7/2023 CA PE NO. 22911 **

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City of Ukiah

CITY OF UKIAH

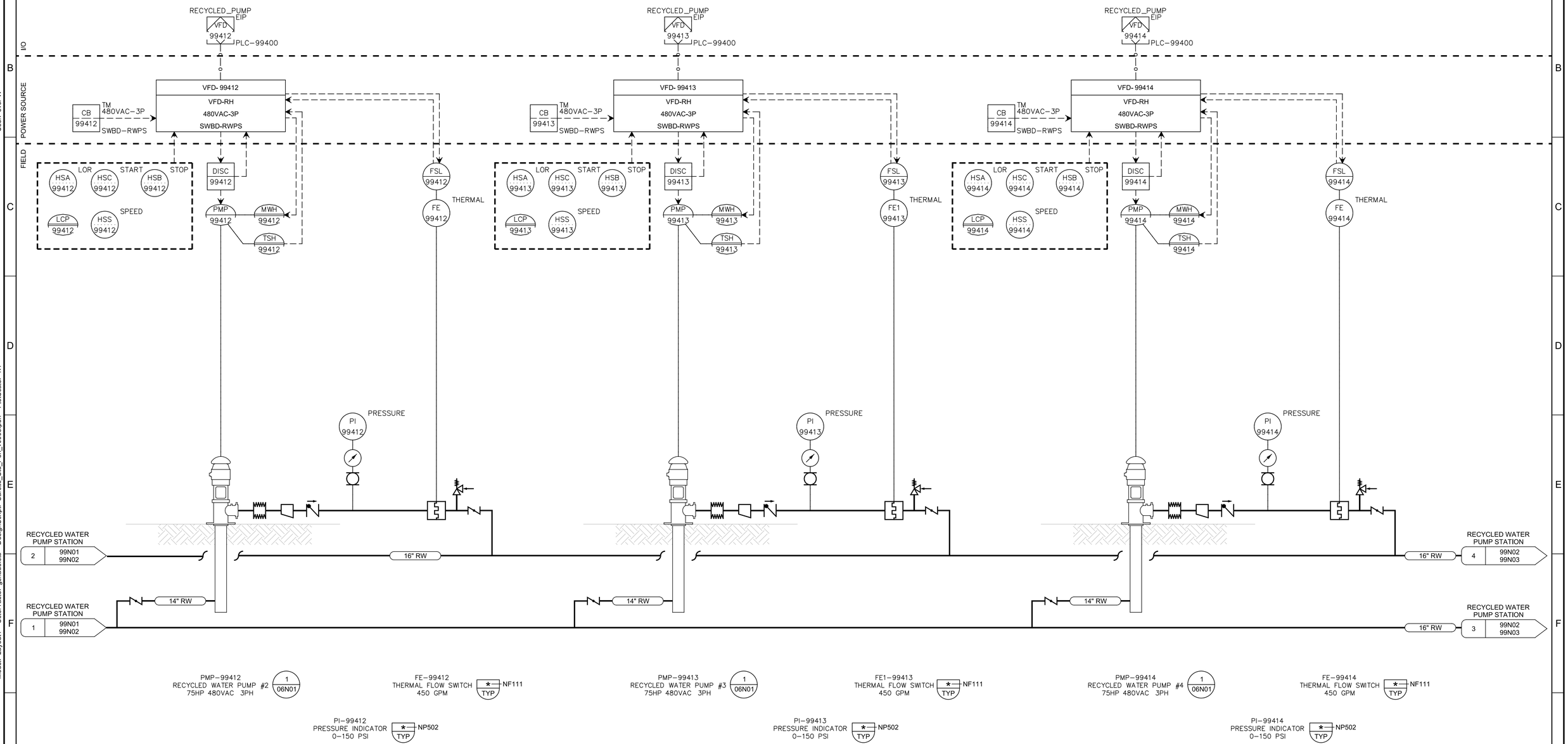
RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

RECYCLED WATER PUMP STATION 1 P&ID

VERIFY SCALES
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99N01
SHEET NO. 168 OF 200



REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

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CHECKED BAL
DATE JULY 2023

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CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

INSTRUMENTATION

RECYCLED WATER PUMP STATION 2 P&ID

VERIFY SCALES
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0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99N02
SHEET NO. 169 OF 200

FUTURE

RECYCLED_PUMP
F VFD EIP
99415
PLC–99400

I/O

POWER SOURCE

F CB 99415 TM 480VAC–3P SWBD–RWPS

F VFD- 99415
VFD-RH
480VAC-3P
SWBD-RWPS

FIELD

F HSA 99415 LOR F HSC 99415 START F HSB 99415 STOP
F LCP 99415 F HSS 99415 SPEED

F DISC 99415
F PMP 99415 F MWH 99415
F TSH 99415

F PI 99415
F PSH 99415
F PE 99415 PRESS SW
F FSL 99415
FE 99415 THERMAL

F 99431 AI
PLC–99400

CB 99431 TM 120VAC–1P
PCM–99400

FIT 99431
FE2 99431 MAGNETIC

P 99432 AI
PLC–99400

PIT 99432
PE 99432 PRESSURE

PI 99432 PRESSURE

TNK 99432

RECYCLED WATER PUMP STATION
3 99N02 99N03
RECYCLED WATER PUMP STATION
4 99N02 99N03
16" RW
16" RW

MM

DISTRIBUTION SYSTEM

PI–99415
PRESSURE INDICATOR
0–150 PSIG

FE–99415
THERMAL FLOW SWITCH
450 GPM

PI–99432
PRESSURE INDICATOR
0–300 PSI

PMP–99415
RECYCLED WATER PUMP #5
75HP 480VAC 3PH
1 06N01

PE–99415
PRESSURE SWITCH LOW
75 PSIG OPEN

FE2–99431
FLOW METER
400–4000 GPM
16"
TYP NF130 NF136

PE–99432
PRESSURE TRANSMITTER
0–300 PSIG
TYP NP501

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
DRAWN AAW
CHECKED BAL
DATE JULY 2023

**
ORIGINAL
SEALED BY
BRETT A. LEE
4/7/2023
CA PE NO. 22911
**

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RECYCLED WATER PROJECT - PHASE 4
INSTRUMENTATION
RECYCLED WATER PUMP STATION 3 P&ID

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 99N03
SHEET NO. 170 OF 200

1 2 3 4 5 6 7 8 9 10 11 12 13

A B C D E F G

I/O

POWER SOURCE

FIELD

JS4 99400 — DI ACB OK — PLC-99400
JS3 99400 — DI REDUNDANCY OK — PLC-99400
JS2 99400 — DI PWR SUP OK — PLC-99400
JS1 99400 — DI PWR SUP OK — PLC-99400

ZS1 99400 — DI INTRUSION — PLC-99400
ZS1 99400 — INTRUSION DR

CB1 99400 — TM 120VAC-1P — PNL-RWPS-L
CB2 99400 — TM 120VAC-1P — PNL-RWPS-L

XA6 99400 — DI SPD FAIL — PLC-99400
SPD 99400

XA4 99400 — DI SPD2 FAIL — PLC-99400
SPD2 99400

TSH 99400 — DI PLC TEMP — PLC-99400
TSH 99400

XA5 99400 — DI ES-P FAIL — PLC-99400
XA5 99400

XA7 99400 — DI ECP-P FAIL — PLC-99400
XA7 99400

POWER_QUALITY_METER — EIP
PQM 99400 — PCM-9940
PQM 99400

PCM 99400
PCM-99400

PCM-99400 PCM CABINET (2 / 06N02)

SPD-99400 PCM SURGE PROTECTOR

SPD2-99400 PCM SURGE PROTECTOR

PQM-99400 RECYCLED WATER PUMP STATION

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED DB
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CHECKED BAL
DATE JULY 2023

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City of Ukiah

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RECYCLED WATER PROJECT - PHASE 4

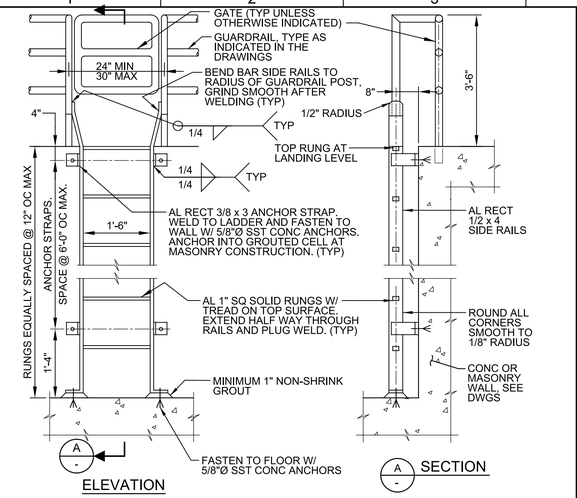
INSTRUMENTATION

RECYCLED WATER PUMP STATION PCM-99400 CABINET P&ID

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DRAWING NO. 99N04
SHEET NO. 171 OF 200

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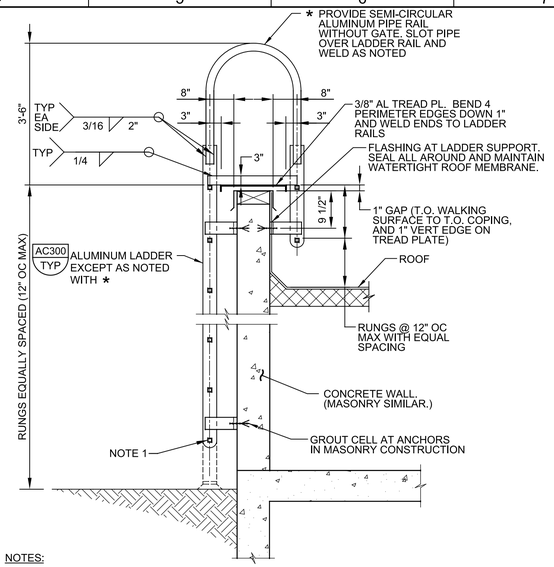


NOTES:

1. INSTALL FALL PREVENTION SYSTEM PER SPEC WHERE HEIGHT OF LADDER EXCEEDS 24'-0".
2. MINIMUM CLEARANCE TO ANY OBSTRUCTION ADJACENT TO LADDER; 2'-6" ON CLIMBING SIDE (2'-3" AT SMOOTH WALL). 1'-3" EACH SIDE OF CENTER LINE, ON EACH SIDE OF LADDER.
3. COAT ALL AL SURFACES IN CONTACT W/ CONC AND MASONRY, AND INSTALL ISOLATION SLEEVES AND WASHERS AT DISSIMILAR METALS, AS SPECIFIED.
4. WHERE GUARDRAIL IS SST, BOLT PIPE TO RAIL W/ 2 - 1/2"Ø SST BOLTS.

AC300 TYP S LADDER - ALUMINUM - WALL

12/28/20

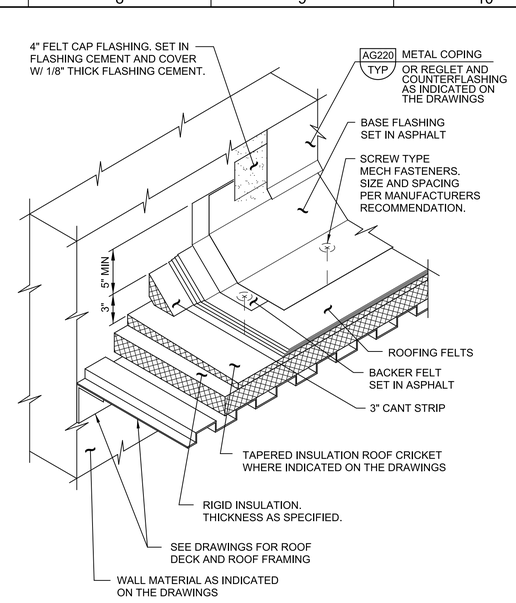


NOTES:

1. WHERE NOT ABOVE CONCRETE SLAB, TERMINATE SIDE RAILS AS SHOWN.
2. ABOVE CONCRETE SLAB, EXTEND RAILS DOWN. SET ON MIN 1" NON-SHRINK GROUT. FASTEN TO CONCRETE WITH 1/2"Ø SST CONCRETE ANCHOR EACH SIDE. MIN 4" EMBED.
3. INSTALL FALL PREVENTION SYSTEM WHERE HEIGHT OF LADDER EXCEEDS 24'-0".

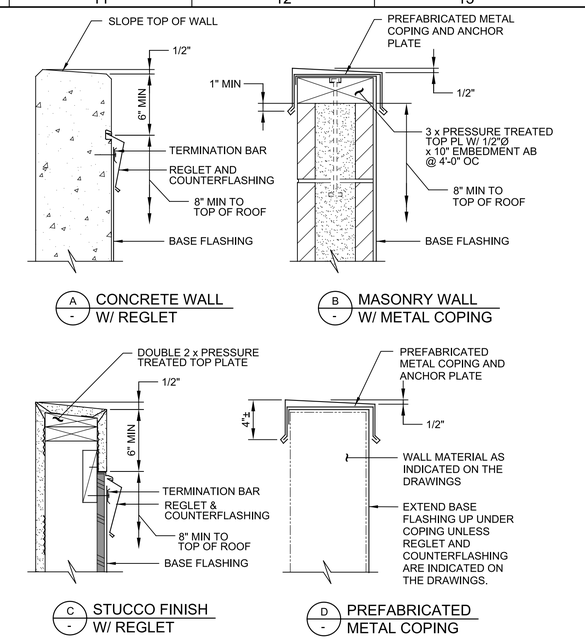
AC310 TYP LADDER - ALUMINUM - PARAPET

06/21/19



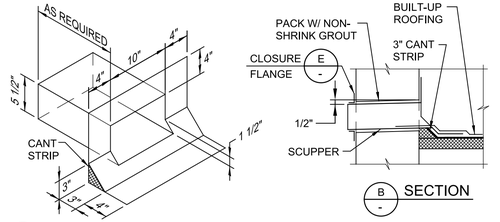
AG140 TYP ROOF SYSTEM - BUILT-UP - DETAIL

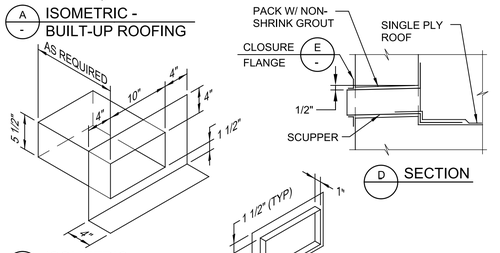
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AG220 TYP PARAPET DETAILS

06/21/19



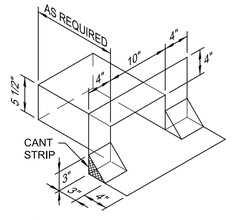


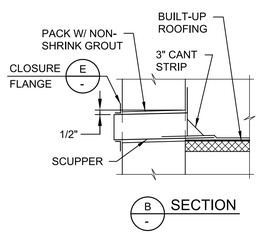
NOTES:

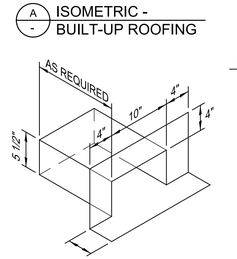
1. PROVIDE SCUPPER AS DETAILED AND ADHERE TO SURROUNDING STRUCTURE UNLESS OTHERWISE RECOMMENDED BY ROOFING MANUFACTURER.
2. FABRICATE SCUPPER AND FLANGE FROM MIN 0.032" THICK PRE-FINISHED AL. FINISH SHALL BE KYNAR. COLOR SHALL BE ENGINEER SELECTED FROM STANDARD COLOR OFFERINGS. COAT AL IN CONTACT WITH CONC AND CMU AS SPECIFIED.
3. LOCATE INVERT OF SCUPPER 2" ABOVE ADJACENT ROOF DRAIN INLET.
4. PROVIDE CLOSURE FLANGE AT EXTERIOR WALL. SET FLANGE IN SEALANT.

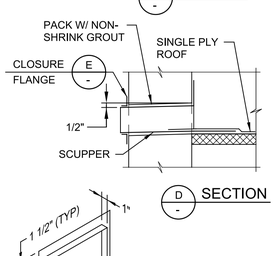
AG222 TYP SCUPPER - SECONDARY BUILT-UP AND SINGLE-PLY SYSTEMS

06/21/19







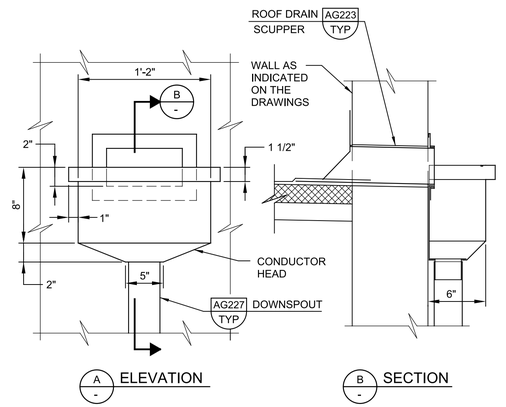


NOTES:

1. PROVIDE SCUPPER AS DETAILED AND ADHERE TO SURROUNDING STRUCTURE UNLESS OTHERWISE RECOMMENDED BY ROOFING MANUFACTURER.
2. FABRICATE SCUPPER AND FLANGE FROM MIN 0.032" THICK PRE-FINISHED AL. FINISH SHALL BE KYNAR. COLOR SHALL BE ENGINEER SELECTED FROM STANDARD COLOR OFFERINGS. COAT AL IN CONTACT WITH CONC AND CMU AS SPECIFIED.
3. PROVIDE CLOSURE FLANGE AT EXTERIOR WALL. SET FLANGE IN SEALANT.

AG223 TYP SCUPPER - PRIMARY BUILT-UP AND SINGLE-PLY SYSTEMS

06/21/19

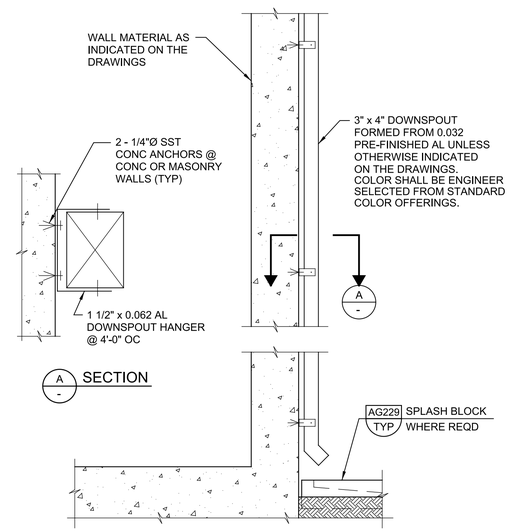


NOTES:

1. PROVIDE CONDUCTOR HEAD AS DETAILED UNLESS OTHERWISE RECOMMENDED BY ROOFING MANUFACTURER.
2. FABRICATE CONDUCTOR HEAD FROM MIN 0.032" THICK PRE-FINISHED AL. FINISH SHALL BE KYNAR. COLOR SHALL BE ENGINEER SELECTED FROM STANDARD COLOR OFFERINGS. COAT AL IN CONTACT WITH CONC OR CMU AS SPECIFIED. SEAL ALL JOINTS.
3. SEE SPEC FOR SPECIFIC ROOFING AND INSULATION MATERIAL. SCUPPER SHAPE WILL VARY WITH ROOFING TYPE.

AG225 TYP CONDUCTOR HEAD - ALUMINUM

06/21/19



NOTE:

1. PROVIDE SPLASH BLOCK AS SHOWN EXCEPT AT PAVING AND SIDEWALKS.
2. ALTERNATE SIZE DOWNSPOUTS WILL BE REQUIRED, IF SO INDICATED ON THE DRAWINGS.
3. COAT AL IN CONTACT WITH CONC AND CMU AS SPECIFIED.

AG227 TYP DOWN SPOUT - ALUMINUM

06/21/19

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED JKN
DATE JULY 2023

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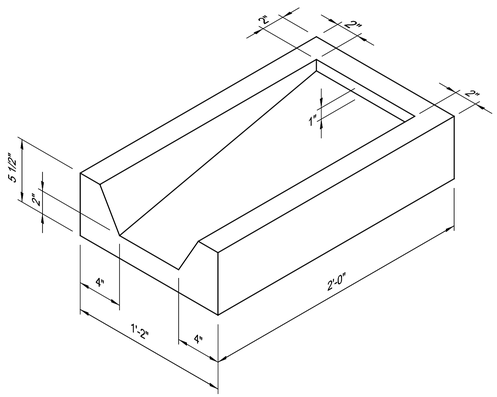
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
TYPICALS
TYPICAL DETAILS ARCHITECTURAL

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

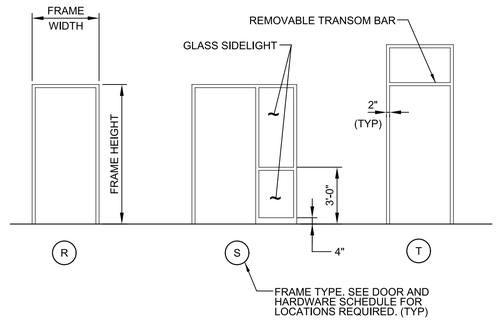
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DRAWING NO. 00TA01
SHEET NO. 172 OF 200

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AG229 TYP SPLASH BLOCK - CONCRETE - SURFACE MOUNTED

06/21/19

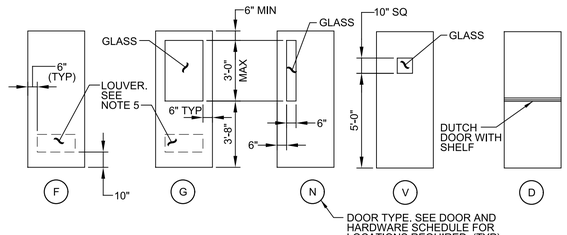


NOTES:

1. SEE DOOR AND HARDWARE SCHEDULE FOR FRAME SIZE, MATERIAL, AND DETAILS.
2. SIDELIGHT MAY BE ON EITHER SIDE OF DOOR. SEE DRAWINGS FOR REQUIRED SIDELIGHT LOCATION.
3. GLASS AT SIDELIGHTS SHALL BE TEMPERED.
4. GLASS AT INTERIOR SIDELIGHTS SHALL BE CLEAR. GLASS AT EXTERIOR SIDELIGHTS SHALL BE TINTED INSULATING GLASS.

AJ100 TYP DOOR - FRAME - STICK

06/21/19

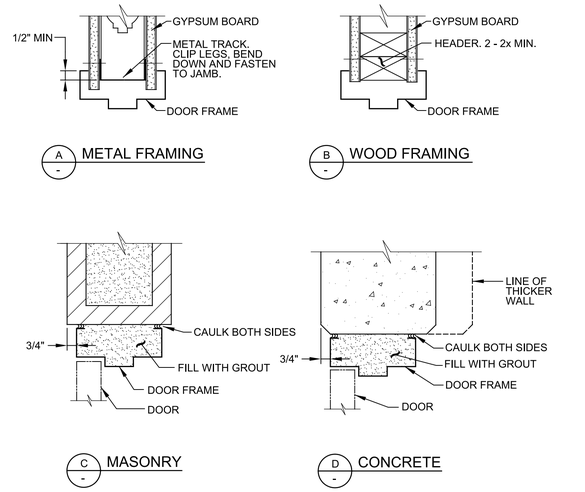


NOTES:

1. DOOR SIZE AND TYPE SHALL BE IN ACCORDANCE WITH DOOR AND HARDWARE SCHEDULE.
2. GLASS AT DOORS SHALL BE TEMPERED UNLESS OTHERWISE INDICATED ON THE DRAWINGS.
3. GLASS AT INTERIOR DOORS SHALL BE CLEAR. GLASS AT EXTERIOR DOORS SHALL BE TINTED.
4. PROVIDE WIRE GLASS AT LABELED DOORS.
5. LOUVER MAY BE REQD AT ANY DOOR TYPE. IF A LOUVER IS REQUIRED, SIZES AND LOCATIONS WILL BE NOTED ON DOOR AND HARDWARE SCHEDULE.
6. PROVIDE LABELED DOORS IN ACCORDANCE WITH DOOR AND HARDWARE SCHEDULE.

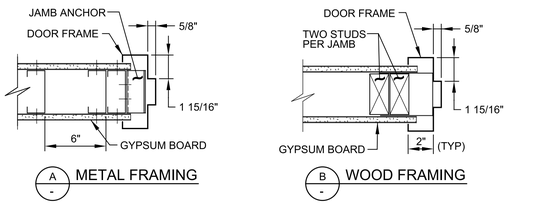
AJ103 TYP DOOR - ELEVATIONS - TYPES

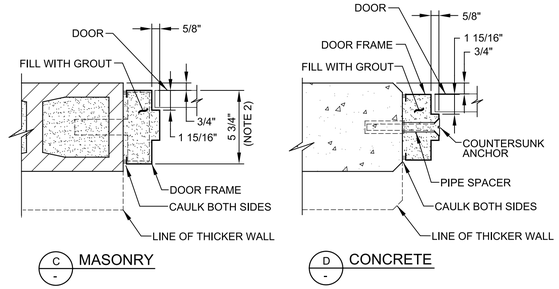
06/21/19



AJ105 TYP DOOR - HEAD - DETAILS

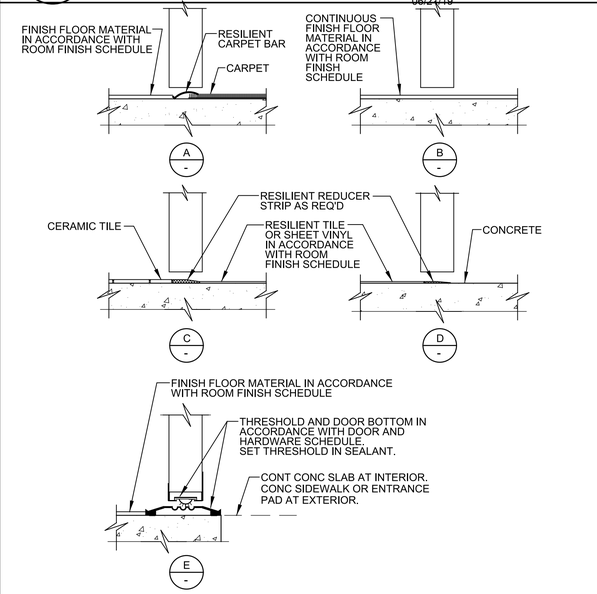
SHEET 1 OF 2 06/21/19





AJ107 TYP DOOR - JAMB - DETAILS

SHEET 1 OF 2 06/21/19

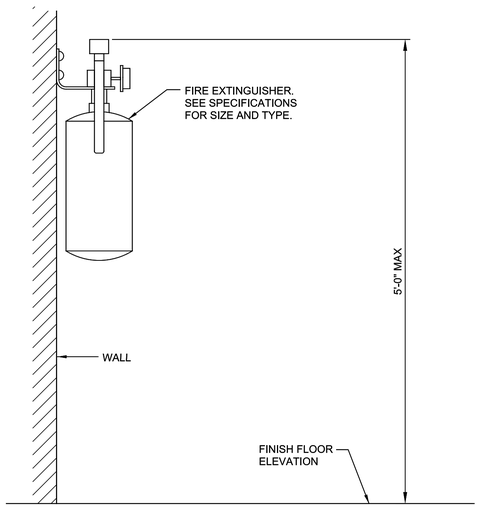


NOTE:

1. DOOR CLEARANCE AT BOTTOM OF DOOR SHALL BE 1/4" MIN AND 3/8" MAX.

AJ109 TYP DOOR - SILL - DETAILS

06/21/19



NOTES:

1. MOUNT TO WALL WITH NUMBER AND SIZE OF ANCHORS TO MATCH BRACKET. USE CONCRETE ANCHORS FOR MASONRY OR CONCRETE WALLS. AT MASONRY INSTALL AT GROUTED CELL. MOUNT TO STUD WITH LAG BOLTS, OR WOOD SCREWS FOR WOOD PARTITION WALL.
2. SEE SPECIFICATIONS FOR SIGNAGE REQUIREMENTS ABOVE FIRE EXTINGUISHERS.

AN400 TYP FIRE EXTINGUISHER WALL-MOUNTED

06/21/19

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED JKN
DATE JULY 2023

** ORIGINAL SEALED BY MATTHEW C. KALLEVANT 4/7/2023 CA PE NO. 84405 **

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City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

TYPICALS

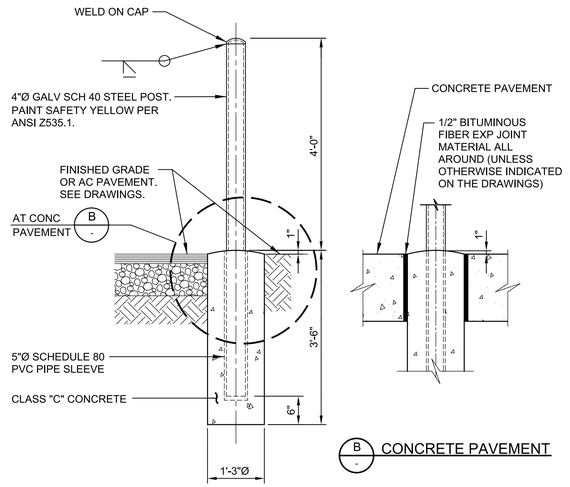
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JOB NO. 8660F.10
DRAWING NO. 00TA02
SHEET NO. 173 OF 200

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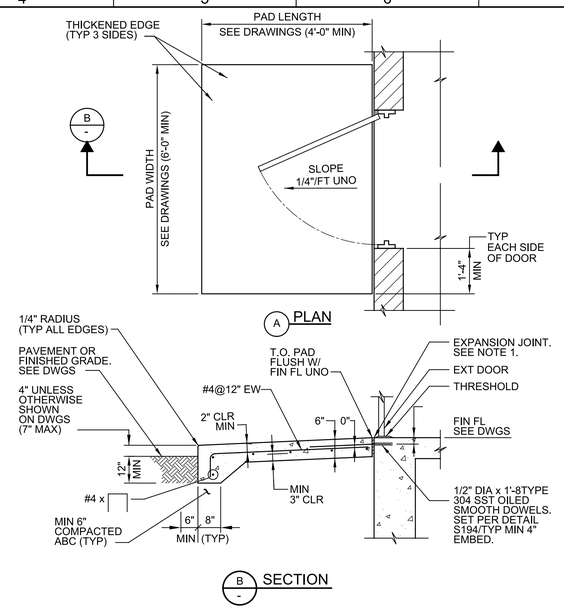


CF161 GUARD POST - REMOVABLE

TYP

N

12/29/2020



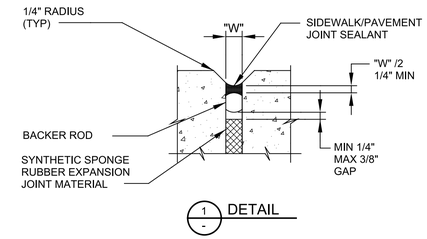
NOTES:

1. EXPANSION JOINT AT FACE OF STRUCTURE: 3/8" WIDE AND AS INDICATED IN DETAIL 1.

CR314 SIDEWALK - ENTRANCE PAD

TYP

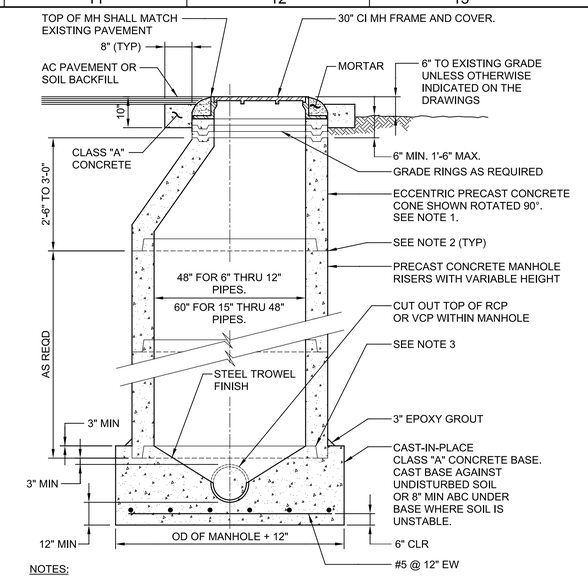
12/24/2020



CR314 SIDEWALK - ENTRANCE PAD

TYP

12/24/2020



NOTES:

1. LOCATE MANHOLE COVER ON DOWNSTREAM SIDE OF MANHOLE. SET MANHOLE FRAME IN GROUT.
2. SEAL JOINTS WITH PRECAST CONCRETE JOINT SEALANT.
3. FORM GROOVE IN MANHOLE BASE WITH STEEL OR ALUMINUM BASERING PER MANUFACTURER'S DETAIL.

CS110 MANHOLE

TYP

N

12/24/2020

REV	DATE	BY	DESCRIPTION

CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED JM
DATE JULY 2023

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CITY OF UKIAH

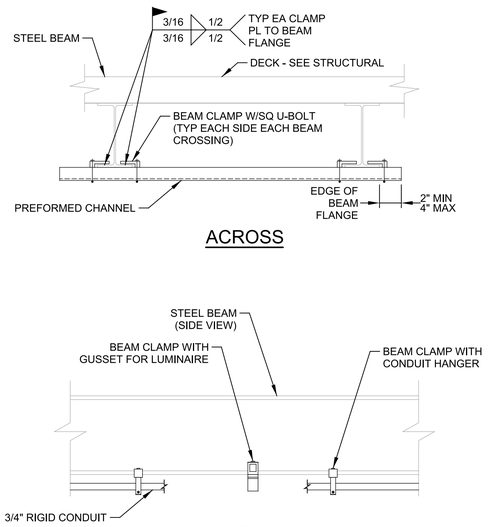
RECYCLED WATER PROJECT - PHASE 4

TYPICALS

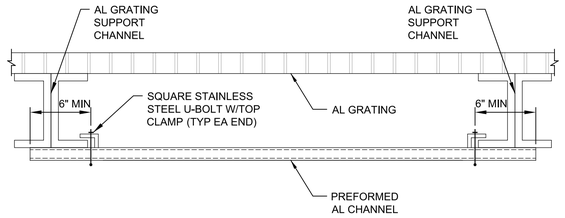
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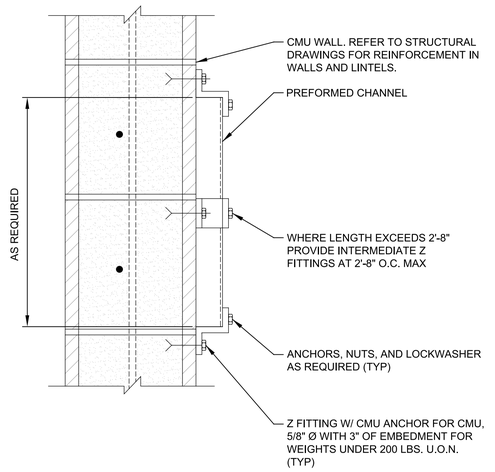
JOB NO. 8660F.10
DRAWING NO. 00TC01
SHEET NO. 174 OF 200



EA030 TYP S ATTACHMENT TO STEEL BEAMS



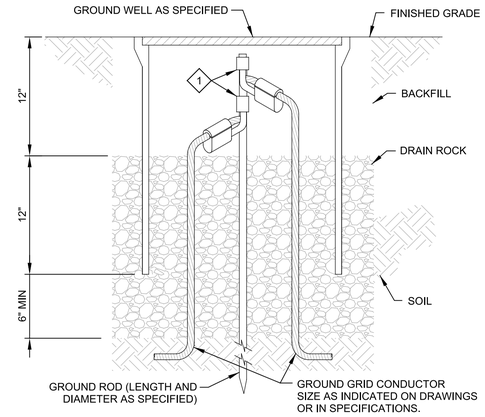
EA060 TYP S ATTACHMENT TO ALUMINUM GRATING SUPPORTS



GENERAL NOTES:

1. THIS DETAIL TYPICAL FOR BOTH VERTICAL AND HORIZONTAL MOUNTING.
2. SUPPORTS TO BE SPACED IN ACCORDANCE WITH NEC REQUIREMENTS. CONCRETE ANCHORS SHALL BE PER THE SPECIFICATIONS.

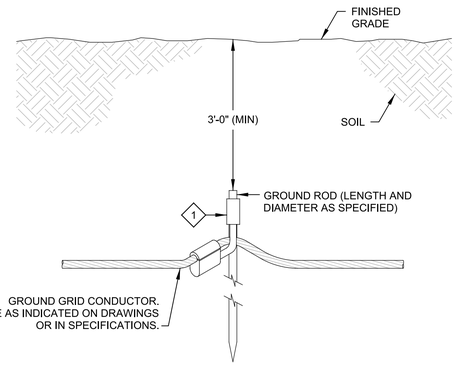
EA080 TYP S PREFORMED CHANNEL ATTACHMENT TO FULLY GROUTED CMU WALL



KEY NOTES:

1 GROUND ROD TO GROUND GRID CROSS CONNECTOR. SIZE FOR ROD AND CABLE PER CONNECTOR MANUFACTURERS GUIDELINES.

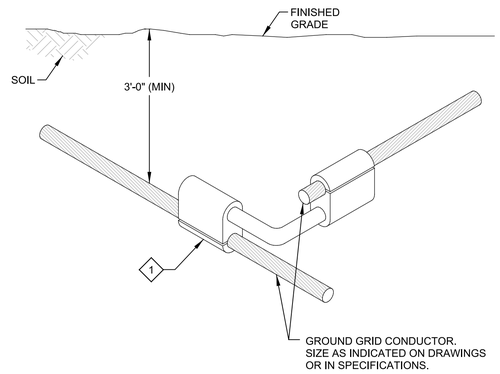
EG001 TYP S GROUND ROD AND GROUNDWELL COMPRESSION CONNECTION



KEY NOTES:

1 GROUND ROD TO GROUND GRID CROSS CONNECTOR. SIZE FOR ROD AND CABLE PER CONNECTOR MANUFACTURERS GUIDELINES.

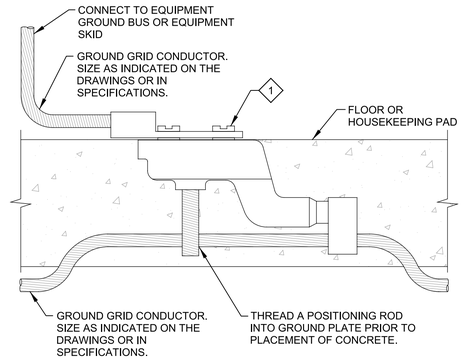
EG002 TYP S GROUND ROD COMPRESSION CONNECTION



KEY NOTES:

1 GROUND GRID CROSS CONNECTOR. SIZE FOR CABLE PER CONNECTOR MANUFACTURERS GUIDELINES.

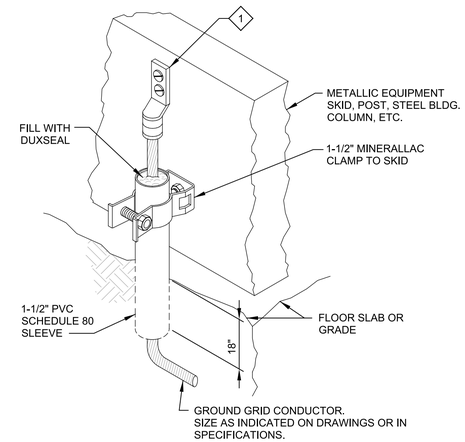
EG101 TYP S COPPER GROUNDING CABLE CONNECTION COMPRESSION CONNECTION



KEY NOTES:

1 GROUNDING PLATE

EG102 TYP S CAST GROUNDING PLATE COMPRESSION CONNECTION



NOTES:

1. CLEAN ALL PAINTED SURFACES TO BARE METAL BEFORE BOLTING ON THE GROUND LUG.
2. NOTE: BOLT GROUND LUG ONLY TO EQUIPMENT SKIDS OR STRUCTURE, NOT TO EQUIPMENT OR TANK SHELLS.

KEY NOTES:

1 HEAVY DUTY COMPRESSION TERMINAL.

EG201 TYP S EQUIPMENT SKID GROUNDING COMPRESSION CONNECTION

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RECYCLED WATER PROJECT - PHASE 4

TYPICALS

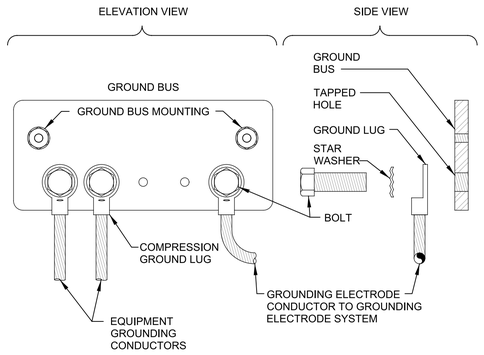
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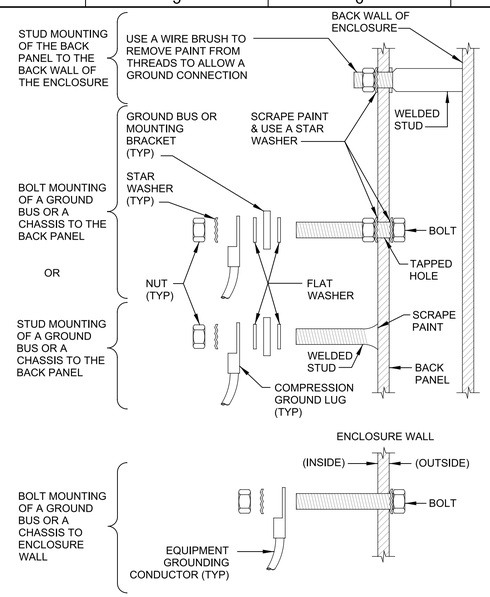
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DRAWING NO. 00TE01
SHEET NO. 175 OF 200

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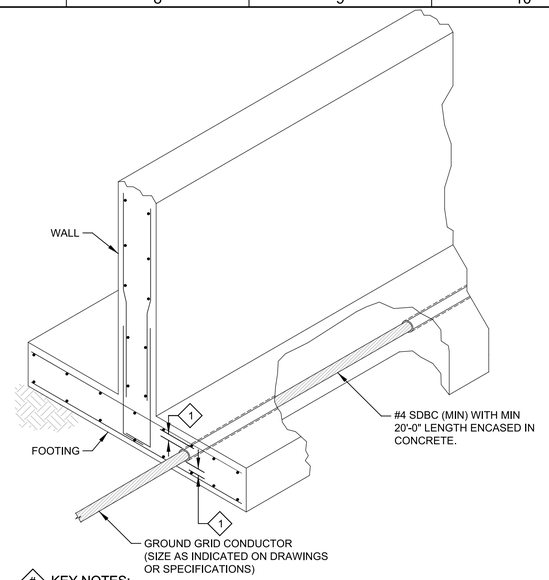
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EG204 TYP S GROUND BUS CONNECTIONS



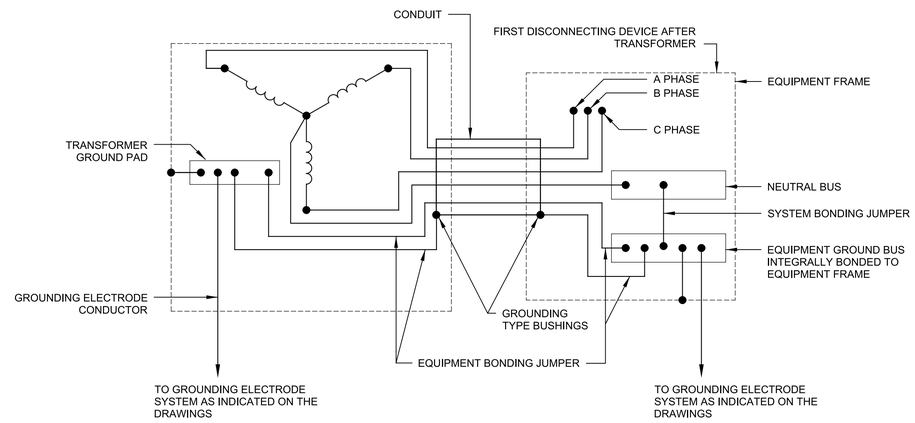
EG205 TYP S ENCLOSURE GROUNDING DETAILS



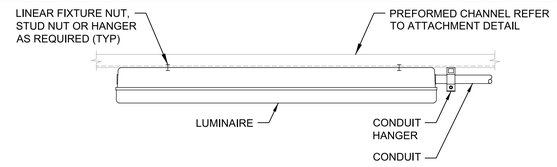
KEY NOTES:

1. GROUND GRID CONDUCTOR TO BE FULLY ENCASED IN CONCRETE. PROVIDE MIN 1 1/2" CLEAR BETWEEN CONDUCTOR & REINFORCEMENT, OR BETWEEN CONDUCTOR AND FACE OF CONCRETE.

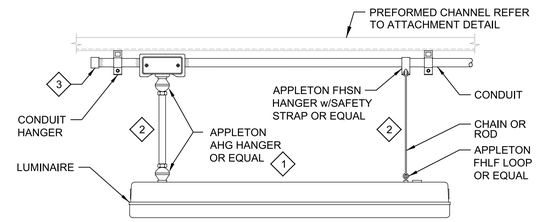
EG304 TYP S GROUNDING CONNECTION TO FOOTING (UFER)



EG511 TYP S TRANSFORMER (NON-UTILITY) 3-PHASE, 4-WIRE SECONDARY POWER GROUNDING DETAIL



FLUSH MOUNTED

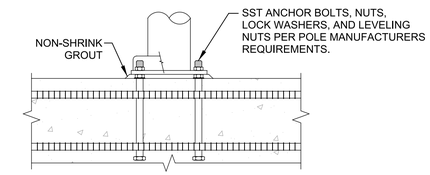


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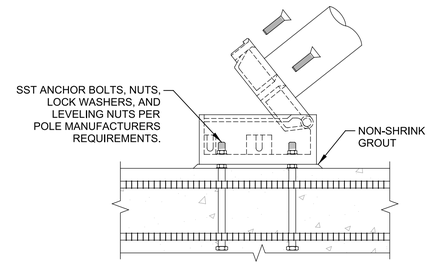
KEY NOTES:

1. USE MEYERS HUB IN WET AND/OR CORROSIVE AREAS.
2. LENGTH AS REQUIRED FOR INDICATED MOUNTING HEIGHT.
3. CAP END CONDUIT AS REQUIRED.

EL200 TYP S LINEAR LUMINAIRE MOUNTING



ONE-PIECE POLE



HINGED POLE TYP

EL502 TYP S ANCHOR BASE FOR LIGHT POLE MOUNTED ON SLAB

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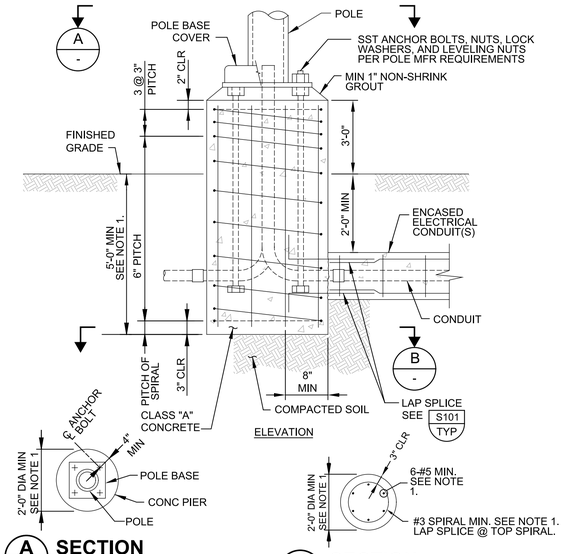
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TYPICAL DETAILS ELECTRICAL

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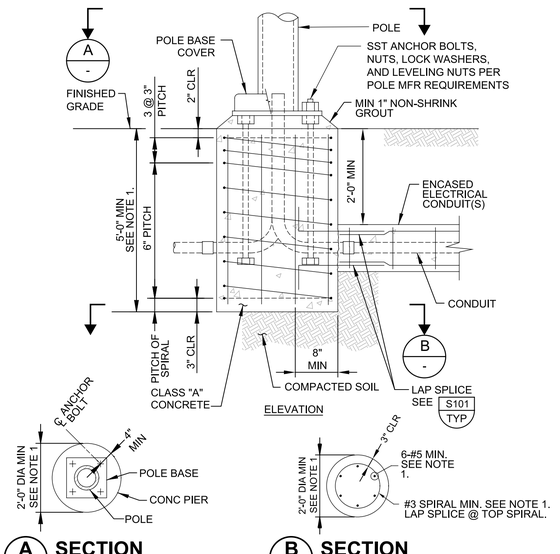
JOB NO. 8660F.10
DRAWING NO. 00TE02
SHEET NO. 176 OF 200



GENERAL NOTES:

1. USE MINIMUM DIMENSIONS AND REINFORCEMENT SHOWN UNLESS OTHERWISE NOTED. PROVIDE WIND LOAD CALCULATIONS AND INCREASE DIMENSIONS AND INCREASE DIMENSIONS AS REQUIRED.

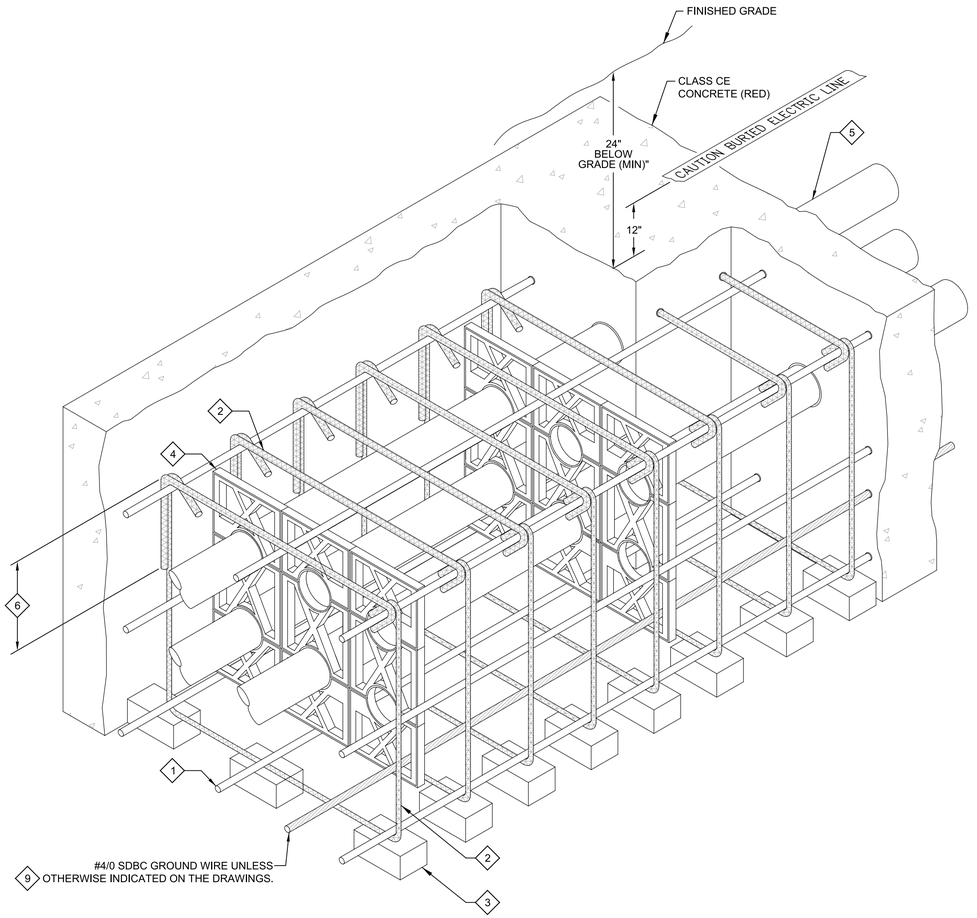
EL506 TYP S POLE FOUNDATION
TRAFFIC AREAS



GENERAL NOTES:

1. USE MINIMUM DIMENSIONS AND REINFORCEMENT SHOWN UNLESS OTHERWISE NOTED. PROVIDE WIND LOAD CALCULATIONS AND INCREASE DIMENSIONS AS REQUIRED.

EL507 TYP S POLE FOUNDATION
NON-TRAFFIC AREAS



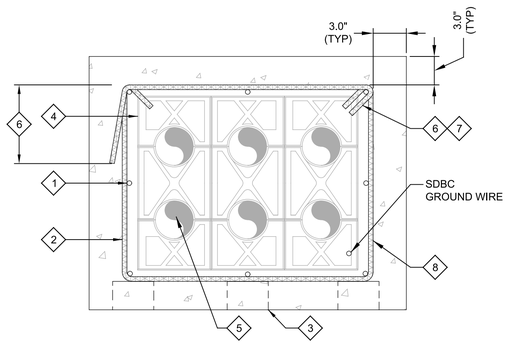
NOTES:

1. DIMENSIONS SHOWN ARE MINIMUM.
2. ADJUST SIZE OF DUCT BANK BASED UPON THESE GUIDELINES AND THE DUCT BANK SPECIFICATION TO ACCOMMODATE ACTUAL NUMBER OF CONDUITS WITHIN DUCT BANK. REFER TO DUCT BANK SECTIONS, AND CONDUIT SCHEDULE FOR NUMBER AND SIZE OF CONDUITS.
3. MAKE PROVISIONS TO PREVENT CONDUIT FLOTATION DURING CONCRETE PLACEMENT & CURING.

KEY NOTES:

1. #4 REINFORCING STEEL 12" MAXIMUM ON CENTER AROUND ENTIRE PERIMETER OF DUCT BANK.
2. #4 REINFORCING STEEL TIES MAXIMUM 24" ON CENTER ALONG LENGTH OF DUCT BANK.
3. MINIMUM OF TWO PRECAST CONCRETE BAR SUPPORTS PLACED UNDER A TIE AT EACH PVC CONDUIT SPACER ALONG LENGTH OF DUCT BANK. PROVIDE PRECAST BAR SUPPORTS AT INTERVALS OF 24" TO REDUCE DEFLECTION.
4. PVC CONDUIT SPACERS ON 8'-0" CENTERS (MAXIMUM). LOCATE 12" FROM TIES.
5. REFER TO DUCT BANK SECTIONS AND SPECIFICATIONS FOR CONDUIT REQUIREMENTS.
6. 1'-4" OR 135 DEGREE HOOK FOR SHALLOW DUCT BANKS SHALLOWER THAN 21"
7. CONTRACTOR'S OPTION TO PROVIDE 1'-4" LAP LENGTH EACH SIDE OF HORIZONTAL TIE.
8. LOWER PORTION OF TIES COULD BE U-BARS IF UPPER PORTIONS PROVIDES 1'-4" VERTICAL LEGS EACH SIDE.
9. BOND THE DUCT BANK GROUND WIRE TO THE GROUNDING SYSTEM AT BOTH ENDS OF THE DUCT BANK.

EM001 TYP S REINFORCED CONCRETE DUCT BANK



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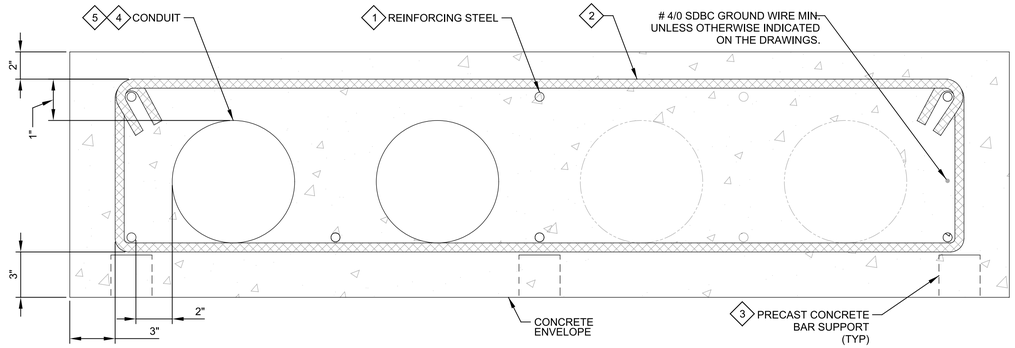
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
TYPICALS
TYPICAL DETAILS ELECTRICAL

VERIFY SCALES
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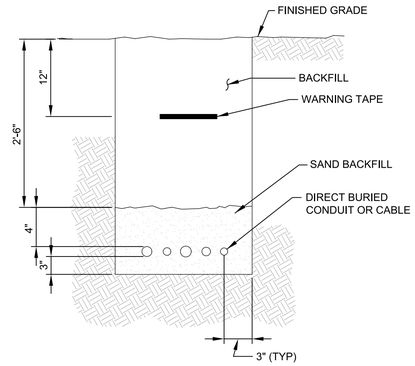
NOTES:

1. DIMENSIONS SHOWN ARE MINIMUM.
2. ADJUST SIZE OF DUCT BANK BASED UPON THESE GUIDELINES AND SPECIFICATION SECTION 16133 TO ACCOMMODATE ACTUAL NUMBER OF CONDUITS WITHIN DUCT BANK. REFER TO DUCT BANK SECTIONS, AND CONDUIT SCHEDULE FOR NUMBER AND SIZE OF CONDUITS.
3. MAKE PROVISIONS TO PREVENT CONDUIT FLOTATION DURING CONCRETE PLACEMENT & CURING.

KEY NOTES:

1. #4 REINFORCING STEEL 12" MAXIMUM ON CENTER AROUND ENTIRE PERIMETER OF DUCT BANK.
2. #4 REINFORCING STEEL STIRRUPS 6" MAXIMUM ON CENTER ALONG LENGTH OF DUCT BANK.
3. MINIMUM OF THREE PRECAST CONCRETE BAR SUPPORTS PLACED UNDER STIRRUPS AT MIN 4'-0" ON CENTER ALONG LENGTH OF DUCT BANK OR CLOSER SPACING AS NECESSARY TO PREVENT SAGGING OR MOVEMENT OF THE REBAR.
4. REFER TO DUCTBANK SECTIONS AND CONDUIT SCHEDULES FOR CONDUIT REQUIREMENTS.
5. TIE CONDUIT TO BOTTOM REINFORCING STEEL AT MIN 2'-0" ON CENTER OR CLOSER SPACING ALONG THE LENGTH AS REQUIRED TO MAINTAIN CONDUIT LOCATION AND TO PREVENT IT FROM FLOATING DURING CONCRETE POUR.

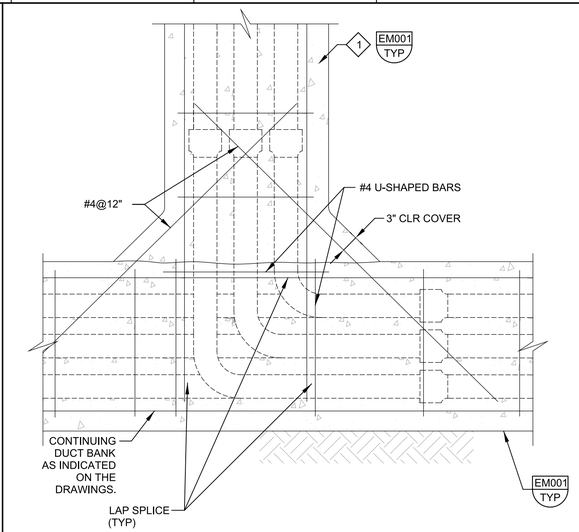
EM002 TYP R REDUCED DEPTH REINFORCED CONCRETE DUCT BANK



NOTES:

1. ALL DIMENSIONS ARE MINIMUM UNLESS OTHERWISE INDICATED ON THE DRAWINGS.
2. REFER TO THE SPECIFICATIONS FOR TRENCH BACKFILL REQUIREMENTS.

EM015 TYP S DIRECT BURIED CONDUIT OR CABLE



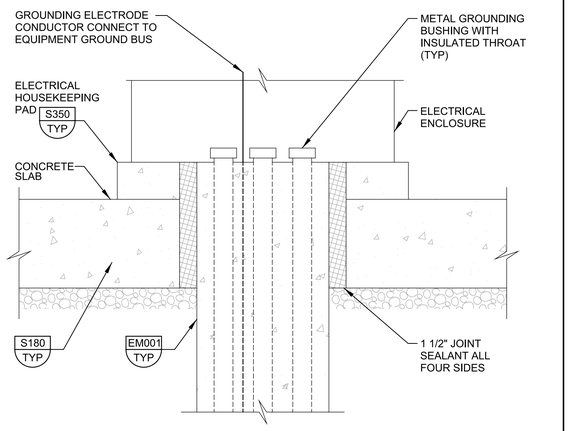
GENERAL NOTES:

1. REFER TO THE SPECIFICATIONS FOR MATERIAL REQUIREMENTS.

KEY NOTES:

1. ADJUST DUCT SPACING TO FIT OPENING IN THE SLAB AND EQUIPMENT ABOVE.

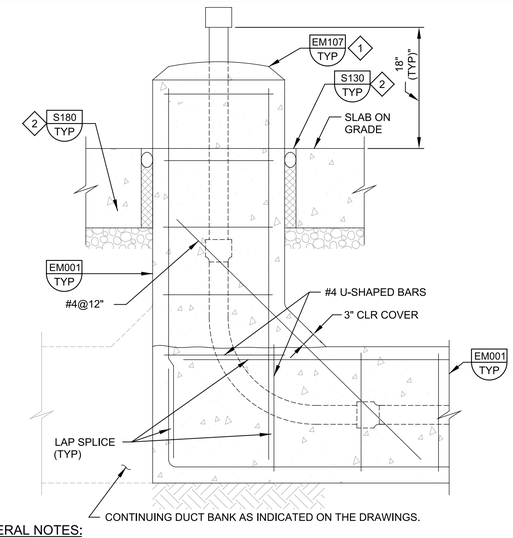
EM020 TYP S DUCT BANK RISER



GENERAL NOTES:

1. OPENING SIZE IN CONCRETE HOUSE KEEPING PAD IS SET BY CONDUIT SIZE AND NUMBER OF CONDUITS. CONDUITS AT TOP OF HOUSE KEEPING PAD MUST FIT IN MANUFACTURER PROVIDED WINDOW IN BOTTOM OF ELECTRICAL ENCLOSURE.

EM022 TYP S DUCT BANK ENTRY INTO ELECTRICAL EQUIPMENT



GENERAL NOTES:

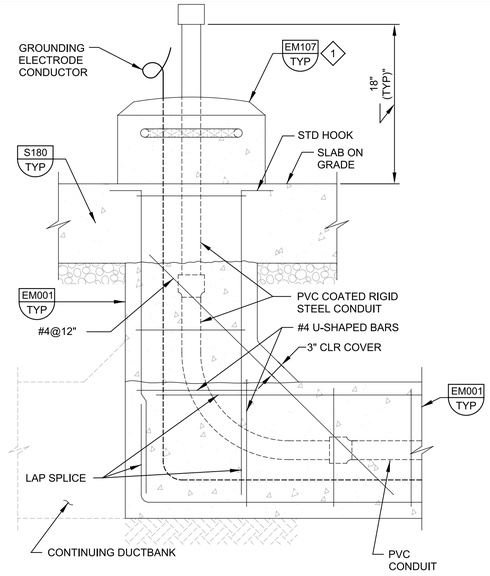
1. REFER TO THE SPECIFICATIONS FOR MATERIAL REQUIREMENTS.

KEY NOTES:

1. PROVIDE CONDUIT HOUSE KEEPING CURB AT ALL LOCATIONS WHERE THE CONDUIT IS NOT PROTECTED BY AN EQUIPMENT PAD.
2. SHALL ONLY BE PROVIDED FOR DUCT BANK RISER THROUGH NEW CONCRETE SLAB.

EM032 TYP R RISER FROM DUCT BANK SLAB ON GRADE

12-06-21



KEY NOTES:

1. PROVIDE CONDUIT HOUSE KEEPING CURB AT ALL LOCATIONS WHERE THE CONDUIT IS NOT PROTECTED BY AN EQUIPMENT PAD.

EM033 TYP S RISER FROM DUCTBANK SLAB ON GRADE

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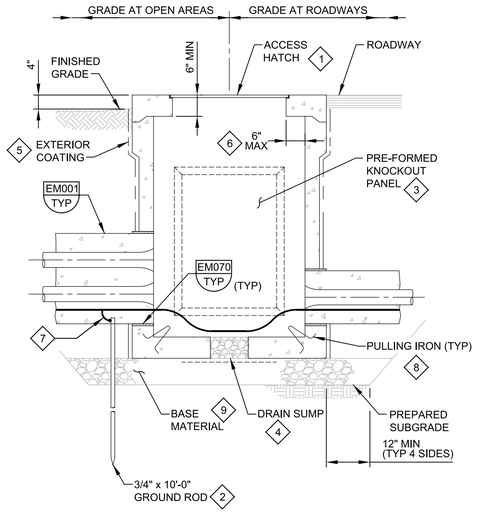
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DRAWING NO. 00TE04
SHEET NO. 178 OF 200

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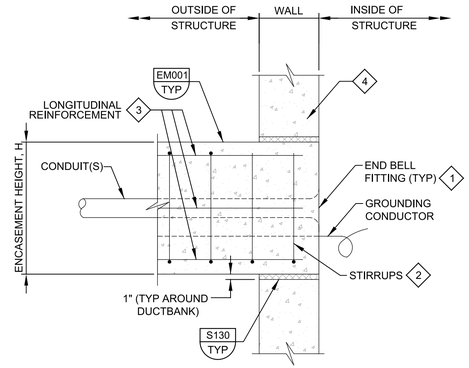
EM056 TYP J — ELECTRICAL HANDHOLE PRECAST CONCRETE W/HATCH

GENERAL NOTES:

1. PROVIDE MINIMUM INTERIOR DIMENSIONS AS SHOWN IN THE ELECTRICAL HANDHOLE AND MANHOLE SCHEDULE (MAXIMUM INTERIOR DIMENSIONS: 60"WIDE x 60"LONG x 60"DEEP)
2. BOND ALL METALLIC ITEMS INSIDE HANDHOLE TO GROUND ROD USING #4 AWG BARE COPPER CABLE.
3. SEE DRAWINGS FOR ORIENTATION, NUMBER, AND SIZE OF DUCT BANKS AT EACH HANDHOLE.

KEY NOTES:

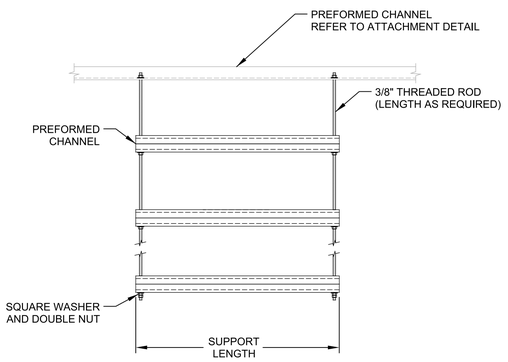
1. SEE THE MANHOLE AND HANDHOLE SCHEDULE FOR REQUIRED LOAD RATING OF HATCH.
2. BOND DUCT BANK GROUND CABLE TO GROUND ROD. REFER TO THE SPECIFICATIONS FOR CONNECTION REQUIREMENTS.
3. INSTALL DUCT BANKS ONLY THROUGH CAST-IN OPENINGS OR PREFORMED KNOCKOUT PANELS. PROVIDE KNOCKOUTS ON EACH WALL AROUND HANDHOLE.
4. PROVIDE MINIMUM 4 INCH DIAMETER, GRAVEL FILLED PENETRATION THROUGH FLOOR OF HANDHOLE. SET SUMP OPENING OVER MINIMUM 18" SQUARE FILTER FABRIC TO ISOLATE GRAVEL FROM BASE MATERIAL BELOW.
5. COAT EXTERIOR WALLS BELOW GRADE WITH BITUMINOUS DAMP PROOFING.
6. MAXIMUM TOP SLAB OVERHANG IS TYPICAL AROUND 4 SIDES OF HANDHOLE.
7. GROUNDING CABLE CONNECTION. REFER TO THE SPECIFICATIONS FOR CONNECTION REQUIREMENTS.
8. PROVIDE ONE PULLING IRON ON EACH WALL OF HANDHOLE.
9. BASE MATERIAL: PROVIDE MIN 12" COMPACTED AGGREGATE BASE COURSE.



KEY NOTES:

1. PROVIDE GROUNDING FITTING FOR METALLIC CONDUITS ENTERING MANHOLE. BOND GROUNDING FITTING TO DUCTBANK GROUNDING CONDUCTOR.
2. FOR FIRST 12'-0" FROM INSIDE FACE OF STRUCTURE, STIRRUP SPACING IN INCHES = (H-4)/2 WHERE H = CONCRETE ENCASEMENT HEIGHT IN INCHES.
3. ADDITIONAL #4 x 12'-0" @ 12" ON ALL FOUR FACES OF ENCASEMENT. ALTERNATE WITH TYPICAL REINFORCEMENT FOR 6" SPACING.
4. PROVIDE ADDITIONAL REINFORCEMENT AROUND OPENING AS REQUIRED. FOR CAST-IN-PLACE STRUCTURES, PROVIDE REINFORCEMENT PER S180 TYP

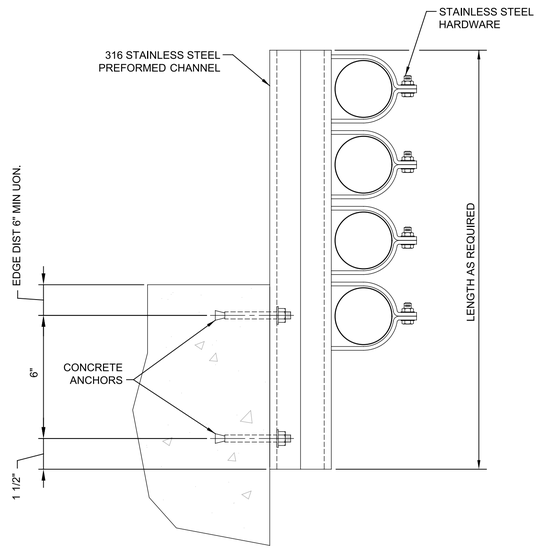
EM070 TYP S — ENCASED CONDUITS AT MANHOLES OR STRUCTURES - W/O WATERSTOP



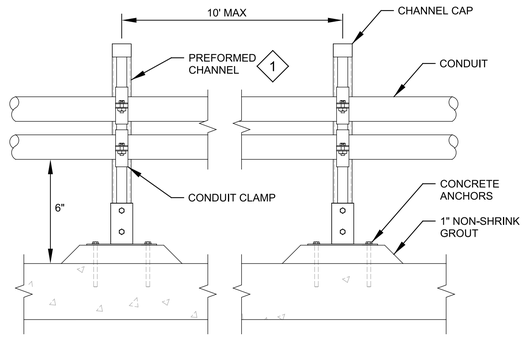
GENERAL NOTES:

1. PROVIDE NUMBER AND LENGTH OF PREFORMED CHANNEL SUPPORTS AS REQUIRED BY EQUIPMENT AND MATERIALS TO BE INSTALLED.
2. PROVIDE SEISMIC BRACING PER THE SPECIFICATIONS.
3. REFER TO SPECIFICATIONS FOR MATERIAL REQUIREMENTS.

EM102 TYP S — TRAPEZE SUPPORT



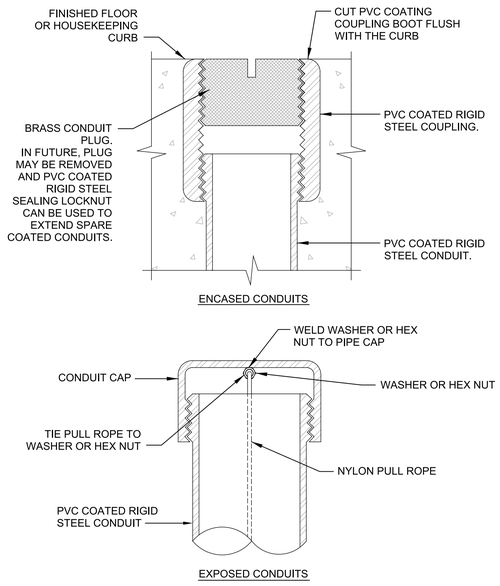
EM103 TYP S — CONDUIT SUPPORT



KEY NOTES:

1. SIZE PREFORMED CHANNEL FOR CONDUITS INDICATED ON THE DRAWINGS.

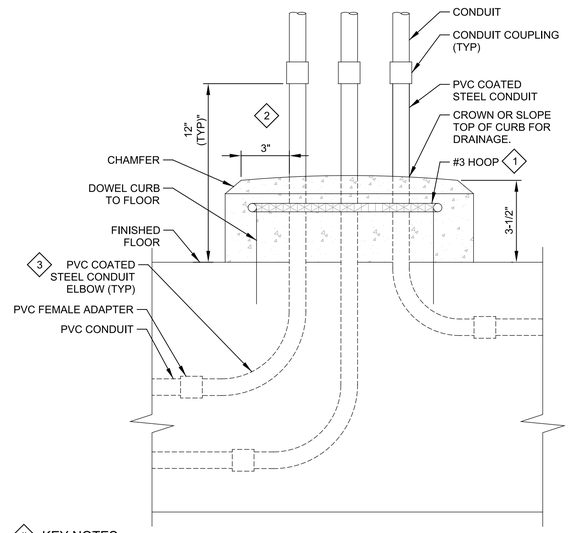
EM104 TYP S — CONDUIT FLOOR SUPPORT FOR ELECTRICAL CONDUITS



GENERAL NOTES:

1. PROVIDE 2" MIN CLEAR BETWEEN ADJACENT CONDUITS

EM105 TYP S — SPARE CONDUIT DETAIL



KEY NOTES:

1. COORDINATE REINFORCING STEEL REQUIREMENTS WITH THE GENERAL CONTRACTOR.
2. TYPICAL BOTH SIDES, FRONT AND REAR.
3. FIELD BEND 1" CONDUITS. PROVIDE MANUFACTURED PCS ELBOWS FOR CONDUITS 1.25" AND LARGER.

EM107 TYP S — CONDUIT HOUSEKEEPING CURB

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

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City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
TYPICALS
TYPICAL DETAILS ELECTRICAL

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

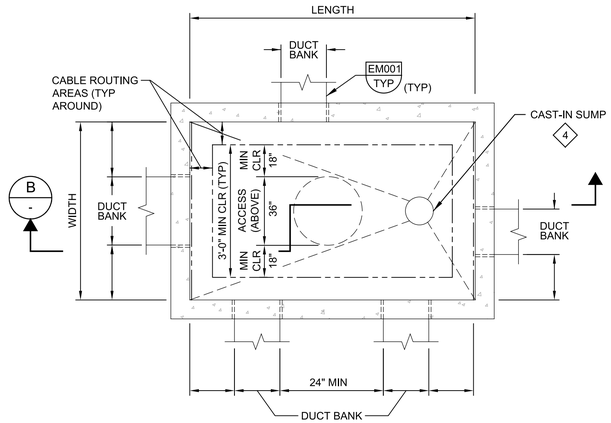
JOB NO. 8660F.10
DRAWING NO. 00TE05
SHEET NO. 179 OF 200

GENERAL NOTES:

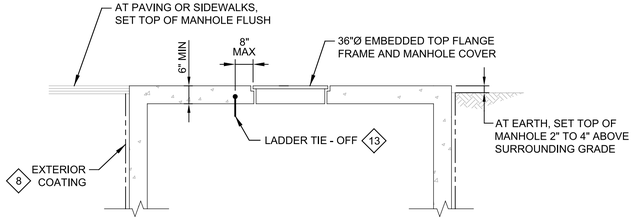
1. PROVIDE MINIMUM INTERIOR DIMENSIONS AS SHOWN IN THE ELECTRICAL HANDHOLE AND MANHOLE SCHEDULE.
2. PROVIDE MANHOLE ALTERNATES (TOP OR BASE) AS SHOWN IN THE HANDHOLE AND MANHOLE SCHEDULE.
3. BOND ALL METALLIC ITEMS INSIDE MANHOLE TO GROUND ROD USING #4 AWG BARE COPPER CABLE.
4. SEE DRAWINGS FOR ORIENTATION, NUMBER, AND SIZE OF DUCT BANKS AND PENETRATIONS AT EACH MANHOLE.
5. RACK MEDIUM VOLTAGE CABLES USING PORCELAIN INSULATOR CLAMPS PER TYPICAL DETAIL EM076.

KEY NOTES:

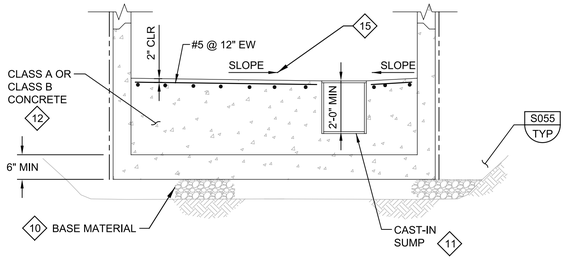
1. MANHOLE ACCESS FOR BURIED MANHOLE SHOWN IN SECTION B. FOR MANHOLES WITH EXPOSED TOP SLAB, SEE SECTION C (ALTERNATE 1).
2. STANDARD MANHOLE BASE SHOWN. FOR MANHOLES WITH DEEPER SUMP OR CONCRETE BALLAST TO RESIST FLOTATION, SEE SECTION D (ALTERNATE 2).
3. SPACE EMBEDDED CHANNELS TO CLEAR DUCT BANK KNOCKOUTS AND MAXIMUM 24" ON CENTER AROUND PERIMETER OF MANHOLE.
4. MINIMUM 12" DIAMETER x MIN 2" DEEP SUMP WITH REMOVABLE SLOTTED COVER. LOCATE SUMP OUTSIDE VERTICAL ACCESS CORRIDOR BELOW MANHOLE COVER.
5. BOND DUCT BANK AND INTERIOR GROUND CABLE TO GROUND ROD. SEE SPECIFICATIONS FOR CONNECTION REQUIREMENTS.
6. INSTALL DUCT BANKS ONLY THROUGH BLOCKOUTS, WINDOWS OR PREFORMED KNOCKOUT PANELS. PROVIDE KNOCKOUTS ON EACH WALL AROUND MANHOLE.
7. COAT EXTERIOR WALLS AND BURIED TOP SLAB OF MANHOLE WITH BITUMINOUS DAMP PROOFING.
8. COAT EXTERIOR WALLS OF MANHOLE WITH BITUMINOUS DAMP PROOFING. LEAVE EXPOSED TOP SLAB UNCOATED.
9. PROVIDE ONE PULLING IRON ON EACH WALL ABOVE OR BELOW EACH DUCT BANK PENETRATION.
10. PROVIDE MIN 12" COMPACTED AGGREGATE BASE COURSE.
11. MINIMUM 12" DIAMETER SUMP WITH REMOVABLE SLOTTED COVER. LOCATE SUMP OUTSIDE VERTICAL CORRIDOR BELOW MANHOLE COVER.
12. SEE SPECIFICATIONS FOR CAST-IN-PLACE CONCRETE FULL MIXING, PLACING, FINISHING AND CURING REQUIREMENTS.
13. AT ONE SIDE OF MANHOLE ACCESS, PROVIDE LADDER TIE - OFF PER DETAIL E.
14. USE OF PREFORMED AND EMBEDDED CHANNELS FOR CABLE RACKS MAY NOT BE REQUIRED FOR PRODUCTS WHICH SECURE DIRECTLY INTO CONCRETE SEE SECTION 16070 - HANGERS & SUPPORTS.
15. SLOPE TO BE COMPLETED BY CONTRACTOR.



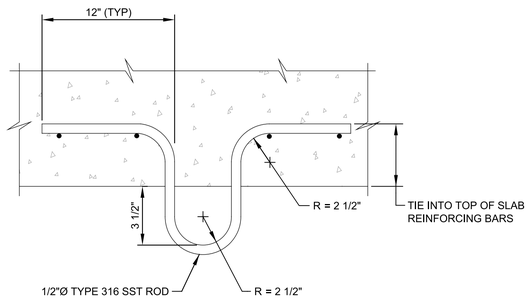
A PLAN - LAYOUT



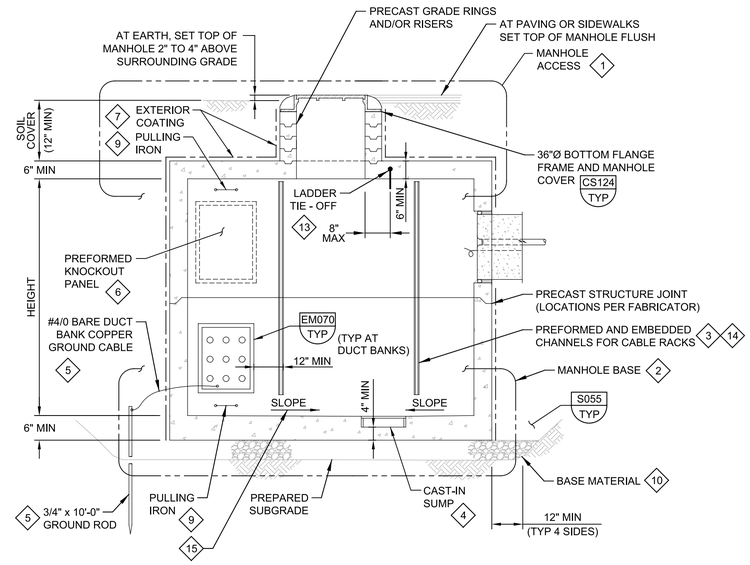
C - ALTERNATE 1: SECTION EXPOSED TOP SLAB



D - ALTERNATE 2: SECTION BASE WITH SUMP OR BALLAST



E - LADDER TIE-OFF



B - SECTION

EM062 TYP S — ELECTRICAL MANHOLE: PRECAST CONCRETE

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

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City of Ukiah

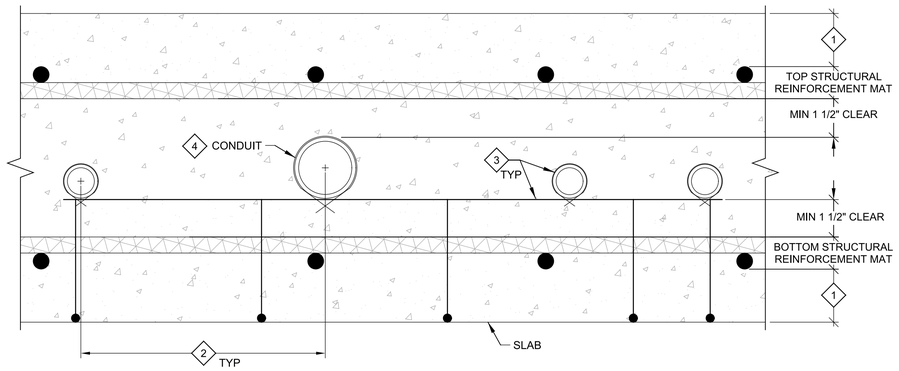
CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
TYPICALS
TYPICAL DETAILS ELECTRICAL

VERIFY SCALES
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

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DRAWING NO. 00TE06
SHEET NO. 180 OF 200

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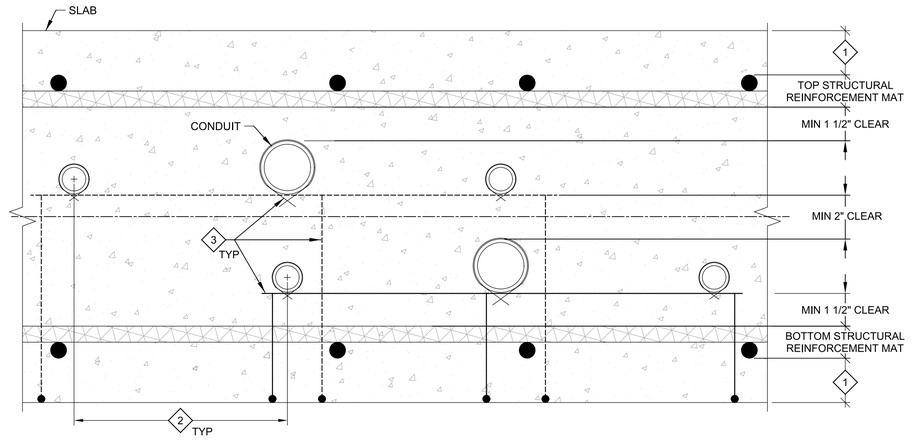
NOTES:

1. MOVE CONDUITS TO AVOID CONFLICTS WITH WATERSTOPS. WHERE HORIZONTAL & VERTICAL CLEARANCES CANNOT BE MAINTAINED, CONTACT ENGINEER FOR INSTRUCTION'S BEFORE PLACING CONCRETE.

KEY NOTES:

1. FOR REQUIRED TOP AND BOTTOM COVER OVER REINFORCEMENT SEE DETAIL. S101 TYP
2. MINIMUM ON CENTER HORIZONTAL SPACING OF PARALLEL CONDUITS = 4X OUTSIDE DIAMETER OF THE LARGER CONDUIT.
3. SUPPORT CONDUITS ON ADDED REINFORCEMENT CHAIRS OR BOLSTERS. TIE CONDUITS TO SUPPORTS & ANCHOR TO PREVENT FLOTATION.
4. CENTER LARGEST DIAMETER CONDUIT BETWEEN TOP AND BOTTOM REINFORCEMENT MATS.

EM115 TYP S — EMBEDDED CONDUIT IN CONCRETE SLAB SINGLE RUN



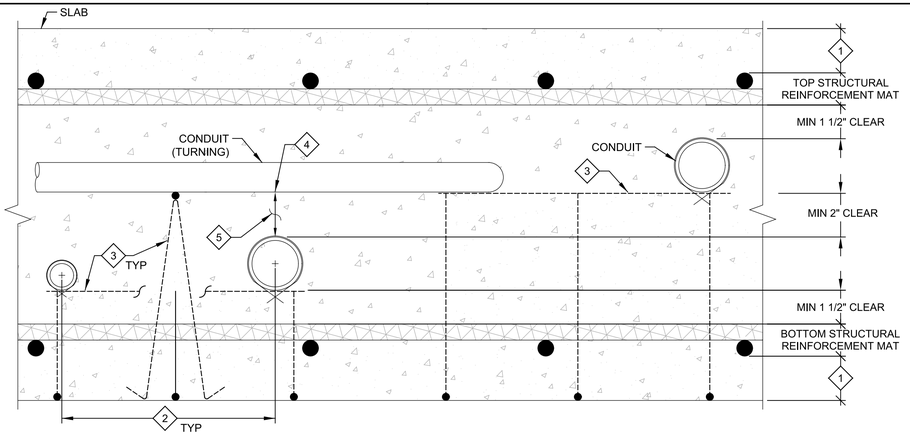
NOTES:

1. MOVE CONDUITS TO AVOID CONFLICTS WITH WATERSTOPS. WHERE HORIZONTAL & VERTICAL CLEARANCES CANNOT BE MAINTAINED, CONTACT ENGINEER FOR INSTRUCTION'S BEFORE PLACING CONCRETE.

KEY NOTES:

1. FOR REQUIRED TOP AND BOTTOM COVER OVER REINFORCEMENT SEE DETAIL. S101 TYP
2. MINIMUM ON CENTER HORIZONTAL SPACING OF PARALLEL CONDUITS = 4X OUTSIDE DIAMETER OF THE LARGER CONDUIT.
3. SUPPORT CONDUITS ON ADDED REINFORCEMENT CHAIRS OR BOLSTERS. TIE CONDUITS TO SUPPORTS & ANCHOR TO PREVENT FLOTATION.
4. WHERE MORE THAN 2 RUNS ARE STACKED, PROVIDE HORIZONTAL & VERTICAL SPACING SHOWN BETWEEN EACH PAIR.

EM116 TYP S — EMBEDDED CONDUIT IN CONCRETE SLAB STACKED RUNS



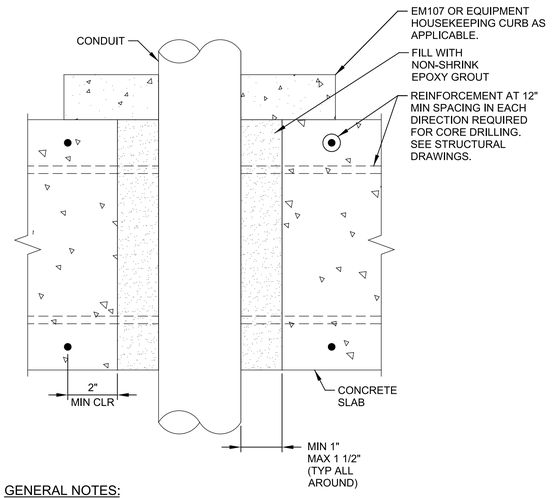
NOTES:

1. MOVE CONDUITS TO AVOID CONFLICTS WITH WATERSTOPS. WHERE HORIZONTAL & VERTICAL CLEARANCES CANNOT BE MAINTAINED, CONTACT ENGINEER FOR INSTRUCTION'S BEFORE PLACING CONCRETE.

KEY NOTES:

1. FOR REQUIRED TOP AND BOTTOM COVER OVER REINFORCEMENT SEE DETAIL. S101 TYP
2. MINIMUM ON CENTER HORIZONTAL SPACING OF PARALLEL CONDUITS = 4X OUTSIDE DIAMETER OF THE LARGER CONDUIT.
3. SUPPORT CONDUITS ON ADDED REINFORCEMENT BOLSTERS, OCM METAL BAR SUPPORT PRODUCT TYPE OR EQUAL. TIE CONDUITS TO SUPPORTS & ANCHOR TO PREVENT FLOTATION.
4. WHERE CONDUITS CROSS, PROVIDE MIN HORIZONTAL SPACING BETWEEN PARALLEL CONDUITS NOT LESS THAN DIAMETER OF THE LARGER CONDUIT IN THE SAME HORIZONTAL PLAN.
5. SUPPORT CONDUITS AT CROSSING TO PREVENT SAG & MAINTAIN CLEARANCE SHOWN.
6. WHERE MORE THAN 2 RUNS ARE STACKED, PROVIDE HORIZONTAL & VERTICAL SPACING SHOWN BETWEEN EACH PAIR.

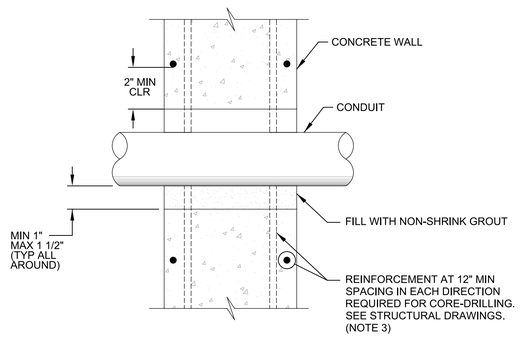
EM117 TYP S — EMBEDDED CONDUIT IN CONCRETE SLAB CROSSING RUNS



GENERAL NOTES:

1. PROVIDE NON-DESTRUCTIVE TESTING TO DETERMINE LOCATIONS OF REINFORCEMENT. MAINTAIN MIN 2" CLEAR BETWEEN CORE DRILLED OPENING AND REINFORCEMENT.
2. APPLY EPOXY CEMENT BONDING AGENT PRIOR TO GROUTING.

EM139 TYP S — CORE DRILLED PENETRATION CONCRETE SLAB



GENERAL NOTES:

1. PROVIDE NON-DESTRUCTIVE TESTING TO DETERMINE LOCATIONS OF REINFORCEMENT. MAINTAIN MIN 2" CLEAR BETWEEN CORE DRILLED OPENING AND REINFORCEMENT.
2. APPLY EPOXY CEMENT BONDING AGENT OR ROUGHEN CONCRETE SURFACE PRIOR TO GROUTING.
3. PROVIDE CAST-IN SLEEVE FOR PENETRATIONS IN WALLS WITH REINFORCEMENT SPACING LESS THAN 2" IN EACH DIRECTION. REFER TO STRUCTURAL DRAWINGS.

EM163 TYP S — CORE DRILLED PENETRATION CONCRETE WALL

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

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City of Ukiah

CITY OF UKIAH

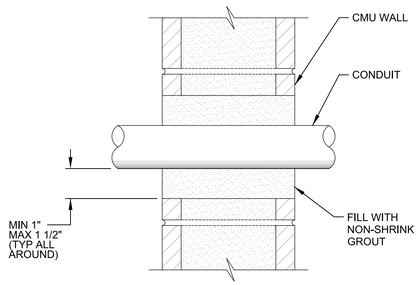
RECYCLED WATER PROJECT - PHASE 4

TYPICALS

TYPICAL DETAILS ELECTRICAL

VERIFY SCALES
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

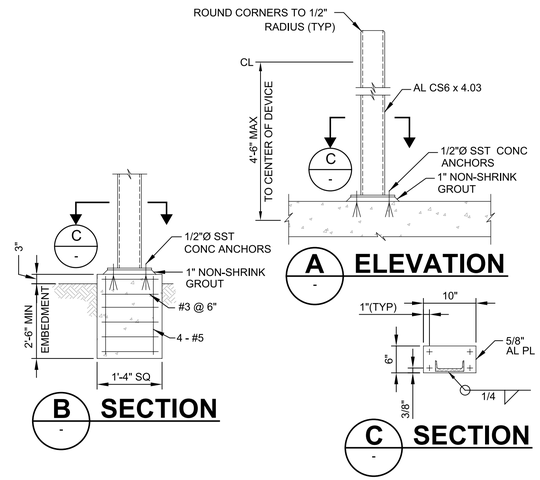
JOB NO. 8660F.10
DRAWING NO. 00TE07
SHEET NO. 181 OF 200



NOTES:

1. PROVIDE NON-DESTRUCTIVE TESTING TO DETERMINE LOCATIONS OF REINFORCEMENT. MAINTAIN MIN 2" CLEAR BETWEEN CORE DRILLED OPENING AND REINFORCEMENT.
2. ROUGHEN SURFACE OF OPENING TO A 1/4" AMPLITUDE AND APPLY EPOXY CEMENT BONDING AGENT IMMEDIATELY PRIOR TO GROUTING.
3. PROVIDE 8" MINIMUM CENTER-TO-CENTER SPACING FOR CONDUITS.

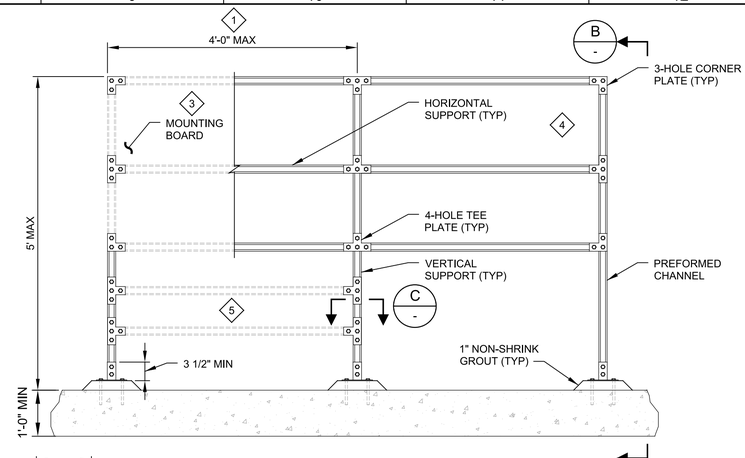
EM173 TYP S — CORE HOLE PENETRATION FULLY GROUTED CMU WALL

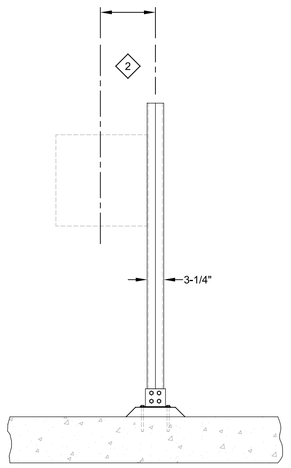


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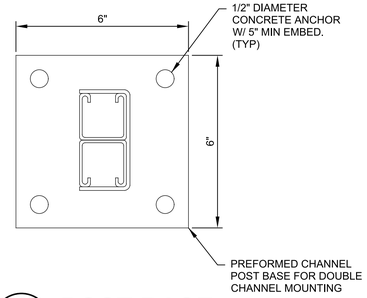
1. WHERE SEPARATE FOUNDATION IS REQUIRED, SEE SECTION B.
2. COAT ALUMINUM SURFACES IN CONTACT WITH CONCRETE PER SPECIFICATIONS.
3. USE STAINLESS STEEL FASTENERS FOR MOUNTING DEVICES.
4. WEIGHT OF DEVICE(S) SHALL NOT EXCEED 100 POUNDS.

EM201 TYP S — DEVICE SUPPORT AND MOUNTING





B SECTION



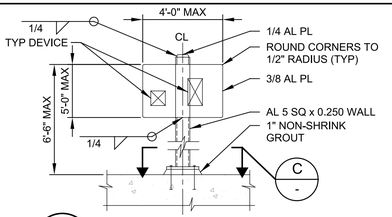
C POST BASE

GENERAL NOTES:

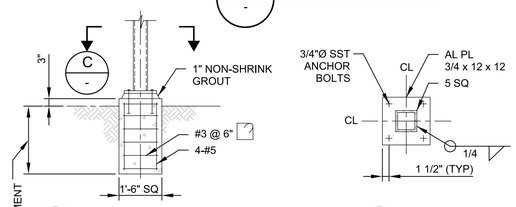
1. AS SHOWN, THE MOUNTING STAND IS SUITABLE FOR THE FOLLOWING DESIGN CRITERIA.
   - STAINLESS STEEL OR HOT-DIPPED GALVANIZED PREFORMED CHANNEL
   - BASIC WIND SPEED (3 SECOND GUST. 33 FEET ABOVE GROUND) : 120 MPH
   - WIND EXPOSURE CATEGORY: C
   - NON -SPECIAL WIND REGIONS
   - SEISMIC DESIGN CATEGORY: A THROUGH D
   - RISK CATEGORY: III AND IV
   - MAXIMUM EQUIPMENT LOAD OF 100 LBS PER VERTICAL SUPPORT

   SUBMIT DESIGN CALCULATIONS FOR EACH INSTALLATION THAT EXCEEDS THE SPECIFIED DESIGN CRITERIA OR DIMENSIONAL LIMITATIONS IN THIS DETAIL. REFER TO THE SPECIFICATIONS FOR DESIGN CALCULATION SUBMITTAL REQUIREMENTS.
2. THE TOTAL SURFACE AREA OF ALL EQUIPMENT AND MOUNTING BOARDS SHALL NOT EXCEED 12 SQUARE FEET PER VERTICAL SUPPORT.
3. REFER TO THE SPECIFICATIONS FOR MATERIAL REQUIREMENTS.
4. WHERE CONCRETE ANCHORS COME IN CONTACT WITH DISSIMILAR METALS, ISOLATE DISSIMILAR METALS AS SPECIFIED IN THE SPECIFICATIONS.
5. VERTICAL SUPPORTS SHALL CONSIST OF PREFORMED DOUBLE CHANNELS. HORIZONTAL SUPPORTS SHALL CONSIST OF PREFORMED SINGLE CHANNELS.

EM211 TYP S — OUTDOOR EQUIPMENT MOUNTING STAND



A ELEVATION



B ELEVATION — C SECTION

GENERAL NOTES:

1. USE ELEVATION B WHERE A SEPARATE FOUNDATION IS REQUIRED.
2. COAT ALUMINUM SURFACES IN CONTACT W/ CONCRETE PER SPECIFICATIONS.
3. USE STAINLESS STEEL FASTENERS FOR MOUNTING DEVICES.
4. WEIGHT OF DEVICE(S) SHALL NOT EXCEED 300 POUNDS.

EM202 TYP S — DEVICE SUPPORT AND MOUNTING

◇# KEY NOTES:

1. FOR MOUNTING STANDS WIDER THAN 4 FEET PROVIDE EQUALLY SPACED VERTICAL SUPPORTS AT 4 FOOT MAXIMUM SPACING.
2. MAXIMUM OFFSET TO THE CENTERLINE OF EQUIPMENT OR ENCLOSURES IS 1'-6".
3. PROVIDE A MOUNTING BOARD FOR INSTRUMENTS AND DEVICES WEIGHING LESS THAN 20 POUNDS THAT CANNOT BE MOUNTED DIRECTLY TO PREFORMED CHANNEL. EQUIPMENT ANCHORAGE TO THE MOUNTING BOARD SHALL BE DESIGNED BY THE CONTRACTOR.
4. PROVIDE ADDITIONAL PREFORMED CHANNEL SUPPORTS FOR ENCLOSURES THAT CAN BE MOUNTED DIRECTLY TO THE PREFORMED CHANNEL.
5. OPTIONAL HORIZONTAL SUPPORTS AND AVAILABLE SPACE FOR JUNCTION BOXES.

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

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City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
TYPICALS
TYPICAL DETAILS ELECTRICAL

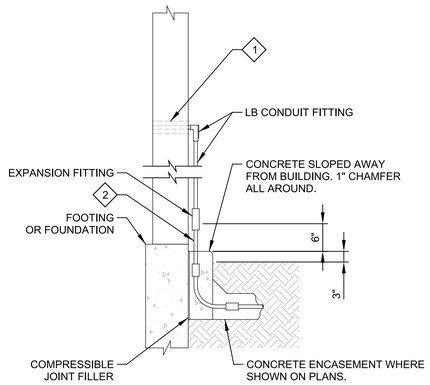
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

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DRAWING NO. 00TE08
SHEET NO. 182 OF 200

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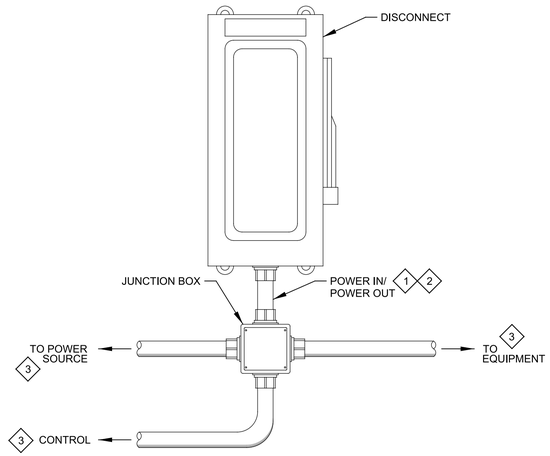
GENERAL NOTES:

1. REFER TO THE SPECIFICATIONS FOR MATERIAL REQUIREMENTS.

KEY NOTES:

1. CONTRACTOR SHALL PROVIDE A WATERPROOF AND WEATHERTIGHT SEAL AROUND THE CONDUIT PENETRATION. SEAL SHALL INCLUDE CAULKING AND PLATE AS RECOMMENDED BY MANUFACTURER. SUBMIT TO ENGINEER OF RECORD FOR REVIEW BEFORE INSTALLATION.
2. DO NOT ATTACH THE CONDUIT TO THE BUILDING BEFORE THE EXPANSION FITTING.

EM219 TYP — CONDUIT PENETRATION ABOVE GRADE



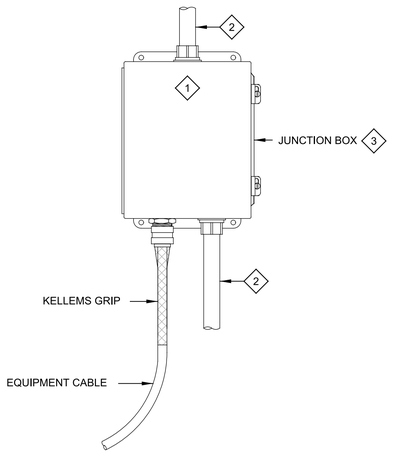
GENERAL NOTES:

1. CONDUIT AND ENCLOSURE REQUIREMENTS AS SPECIFIED.

KEY NOTES:

1. CONDUIT IS NOT INCLUDED IN THE CONDUIT SCHEDULE.
2. SIZE CONDUIT IN ACCORDANCE WITH THE NEC.
3. REFER TO CONDUIT SCHEDULE FOR CONDUIT SIZE, WIRE SIZE AND QUANTITY.

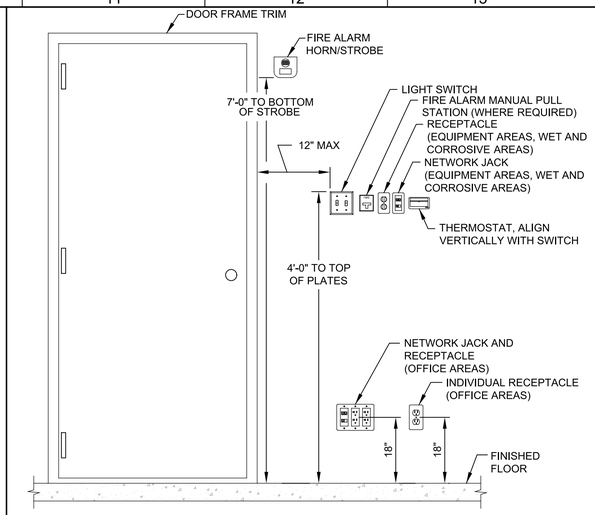
EM221 TYP S — DISCONNECT CONDUIT INSTALLATION



KEY NOTES:

1. PROVIDE TERMINAL STRIPS TO TRANSITION FROM THE EQUIPMENT CABLE TO FIELD WIRING.
2. POWER AND CONTROL CONDUITS. REFER TO THE ELECTRICAL DRAWINGS, CONDUIT AND CABLE SCHEDULE FOR DETAILS.
3. REFER TO SPECIFICATIONS AND PLANS FOR NEMA TYPE.

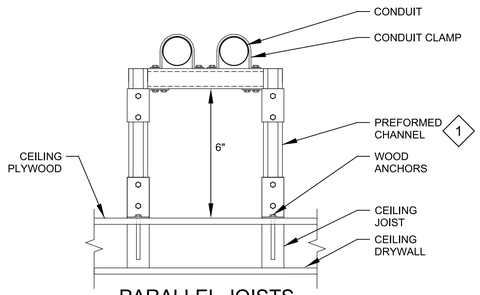
EM315 TYP S — SUBMERSIBLE EQUIPMENT CABLE CONNECTION DETAIL



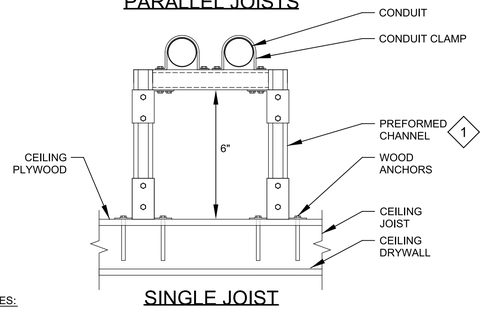
NOTES:

1. ALL SWITCHES AND RECEPTACLES SHALL BE EMBEDDED IN THE WALL UNLESS OTHERWISE INDICATED ON THE DRAWINGS.

EM725 TYP S — OUTLET BOX MOUNTING



PARALLEL JOISTS



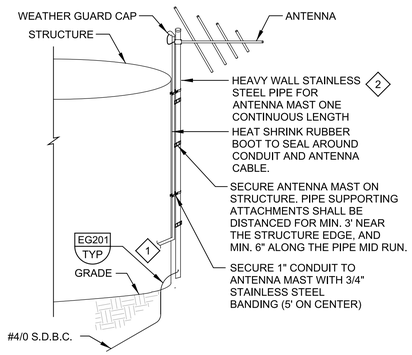
SINGLE JOIST

KEY NOTES:

1. SIZE PREFORMED CHANNEL FOR CONDUITS INDICATED ON THE DRAWINGS.

EM901 TYP J — CONDUIT SUPPORT ABOVE CEILING JOIST FOR ELECTRICAL CONDUITS

11/24/2021

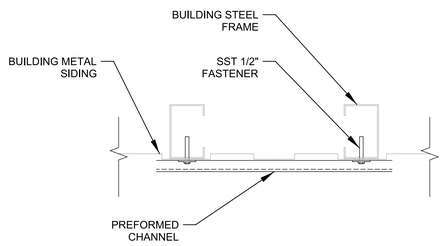


KEYNOTE:

1. TO FIELD MOUNTED JUNCTION BOX.
2. SUPPORT STEEL PIPE ON STRUCTURE WITH PREFORMED CHANNEL AND STRAP CLAMPS. REFER TO PLAN DRAWINGS FOR ATTACHMENT DETAILS AND NOTES.

EM902 TYP J — ANTENNA MAST MOUNTING DETAIL

11/24/2021



EM903 TYP J — ATTACHMENT TO STEEL FRAMING WALL

11/24/2021

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED JGB
DATE JULY 2023

** ORIGINAL SEALED BY ERIK M. BAHNEMAN 4/7/2023 CA PE NO. 19683 **

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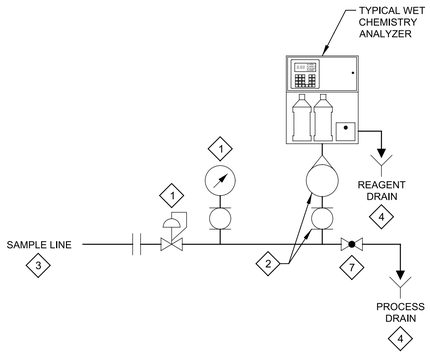
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
TYPICALS
TYPICAL DETAILS ELECTRICAL

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00TE09
SHEET NO. 183 OF 200

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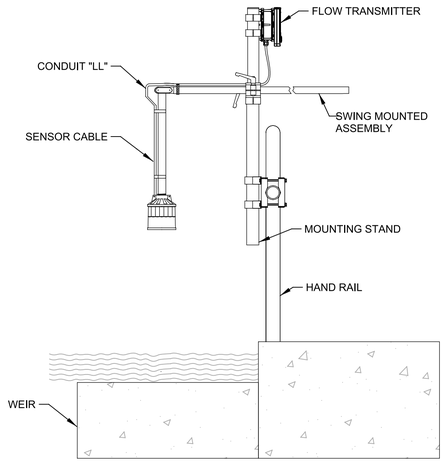


KEY NOTES:

1. PRESSURE CONTROL VALVE AND GAUGE ARE REQUIRED AT PRESSURE EXCEEDING 40 PSI.
2. PROVIDE ISOLATION VALVE AND ROTAMETER WITH FLOW CONTROL FOR EACH INSTRUMENT.
3. MINIMIZE SAMPLE LINE LENGTH TO KEEP SAMPLE FLOW LAG TO A MINIMUM.
4. PROVIDE AIR GAPS FOR ALL DRAINS.
5. PROVIDE GLOBE VALVE FOR FLOW CONTROL.

NA090 SAMPLE PANEL PLUMBING DETAIL

TYP R — 11/9/2022

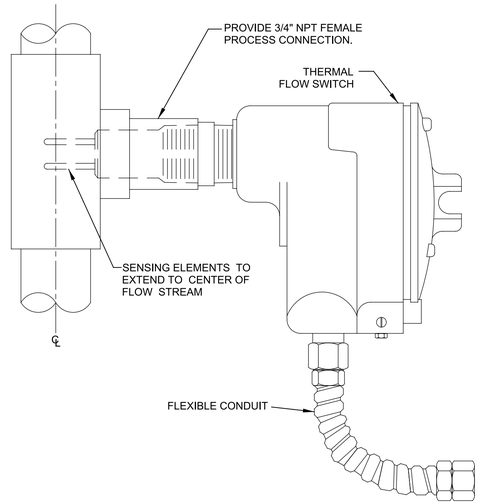


NOTES:

1. MOUNT THE SWIVEL / PIVOT / PIPE CLAMP ASSEMBLY TO A GUARDRAIL OR HORIZONTAL PIPE AS INDICATED ON THE PLAN DRAWINGS.

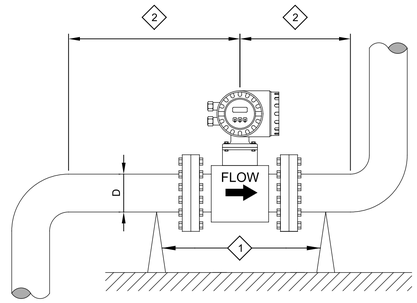
NA901 PIPE MOUNTING STAND - WEIR LEVEL PROBE

TYP J — 03/8/2023



NF111 THERMAL FLOW SWITCH MOUNTING DETAIL

TYP S



GENERAL NOTES:

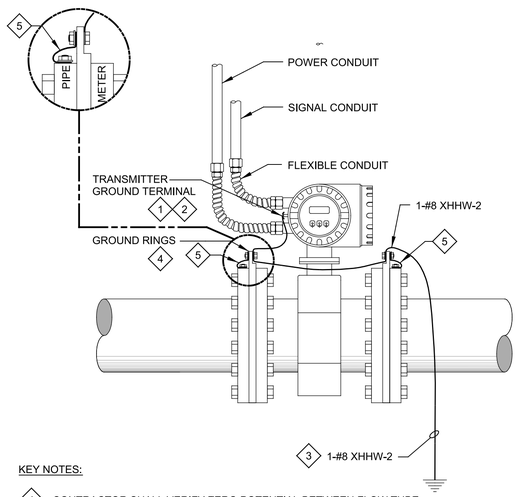
1. FOLLOW MANUFACTURER'S RECOMMENDED MAXIMUM TORQUE SETTINGS. DO NOT OVER-TORQUE FLANGE BOLTS. OVERTIGHTENING THE FASTENERS WILL DEFORM SEALING FACES OR DAMAGE THE LINE.
2. ALWAYS TIGHTEN FLANGE BOLTS UNIFORMLY AND IN DIAGONALLY OPPOSITE SEQUENCE.
3. MOUNT METER SO THAT IT REMAINS FULLY FLOODED.
4. FOR METERS SPECIFIED WITH ZERO DIAMETER FEATURE, REFER TO THE MECHANICAL DRAWINGS FOR INSTALLATION.

KEY NOTES:

1. PIPE SUPPORTS BY MECHANICAL CONTRACTOR. NO SUPPORTS SHALL BE INSTALLED AT THE METER HOUSING.
2. INSTALL METER SUCH THAT THERE ARE NO PIPE BENDS FOR 5 PIPE DIAMETERS UPSTREAM AND 3 PIPE DIAMETERS DOWNSTREAM OF THE METER.

NF130 MAGNETIC FLOWMETER MOUNTING DETAIL

TYP S

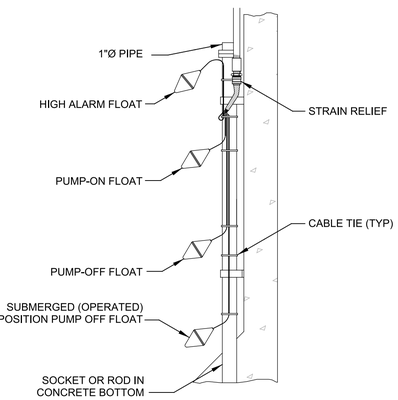


KEY NOTES:

1. CONTRACTOR SHALL VERIFY ZERO POTENTIAL BETWEEN FLOW TUBE, EARTH GROUND AND TRANSMITTER GROUND TERMINAL.
2. CONNECT TRANSMITTER GROUND TERMINAL TO GROUND RINGS.
3. CONNECT METER BODY TO EARTH GROUND POTENTIAL.
4. EQUALIZE POTENTIAL VIA GROUND RINGS BETWEEN FLUID AND MAGMETER.
5. PROVIDE BONDING JUMPER ON CONDUCTIVE PIPES.

NF136 INTEGRAL MAGNETIC FLOWMETER GROUNDING DETAIL

TYP S

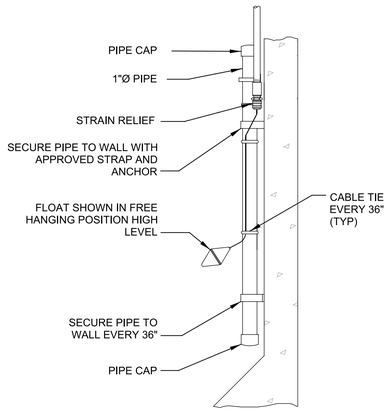


GENERAL NOTES:

1. NUMBER OF FLOATS SHALL BE AS SHOWN ON SCHEMATICS AND P&IDS.
2. FLOATS SHOWN IN FREE HANGING POSITION.

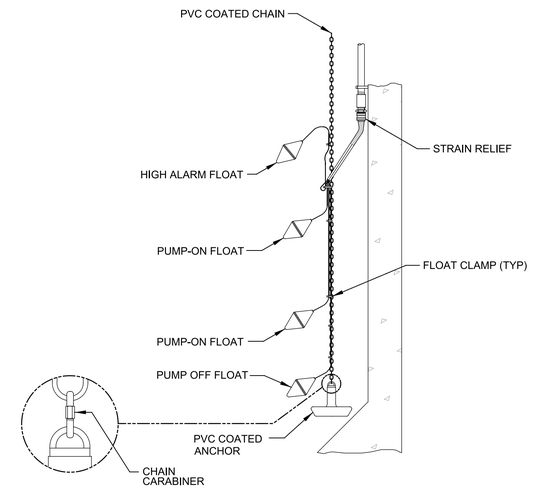
NL100 FLOAT SWITCH INSTALLATION

TYP S



NL101 FLOAT SWITCH INSTALLATION

TYP S



NOTES:

1. NUMBER OF FLOATS AS SHOWN ON DRAWINGS.

NL108 LEVEL FLOAT WITH CHAIN

TYP S

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED BAL
DATE JULY 2023

** ORIGINAL SEALED BY BRETT A. LEE 4/7/2023 CA PE NO. 22911 **

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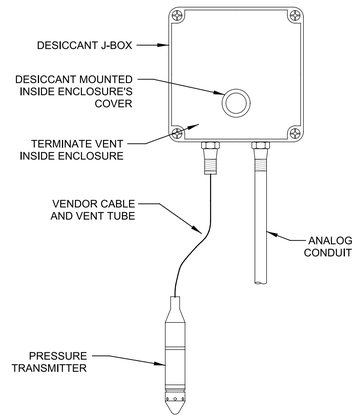
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
TYPICAL
TYPICAL DETAILS INSTRUMENTATION

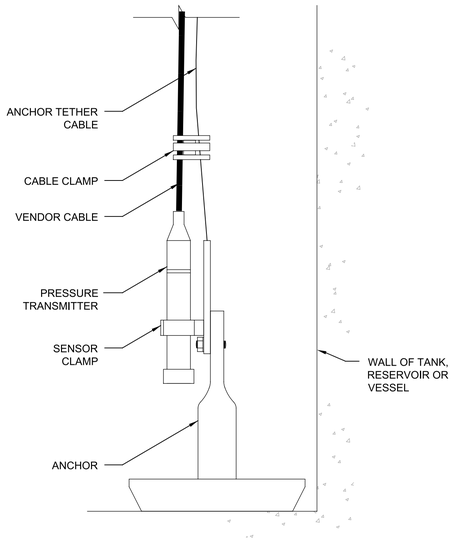
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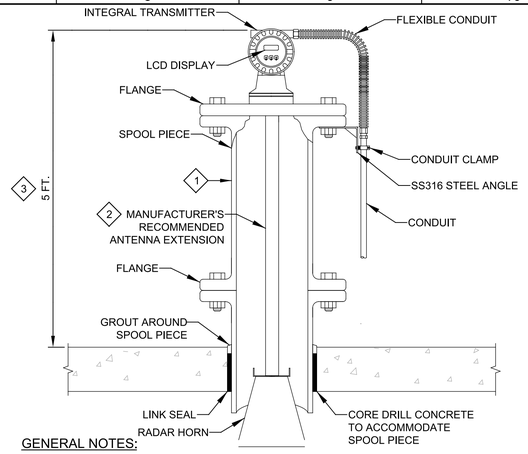
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NL132 TYP S — DROP-IN PRESSURE TRANSMITTER DESICCANT J-BOX DETAIL



NL133 TYP S — PRESSURE TRANSDUCER ANCHOR WEIGHT DETAIL



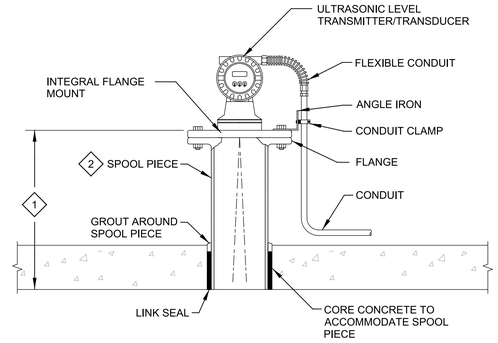
GENERAL NOTES:

1. LENGTH OF ANTENNA EXTENSION AND SPOOL PIECE SHALL BE AS REQUIRED TO INSTALL LCD DISPLAY.
2. CONTRACTOR SHALL SCAN THE EXISTING REBAR IN THE SLAB AND CORE DRILL MAXIMUM 8" DIAMETER CONCRETE WITHOUT DAMAGING THE EXISTING STEEL REINFORCEMENT IN SLAB. THE CORE DRILL SHALL BE LOCATED SUCH THAT THERE WILL BE MINIMUM 1 1/2" CLEARANCE (CONCRETE COVER) BETWEEN EXISTING REBAR AND CORE DRILL.

KEY NOTES:

1. 1 INCH LARGER THAN DIAMETER OF RADAR HORN.
2. PROVIDE ANTENNA EXTENSION SUCH THAT THE RADAR HORN EXTENDS INTO THE STRUCTURE, PER MANUFACTURER'S RECOMMENDATION.
3. VERIFY SUITABLE ANTENNA EXTENSION IS AVAILABLE.

NL153 TYP R — RADAR INSTRUMENT MOUNTING DETAIL — 11/9/2022



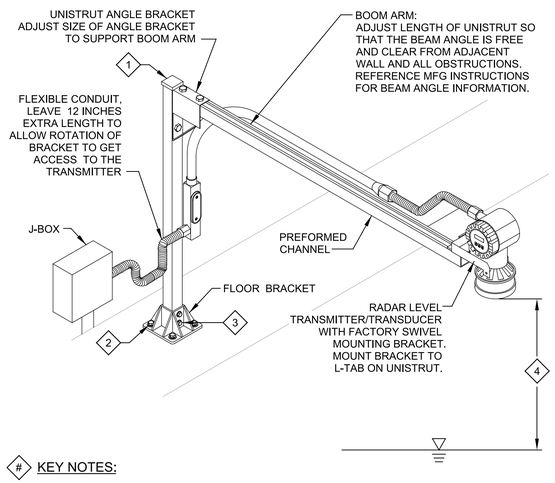
GENERAL NOTES:

1. DO NOT DAMAGE OR CUT ANY EXISTING REBAR.
2. CONTRACTOR SHALL SCAN THE EXISTING REBAR IN THE SLAB AND CORE DRILL MAXIMUM 8" DIAMETER CONCRETE WITHOUT DAMAGING THE EXISTING STEEL REINFORCEMENT IN SLAB. THE CORE DRILL SHALL BE LOCATED SUCH THAT THERE WILL BE MINIMUM 1 1/2" CLEARANCE (CONCRETE COVER) BETWEEN EXISTING REBAR AND CORE DRILL.

KEY NOTES:

1. MINIMUM DISTANCE BETWEEN HIGHEST POSSIBLE LEVEL, INCLUDING OVERFLOW, AND PROBE FACE SHALL BE MANUFACTURER'S BLANKING ZONE PLUS 2 INCHES.
2. MINIMUM 6 INCHES DIAMETER. INCREASE DIAMETER AS REQUIRED TO ALLOW CONE ANGLE TO CLEAR BOTTOM OF THE TANK NOZZLE. MAXIMUM 8 INCHES DIAMETER OPENING.

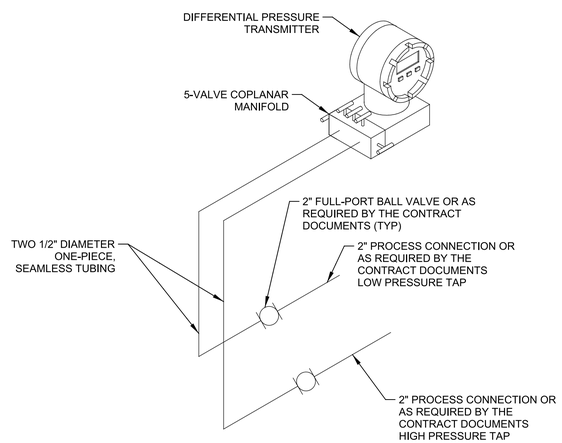
NL175 TYP R — ULTRASONIC LEVEL TRANSMITTER MOUNTING DETAIL — 11/9/2022



KEY NOTES:

1. CONTRACTOR SHALL FURNISH END CAPS AND CHANNEL CAPS ON ALL EXPOSED PREFORMED CHANNEL.
2. USE APPROVED CONCRETE ANCHOR AND FASTENERS.
3. TO ACCESS TRANSDUCER/TRANSMITTER REMOVE BOLTS FROM FLOOR BRACKET.
4. MINIMUM DISTANCE BETWEEN HIGHEST POSSIBLE LEVEL, INCLUDING OVERFLOW, AND PROBE FACE SHALL BE MANUFACTURER'S BLANKING ZONE PLUS 2 INCHES.

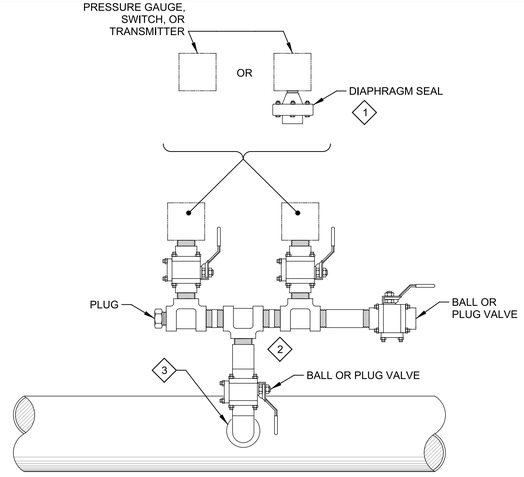
NL180 TYP R — RADAR LEVEL TRANSDUCER/TRANSMITTER FLUME OR BASIN MOUNTING DETAIL



GENERAL NOTES:

1. SLOPE BOTH 1/2" IMPULSE LINES DOWN AWAY FROM THE DP TRANSMITTER TOWARDS BOTH PROCESS CONNECTIONS A MINIMUM OF 1" PER 1/2" OF HORIZONTAL RUN.
2. INSTALL TRANSMITTER USING MANUFACTURER PROVIDED PIPE MOUNTING BRACKET ATTACHED TO AN APPROVED STRUCTURE.
3. SUPPORT ALL 1/2" TUBING EVERY 48" OF RUN MAXIMUM OR AS NEEDED.

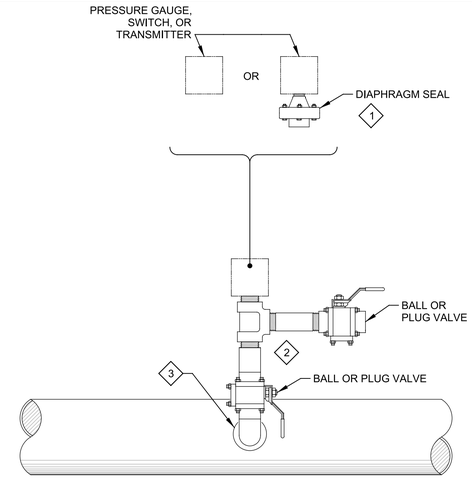
NP188 TYP S — DIFFERENTIAL PRESSURE TRANSMITTER GAS OR AIR APPLICATIONS WITH COPLANAR MANIFOLD



KEY NOTES:

1. USE THE INSTRUMENT DATA SHEETS IN DIVISION 17 OR DIVISIONS 40 SPECS TO IDENTIFY INDIVIDUAL REQUIREMENTS FOR DIAPHRAGM SEALS.
2. ALL VALVE AND PIPE MATERIAL SHALL BE COMPATIBLE WITH PROCESS FLUID.
3. THREADED TAP OR SADDLE CONNECTION FOR DUCTILE IRON PIPE. WELD-O-LET OR THREAD-O-LET FOR WELDED PIPE. TEE OR REDUCING TEE FOR NON-METALLIC PIPE.

NP501 TYP S — MULTIPLE PRESSURE INSTRUMENTS MOUNTING DETAIL



KEY NOTES:

1. USE THE INSTRUMENT DATA SHEETS IN DIVISION 17 OR DIVISIONS 40 SPECS TO IDENTIFY INDIVIDUAL REQUIREMENTS FOR DIAPHRAGM SEALS.
2. ALL VALVE AND PIPE MATERIAL SHALL BE COMPATIBLE WITH PROCESS FLUID.
3. THREADED TAP OR SADDLE CONNECTION FOR DUCTILE IRON PIPE. WELD-O-LET OR THREAD-O-LET FOR WELDED PIPE. TEE OR REDUCING TEE FOR NON-METALLIC PIPE.

NP502 TYP S — PRESSURE INSTRUMENT MOUNTING DETAIL

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED BAL
DATE JULY 2023

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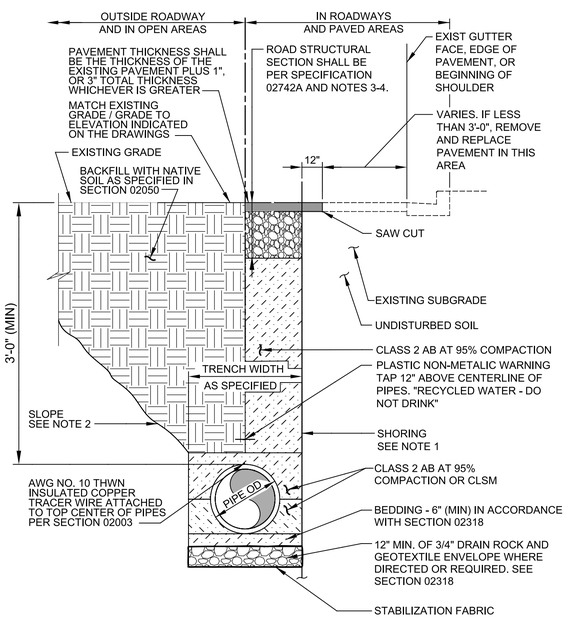
CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
TYPICAL
TYPICAL DETAILS INSTRUMENTATION

VERIFY SCALES
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

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SHEET NO. 185 OF 200

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CY111 TYP J — PIPE TRENCH

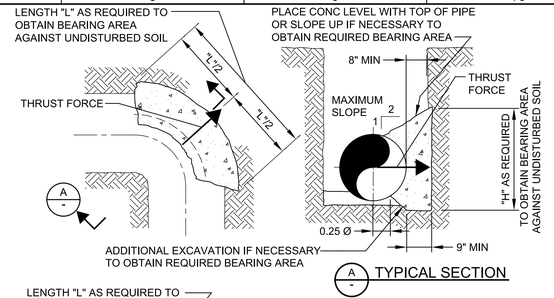
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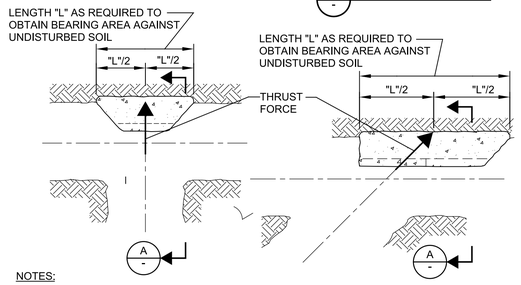
1. IN GENERAL, TRENCH WALLS SHALL BE VERTICAL. IN OPEN FIELD CONSTRUCTION, THE WALLS MAY BE SLOPE TO REMOVED THE NEED FOR SHORING, CM TO APPROVE SLOPED TRENCHING PRIOR TO SLOPED EXCAVATION.
2. WHERE MECHANICAL RESTRAINTS ARE USED, THE MINIMUM CLEARANCES SHALL BE MAINTAINED FROM TRENCH WALL TO OUTSIDE OF PIPE RESTRAINT MATERIALS. THE MINIMUM CLEARANCE SHALL NOT BE LESS THAN 9-INCH TO ENSURE ADEQUATE SPACE FOR APPLICATION OF CORROSION PROTECTION OF JOIN RESTRAINT.
3. FOR PAVED AREAS, TRENCH BACKFILL SHALL BE CLASS II AB AT 95% COMPACTION. FOR UNIMPROVED AREAS, TRENCH BACKFILL SHALL BE NATIVE MATERIAL AT 90% COMPACTION AND UPPER 30" SHALL BE NATIVE MATERIAL AT 85% COMPACTION.
4. REPLACE ALL TRAFFIC STRIPING AS REQUIRED.
5. REFER TO SECTION 02318 FOR TRENCH WIDTH.

CY111 TYP J — PIPE TRENCH

SHEET 2 OF 2 08/19/22



TYPICAL SECTION

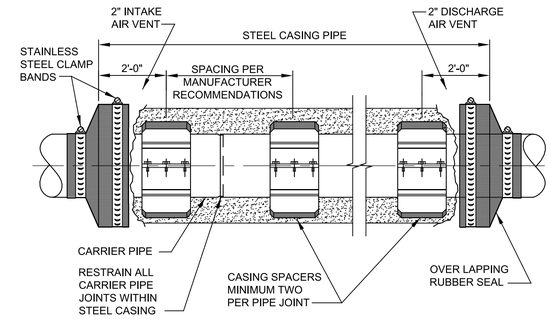


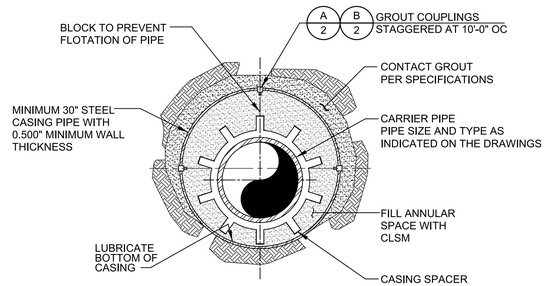
NOTES:

1. BEARING AREA IS THE AREA REQUIRED TO OBTAIN A MAXIMUM PRESSURE NOT GREATER THAN 1500 PSF AT THE TOP OF THRUST BLOCK WHEN THE PIPE IS SUBJECTED TO ITS TEST PRESSURE. OR BEARING AREA INDICATED ON THE DRAWINGS USING A PASSIVE RESISTANCE OF 200 PSF/FT DEPTH.
2. CONCRETE SHALL BE CLASS "A" OR "C".
3. THRUST BLOCK SHALL BEAR ON UNDISTURBED SOIL.

CY131 TYP SN — THRUST RESTRAINT - BURIED THRUST BLOCK

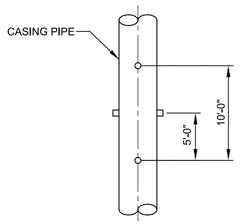
08/19/22



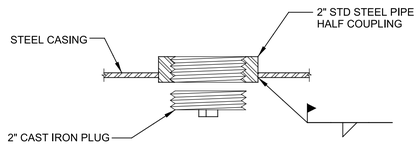


CY165 TYP S — MICROTUNNEL STEEL CASING

SHEET 1 OF 3 08/19/22



A 1 — GROUT COUPLING SPACING



B 1 — GROUT COUPLING

CY165 TYP S — MICROTUNNEL STEEL CASING

SHEET 2 OF 3 08/19/22

CASING / CARRIER PIPE		
8-12" SPACER WIDTH		
CARRIER PIPE SIZE	CASING ID	MIN THICKNESS *
18"	29"	0.500"

* CASING WALL THICKNESS TO BE VERIFIED BY CONTRACTOR'S ENGINEER (LICENSED IN THE STATE WHERE PROJECT IS LOCATED) FOR MAXIMUM JACKING LOADS AND PIPE BENDING.

NOTES:

1. STEEL CASING PIPE SHALL CONFORM TO THE REQUIREMENTS OF ASTM A283, GRADE B, C, OR D. ALL JOINTS SHALL BE WELDED. INTERIOR JOINTS SHALL BE GROUND TO SMOOTH FINISH. ALL WELDING SHALL BE PERFORMED IN ACCORDANCE WITH AWWA C206, "AWWA STANDARD FOR FIELD WELDING OF STEEL WATER PIPE." COATINGS FOR STEEL CASING ARE NOT REQUIRED.
2. CASING PIPE SHALL BE LAID TRUE TO LINE AND GRADE WITH NO BENDS OR CHANGES IN GRADE FOR THE FULL LENGTH OF THE CASING.
3. ADVANCE PRODUCTS AND SYSTEMS, INC., OR EQUAL, CASING SPACERS AND END SEALS SHALL BE INSTALLED PER MANUFACTURER'S SPECIFICATIONS.
4. ALL PIPE JOINTS WITHIN THE CASING ARE TO BE FULLY RESTRAINED.
5. ANNULAR SPACE BETWEEN CARRIER PIPE AND CASING TO BE FILLED WITH CLSM PER THE SPECIFICATIONS.
6. CONTACT GROUT SHALL BE PLACED BETWEEN THE CASING PIPE AND THE GROUND PER THE SPECIFICATIONS.
7. CASINGS SHALL BE INSTALLED TO THE GRADE SHOWN ON THE DRAWINGS, WITH A MAXIMUM VERTICAL DEVIATION OF +0" AND -2", AND A MAXIMUM HORIZONTAL DEVIATION OF ±2" PROVIDED THE ALIGNMENT DOES NOT CONFLICT WITH OTHER UTILITIES AND/OR RIGHTS-OF-WAY.
8. CONTRACTOR TO PROVIDE LOCATIONS OF INTAKE AND DISCHARGE AIR VENTS.

CY165 TYP SN — MICROTUNNEL STEEL CASING

SHEET 3 OF 3 08/19/22

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED JD
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

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City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

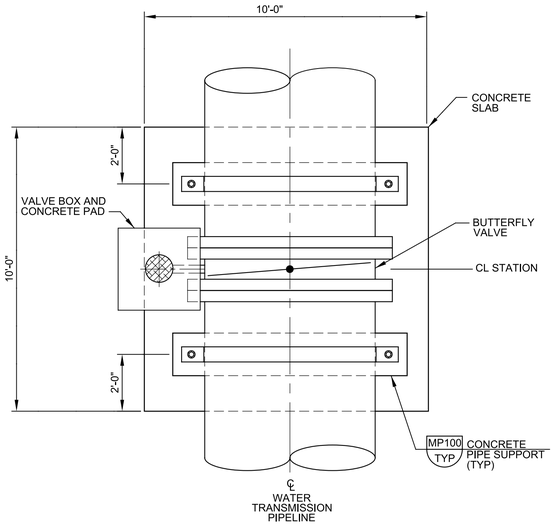
TYPICALS

TYPICAL DETAILS PIPING

VERIFY SCALES
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00TP01
SHEET NO. 186 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1000TP01.dgn



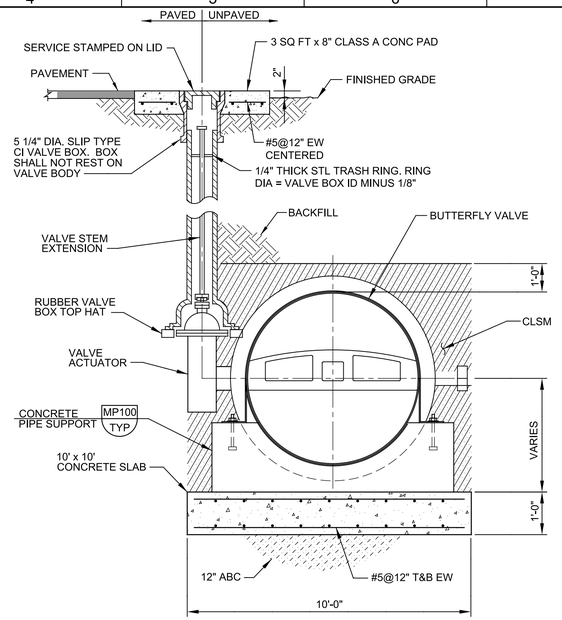
PLAN

NOTES:

1. ALL BURIED VALVES SHALL BE PROVIDED WITH EXTENSION STEM OPERATOR WITH 2" SQUARE AWWA NUT WITHIN 36" OF VALVE BOX COVER. INDICATE ON NUT DIRECTION OF ROTATION TO OPEN VALVE.
2. COAT BURIED PIPE AND VALVE BOX PER SPECIFICATIONS.
3. CLEAN VALVE BOX OF ALL DEBRIS AND SOIL.

CY715 TYP S — BUTTERFLY VALVE - DIRECT BURY

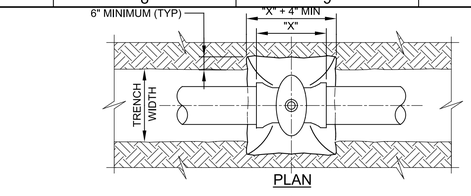
SHEET 1 OF 2 5/21/19



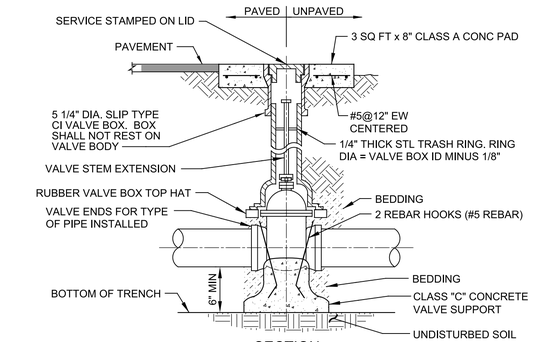
ELEVATION

CY715 TYP S — BUTTERFLY VALVE - DIRECT BURY

SHEET 2 OF 2 5/21/19



PLAN



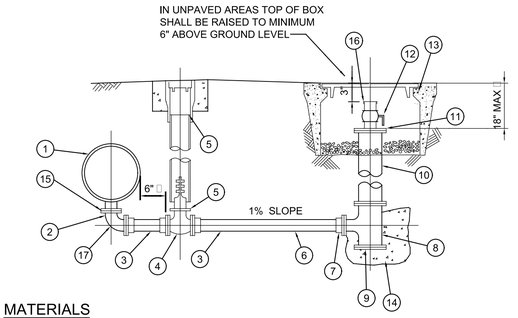
SECTION

NOTES:

1. ALL BURIED VALVES SHALL BE PROVIDED WITH EXTENSION STEM OPERATION WITH 2" SQUARE AWWA NUT WITHIN 36" OF VALVE BOX COVER. NUT IS TO INDICATE DIRECTION OF ROTATION TO OPEN VALVE.
2. COAT BURIED PIPE AND VALVE BOX AS SPECIFIED.
3. CLEAN VALVE BOX OF ALL DEBRIS AND SOIL.
4. VALVE TYPE AS INDICATED ON THE DRAWINGS.

CY716 TYP S — GATE VALVE - DIRECT BURY

10/20/20



MATERIALS

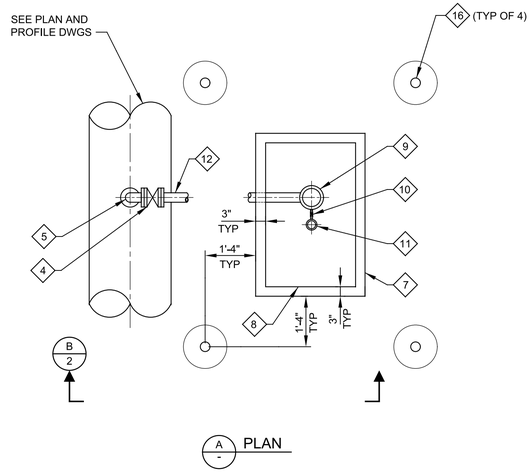
1. PIPE DIA. x 4" D.I. TEE MJ x MJ x FL
2. 4" D.I. 90° ELL, FLG. x MJ.
3. 4" PVC C900-DR-18 LENGTH AS REQUIRED.
4. 4" RW GATE VALVE, MJ x MJ
5. VALVE AND VALVE BOX INSTALLATION PER DETAIL CY716.
6. 4" PVC C900-DR-18 LENGTH AS REQUIRED.
7. 4" MJ
8. 6" x 4" D.I. TEE
9. 6" D.I. BLIND FLANGE
10. 6" x AS REQ'D D.I. PIPE
11. 6" BLIND FLANGE W/ 2 1/2 " TAP
12. 2 1/2" BRASS NIPPLE AND 2 1/2" BALL VALVE, IP THREAD
13. 12" MINIMUM DIAMETER VALVE BOX-H2O RATED
14. 3 CU. FT. CLASS "C" CONCRETE
15. INSULATING KIT SHALL BE PROVIDED AS REQUIRED BY CORROSION STUDY & CITY
16. 2 1/2" BRASS NIPPLE, I.P. THREAD X FH THREAD, WITH PROTECTIVE CAP
17. CONCRETE THRUST BLOCK PER DETAIL CY131

NOTES:

1. LOCATE WITHIN PUBLIC RIGHT-OF-WAY.
2. ALL JOINTS SHALL BE FLANGED OR MJ WITH RESTRAINTS.

CY733 TYP J — 4" DRAIN BLOWOFF - ASSEMBLY

04/23/14



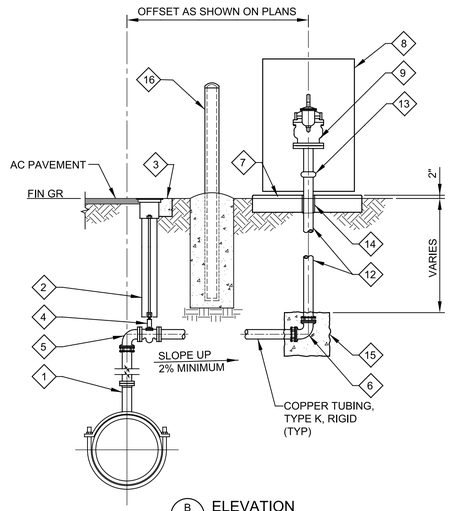
A - PLAN

NOTES:

1. LOCATE AIR VALVES AS SHOWN ON PLANS
2. CONNECTION PIPING SHALL BE THE SAME SIZE AS THE AIR/VACUUM VALVE.
3. ALL MJ FITTINGS SHALL BE FULLY RESTRAINED.

CY745 TYP SN — AIR/VACUUM VALVE ASSEMBLY - ABOVE GRADE

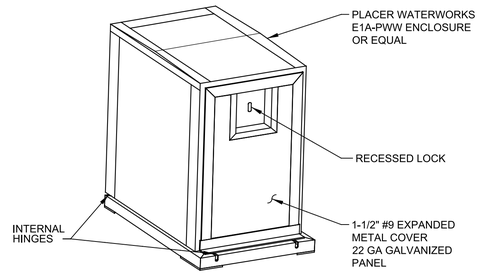
SHEET 1 OF 4 08/22/22

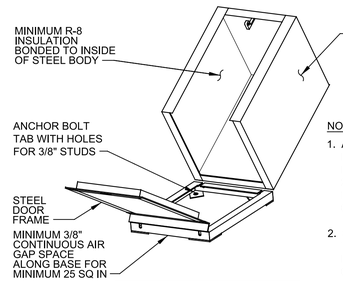


B 1 ELEVATION

CY745 TYP RN — AIR/VACUUM VALVE ASSEMBLY - ABOVE GRADE

SHEET 2 OF 4 08/22/22





DIMENSIONS	
VALVE SIZE	ENCLOSURE SIZE
8"	24" L x 36" W x 36" H

NOTES:

1. ALL SURFACES SHALL BE ABRASIVE BLASTED (SSPC SP-5 WHITE METAL BLAST) AND POWDER COATED WITH 2-3 MILS ZINC RICH PRIMER WITH 4-5 MILS ANTI-GRAFFITI CHEMISTRY TOP COAT (DFT 6-8 MILS).
2. ENCLOSURE SHALL MOUNT SECURELY TO CONCRETE PAD USING INTEGRAL BOLT TABS. ONE ANCHOR IN EACH CORNER (4 TOTAL).
3. ENCLOSURE SHALL INCLUDE A RECESSED LOCK.
4. SIZE BOX APPROPRIATELY PER TABLE.

CY745 TYP SN — AIR/VACUUM VALVE ASSEMBLY - ABOVE GRADE

SHEET 3 OF 4 08/22/22

ITEM	DESCRIPTION
1	SERVICE SADDLE AND CORPORATION STOP TO MATCH VALVE SIZE.
2	VALVE BOX INSTALLATION FOR BURIED VALVE SEE TYPICAL DETAIL CY716.
3	INSTALL CONCRETE COLLAR IN NON-TRAFFIC AREAS.
4	2" FLANGED RESILIENT SEATED GATE VALVE.
5	2" 90° FLG x MJ ELBOW.
6	2" 90° MJ x MJ ELBOW.
7	6" THICK CONCRETE PAD WITH #4 @ 12" EW REINFORCEMENT BARS.
8	AIR VALVE ENCLOSURE.
9	2" DUAL BODY COMBINATION AIR RELEASE VALVE AND VACUUM VALVE.
10	2" BRASS GATE VALVE.
11	2" COMBINATION AIR RELEASE AND AIR VACUUM VALVE WITH 180° GOOSENECK PIPED TO FLOOR.
12	2" COPPER TUBING WITH RESTRAINED JOINTS AND CEMENT MORTAR LINING WITH POLYETHYLENE ENCASEMENT PER AWWA C105. BOND ALL JOINTS.
13	2" GROOVED COUPLING.
14	FLOOR AND SLAB PENETRATION, EXTEND COATING FOR BURIED SURFACE ABOVE GRADE. SEE TYPICAL DETAIL MP544.
15	CONCRETE ANCHOR BLOCK, 24" SQ. MINIMUM BEARING AREA.
16	REMOVABLE GUARDPOST. SEE TYPICAL DETAIL CF161.

CY745 TYP RN — AIR/VACUUM VALVE ASSEMBLY - ABOVE GRADE

SHEET 4 OF 4 08/22/22

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED JD
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

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RECYCLED WATER PROJECT - PHASE 4

TYPICALS

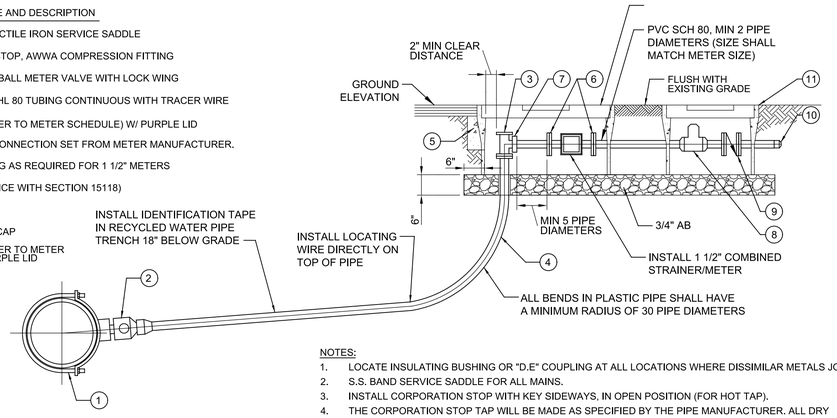
TYPICAL DETAILS PIPING

VERIFY SCALES
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00TP02
SHEET NO. 187 OF 200

PROJECT NO. 8660F10 FILE NAME: 8660F1000TP02.dgn

ITEM NO.	SIZE AND DESCRIPTION
1	DOUBLE STRAP DUCTILE IRON SERVICE SADDLE
2	2" CORPORATION STOP, AWWA COMPRESSION FITTING
3	2" BRONZE ANGLE BALL METER VALVE WITH LOCK WING
4	2" PURPLE PVC SCHL 80 TUBING CONTINUOUS WITH TRACER WIRE
5	METER BOX 1 (REFER TO METER SCHEDULE) W/ PURPLE LID
6	BRONZE FLANGE CONNECTION SET FROM METER MANUFACTURER.
7	REDUCING BUSHING AS REQUIRED FOR 1 1/2" METERS
8	PRV (IN ACCORDANCE WITH SECTION 15118)
9	CHECK VALVE
10	RESTRAINED END CAP
11	METER BOX 2 (REFER TO METER SCHEDULE) W/ PURPLE LID

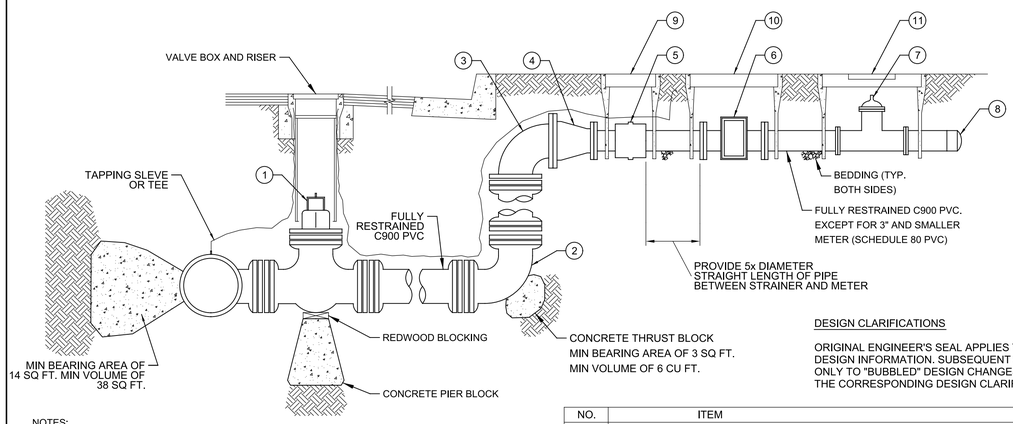


NOTES:

1. LOCATE INSULATING BUSHING OR "D.E" COUPLING AT ALL LOCATIONS WHERE DISSIMILAR METALS JOIN.
2. S.S. BAND SERVICE SADDLE FOR ALL MAINS.
3. INSTALL CORPORATION STOP WITH KEY SIDEWAYS, IN OPEN POSITION (FOR HOT TAP).
4. THE CORPORATION STOP TAP WILL BE MADE AS SPECIFIED BY THE PIPE MANUFACTURER. ALL DRY TAPS WILL BE MADE USING MACHINE GUIDE OR PILOT TAP.
5. THE WATER SERVICE SHALL EXTEND PERPENDICULAR TO THE CENTERLINE OF THE STREET FROM THE WATER MAIN TO THE METER STOP EXCEPT WHERE NON- PERPENDICULAR INSTALLATION IS ALLOWED.
6. NO TAP TO MAIN SHALL BE WITHIN 18" OF VALVE, COUPLING, JOINT OR FITTING.
7. NO SPLICES WILL BE PERMITTED BETWEEN CORPORATION STOP AND ANGLE METER STOP. SERVICE RUN EXCEEDS 20 FEET, IN WHICH CASE A SILVER SOLDER COUPLING SHALL BE USED.
8. METER BOXES ARE NOT TO BE PLACED IN DRIVEWAYS.
9. LID SHALL BE MARKED "UKIAH RECYCLED WATER", COLOR SHALL BE PURPLE.
10. WARNING TAG SHALL BE PLACED IN THE RECYCLED WATER FACILITY.
11. #10 AWG SOLID COPPER THHN-THNN WIRE TO BE CONNECTED AT ALL SPLICES WITH SILICONE FILLED DIRECT BURIED WIRE NUTS. EXTEND TRACER WIRE TO METER BOX.
12. SEE DETAIL 4 IN DWG CP-6 FOR CORROSION PROTECTION.
13. CONTRACTOR TO CONFIRM ALL METER BOX LOCATIONS WITH CITY PRIOR TO CONSTRUCTION. LOCATION OF METER BOX AND SERVICE FROM RW MAIN AS SHOWN ON PLANS SUBJECT TO CHANGE IN FIELD ALONG EACH SERVICE PARCEL PER DIRECTION OF CONSTRUCTION MANAGER. CONTRACOR SHALL FURNISH AND INSTALL PIPE FITTINGS, VALVES, AND RELATED ITEMS SHOWN AT NO ADDITIONAL COST TO THE OWNER.

CY901 TYP R — 1 1/2" OR 2" METER ASSEMBLY

SHEET 1 OF 2 — 6/17/20



NOTES:

1. BOX PIPE KNOCKOUTS TO BE GROUTED SUFFICIENTLY TO PREVENT INTRUSION OF DIRT. PIPE OPENINGS IN BOX TO BE NEATLY CUT - DO NOT USE HAMMER.
2. RESTRAINED JOINTS ARE REQUIRED FOR ALL NEW CONSTRUCTION FROM GATE VALVE TO 90° BEND. THRUST BLOCKS ARE ONLY REQUIRED WHERE EXISTING SERVICES ARE BEING MODIFIED AND RESTRAINED JOINTS ARE NOT USED.
3. ALL BOXES AND COVERS SHALL BE RATED FOR TRAFFIC LOADING.
4. CONTRACTOR TO CONFIRM ALL METER BOX LOCATIONS WITH CITY PRIOR TO CONSTRUCTION. LOCATION OF METER BOX AND SERVICE FROM RW MAIN AS SHOWN ON PLANS SUBJECT TO CHANGE IN FIELD ALONG EACH SERVICE PARCEL PER DIRECTION OF CONSTRUCTION MANAGER. CONTRACOR SHALL FURNISH AND INSTALL PIPE FITTINGS, VALVES, AND RELATED ITEMS SHOWN AT NO ADDITIONAL COST TO THE OWNER.

NO.	ITEM	SIZE
1	GATE VALVE	REFER TO METER SCHEDULE - SERVICE LINE SIZE
2	90° BEND (RESTRAINED MECHANICAL JOINT OR FLANGED)	
3	90° FLANGED OR FLANGE/MECHANICAL JOINT	
4	REDUCER (FLANGED)	SERVICE LINE SIZE TO METER SIZE
5	WATER METER STRAINER	REFER TO METER SCHEDULE - METER SIZE
6	WATER METER	
7	COMBINATION PRV/CHECK VALVE (REFER TO SECTION 15118)	
8	RESTRAINED PVC PIPE END CAP	
9	METER BOX 1	REFER TO METER SCHEDULE - SIZE AND LABEL
10	METER BOX 2	
11	METER BOX 3	

DESIGN CLARIFICATIONS

ORIGINAL ENGINEER'S SEAL APPLIES TO THE ORIGINAL DESIGN INFORMATION. SUBSEQUENT SEAL(S) ARE APPLIED ONLY TO "BUBBLED" DESIGN CHANGES ASSOCIATED WITH THE CORRESPONDING DESIGN CLARIFICATION NUMBER.

CY901 TYP J — 3", 4", OR 6" METER ASSEMBLY

08/04/16

VERTICAL BEND ANGLE		18" PVC THRUST RESTRAINT LENGTH (LF)	12" PVC THRUST RESTRAINT LENGTH (LF)
90°	UPPER BEND	315	217
	LOWER BEND	77	54

HORIZONTAL BEND ANGLE	18" PVC THRUST RESTRAINT LENGTH (LF)	16" PVC THRUST RESTRAINT LENGTH (LF)	12" PVC THRUST RESTRAINT LENGTH (LF)	10" PVC THRUST RESTRAINT LENGTH (LF)	8" PVC THRUST RESTRAINT LENGTH (LF)	6" PVC THRUST RESTRAINT LENGTH (LF)	4" PVC THRUST RESTRAINT LENGTH (LF)
11.25°	8	7	5	5	4	3	2
22.5°	15	14	11	9	8	6	4
45°	32	29	22	19	16	12	8
90°	77	69	54	45	38	29	20

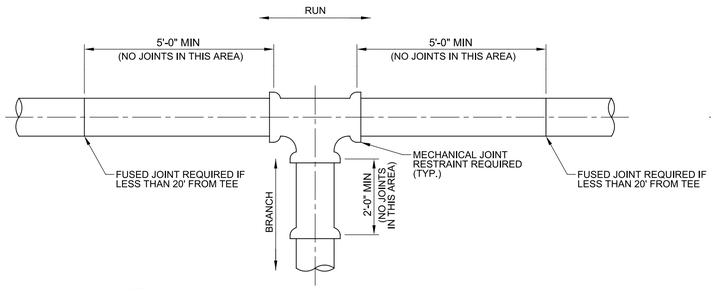
OTHER FITTINGS	18" PVC THRUST RESTRAINT LENGTH (LF)	16" PVC THRUST RESTRAINT LENGTH (LF)	12" PVC THRUST RESTRAINT LENGTH (LF)	10" PVC THRUST RESTRAINT LENGTH (LF)	8" PVC THRUST RESTRAINT LENGTH (LF)	6" PVC THRUST RESTRAINT LENGTH (LF)	4" PVC THRUST RESTRAINT LENGTH (LF)
DEAD END	220	198	151	127	105	79	56

NOTES:

1. THRUST RESTRAINT DESIGN PRESSURE: 225 PSI, SOIL TYPE: CL GRANULAR FILL, SAFETY FACTOR: 2, TRENCH TYPE: 5, DEPTH OF BURY, 4 FT. NOTIFY ENGINEER IF FIELD CONDITIONS DIFFER.
2. LENGTHS SHALL APPLY EACH WAY FROM BEND OR VALVE. FOR A TEE OR WYE, THE LENGTH SHALL APPLY TO THE BRANCH SIDE OF THE FITTING (ADDITIONALLY, RESTRAIN ONE STANDARD JOINT LENGTH OF PIPE ALONG THE RUN SIDE OF THE TEE OR WYE). SEE DETAIL A.
3. EXTEND ALL LENGTHS TO THE NEXT PIPE JOINT PAST REQUIRED LENGTH.
4. PIPE SHALL BE FULLY RESTRAINED IN RADIAL CURVES, RESTRAIN PIPE ONE FULL PIPE LENGTH (20') BEFORE POINT OF CURVATURE (PC) AND ONE FULL PIPE LENGTH AFTER POINT OF TANGENCY (PT) (20').
5. MAX. ALLOWABLE DEFLECTION AT BELL JOINT HALF OF THE MANUFACTURERS SPECIFIED DEFLECTION.

CY907 TYP J — PIPE RESTRAINT REQUIREMENTS

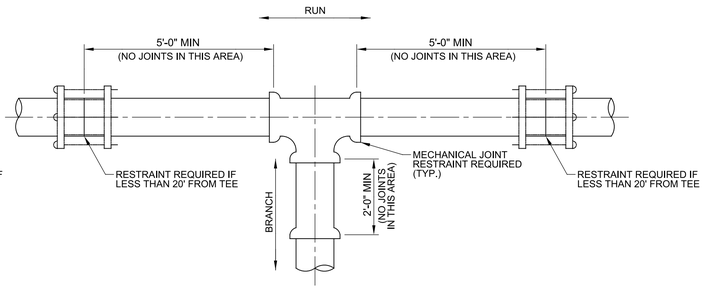
04/23/14



NOTES:

1. ALONG THE RUN OF THE TEE, NO JOINTS SHALL BE WITHIN 5 FEET OF TEE CONNECTION.
2. ALONG THE BRANCH OF THE TEE, NO JOINTS SHALL BE WITHIN 2 FEET OF TEE CONNECTION.

FUSIBLE PVC



MECHANICAL RESTRAINT

A - DETAIL - TEE RESTRAINT

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED JD
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

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RECYCLED WATER PROJECT - PHASE 4

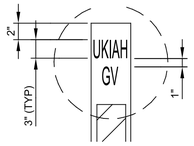
TYPICALS

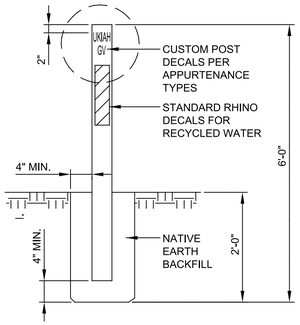
TYPICAL DETAILS PIPING

VERIFY SCALES
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00TP03
SHEET NO. 188 OF 200

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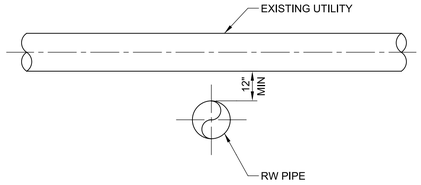


LETTERS	APPURTENANCE
BO	BLOWOFF
BV	BUTTERFLY VALVE
GV	GATE VALVE
AV	AIR VALVE
TO	TURNOUT

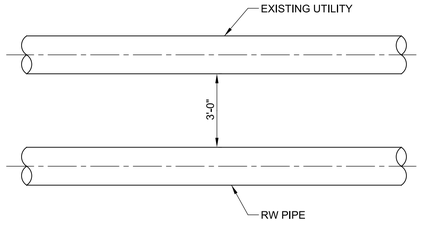
NOTES:

1. MARKER POSTS SHALL BE IN PURPLE. (PANTONE 512 OR EQUAL).
2. MARKER POSTS SHALL BE SET WITHIN 2-FEET OF THE ABOVE GROUND APPURTENANCE AND SET TRUE FACING THE FACILITY WHERE POSSIBLE AND PER CONSTRUCTION MANAGER'S DIRECTION.
3. MARKER POSTS SHALL BE "RHINO 3-RAIL" FIBERGLASS COMPOSITE POSTS BY REPNET, INC. OR APPROVED EQUAL.

CY908 TYP J — MARKER POST — 04/23/14

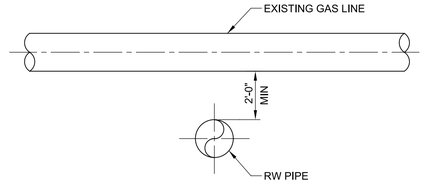


PERPENDICULAR CROSSING

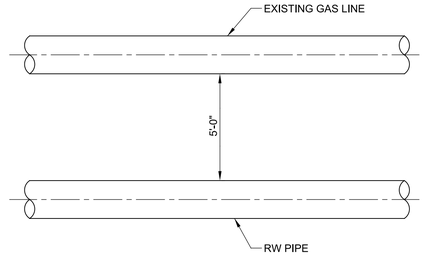


PARALLEL ALIGNMENT

CY921 TYP J — EXISTING UTILITY CROSSING — 10/06/14

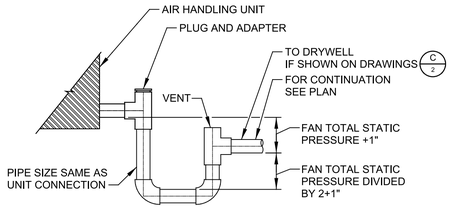


PERPENDICULAR CROSSING

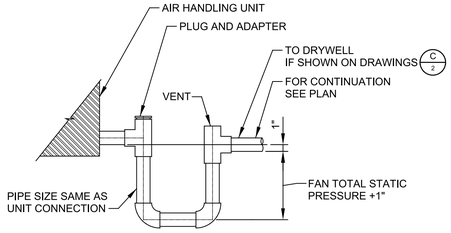


PARALLEL ALIGNMENT

CY922 TYP J — GAS LINE CROSSING — 10/06/14

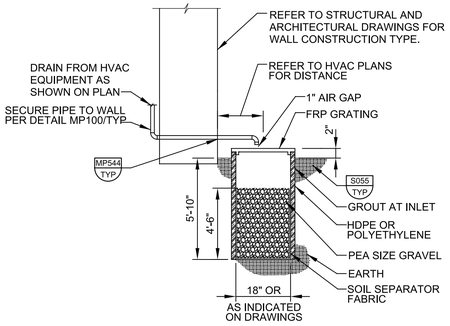


A DRAW THRU UNIT



B BLOW THRU UNIT

HE620 TYP S — PIPE CONNECTION - AC CONDENSATE — SHEET 1 OF 2 — 12/28/18



C 1 DRYWELL

NOTE:

1. ROUTE CONDENSATE LINE BELOW GRADE AND ENTER SIDE OF DRYWELL IF CONDENSATE PIPE IS TRIPPING HAZARD.

HE620 TYP S — PIPE CONNECTION - AC CONDENSATE — SHEET 2 OF 2 — 12/28/18

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED JD
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

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RECYCLED WATER PROJECT - PHASE 4

TYPICALS

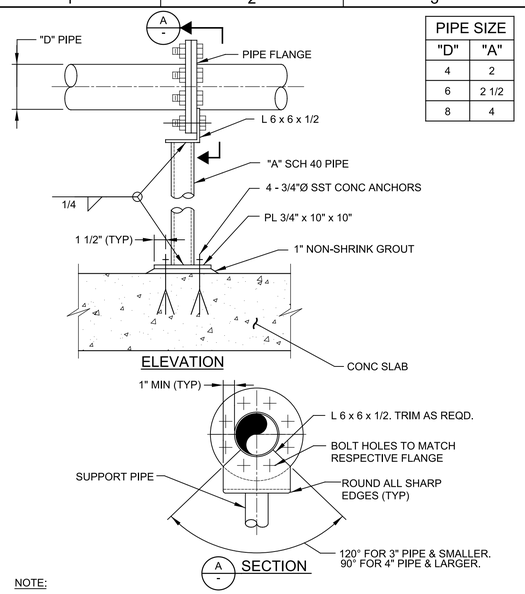
TYPICAL DETAILS PIPING

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00TP04
SHEET NO. 189 OF 200

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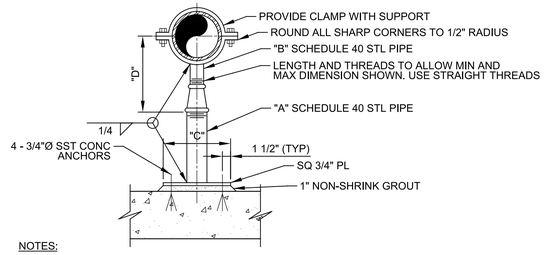
PIPE SIZE	
"D"	"A"
4	2
6	2 1/2
8	4

NOTE:

1. IF SUPPORT IS SUBMERGED OR LOCATED BELOW THE TOP OF WALL IN WATER BEARING STRUCTURE, ALL MATERIAL FOR SUPPORT SHALL BE STAINLESS STEEL. IN ALL OTHER AREAS, ALL MATERIAL FOR SUPPORT SHALL BE HOT-DIP GALVANIZED STEEL UNLESS OTHERWISE INDICATED ON DRAWINGS. HOT-DIP GALVANIZE AFTER FABRICATION.

MP032 TYP NS — PIPE SUPPORT - POST ON CONCRETE: FIXED HEIGHT STEEL W/ TOP CONNECTION TO PIPE FLANGE — 12/01/22

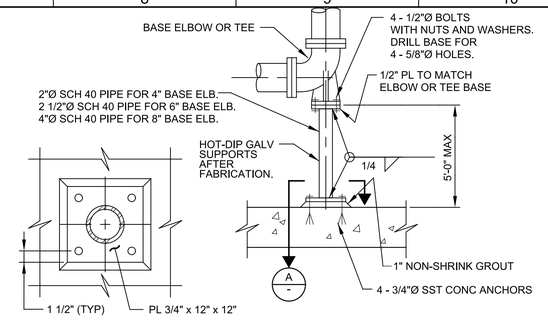
ADJUSTABLE PIPE SADDLE SUPPORT SCHEDULE (INCHES)					
SIZE OF SUPPORTED PIPE **	PIPE SIZE "A"	PIPE SIZE "B"	"C"	"D" MINIMUM	"D" MAXIMUM
2 1/2 *	2 1/2	1 1/2	12	8	13
3	2 1/2	1 1/2	12	8 1/2	13 1/2
3 1/2	2 1/2	1 1/2	12	8 1/2	13 1/2
4	3	2 1/2	12	9 1/2	14
6	3	2 1/2	12	10 1/2	15 1/2
8	3	2 1/2	12	11 1/2	16 1/2
10	3	2 1/2	12	13 1/2	18 1/2
12	3	2 1/2	12	15	19 1/2
14	4	3	12	16 1/2	20 1/2
16	4	3	12	17 1/2	22 1/2
18	6	3 1/2	14	19 1/2	24
20	6	3 1/2	14	21	25 1/2
24	6	4	14	23 1/2	28 1/2
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32	6	4	14	28 1/2	32 1/2
36	6	4	14	30 1/2	34 1/2



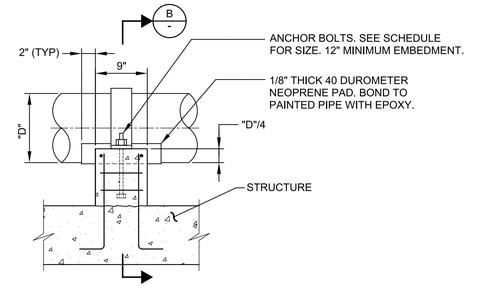
NOTES:

1. HOT-DIP GALVANIZED SUPPORT AFTER FABRICATION.
2. * = USE 2 1/2" SUPPORTS FOR PIPES LESS THEN 2 1/2"Ø.
3. ** = NOMINAL PIPE SIZE.

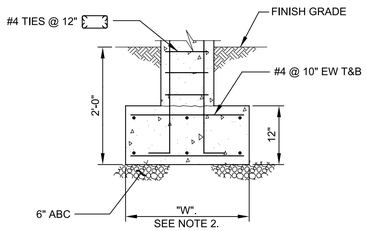
MP034 TYP NS — PIPE SUPPORT - POST ON CONCRETE: ADJUSTABLE HEIGHT STEEL W/ TOP SADDLE — 12/01/22



MP080 TYP NS — PIPE SUPPORT - BASE ELBOW OR TEE - DUCTILE IRON PIPE ON CONCRETE PEDESTAL — 12/01/22



MP100 TYP N — PIPE SUPPORT - CONCRETE CRADLE — SHEET 1 OF 2 — 12/01/22

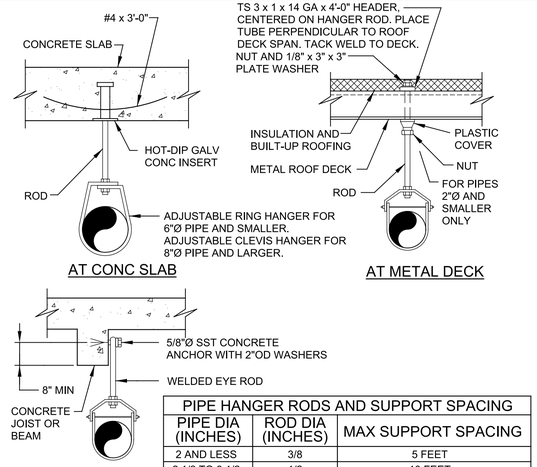


SCHEDULE		
PIPE SIZE	STRAP SIZE	ANCHOR BOLT DIA
8" - 12"	FB 1/4" x 4"	1/2"
14" - 24"	FB 5/16" x 4"	5/8"
26" - 36"	FB 3/8" x 4"	3/4"

NOTES:

1. IF SUPPORT IS SUBMERGED OR LOCATED BELOW THE TOP OF WALL IN WATER BEARING STRUCTURE, MATERIAL FOR ANCHOR BOLTS AND STRAP SHALL BE STAINLESS STEEL. IN ALL OTHER AREAS, THE MATERIAL FOR ANCHOR BOLTS AND STRAP SHALL BE HOT-DIP GALVANIZED STEEL UNLESS OTHERWISE INDICATED ON THE DRAWINGS.
2. THE WIDTH OF THE FOOTING "W" = 2'-6". THE LENGTH OF THE FOOTING = "D" + 2'-0".

MP100 TYP N — PIPE SUPPORT - CONCRETE CRADLE — SHEET 2 OF 2 — 12/01/22

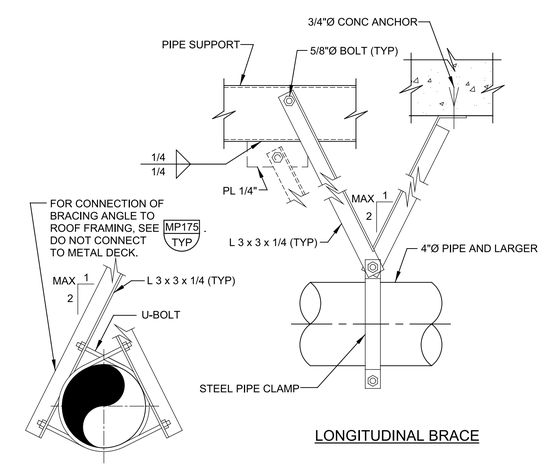


PIPE HANGER RODS AND SUPPORT SPACING		
PIPE DIA (INCHES)	ROD DIA (INCHES)	MAX SUPPORT SPACING
2 AND LESS	3/8	5 FEET
2 1/2 TO 3 1/2	1/2	10 FEET
4 TO 5	5/8	10 FEET
6	3/4	10 FEET
8	7/8	10 FEET
10	7/8	10 FEET
12	7/8	10 FEET

NOTES:

1. ISOLATE ALL COPPER PIPE FROM SUPPORT WITH PVC TAPE.
2. ALL MATERIALS SHALL BE HOT-DIP GALVANIZED.
3. PROVIDE ADDITIONAL HANGER AT EACH SIDE OF ALL VALVES 4 INCHES AND LARGER.

MP132 TYP N — PIPE SUPPORT - OVERHEAD ROD W/ ADJUSTABLE RING OR CLEVIS — SHEET 1 OF 2 — 12/01/22



NOTES:

1. MAXIMUM LONGITUDINAL BRACE SPACING = 20'-0".
2. MAXIMUM TRANSVERSE BRACE SPACING = 20'-0".
3. DO NOT CONNECT BRACE TO BOTTOM OF ROOF BEAM OR C8 PIPE SUPPORT, EXCEPT AS SHOWN IN MP175 TYP.
4. USE LONGITUDINAL AND TRANSVERSE BRACES FOR PIPES 4" AND LARGER.

MP132 TYP N — PIPE SUPPORT - OVERHEAD ROD W/ ADJUSTABLE RING OR CLEVIS — SHEET 2 OF 2 — 12/01/22

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
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CHECKED JD
DATE JULY 2023

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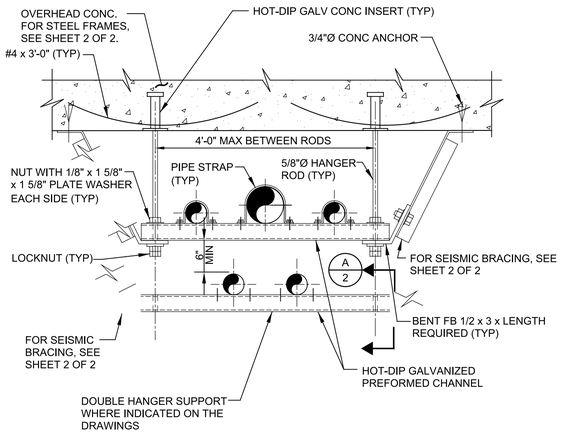
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
TYPICALS
TYPICAL DETAILS PIPING

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00TP05
SHEET NO. 190 OF 200

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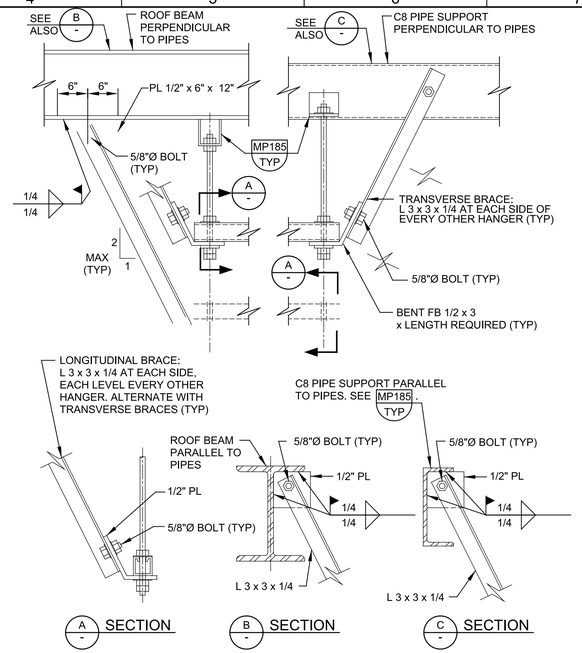


NOTES:

1. HANGER SPACING SHALL BE BASED ON MAXIMUM SPAN ALLOWABLE FOR ANY INDIVIDUAL PIPE.
2. ALL-THREAD ROD SHALL BE USED ONLY FOR DOUBLE SUPPORTS.
3. ALL MATERIALS SHALL BE HOT-DIP GALVANIZED.

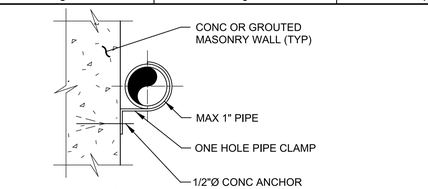
MP175 TYP — PIPE SUPPORT - OVERHEAD TRAPEZE - DOUBLE BEAM

N — SHEET 1 OF 2 — 12/01/22

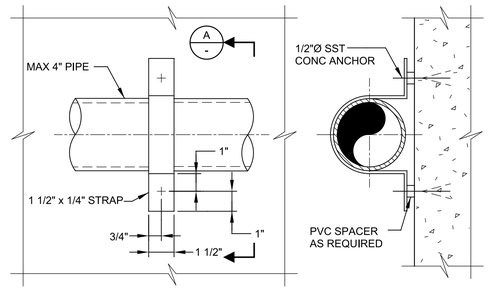


MP175 TYP — PIPE SUPPORT - OVERHEAD TRAPEZE - DOUBLE BEAM

N — SHEET 2 OF 2 — 12/01/22



SECTION



ELEVATION

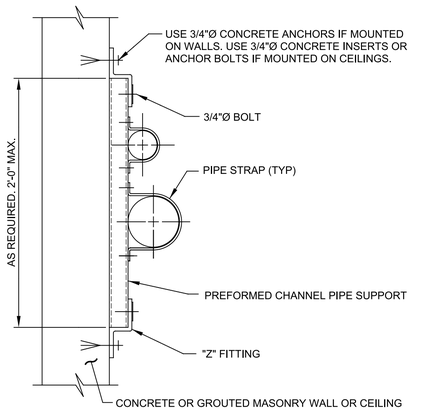
A - SECTION

NOTE:

1. IF SUPPORT IS SUBMERGED OR LOCATED BELOW THE TOP OF WALL IN WATER BEARING STRUCTURE, ALL MATERIAL SHALL BE STAINLESS STEEL. IN ALL OTHER AREAS, ALL MATERIAL SHALL BE HOT-DIP GALVANIZED STEEL UNLESS OTHERWISE INDICATED ON THE DRAWINGS.

MP215 TYP — PIPE SUPPORT - WALL - PIPE CLIP

12/01/22

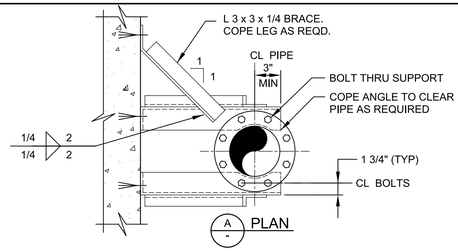


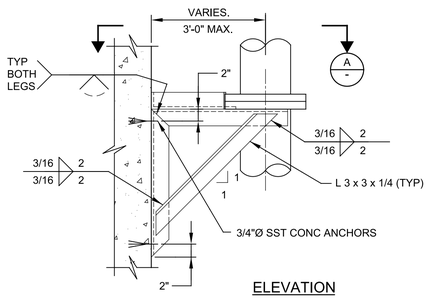
NOTES:

1. IF SUPPORT IS SUBMERGED OR LOCATED BELOW THE TOP OF WALL IN WATER BEARING STRUCTURE, ALL MATERIAL SHALL BE STAINLESS STEEL. IN ALL OTHER AREAS, THE MATERIALS SHALL BE HOT-DIP GALVANIZED STEEL UNLESS OTHERWISE INDICATED ON THE DRAWINGS. HOT-DIP GALVANIZE AFTER FABRICATION.
2. SPACE PREFORMED CHANNEL PIPE SUPPORTS AT MAXIMUM 5'-0" O.C.

MP218 TYP — PIPE SUPPORT - WALL - PREFORMED CHANNEL W/ PIPE CLIPS

N — 12/01/22





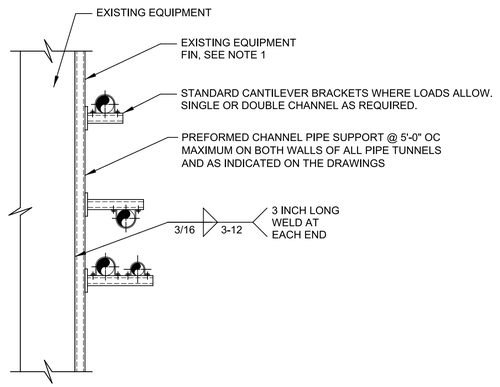
ELEVATION

NOTE:

1. HOT-DIP GALVANIZE SUPPORT AFTER FABRICATION.

MP250 TYP — PIPE SUPPORT - WALL - VERTICAL PIPE ON FABRICATED SUPPORT AT FLANGES

N — 12/01/22



NOTES:

1. LOCATE PIPE SUPPORTS BETWEEN EQUIPMENT FIN PROJECTIONS AND MAINTAIN 2" MINIMUM CLEAR DISTANCE BETWEEN THE FIN AND THE PIPE.

MP272 TYP — PIPE RACK AT EXISTING EQUIPMENT

J — 12/01/22

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
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DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

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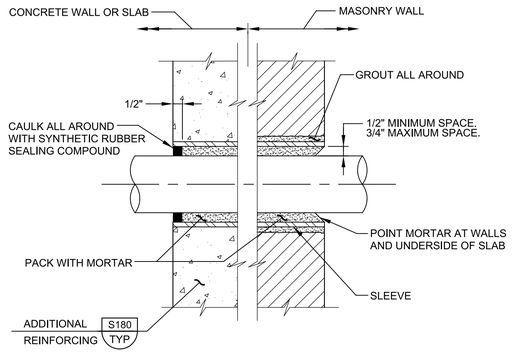
City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
TYPICALS
TYPICAL DETAILS PIPING

VERIFY SCALES
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0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

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DRAWING NO. 00TP06
SHEET NO. 191 OF 200

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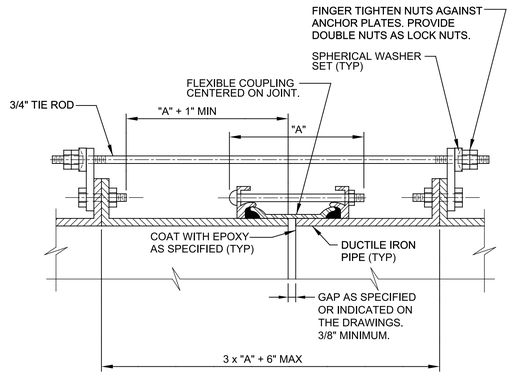


NOTES:

1. 6"Ø DIAMETER SLEEVES AND SMALLER SHALL BE SCHEDULE 40 STEEL PIPE OR SCHEDULE 80 PVC PIPE.
2. SLEEVES LARGER THAN 6"Ø SHALL BE 1/4" THICK STEEL PIPE.
3. STEEL SLEEVE SHALL BE HOT-DIP GALVANIZED AFTER FABRICATION.
4. SLEEVES FOR ELECTRICAL CONDUIT SHALL BE SCHEDULE 80 PVC.

MP302 TYP — SLEEVE INSTALLATION THROUGH DRY WALLS AND FLOOR SLABS

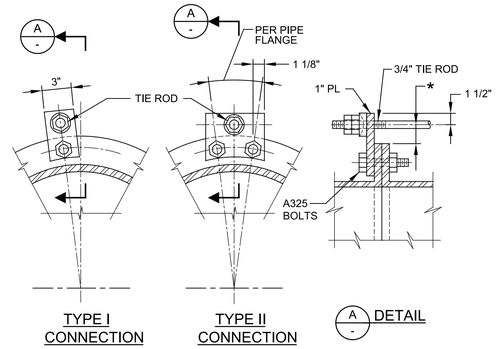
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ROD SCHEDULE		
PIPE THRUST. SEE NOTE 2.	TYPE OF CONNECTION	NO. OF RODS
0-6,000#	I	2
6,001 - 12,000#	II	2
12,001 - 18,000#	II	3
18,001 - 24,000#	II	4
24,001 - 30,000#	II	5

MP310 TYP — PIPE JOINT - DIP - FLEXIBLE COUPLING - RESTRAINED

N SHEET 1 OF 2 12/01/22

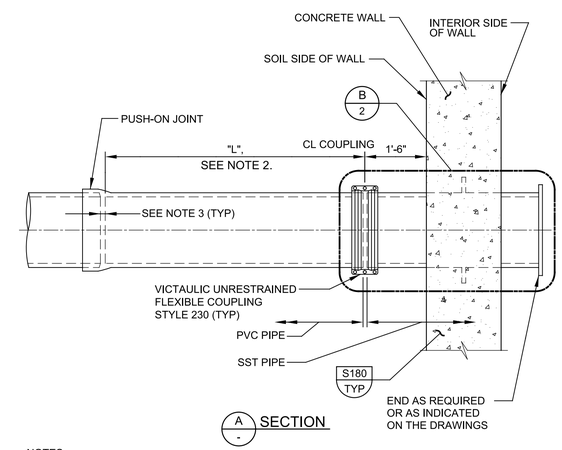


NOTES:

1. ALL EXPOSED FLEXIBLE COUPLINGS SHALL HAVE TIE RODS UNLESS SPECIFICALLY INDICATED OTHERWISE ON THE DRAWINGS.
2. PIPE THRUST SHALL BE BASED ON TEST PRESSURE.
3. PIPE THRUST = 0.7854 x D^2 x TEST PRESSURE, WHERE "D" IS PIPE OD.
4. MINIMUM TIE ROD YIELD = 48,000 PSI.
5. FOR THRUSTS GREATER THAN 30,000 POUNDS, ADD ONE 3/4 INCH DIAMETER TIE ROD FOR EVERY 6,000 POUNDS INCREASE IN THRUST.
6. ALL ROD CONNECTIONS SHALL BE TYPE II FOR THRUSTS GREATER THAN 30,000 POUNDS.
7. GRIND ALL CORNERS SMOOTH.
8. * = AS REQUIRED TO CLEAR FLEXIBLE COUPLING. 3/4" MINIMUM AND 1 1/2" MAXIMUM.

MP310 TYP — PIPE JOINT - DIP - FLEXIBLE COUPLING - RESTRAINED

N SHEET 2 OF 2 12/01/22

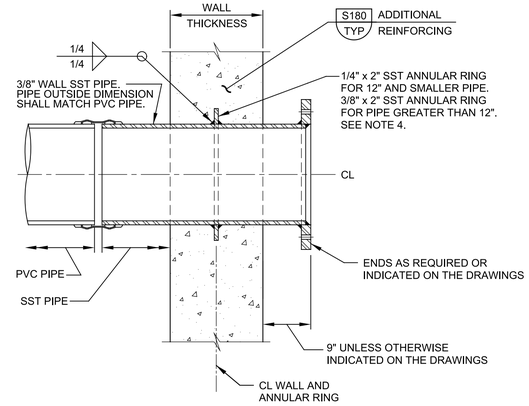


NOTES:

1. PIPES SHALL BE INSTALLED STRAIGHT WITHOUT HORIZONTAL OR VERTICAL OFFSET. DO NOT USE ANGULAR DEFLECTION OF COUPLING AND PIPE JOINT TO MAKE UP FOR MISALIGNED PIPE.
2. "L" = LENGTH INDICATED ON THE DRAWINGS.
3. GAP BETWEEN END OF PIPE AS INDICATED ON THE DRAWINGS OR SPECIFIED.
4. INSTALL ANNULAR RING ON PIPE SO THAT IT IS LOCATED AT CENTER OF WALL AND IN PLANE PARALLEL TO FACE OF WALL.

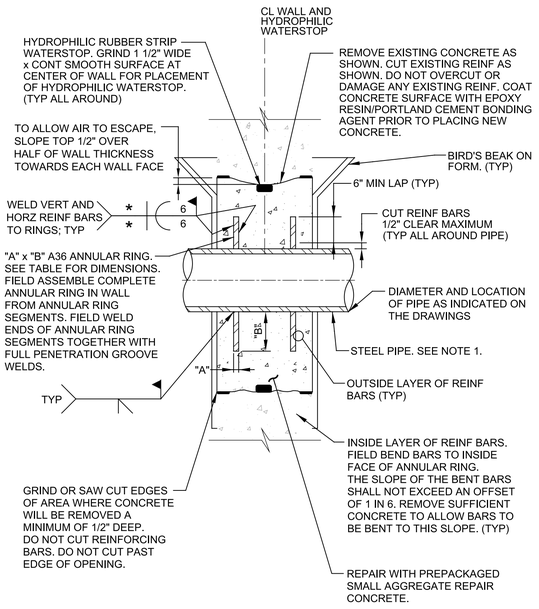
MP370 TYP — UNRESTRAINED PVC AWWA C900 PIPE FLEXIBLE CONNECTION AT WALL PENETRATION

N SHEET 1 OF 2 03/02/15



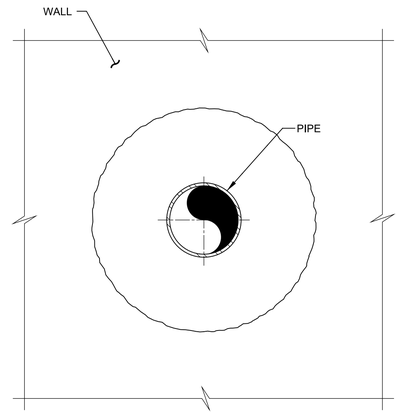
MP370 TYP — UNRESTRAINED PVC AWWA C900 PIPE FLEXIBLE CONNECTION AT WALL PENETRATION

N SHEET 2 OF 2 03/02/15



MP532 TYP — WALL PENETRATION - EXISTING CONCRETE - STEEL PIPE W/ REINF RINGS

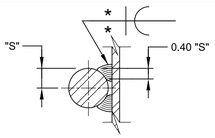
NS SHEET 1 OF 3 12/01/22



ELEVATION

MP532 TYP — WALL PENETRATION - EXISTING CONCRETE - STEEL PIPE W/ REINF RINGS

NS SHEET 2 OF 3 12/01/22



WELDED SPLICE BAR

LOCATION OF PIPE PENETRATION	THICKNESS OF ANNULAR RING "A"	WIDTH OF ANNULAR RING "B"

NOTES:

1. FIELD APPLY LINING AFTER WELDING IS COMPLETE.
2. CUT WALL REINFORCING THAT INTERFERING WITH PIPE. DO NOT CUT OR DAMAGE ANY OTHER BARS.
3. * = 0.40 "S" REINFORCING BAR RADIUS.
4. E 70 ELECTRODE FOR GRADE 40 REINF BARS; E 90 ELECTRODE FOR GRADE 60 REINF BARS.
5. SEE AWS D1.4 FOR WELDING PROCESS, PREHEAT REQUIREMENTS, AND OTHER DETAILS. SUBMIT WELDING PROCEDURE PER AWS.
6. USE FORMING WITH "BIRDS PEAK" ON BOTH WALL FACES FOR ACCESS FOR VIBRATOR AND TO ALLOW CONCRETE TO BE PLACED UNDER SLIGHT PRESSURE. AFTER FORMS ARE REMOVED, REMOVE PROJECTING CONCRETE AND FINISH TO MATCH FINISH OF EXISTING WALL.
7. WATER CURE REPAIRED CONCRETE FOR MINIMUM OF 7 DAYS. KEEP REPAIRED AREA CONTINUOUSLY WET.

MP532 TYP — WALL PENETRATION - EXISTING CONCRETE - STEEL PIPE W/ REINF RINGS

NS SHEET 3 OF 3 12/01/22

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED JD
DATE JULY 2023

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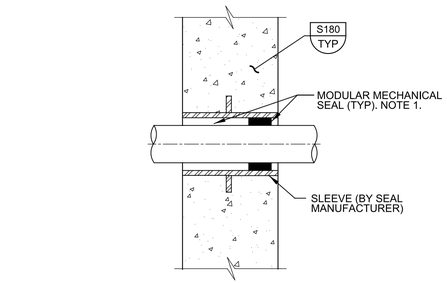
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City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
TYPICALS
TYPICAL DETAILS PIPING

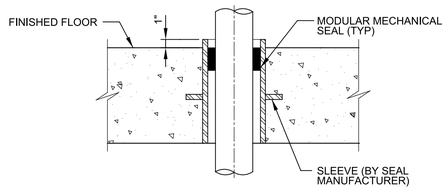
VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00TP07
SHEET NO. 192 OF 200



NEW

A - WALL PENETRATION



NEW

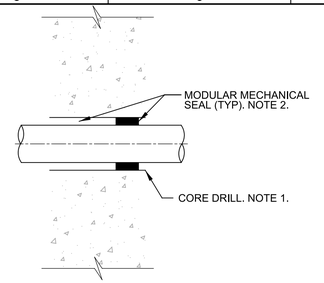
B - SLAB PENETRATION

NOTES:

1. WALLS THICKER THAN 12" INSTALL MODULAR MECHANICAL SEAL AT BOTH ENDS OF WALL SLEEVE.

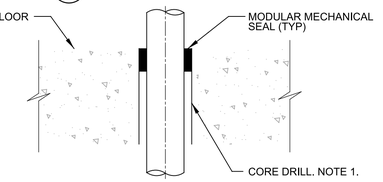
MP544 TYP — WALL PENETRATION - CAST-IN SLEEEVE W/ BARRIER SEALS

NS SHEET 1 OF 2 12/01/22



EXISTING

A - WALL PENETRATION



EXISTING

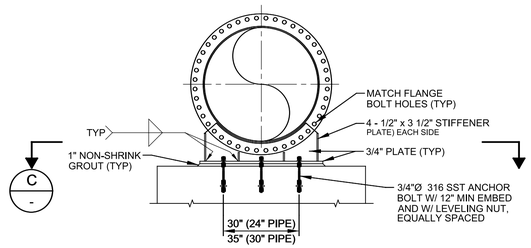
B - SLAB PENETRATION

NOTES:

1. CORE DRILL DIAMETER, PROCEDURES, AND POST -DRILLING SURFACE PREPARATION PER MODULAR MECHANICAL SEAL MANUFACTURER'S RECOMMENDATIONS FOR SPECIFIC PIPE OD.
2. WALLS 12" OR THICKER INSTALL MODULAR MECHANICAL SEAL AT BOTH ENDS OF PENETRATION.

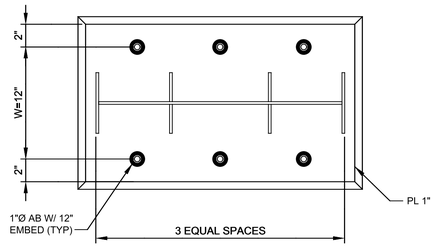
MP544 TYP — WALL PENETRATION - CAST-IN SLEEVE W/ BARRIER SEALS

NS SHEET 2 OF 2 12/01/22



C -

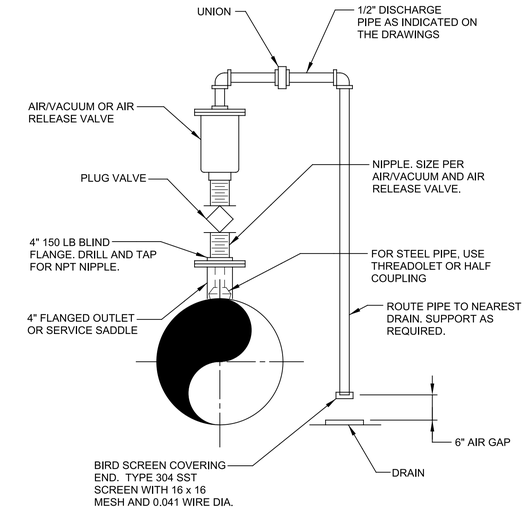
ELEVATION - 24" THROUGH 30" PIPE SUPPORT



C - SECTION

MP637 TYP — PIPE SUPPORT

J



NOTES:

1. VALVE SIZE SHALL BE AS INDICATED ON THE DRAWINGS.
2. SERVICE TAP AND PLUG VALVE SHALL MATCH VALVE INLET SIZE.

MP898 TYP — PIPING - VALVE - VACUUM AND AIR RELEASE: 3" AND SMALLER VALVE

12/01/22

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED CE
DRAWN CE
CHECKED JD
DATE JULY 2023

** ORIGINAL SEALED BY BRIAN W. AVON 4/10/2023 CA PE NO. 76832 **

carollo®

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

TYPICALS

TYPICAL DETAILS PIPING

VERIFY SCALES

BAR IS ONE INCH ON ORIGINAL DRAWING

0 1"

IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10

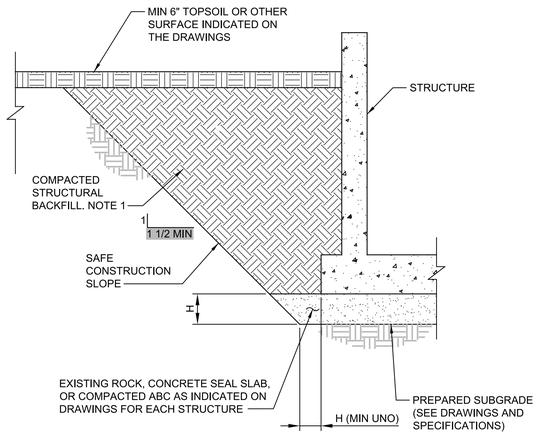
DRAWING NO. 00TP08

SHEET NO. 193 OF 200

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Model: Layout1
LAST SAVED BY: kjackson



NOTES:

1. SEE SPECIFICATIONS FOR ACCEPTABLE BACKFILL MATERIALS.

S055 TYP S — STRUCTURAL BACKFILL - OUTSIDE STRUCTURE

07/08/16

1. SEE DIVISION 03 SPECIFICATION FOR REQUIREMENTS FOR CONCRETE CONSTRUCTION.
2. UNLESS OTHERWISE INDICATED ON THE DRAWINGS, MINIMUM REINFORCEMENT OF CONCRETE WALLS OR SLABS SHALL BE AS FOLLOWS. CONTACT ENGINEER FOR LOCATIONS INSIDE CONCRETE.
   10" THICK OR LESS: .....#5 @ 12" EACH WAY.
   MORE THAN 10" THICK: .....#5 @ 12" EACH WAY, EACH FACE.
3. WALL REINFORCEMENT AT CORNERS OR JUNCTIONS OF WALLS SHALL BE CONTINUOUS, LAP SPLICED, OR TERMINATED IN AN ACI STANDARD 90 DEGREE HOOK. SEE DETAIL S144/TYP.
4. UNLESS OTHERWISE INDICATED ON THE DRAWINGS, DOWELS BETWEEN ADJACENT CONCRETE PLACEMENTS SHALL BE THE SAME SIZE AND SPACING AS THE REINFORCEMENT WHICH IS SPLICED TO THE DOWELS.
5. SLAB, BEAM AND COLUMN REINFORCING BARS SHALL HAVE A MINIMUM EXTENSION OR ANCHORAGE INTO SUPPORTS IN ACCORDANCE WITH ACI 318 AND ACI 350.
6. PROVIDE STIRRUP SUPPORT BARS SHALL BE TO SECURE TOP BARS AGAINST DISPLACEMENT AS REQUIRED.
7. UNLESS OTHERWISE INDICATED ON THE DRAWINGS, CONCRETE COVER OVER #11 AND SMALLER REINFORCING BARS SHALL BE AS FOLLOWS:
   A. SLABS AND JOISTS:
      FORMED CONCRETE SURFACES AND UNFORMED TOP SURFACES FOR DRY CONDITIONS
      #7 BARS AND SMALLER.....1"
      #8 BARS AND LARGER.....1 1/2"
      FORMED CONCRETE SURFACES AND UNFORMED TOP SURFACES EXPOSED TO WEATHER, IN CONTACT WITH SOIL OR FLUIDS, OR LOCATED OVER FLUIDS.....2"
   B. BEAMS AND COLUMNS:
      FORMED CONCRETE SURFACES FOR DRY CONDITIONS:
      STIRRUPS, SPIRALS, AND TIES.....1 1/2"
      PRINCIPAL REINFORCEMENT.....2"
      FORMED CONCRETE SURFACES EXPOSED TO WEATHER, IN CONTACT WITH SOIL OR FLUIDS, OR IN BEAMS LOCATED OVER FLUIDS:
      STIRRUPS AND TIES.....2"
      PRINCIPAL REINFORCEMENT.....2 1/2"
   C. WALLS:
      FORMED CONCRETE SURFACES FOR DRY CONDITIONS:
      #7 BARS AND SMALLER.....1"
      #8 BARS AND LARGER.....1 1/2"
      FORMED CONCRETE SURFACES EXPOSED TO WEATHER, OR IN CONTACT WITH SOIL OR FLUIDS.....2"
   D. FOOTINGS AND SLABS ON GRADE:
      FORMED VERTICAL CONCRETE SURFACES.....2"
      AT UNFORMED CONCRETE SURFACES CAST AGAINST SOIL, ROCK, OR CONCRETE WORK MATS.....3"
      TOP SURFACE OF FOOTINGS AND SLABS.....SAME AS SLABS
8. WATERSTOPS:
   A. PROVIDE WATERSTOPS AT JOINTS IN SLABS AND WALLS OF LIQUID-CONTAINING STRUCTURES, AND PORTIONS OF STRUCTURES BELOW THE DESIGN GROUNDWATER LEVEL. MAKE WATERSTOPS CONTINUOUS THROUGH STRUCTURE, SPLICING WATERSTOPS IN SLABS WITH WATERSTOPS IN WALLS.
   B. END WATERSTOPS 3" BELOW TOP OF WALLS. WHERE TOP OF WALL IS COVERED BY A SLAB WITHOUT WATERSTOPS, CONTINUE WATERSTOP TO WALL/SLAB JOINT. WHERE TOP OF WALL IS COVERED BY A SLAB WITH WATERSTOPS, MAKE WATERSTOPS CONTINUOUS, SPLICING WATERSTOPS IN WALLS WITH WATERSTOPS IN SLAB.
9. CURE CONCRETE IN ACCORDANCE WITH THE CONTRACT DOCUMENTS. WHERE WATER CURING IS SPECIFIED, MEMBRANE CURING IS NOT ALLOWED.
   A. THE CONTRACTOR IS WARNED THAT WATER CURING IS DIFFICULT AT TIMES DUE TO WIND AND DRY CONDITIONS. STUDY SPECIFICATION REQUIREMENTS AND FURNISH ADEQUATE SYSTEMS TO PROVIDE WATER CURING WHERE REQUIRED.
   B. KEEP WATER CURED SURFACES VISIBLY MOIST AT ALL TIMES. FLOOD TOPS OF WALLS NOT LESS THEN 3 TIMES DAILY.
10. DO NOT PLACE BACKFILL AGAINST WALLS UNTIL:
    A. WALLS HAVE BEEN CAST TO FULL HEIGHT OF STRUCTURE AND CONCRETE HAS REACHED THE MINIMUM SPECIFIED COMPRESSIVE STRENGTH (f'c).
    B. CONNECTING SLABS AND BEAMS HAVE BEEN CAST AND CONCRETE IN THOSE ELEMENTS HAS REACHED THE MINIMUM SPECIFIED COMPRESSIVE STRENGTH (f'c).
11. LAP SPLICES:
    A. SEE TABLE 1 OF THIS DETAIL FOR LAP SPLICE LENGTHS.
    B. WHEN MULTIPLE BARS ARE SPLICED AT THE SAME SECTION, THE "CLEAR BAR SPACING" IS DEFINED AS THE MINIMUM CLEAR DISTANCE BETWEEN THE BARS OUTSIDE THE SPLICE LENGTH MINUS ONE BAR DIAMETER.
    C. UNLESS OTHERWISE INDICATED ON THE DRAWINGS, BARS AT A LAP SPLICE SHALL BE IN CONTACT WITH EACH OTHER.
    D. "TOP BARS" ARE HORIZONTAL REINFORCEMENT AT LOCATIONS WHERE MORE THAN 12 INCHES OF FRESH CONCRETE IS CAST IN THE MEMBER BELOW THE BAR.
12. FORM EXPOSED CONCRETE CORNERS AND EDGES WITH 3/4" CHAMFER UNLESS OTHERWISE INDICATED ON THE DRAWINGS.

S101 TYP S — REINFORCED CONCRETE NOTES

SHEET 1 OF 3 03/12/19

TABLE 1: REINFORCING BAR LAP SPLICES: f'c = 4000 PSI, Fy = 60,000 PSI				
BAR SIZE	MINIMUM COVER (BAR DIA)	MINIMUM CLEAR BAR SPACING (BAR DIA)	LAP SPLICE LENGTH (INCHES)	
			TOP BARS	OTHER BARS
#4	MORE THAN 1	MORE THAN 2	32 *	25 *
	MORE THAN 2	MORE THAN 4	20	16
#5	MORE THAN 1	MORE THAN 2	40 *	31 *
	MORE THAN 2	MORE THAN 4	26	20
#6	MORE THAN 1	MORE THAN 2	48 *	37 *
	MORE THAN 2	MORE THAN 4	30	24
#7	MORE THAN 1	MORE THAN 2	70 *	54 *
	MORE THAN 2	MORE THAN 4	43	33
#8	MORE THAN 1	MORE THAN 2	81 *	62 *
	MORE THAN 2	MORE THAN 4	50	38
#9	MORE THAN 1	MORE THAN 2	90 *	70 *
	MORE THAN 2	MORE THAN 4	56	42
#10	MORE THAN 1	MORE THAN 2	104 *	81 *
	MORE THAN 2	MORE THAN 4	62	48
#11	MORE THAN 1	MORE THAN 2	114 *	88 *
	MORE THAN 2	MORE THAN 4	69	54

REINFORCING BAR LAP SPLICE TABLE NOTES:

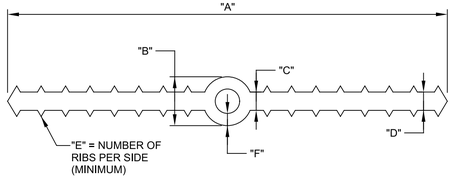
1. TABULATED SPLICE LENGTHS ARE APPLICABLE ONLY WHEN BOTH REQUIREMENTS FOR MINIMUM COVER AND FOR MINIMUM CLEAR BAR SPACING ARE SATISFIED.
2. * = IF THE CLEAR BAR SPACING IS LESS THAN OR EQUAL TO TWO BAR DIAMETERS, OR THE COVER IS LESS THAN OR EQUAL TO ONE BAR DIAMETER, THE LAP SPLICE LENGTH SHALL BE INCREASED BY 50 PERCENT.

S101 TYP S — REINFORCED CONCRETE NOTES

SHEET 2 OF 3 03/12/19

S101 TYP S — REINFORCED CONCRETE NOTES

SHEET 3 OF 3 03/12/19



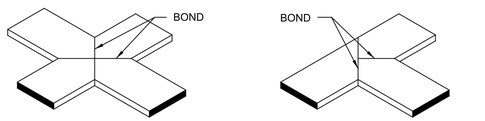
TYPE	"A"	"B"	"C"	"D"	"E"	"F"	APPLICATION
W/O CENTER BULB	6"	-	3/8"	3/8"	7	-	CONSTRUCTION AND CONTROL JOINTS
CENTER BULB	9"	1"	3/8"	3/8"	7	1/4"	EXPANSION JOINTS 1" AND NARROWER

NOTES:

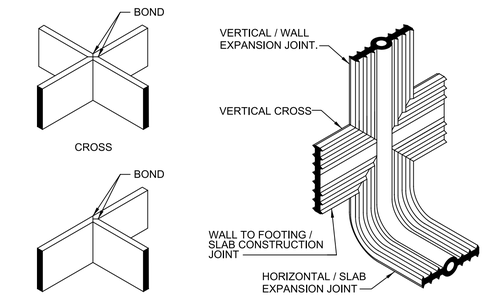
1. SEE SPECIFICATIONS FOR MATERIAL REQUIREMENTS.
2. DIMENSIONS ARE MINIMUM, UNLESS OTHERWISE NOTED.

S106 TYP — PVC WATERSTOP SCHEDULE

12/15/20



IN-PLANE JOINTS



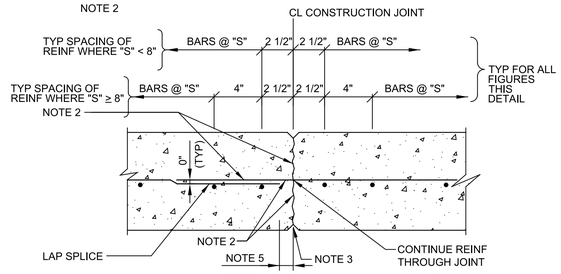
OUT-OF-PLANE JOINTS

NOTES:

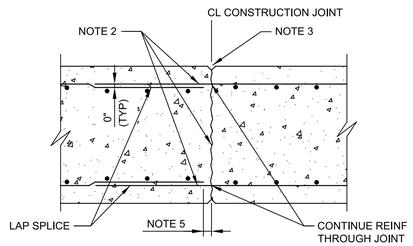
1. MAKE WELDS AS SPECIFIED AND IN ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDATIONS.
2. CROSSES AND TEES SHALL BE FACTORY PREFABRICATED BY THE MANUFACTURER. FIELD WELDS SHALL BE BUTT WELDS ONLY.

S107 TYP — PREFABRICATED PVC WATERSTOP JOINTS

07/08/16



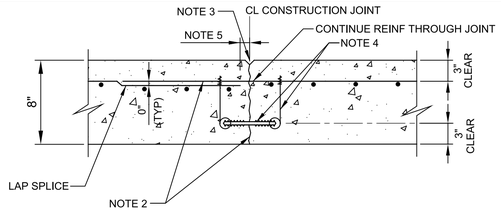
NON-WATER BEARING WALL OR SLAB
SINGLE LAYER REINFORCEMENT



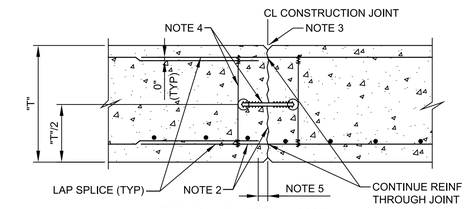
NON-WATER BEARING WALL OR SLAB
DOUBLE LAYER REINFORCEMENT

S110 TYP S — CONSTRUCTION JOINT

SHEET 1 OF 2 07/11/16



WATER BEARING SLAB LESS THAN 12" THICK



WATER BEARING SLAB OR WALL

NOTES:

1. "S" EQUALS TYPICAL BAR SPACING INDICATED ON THE DRAWINGS.
   "T" EQUALS SLAB OR WALL THICKNESS.
2. WATER-BLAST EXPOSED JOINT FACE AND PROJECTING REINFORCEMENT BEFORE PLACING CONCRETE.
3. JOINT EDGES:
   A. FOR WALLS AND BOTTOM OF EXPOSED SLABS: FORM EDGES WITH 1/2" CHAMFER.
   B. FOR SLABS: EDGE TOP AND ENDS WITH 1/4" RADIUS.
4. 6" WATERSTOP CENTERED ON JOINT - SEE DETAIL S106/TYP. PROVIDE WIRE TIES MAX 2'-0" OC. HOG RINGS MAY BE USED IN LIEU OF WIRE LOOPS. THOROUGHLY CLEAN WATERSTOP BEFORE PLACING CONCRETE IN SECOND POUR.
5. STOP REINFORCING 2" CLEAR OF JOINT.

S110 TYP S — CONSTRUCTION JOINT

SHEET 2 OF 2 07/11/16

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED JKN
DRAWN CE
CHECKED KP
DATE JULY 2023

** ORIGINAL SEALED BY JITESH K. RE NALAGOTLA 4/7/2023 CA PE NO. 86094 **

carollo®

City of Ukiah

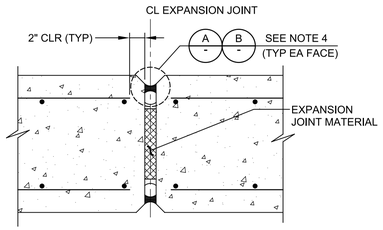
CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
TYPICALS
TYPICAL DETAILS STRUCTURAL

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

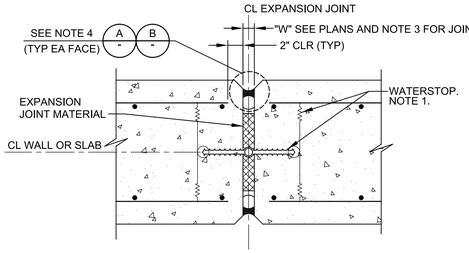
JOB NO. 8660F.10
DRAWING NO. 00TS01
SHEET NO. 194 OF 200

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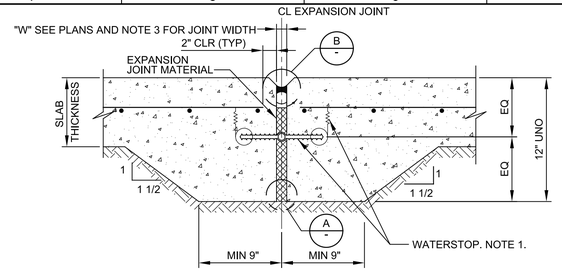
NON-WATER BEARING SLAB OR WALL



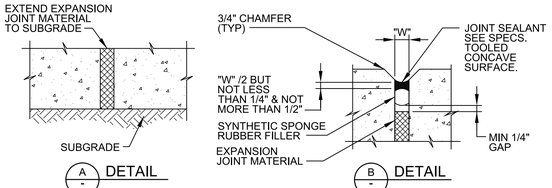
WATER BEARING SLAB OR WALL

S130 TYP S — EXPANSION JOINT

SHEET 1 OF 2 07/22/16



WATER BEARING SLAB LESS THAN 12" THICK

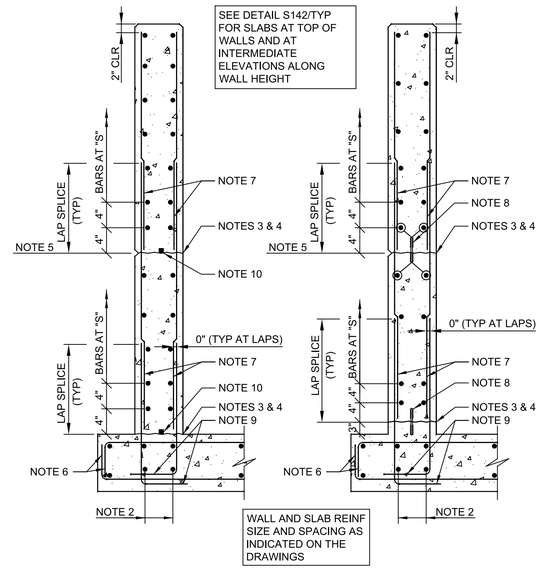


NOTES:

1. 9" WATERSTOP WITH CENTER BULB CENTERED ON JOINT - SEE DETAIL S106/TYP. PROVIDE WIRE TIES MAX 2'-0" OC. HOG RINGS MAY BE USED IN LIEU OF WIRE LOOPS. THOROUGHLY CLEAN WATERSTOP BEFORE PLACING CONCRETE IN SECOND POUR.
2. JOINT EDGES:
   A. FOR WALLS AND BOTTOM OF EXPOSED SLABS: FORM EDGES WITH 3/4" CHAMFER.
   B. FOR SLABS: EDGE TOP AND ENDS WITH 1/4" RADIUS.
3. "W"=1" UNLESS OTHERWISE INDICATED ON PLANS. (MIN JOINT WIDTH = 3/8". MAX JOINT WIDTH = 2")
4. USE DETAIL A ONLY AT SOIL SIDE OF SLABS ON GRADE. USE DETAIL B AT ALL OTHER LOCATIONS.

S130 TYP S — EXPANSION JOINT

SHEET 2 OF 2 07/22/16



S140 TYP S, N — CONSTRUCTION JOINT - WALLS

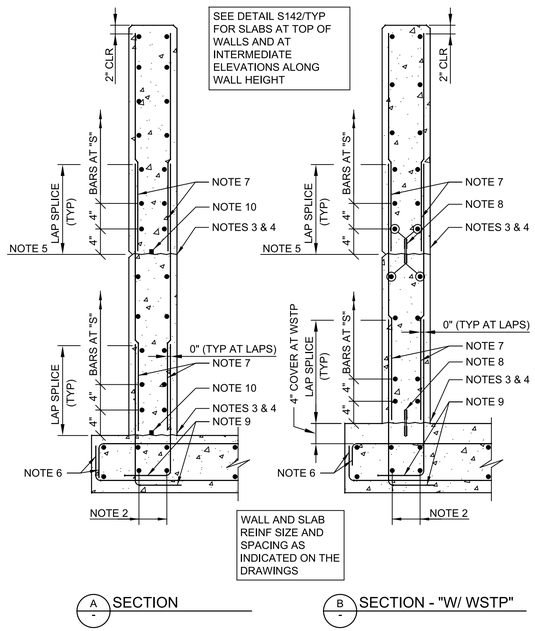
SHEET 1 OF 2 03/12/19

NOTES:

1. "S" EQUALS TYPICAL BAR SPACING INDICATED ON THE DRAWINGS.
2. PLACE AND ALIGN BARS BEFORE PLACING DOWELS. BAR SIZE TO MATCH SLAB BARS.
3. WATER-BLAST JOINT FACE AND PROJECTING REINFORCEMENT BEFORE PLACING CONCRETE.
4. PLACE CEMENT GROUT OVER JOINT FACE IMMEDIATELY BEFORE PLACING CONCRETE. (SEE SPECIFICATIONS.)
5. CONSTRUCTION JOINT WHERE INDICATED ON THE DRAWINGS. WHERE WALL SURFACE IS EXPOSED TO VIEW IN THE FINISHED WORK, PROVIDE V-GROOVE PER DETAIL S162/TYP.
6. STANDARD 90° HOOK WHERE INDICATED ON THE DRAWINGS. (ALTERNATE: PROVIDE 180° HOOK WHERE REQUIRED BY SLAB THICKNESS.)
7. DOWELS: SAME SIZE AND SPACING AS VERTICAL WALL BARS, UNLESS OTHERWISE NOTED.
8. 6" PVC WATERSTOP CENTERED VERTICALLY ON JOINT. PROVIDE WIRE TIES MAX 2'-0" OC. HOG RINGS MAY BE USED IN LIEU OF WIRE LOOPS. THOROUGHLY CLEAN WATERSTOP BEFORE PLACING CONCRETE.
9. STANDARD 90° HOOK UNLESS OTHERWISE INDICATED ON THE DRAWINGS.
10. WHERE DRAWINGS INDICATE "W/ STRIP WSTP" PROVIDE LOW EXPANSION HYDROPHILIC WATERSTOP AT TOP SURFACE OF JOINT AND CENTERED BETWEEN VERTICAL BARS.

S140 TYP S, N — CONSTRUCTION JOINT - WALLS

SHEET 2 OF 2 03/12/19



S141 TYP S, N — CONSTRUCTION JOINT - WALLS

SHEET 1 OF 2 11/08/21

NOTES:

1. "S" EQUALS TYPICAL BAR SPACING INDICATED ON THE DRAWINGS.
2. PLACE AND ALIGN BARS BEFORE PLACING DOWELS. BAR SIZE TO MATCH SLAB BARS.
3. WATER-BLAST JOINT FACE AND PROJECTING REINFORCEMENT BEFORE PLACING CONCRETE.
4. PLACE CEMENT GROUT OVER JOINT FACE IMMEDIATELY BEFORE PLACING CONCRETE. (SEE SPECIFICATIONS.)
5. CONSTRUCTION JOINT WHERE INDICATED ON THE DRAWINGS. WHERE WALL SURFACE IS EXPOSED TO VIEW IN THE FINISHED WORK, PROVIDE V-GROOVE PER DETAIL S162/TYP.
6. STANDARD 90° HOOK WHERE INDICATED ON THE DRAWINGS. (ALTERNATE: PROVIDE 180° HOOK WHERE REQUIRED BY SLAB THICKNESS.)
7. DOWELS: SAME SIZE AND SPACING AS VERTICAL WALL BARS, UNLESS OTHERWISE NOTED.
8. 6" PVC WATERSTOP CENTERED VERTICALLY ON JOINT. PROVIDE WIRE TIES MAX 2'-0" OC. HOG RINGS MAY BE USED IN LIEU OF WIRE LOOPS. THOROUGHLY CLEAN WATERSTOP BEFORE PLACING CONCRETE.
9. STANDARD 90° HOOK UNLESS OTHERWISE INDICATED ON THE DRAWINGS.
10. WHERE DRAWINGS INDICATE "W/ STRIP WSTP" PROVIDE LOW EXPANSION HYDROPHILIC WATERSTOP AT TOP SURFACE OF JOINT AND CENTERED BETWEEN VERTICAL BARS.

S141 TYP S — CONSTRUCTION JOINT - WALLS

SHEET 2 OF 2 11/08/21

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED JKN
DRAWN CE
CHECKED KP
DATE JULY 2023

** ORIGINAL SEALED BY JITESH K. RE NALAGOTLA 4/7/2023 CA PE NO. 86094 **

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City of Ukiah

CITY OF UKIAH

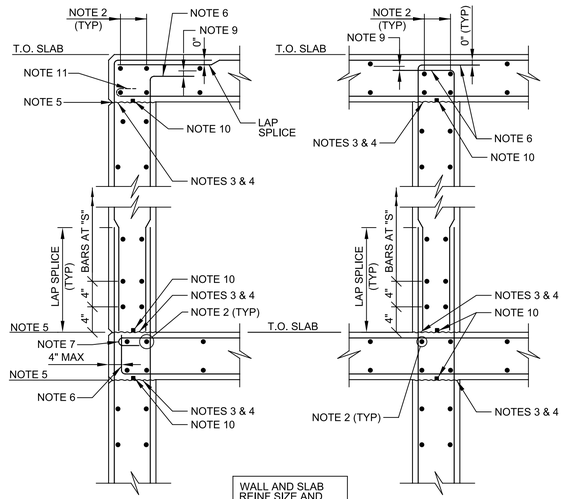
RECYCLED WATER PROJECT - PHASE 4

TYPICALS

TYPICAL DETAILS STRUCTURAL

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00TS02
SHEET NO. 195 OF 200



SLAB AT 1 SIDE

WALL AND SLAB REINF SIZE AND SPACING AS INDICATED ON THE DRAWINGS

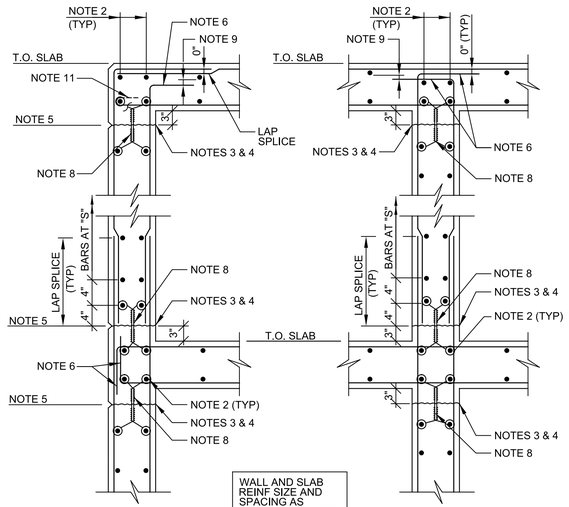
SEE DETAIL S140/TYP FOR SLABS AT BOTTOM OF WALL

SLAB AT 2 SIDES

A - SECTION

S142 TYP — CONSTRUCTION JOINT - WALLS AT ELEVATED SLABS

S, N — SHEET 1 OF 3 — 03/12/19



SLAB AT 1 SIDE

WALL AND SLAB REINF SIZE AND SPACING AS INDICATED ON THE DRAWINGS

SEE DETAIL S140/TYP FOR SLABS AT BOTTOM OF WALL

SLAB AT 2 SIDES

B - SECTION - "W/ WSTP"

S142 TYP — CONSTRUCTION JOINT - WALLS AT ELEVATED SLABS

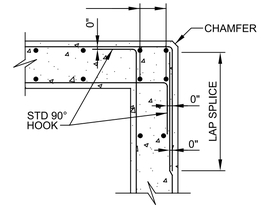
S,N — SHEET 2 OF 3 — 03/12/19

NOTES:

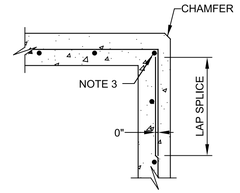
1. "S" EQUALS TYPICAL BAR SPACING INDICATED ON THE DRAWINGS.
2. AT INTERSECTION, MAKE BAR SIZE THE LARGER OF BAR SIZES IN ADJACENT SLAB OR WALL. PLACE BARS AT SAME LAYERS AS IN ADJACENT SLAB OR WALL.
3. WATER-BLAST JOINT FACE AND PROJECTING REINFORCEMENT BEFORE PLACING CONCRETE.
4. PLACE CEMENT GROUT OVER JOINT FACE IMMEDIATELY BEFORE PLACING CONCRETE. (SEE SPECIFICATIONS)
5. CONSTRUCTION JOINT WHERE INDICATED ON THE DRAWINGS. WHERE WALL SURFACE IS EXPOSED TO VIEW IN THE FINISHED WORK, PROVIDE V-GROOVE PER DETAIL S162/TYP.
6. STANDARD 90° HOOK UNLESS OTHERWISE INDICATED ON THE DRAWINGS.
7. STANDARD 180° HOOK (ALTERNATE: 90° HOOK ROTATED OUT OF VERTICAL PLANE IF APPROVED BY ENGINEER.)
8. 6" PVC WATERSTOP CENTERED VERTICALLY ON JOINT. PROVIDE WIRE TIES MAX 2'-0" OC. HOG RINGS MAY BE USED IN LIEU OF WIRE LOOPS. THOROUGHLY CLEAN WATERSTOP BEFORE PLACING CONCRETE.
9. 1 BAR DIAMETER CLEAR.
10. WHERE DRAWINGS INDICATE "W/ STRIP WSTP" PROVIDE LOW EXPANSION HYDROPHILIC WATERSTOP AT TOP SURFACE OF JOINT AND CENTERED BETWEEN VERTICAL BARS.
11. STANDARD 180° HOOK WHERE INDICATED ON THE DRAWINGS.

S142 TYP — CONSTRUCTION JOINT - WALLS AT ELEVATED SLABS

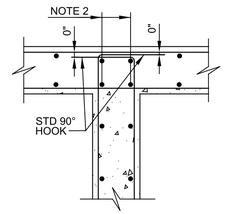
S,N — SHEET 3 OF 3 — 03/12/19



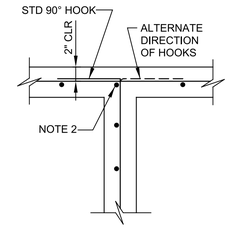
A - DETAIL - CORNER: DOUBLE MAT



B - DETAIL - CORNER: SINGLE MAT



C - DETAIL - INTERSECTION: DOUBLE MAT



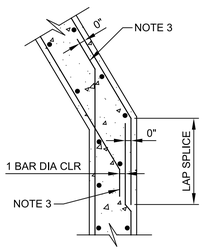
D - DETAIL - INTERSECTION: SINGLE MAT

NOTES:

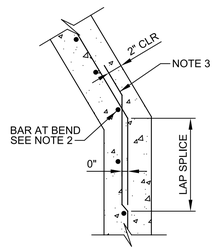
1. BAR SIZE, SPACING, AND ORIENTATION OF BAR LAYERS SHALL BE AS INDICATED ON THE DRAWINGS.
2. AT INTERSECTION, MAKE BAR SIZE THE LARGER OF BAR SIZES IN CONNECTING WALLS. PLACE BARS IN SAME LAYERS AS AT CONNECTING WALLS (TYP).
3. BAR TAILS: 12 BAR DIAMETERS PLUS 12".

S144 TYP — WALL REINFORCEMENT AT CORNERS & INTERSECTIONS — SHEET 1 OF 2

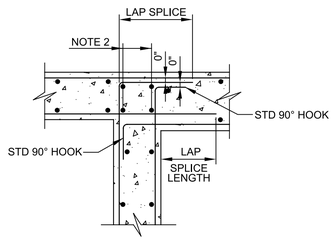
S — 05/31/16



E - DETAIL - INTERSECTION: DOUBLE MAT



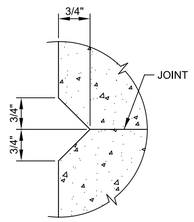
F - DETAIL - INTERSECTION: SINGLE MAT



G - DETAIL - INTERSECTION: CHANGE IN WALL THICKNESS

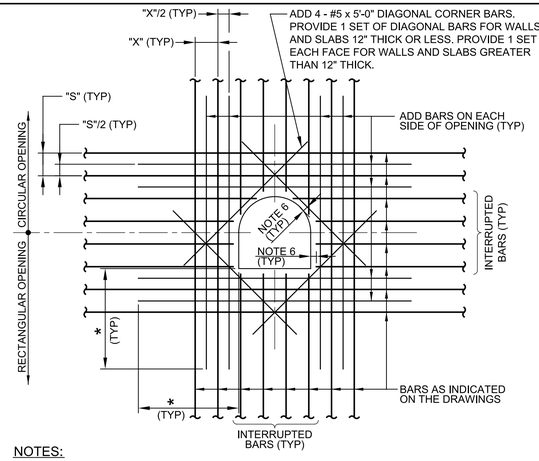
S144 TYP — WALL REINFORCEMENT AT CORNERS & INTERSECTIONS — SHEET 2 OF 2

S — 05/31/16



S162 TYP — V-GROOVE JOINT

N — 07/21/16

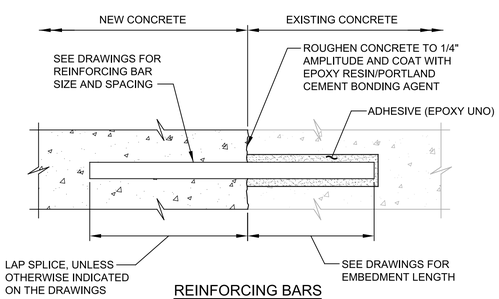


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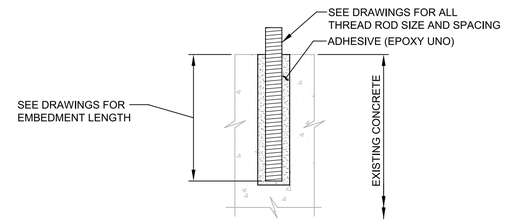
1. AREA OF ADD BARS AT EACH EDGE OF OPENING IN EACH DIRECTION SHALL BE EQUAL TO OR GREATER THAN 1/2 THE CROSS SECTIONAL AREA OF THE INTERRUPTED BARS.
2. PROVIDE STANDARD ACI HOOKS ON BARS IF STRAIGHT EXTENSION PAST THE OPENING, CANNOT BE ACHIEVED.
3. PLACE ADD BARS IN SAME PLANES AS INTERRUPTED REINFORCING.
4. PLACE #5 DIAGONAL BARS ON INSIDE OF INTERRUPTED REINFORCING.
5. * DIMENSION EQUALS OPENING DIMENSION MEASURED PERPENDICULAR TO ADD BARS PLUS LAP SPLICE LENGTH.
6. 2" CLEAR TO CONCRETE OPENINGS OR OUTSIDE FACE OF PIPES AND PIPE SLEEVES. DO NOT OVERCUT REINFORCEMENT FOR EASIER PLACEMENT OF WEEP RINGS AND FLANGES.
7. ADD BARS ARE NOT REQUIRED AT SIDES OF OPENINGS PARALLEL TO AND WITHIN 6" OF A WALL OR BEAM.

S180 TYP — ADDITIONAL REINFORCING AT OPENINGS IN CONCRETE SLABS OR WALLS

S, N — 03/12/19



REINFORCING BARS



ALL-THREAD RODS

NOTE:

1. INSTALLATION OF REINFORCING BARS AND ALL THREAD RODS AS INDICATED IN THE SPECIFICATIONS.

S194 TYP — ADHESIVE BONDED REINFORCING BARS OR ALL THREAD RODS

S — 04/18/17

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED JKN
DRAWN CE
CHECKED KP
DATE JULY 2023

** ORIGINAL SEALED BY JITESH K. RE NALAGOTLA 4/7/2023 CA PE NO. 86094 **

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City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

TYPICALS

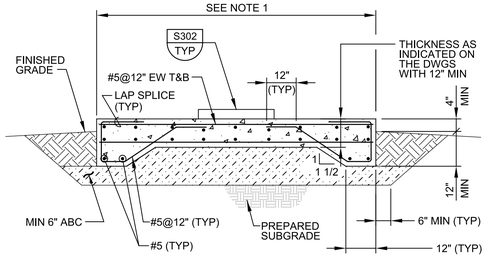
TYPICAL DETAILS STRUCTURAL

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00TS03
SHEET NO. 196 OF 200

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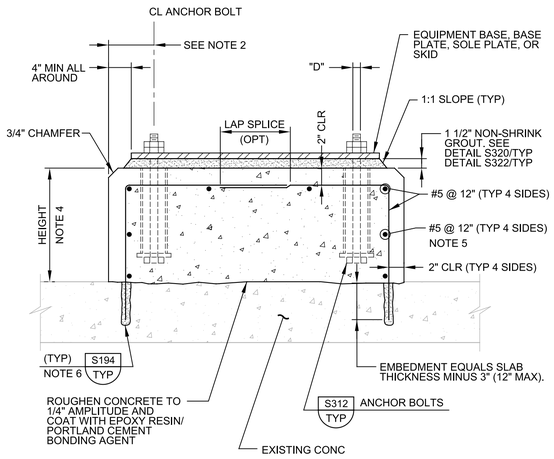


NOTE:

1. DIMENSIONS AS REQUIRED TO SUIT EQUIPMENT OR AS INDICATED ON THE DRAWINGS.

S300 TYP S — EQUIPMENT SLAB

12/15/20

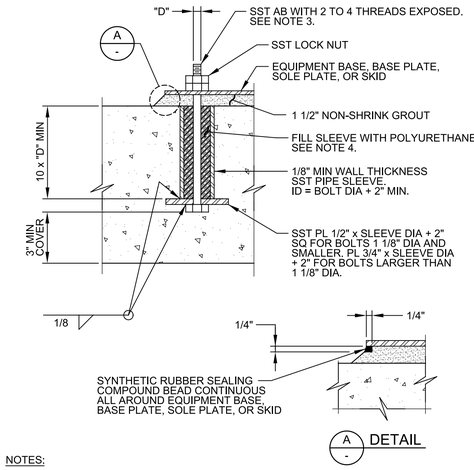


NOTES:

1. "D" = DIAMETER OF ANCHOR BOLT.
2. THE EDGE DISTANCE ON THE ANCHOR BOLTS SHALL NOT BE LESS THAN 6" OR 8 x "D".
3. PAD DIMENSIONS AND ANCHOR BOLT SIZE SHALL CONFORM TO EQUIPMENT MANUFACTURER'S REQUIREMENTS.
4. HEIGHT TO SUIT EQUIPMENT FURNISHED OR AS INDICATED ON THE DRAWINGS.
5. PROVIDE HOOPS OR CORNERS PER DETAIL S144/TYP.
6. FIELD LOCATE EXISTING REINFORCEMENT IN SLAB BEFORE DRILLING. ADJUST DOWEL LOCATIONS TO AVOID REINFORCEMENT.

S304 TYP N — EQUIPMENT BASE ON EXISTING CONCRETE

12/29/2017

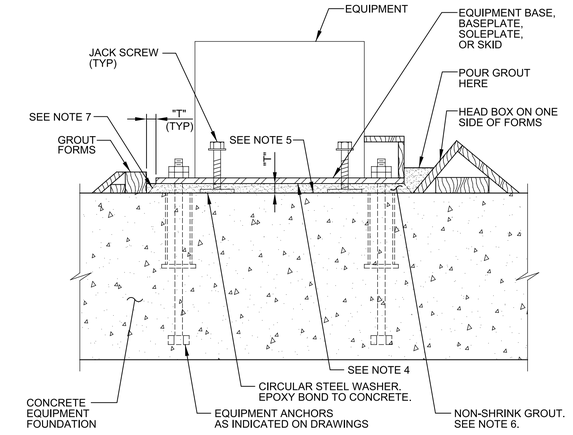


NOTES:

1. "D" = DIAMETER OF ANCHOR BOLT.
2. ANCHOR BOLT DIAMETER AS INDICATED ON THE DRAWINGS. IF NOT INDICATED ON THE DRAWINGS, THE ANCHOR BOLT SIZE SHALL BE AS RECOMMENDED BY THE EQUIPMENT MANUFACTURER.
3. DO NOT USE ALL THREAD RODS AS A SUBSTITUTE FOR BOLTS WITH A BOLT HEAD.
4. COMPLETELY REMOVE ANY POLYURETHANE FOAM FROM CONCRETE, EQUIPMENT BASE, BASE PLATE, SOLE PLATE, OR SKID, AND ANCHOR BOLTS ABOVE TOP OF CONCRETE.
5. DO NOT USE LEVELING NUTS TO SUPPORT AND LEVEL EQUIPMENT BASE, BASE PLATE, SOLE PLATE, OR SKID.

S312 TYP N — ANCHOR BOLT - IN SLEEVE

05/20/15

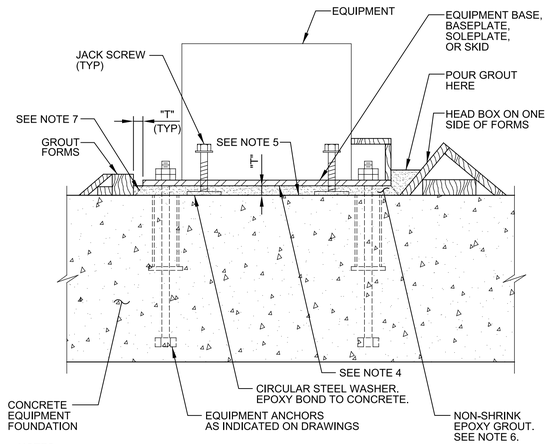


NOTES:

1. "T" = EQUALS GROUT THICKNESS INDICATED ON THE DRAWING. 1" MINIMUM GROUT THICKNESS.
2. FILL ANCHOR SLEEVES WITH POLYURETHANE FOAM BEFORE GROUTING.
3. DO NOT USE LEVELING NUTS ON EQUIPMENT ANCHORS.
4. PREPARE SURFACE OF EQUIPMENT BASES, BASE PLATES, SOLE PLATES, AND SKIDS IN CONTACT WITH GROUT AS SPECIFIED IN SECTION 15050 (46_05_10).
5. PREPARE SURFACES OF CONCRETE FOUNDATION IN CONTACT WITH GROUT AS SPECIFIED IN SECTION 15050 (46_05_10).
6. PLACE NON-SHRINK GROUT AS SPECIFIED IN SECTION 15050 (46_05_10).
7. AFTER GROUT SETS, TRIM GROUT TO 45 DEGREE CHAMFER.

S320 TYP N — EQUIPMENT GROUTING WITH NON-SHRINK GROUT

12/15/20

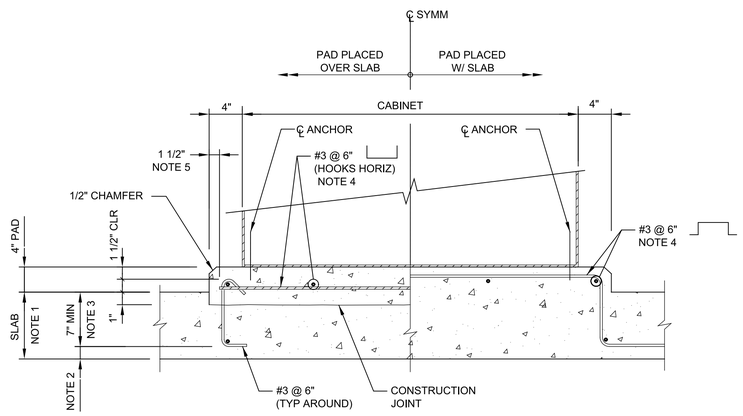


NOTES:

1. "T" = EQUALS GROUT THICKNESS INDICATED ON THE DRAWING. 1" MINIMUM GROUT THICKNESS.
2. FILL ANCHOR SLEEVES WITH POLYURETHANE FOAM BEFORE GROUTING.
3. DO NOT USE LEVELING NUTS ON EQUIPMENT ANCHORS.
4. PREPARE SURFACE OF EQUIPMENT BASES, BASE PLATES, SOLE PLATES, AND SKIDS IN CONTACT WITH GROUT AS SPECIFIED IN SECTION 15050 (46_05_10).
5. PREPARE SURFACES OF CONCRETE FOUNDATION IN CONTACT WITH GROUT AS SPECIFIED IN SECTION 15050 (46_05_10).
6. PLACE NON-SHRINK EPOXY GROUT AS SPECIFIED IN SECTION 15050 (46_05_10).
7. AFTER GROUT SETS, TRIM GROUT TO 45 DEGREE CHAMFER.

S322 TYP N — EQUIPMENT GROUTING WITH NON-SHRINK EPOXY GROUT

12/29/17

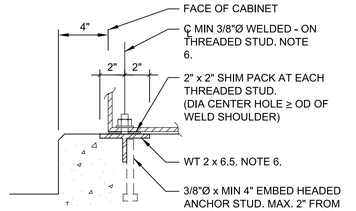


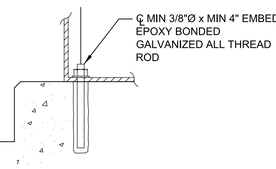
NOTES:

1. SEE STRUCTURAL DRAWINGS FOR THICKNESS OF SLAB BELOW PAD. SLAB REINFORCEMENT NOT SHOWN.
2. SEE S101/ TYP FOR MIN CONCRETE COVER REQUIREMENTS.
3. CONTACT ENGINEER FOR INSTRUCTIONS WHERE HOOK EMBEDMENT IS LESS THAN DIMENSION SHOWN.
4. FOR EQUIPMENT WITH CONDUIT WINDOWS BELOW, ADJUST BAR LOCATIONS TO FIT BETWEEN WINDOWS.
5. LOCATE VERTICAL EDGE OF PAD AND VERTICAL FACE OF #3s USING VERTICAL 2x FORM DURING SLAB PLACEMENT.
6. HOT DIP GALVANIZE WT AND HEADED ANCHOR STUD ASSEMBLY. TOUCH UP GALVANIZING AFTER FIELD WELDING THREADED STUDS.

S350 TYP S — ELECTRICAL EQUIPMENT HOUSEKEEPING PAD

02/21/14





1. UNLESS OTHERWISE INDICATED ON THE DRAWINGS, MINIMUM WALL REINFORCEMENT SHALL BE AS FOLLOWS:

   A. VERTICAL REINFORCEMENT:
   #5 AT 1'-4" IN GROUTED CELLS. CENTERED IN 8" WALLS. EACH FACE IN 12" WALLS.
   ADDITIONAL REINFORCEMENT (SAME SIZE AS VERTICAL WALL BARS UNO):
   VERTICAL BARS AT CORNERS AND INTERSECTIONS: SEE DETAIL S412/TYP.
   VERTICAL BARS EACH SIDE AT MASONRY CONTROL JOINTS: SEE DETAIL S430/TYP.
   VERTICAL BARS IN FIRST 2 CELLS AT EACH JAMB OF WALL OPENINGS: SEE DETAIL S412/TYP.

   B. HORIZONTAL REINFORCEMENT:
   3/16" DIA LADDER JOINT REINFORCEMENT AT 16" OC VERTICAL. SEE DETAIL S414/TYP.
   HORIZONTAL BOND BEAMS AT LOCATIONS INDICATED IN DETAIL S410/TYP AND IN WALL SECTIONS FOR EACH STRUCTURE.
   BOND BEAM REINFORCEMENT: #5 AT 1'-4" IN GROUTED CELLS. CENTERED IN 8" WALLS. EACH FACE IN 12" WALLS.

2. LAP SPLICES:

   A. UNLESS OTHERWISE INDICATED ON THE DRAWINGS, THE BARS AT A LAP SPLICE SHALL BE IN CONTACT WITH EACH OTHER.

   B. BAR LAP SPLICES NOT SPECIFIED ON THE DRAWINGS OR IN THE FOLLOWING TABLE SHALL NOT BE LESS THAN 72 BAR DIAMETERS.

   C. THE MASONRY SIDE COVER OVER THE REINFORCING BARS SHALL NOT BE LESS THAN 2 INCHES FROM FACE OF MASONRY TO THE EXTERIOR FACE OF THE BAR.

REINFORCING BAR LAP SPLICES: f'm = 1500 psi, Fy = 60,000 psi				
BAR SIZE	LAP SPLICE LENGTH (INCHES)			
	8" CMU: BAR CENTERED IN WALL	8" CMU: BAR @ FACE OF WALL	12" CMU: BAR CENTERED IN WALL	12" CMU: BAR @ FACE OF WALL
#4	21"	26"	21"	26"
#5	26"	40"	26"	40"
#6	42"	54"	40"	54"
#7	58"	63"	46"	63"

S400 TYP S — MASONRY NOTES

04/10/17

CONFORMED DOCUMENTS

REV	DATE	BY	DESCRIPTION

DESIGNED JKN
DRAWN CE
CHECKED KP
DATE JULY 2023

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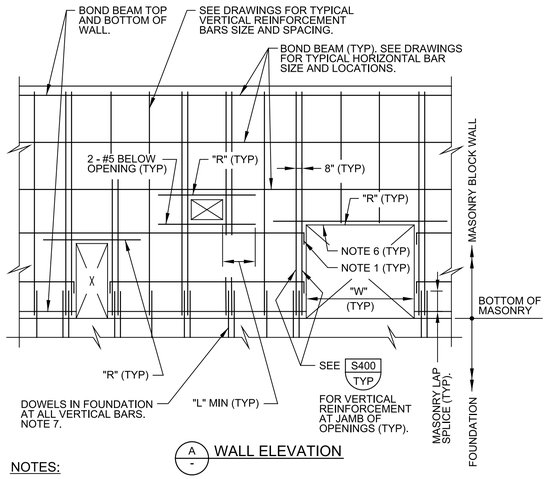
carollo®

City of Ukiah

CITY OF UKIAH
RECYCLED WATER PROJECT - PHASE 4
TYPICALS
TYPICAL DETAILS STRUCTURAL

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

JOB NO. 8660F.10
DRAWING NO. 00TS04
SHEET NO. 197 OF 200



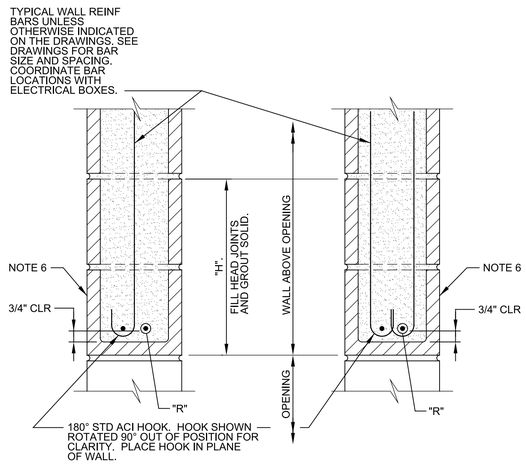
A - WALL ELEVATION

NOTES:

1. ACI STANDARD 90° HOOK ON HORIZONTAL BARS AT OPENINGS.
2. SEE DRAWINGS FOR VERTICAL AND HORIZONTAL REINFORCEMENT SIZE AND SPACING AT EACH STRUCTURE.
3. DO NOT PLACE VERTICAL CONDUITS IN CELLS WITH VERTICAL REINFORCING BARS.
4. SEE DETAIL S412/TYP FOR BOND BEAM REINFORCEMENT AT CORNERS AND INTERSECTIONS.
5. "R" BARS: EXTEND BAR TO "L" DIMENSION INDICATED ON SHEET 2. PROVIDE VERTICAL HOOK AT END IF "L" CANNOT BE ACHIEVED.
6. CHANNEL LINTEL MASONRY UNITS ACROSS OPENINGS. KNOCK-OUT BOND BEAM UNITS BEYOND OPENINGS TO "L."
7. EMBED DOWELS IN CONCRETE PER DETAIL S455/TYP.

S410 TYP S — REINFORCED MASONRY WALL

SHEET 1 OF 2 06/01/17



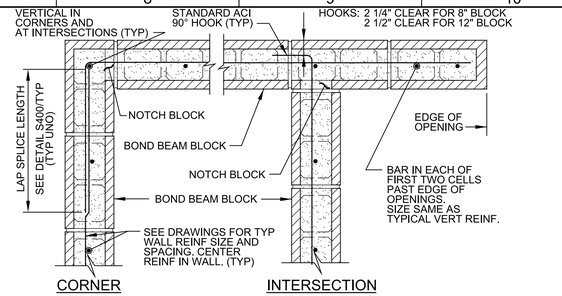
B - LINTEL AT OPENING WITH VERTICAL REINF

C - LINTEL AT OPENING WITH VERTICAL REINF EACH FACE

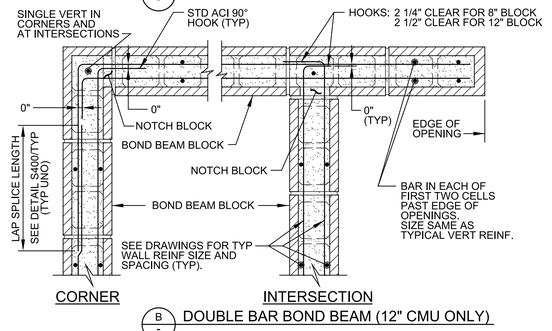
LINTEL REINFORCEMENT SCHEDULE			
"W"	"R"	"L"	"H"
LESS THAN 5'-0"	2 - #5	2'-6"	16"
GREATER THAN 5'-0" TO 7'-0"	2 - #6	3'-0"	32"
GREATER THAN 7'-0" TO 12'-0"	2 - #7	3'-6"	40"

S410 TYP S — REINFORCED MASONRY WALL

SHEET 2 OF 2 06/01/17



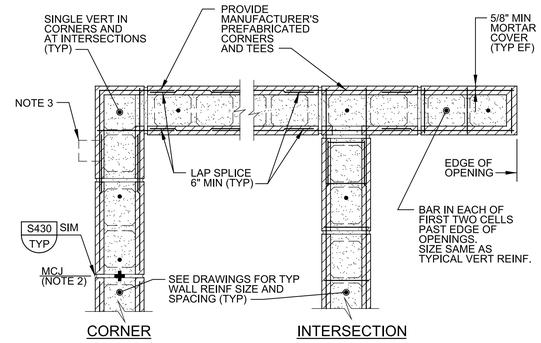
A - SINGLE BAR BOND BEAM



B - DOUBLE BAR BOND BEAM (12" CMU ONLY)

S412 TYP S — MASONRY BOND BEAM REINFORCING

04/10/17

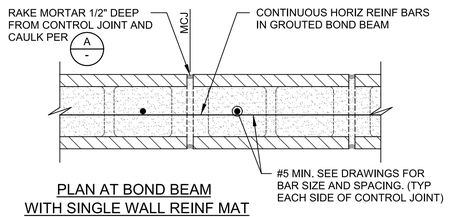


NOTES:

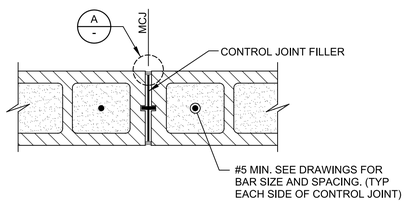
1. PROVIDE HORIZONTAL JOINT REINFORCEMENT AT MAXIMUM 1'-4" OC VERTICAL.
2. DISCONTINUE WIRE REINFORCEMENT ACROSS MASONRY CONTROL JOINTS. PROVIDE MINIMUM 5/8" MORTAR COVER AT CUT ENDS.
3. AT VENEER, PROVIDE TABS AND VENEER TIES PER SPECIFICATIONS.

S414 TYP S — MASONRY JOINT REINFORCEMENT

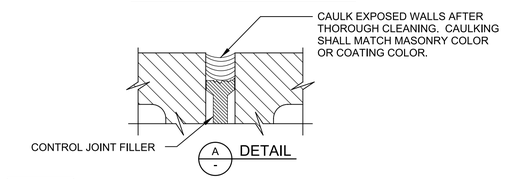
04/11/17



PLAN AT BOND BEAM WITH SINGLE WALL REINF MAT

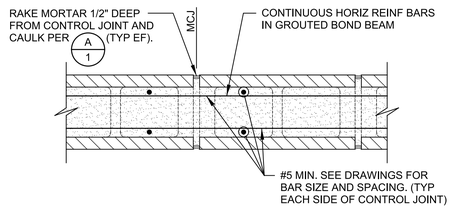


PLAN ABOVE OR BELOW BOND BEAM WITH SINGLE WALL REINF MAT

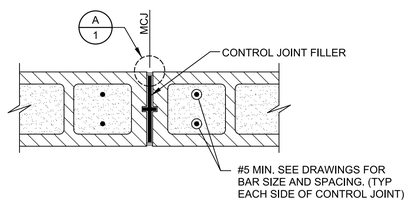


S430 TYP S — MASONRY CONTROL JOINT

SHEET 1 OF 2 04/04/17



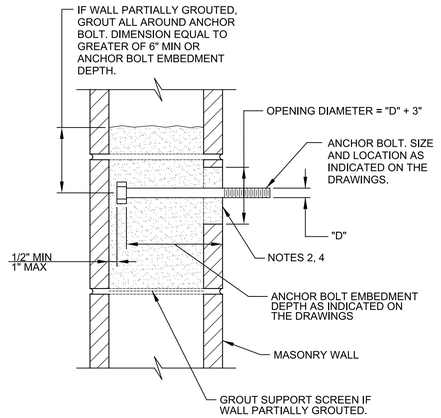
PLAN AT BOND BEAM WITH DOUBLE WALL REINF MAT



PLAN ABOVE OR BELOW BOND BEAM WITH DOUBLE WALL REINF MAT

S430 TYP S — MASONRY CONTROL JOINT

SHEET 2 OF 2 04/04/17



NOTES:

1. "D" = DIAMETER OF ANCHOR BOLT.
2. SET ANCHOR BOLTS WITH TEMPLATE. DO NOT EMBED ADJUSTMENT NUTS IN GROUT AT FACE OF MASONRY.
3. CUT MASONRY WEBS AS REQUIRED TO ALLOW MINIMUM 1/2" GROUT BETWEEN ANCHOR BOLT AND MASONRY SURFACE.
4. REMOVE EXCESS GROUT. LEAVE FINISHED SURFACE FLUSH WITH FACE OF WALL.

S440 TYP S — ANCHOR BOLTS IN MASONRY

04/04/17

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED JKN
DRAWN CE
CHECKED KP
DATE JULY 2023

** ORIGINAL SEALED BY JITESH K. RE NALAGOTLA 4/7/2023 CA PE NO. 86094 **

carollo®

City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

TYPICALS

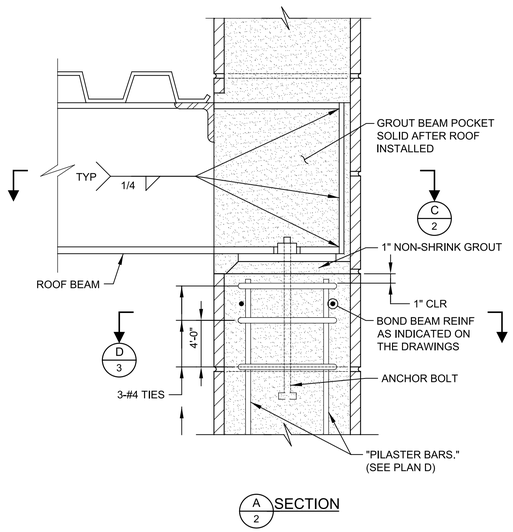
TYPICAL DETAILS STRUCTURAL

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

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DRAWING NO. 00TS05
SHEET NO. 198 OF 200

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FILE NAME: 8660F1000TS05.dgn

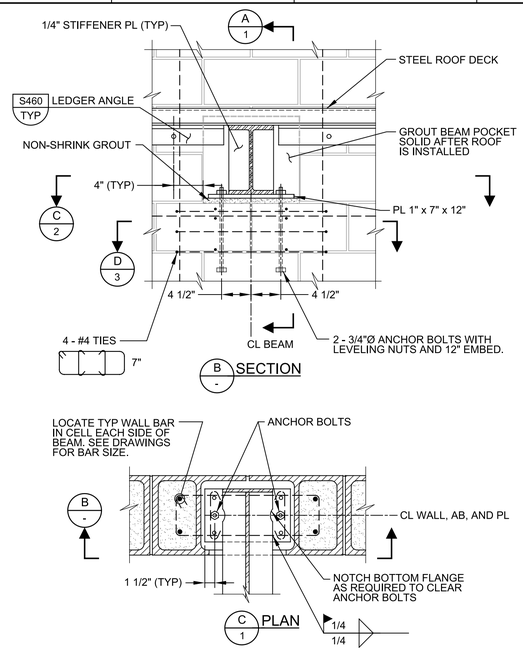
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LAST SAVED BY: kjackson



A 2 SECTION

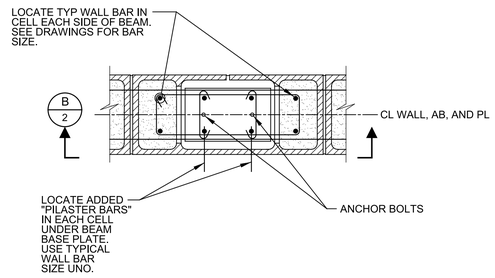
S451 TYP NS — 12" CMU WALL ROOF BEAM TO EXTERIOR WALL CONNECTION

SHEET 1 OF 3 08/18/15



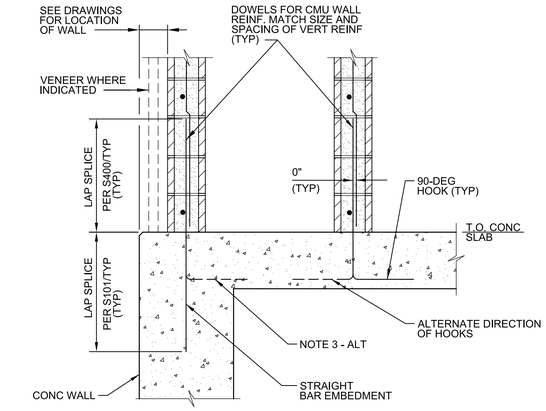
S451 TYP NS — 12" CMU WALL ROOF BEAM TO EXTERIOR WALL CONNECTION

SHEET 2 OF 3 08/18/15



S451 TYP NS — 12" CMU WALL ROOF BEAM TO EXTERIOR WALL CONNECTION

SHEET 3 OF 3 08/18/15

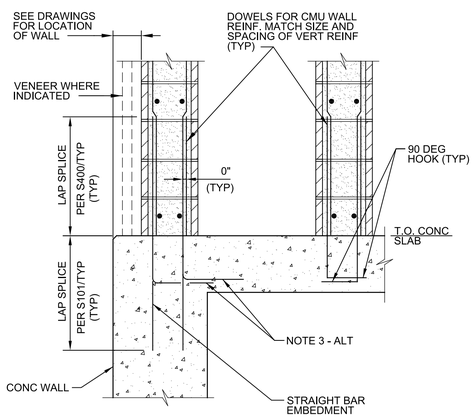


NOTES:

1. FOR CMU WALL REINFORCING SIZE AND SPACING, SEE PLANS.
2. VENEER IS NOT SHOWN FOR CLARITY.
3. WHERE STRAIGHT BAR EMBEDMENT IS NOT AVAILABLE, PROVIDE 90-DEGREE HOOKS. ROTATE HOOKS TO PROVIDE REQUIRED CONCRETE COVER.

S455 TYP — CMU WALL TO CONCRETE

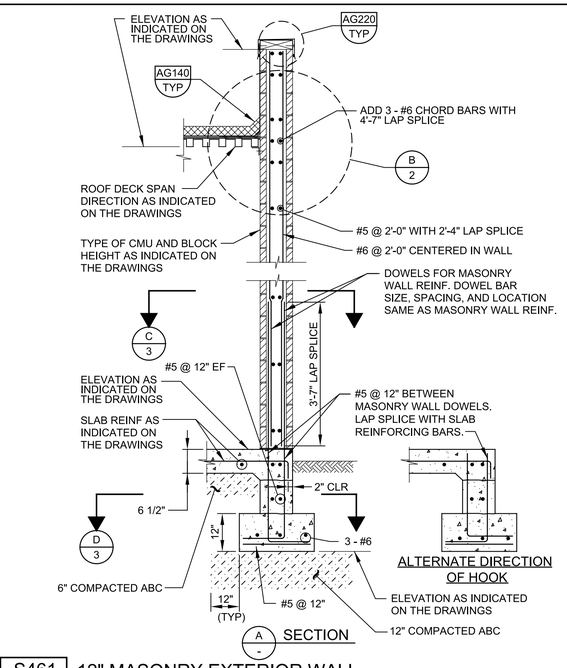
SHEET 1 OF 2 01/09/18



B - SECTION: 12" CMU

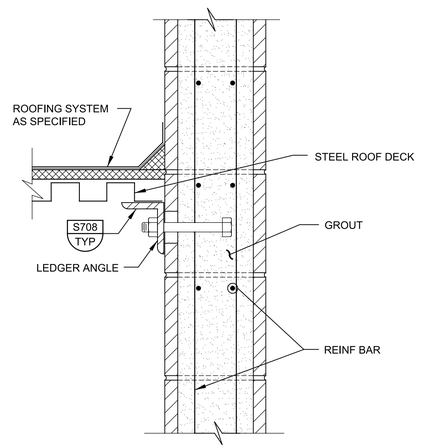
S455 TYP — CMU WALL TO CONCRETE

SHEET 2 OF 2 01/09/18



S461 TYP N — 12" MASONRY EXTERIOR WALL

SHEET 1 OF 3 05/30/19

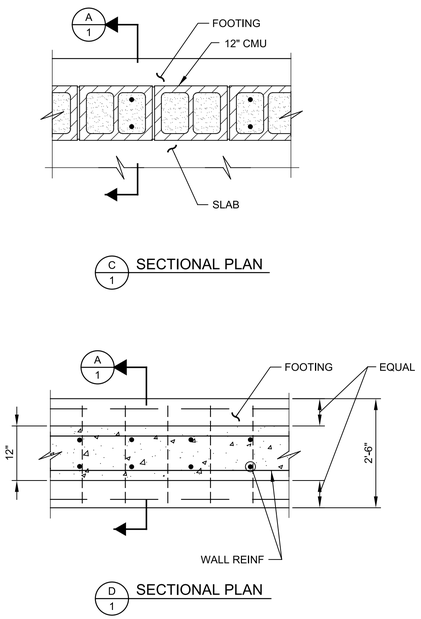


NOTE:

1. FOR ADDITIONAL BARS AT OPENINGS IN WALL, SEE S410/TYP.

S461 TYP N — 12" MASONRY EXTERIOR WALL

SHEET 2 OF 3 05/30/19



S461 TYP N — 12" MASONRY EXTERIOR WALL

SHEET 3 OF 3 05/30/19

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED JKN
DRAWN CE
CHECKED KP
DATE JULY 2023

** ORIGINAL SEALED BY JITESH K. RE NALAGOTLA 4/7/2023 CA PE NO. 86094 **

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CITY OF UKIAH

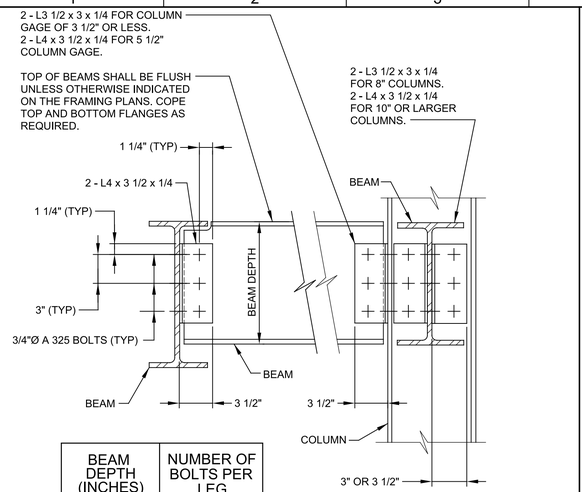
RECYCLED WATER PROJECT - PHASE 4

TYPICALS

TYPICAL DETAILS STRUCTURAL

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
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IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

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DRAWING NO. 00TS06
SHEET NO. 199 OF 200



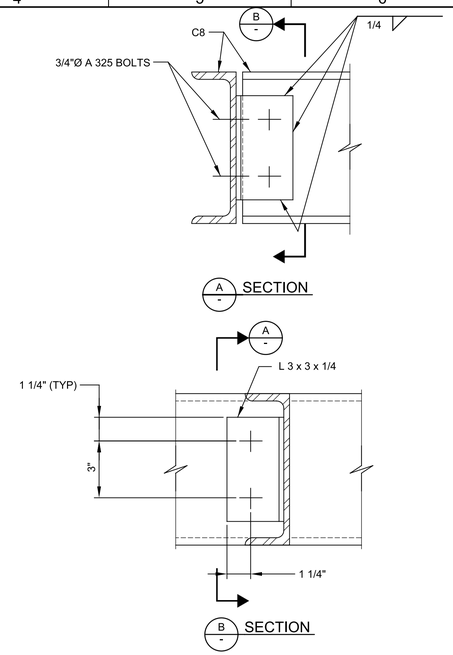
BEAM DEPTH (INCHES)	NUMBER OF BOLTS PER LEG
8 - 10	2
12 - 16	3
18 - 21	4
24 - 30	6

NOTE:

1. SCHEDULE APPLIES TO ALL BEAMS UNLESS NUMBER OF BOLTS PER LEG IS OTHERWISE INDICATED ON THE FRAMING PLAN BY ⬡.

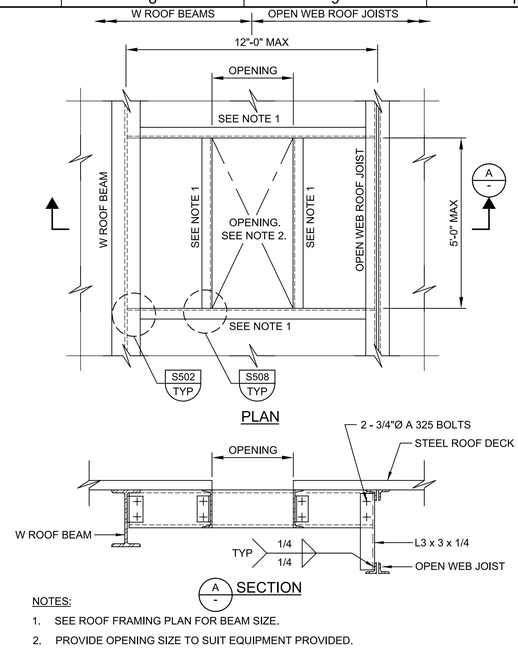
S502 TYP — STEEL DOUBLE ANGLE BOLTED CONNECTION VERTICAL BOLT LINES

4/30/07



S508 TYP — STEEL BOLTED CONNECTION

S 11/16/22

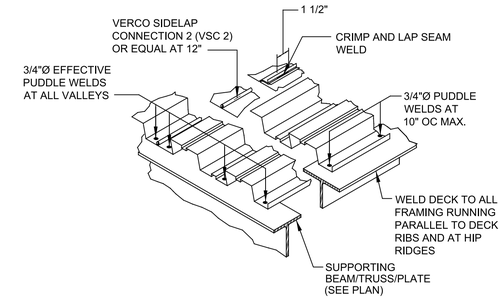


NOTES:

1. SEE ROOF FRAMING PLAN FOR BEAM SIZE.
2. PROVIDE OPENING SIZE TO SUIT EQUIPMENT PROVIDED.

S520 TYP — FRAMED ROOF OPENING ASSEMBLY

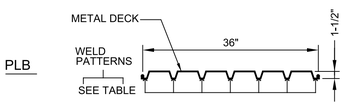
N 08/31/09



TYPICAL METAL DECK WELDING

S701 TYP — METAL DECK - STEEL

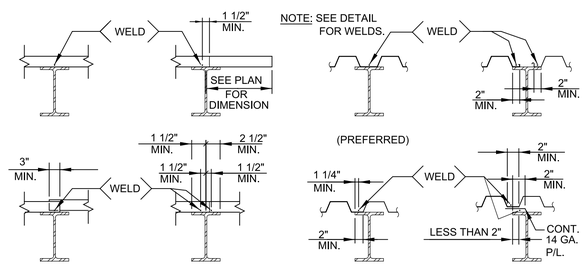
J SHEET 1 OF 3 03/12/21



PLB

APPLICATION	DEPTH	VERCO DESIGN	GAGE	WELD PATTERN	MINIMUM SECTION PROPERTIES PER FOOT WIDTH: S+in^3	S-in^3	Fy KSI	UNFACTORED DIAPHRAGM SHEAR CAPACITY (PLF)
BLOWER BUILDING *	1 1/2"	PLB	18	36/7	0.314	0.331	50	1500

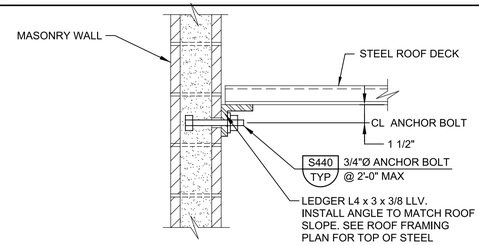
METAL DECK CROSSING SECTION



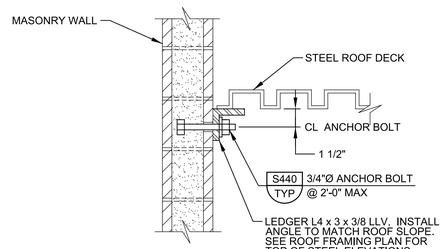
TYPICAL STEEL DECK TO BEAM WELD DETAILS

S701 TYP — METAL DECK - STEEL

J SHEET 3 OF 3 03/12/21



ROOF DECK RIBS PERPENDICULAR TO WALL



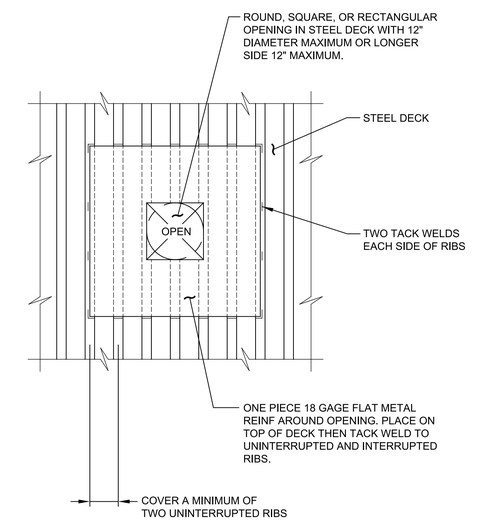
ROOF DECK RIBS PARALLEL TO WALL

NOTES:

1. FIRST ANCHOR BOLT AT EACH END OF SECTION OF ANGLE SHALL BE 6" OR LESS FROM END OF ANGLE.
2. ANGLE SHALL STOP AT EACH SIDE OF CONTROL AND EXPANSION JOINTS. GAP BETWEEN ENDS OF ANGLES SHALL EQUAL WIDTH OF JOINT.

S708 TYP — ROOF DECK TO WALL CONNECTION

N 08/31/09



S720 TYP — STEEL DECK ROOF OPENING

12/15/20

REV	DATE	BY	DESCRIPTION
			CONFORMED DOCUMENTS

DESIGNED JKN
DRAWN CE
CHECKED KP
DATE JULY 2023

** ORIGINAL SEALED BY JITESH K. RE NALAGOTLA 4/7/2023 CA PE NO. 86094 **

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City of Ukiah

CITY OF UKIAH

RECYCLED WATER PROJECT - PHASE 4

TYPICALS

TYPICAL DETAILS STRUCTURAL

VERIFY SCALES
BAR IS ONE INCH ON ORIGINAL DRAWING
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

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DRAWING NO. 00TS07
SHEET NO. 200 OF 200

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Model: Layout1
LAST SAVED BY: kjackson

Please return to:

CITY OF UKIAH
300 Seminary Avenue
Ukiah, California 95482-5400
(707) 463-6200

NOTICE OF COMPLETION

NOTICE IS HEREBY GIVEN:

1. That the project described as: Recycled Water Project - Phase 4, Spec 23-01

2. That the nature of the title to the construction of Phase 4 of the Recycled Water Project.

3. That on the 14th day of November 2025, the Contract work for this project was actually completed.

4. That the name and address of the Contractor is Ghilotti Construction Co., Inc. 246 Ghilotti Ave, Santa Rosa CA 95407

5. That the real property herein referred to is situated in the County of Mendocino, State of California, and is described as follows: City-owned property identified as the Water Treatment Plant, Waste Water Treatment Plant and multiple streets and roads within the City of Ukiah.

I hereby certify under penalty of perjury that the forgoing is true and correct:

City Council Approval CITY OF UKIAH, a Municipal Corporation

_____ By: _____ _____
Date Kristine Lawler, City Clerk Date

State of California

County of Mendocino

Exempt from recording fees pursuant to Government Code Section 27383

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DOCUMENT 00625

CERTIFICATE OF SUBSTANTIAL COMPLETION

Owner: City Of Ukiah
Engineer: Carollo Engineers

Contractor: Ghilotti Construction Company
Project: RECYCLED WATER PROJECT – PHASE 4
Contract Name: RECYCLED WATER PROJECT – PHASE 4

Owner's Project No.: 8860F10
Engineer's Project No.: 8860F10
Contractor's Project No.: 6071

This ☐ Preliminary ☑ Final Certificate of Substantial Completion applies to:

☑ All Work ☐ The following specified portions of the Work:

Date of Substantial Completion: 31 October 2025

The Work to which this Certificate applies has been inspected by authorized representatives of Owner, Contractor, and Engineer, and found to be substantially complete. The Date of Substantial Completion of the Work or portion thereof designated above is hereby established, subject to the provisions of the Contract pertaining to Substantial Completion. The date of Substantial Completion in the final Certificate of Substantial Completion marks the commencement of the contractual correction period and applicable warranties required by the Contract.

A punch list of items to be completed or corrected is attached to this Certificate. This list may not be all-inclusive, and the failure to include any items on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

Amendments of contractual responsibilities recorded in this Certificate should be the product of mutual agreement of Owner and Contractor; see the General Conditions.

The responsibilities between Owner and Contractor for security, operation, safety, maintenance, heat, utilities, insurance, and warranties upon Owner's use or occupancy of the Work must be as provided in the Contract, except as amended as follows:

Amendments to Owner's Responsibilities: ☑ None ☐ As follows:

Amendments to Contractor's Responsibilities: ☑ None ☐ As follows:

The following documents are attached to and made a part of this Certificate:

Attachment 1 - RW Phase-4 Punch List

This Certificate does not constitute an acceptance of Work not in accordance with the Contract Documents, nor is it a release of Contractor's obligation to complete the Work in accordance with the Contract Documents.

Engineer

By *(signature)*: Brian Avon

Digitally signed by Brian Avon
DN: C=US, E=bavon@carollo.com, O=Carollo Engineers, CN=Brian Avon
Reason: I have reviewed this document
Date: 2025.11.13 07:29:09-08'00'

Name *(printed)*: Brian Avon

Title: Design Manager

END OF DOCUMENT

CONSTRUCTION
GHILOTTI
Since · COMPANY · 1914

October 30, 2025, L-09

Carollo Engineers
935 River Street
Ukiah, CA 94582

Attn.; Garett Gentry
Email; ggentry@carollo.com
Subject; Request for Substantial Completion
Phase 4 Recycled Water Project, Ukiah

Dear Garett,

Please consider this our formal request per Specification Section 00625 for Substantial Completion of the Phase 4 Recycled Water Project, Ukiah

Please review with all necessary parties and if you have any questions, please do not hesitate to contact us.

Thank you,

Steve Hanak
Sr. Project manager

November 13, 2025, L-10

Carollo Engineers
935 River Street
Ukiah, CA 94582

Attn.; Garett Gentry
Email; ggentry@carollo.com
Subject; Request for Final Completion & Release of Retention
Phase 4 Recycled Water Project, Ukiah

Dear Garett,

Please consider this our formal request per Specification Section 01770-1.13A for Final Completion and Release of retention of the Phase 4 Recycled Water Project, Ukiah

A). All work has been completed in accordance with the Contract Documents
B). Punch List Items have been completed or corrected.
C). Work is ready for final inspection.

Please review with all necessary parties and if you have any questions, please do not hesitate to contact us.

Thank you,

Steve Hanak
Sr. Project manager

Engineers...Working Wonders With Water®

November 14, 2025

TO: Jason Benson/City of Ukiah
FROM: Carollo Engineers
ADDRESS: 300 Seminary Ave
Ukiah, CA 95482

Subject: Recommendation for Final Acceptance: RECYCLED WATER PIPELINE PROJECT – PHASE 4

This memorandum is submitted following the final inspection of the work completed by the Contractor for the Recycled Water Pipeline Project – Phase 4 (Client Project No. 8860F10).

The Contractor submitted written notification of the completion of the work, as required by the contract. Pursuant to this notification, the Engineer performed a prompt personal inspection to satisfy himself as to the actual completion of the Work in accordance with the terms of the contract. Based on this inspection and review of project records, the project is considered complete and ready for formal acceptance by the City Council of the City of Ukiah.

1. Status of Closeout Requirements and Deliverables
All necessary requirements leading to final completion have been satisfied. This includes verification of the following critical administrative and physical requirements, which precede the final Application for Payment:

Completion of Deficiencies: The Contractor has successfully remedied all deficiencies listed in the final punch list, and the Engineer and Owner are satisfied that all corrective work is complete. A Close-Out Meeting, led by the Engineer, was held to coordinate these final activities.

Final Documentation: The Contractor will submit the following key documents required prior to final payment:

◦ **Final Statement of Accounting,** reflecting all approved adjustments to the Contract amount, including Change Orders and set-offs for liquidated damages or extended services.

◦ **Evidence of Payment and Release of Liens or Stop Payment Notices**.

◦ **Release of claims**.

◦ **Final (As-Built) Schedule (Final Schedule Update),** signed and certified by the Contractor's Project Manager and scheduler as an accurate record reflecting the exact manner and actual start/completion dates of construction. This document is required for the release of retainage.

◦ **Project Record Documents** (Contract Documents, shop drawings, and submittals marked to record field changes and detailed underground pipe locations).

◦ **Post-construction photographs and videos,** which are a condition of final payment, documenting the entire site and work areas at completion.

◦ **Federal and State Funding Records,** including copies of all books and records relative to the Project, submitted to the Owner as a condition for final payment.

◦ **Defective Material and Workmanship (Maintenance) Bond,** required to be delivered to the City before final payment, effective for one (1) year after acceptance.

Sincerely,

DRAFT

CAROLLO ENGINEERS, INC.

Enclosures: List Enclosures

cc:

Agenda Item No: 8.e.

MEETING DATE/TIME: 11/19/2025

ITEM NO: 2025-1300

City of Ukiah

AGENDA SUMMARY REPORT

SUBJECT: Approval of Purchase of Multiple Fleet Vehicles and Equipment from the Willow County Water District in the Amount of $219,670 Plus Tax, and Approval of Corresponding Budget Amendment.

DEPARTMENT: Finance

PREPARED BY: Myles Fisette, Purchasing Manager

PRESENTER: Dan Buffalo, Finance Director

ATTACHMENTS:

1. 2024-02-21 Agenda Item 13a
2. Term Sheet, Willow Vehicles and Equipment, 11-13-2025
3. Exhibit A, Willow Vehicles and Equipment

Summary: Council will consider the approval of purchase of multiple fleet vehicles and equipment from the Willow County Water District in the amount of $219,670 plus tax, and approval of corresponding budget amendment.

Background: In February 2024, the City of Ukiah entered into a Joint Exercise of Powers Agreement for the Ukiah Valley Water Authority (Attachment 1), joining with Willow County Water District and other agencies to consolidate and improve regional water service delivery. This agreement established a framework for shared resources, management, and operational support among member agencies, with Ukiah providing management and operations services to the Authority. The UVWA agreement specifically contemplates the coordinated use, acquisition, and management of assets, including vehicles and equipment, to advance operational integration and maximize service capacity. Willow was the previous service provider to JPA (excluding the City of Ukiah) and MSA members (Hopland and River Estates), and used its vehicles and equipment to provide those services. Now that the City is the service provider, the Willow equipment will be used by the City.

Discussion: Acquisition of vehicles and equipment (Attachment 2) from Willow is aligned with the agreement's intent, enabling the City to efficiently manage, maintain, and expand essential municipal services. These assets are required to support City water and public works functions, enhance Staff readiness, replace aging fleet units, and ensure continued reliability in service delivery to the community. The proposed purchase consists of a variety of essential capital assets, including trucks, pickups, heavy equipment, and specialized machinery. Approval of this purchase will empower City staff to continue delivering high-quality municipal services, provide value to the ratepayers, and honor the commitments made to regional partners under the 2024 agreement.

The agreed upon price of these items was derived from various industry standard value estimation tools, such as Kelley Blue Book. It was evaluated by the City's Fleet Manager as well to judge the reasonableness of the estimates (Attachment 3).

Staff requests Council approve the purchase of multiple fleet vehicles and equipment from the Willow County Water District in the amount of $219,670 plus tax, and approve the corresponding budget amendment.

Recommended Action: Approve purchase of multiple fleet vehicles and equipment from the Willow County Water District in the amount of $219,670 plus tax, and approval of corresponding budget amendment.

BUDGET AMENDMENT REQUIRED: Yes.

CURRENT BUDGET AMOUNT: 82127113.80100: $0: 82127113.54110: $0

PROPOSED BUDGET AMOUNT: 82127113.80100: $96,787.50: 82127113.54110: $142,103.63

FINANCING SOURCE: Water Fund

REVENUE: No GRANT: No

PREVIOUS CONTRACT/PURCHASE ORDER NO.: N/A

COORDINATED WITH: Dan Buffalo, Finance Director; Water Resources Staff; and Dave Kirch, Fleet & Facilities Maintenance Manager

STRATEGIC PLAN (SP):

CLIMATE INITIATIVES (CI):

GENERAL PLAN ELEMENTS (GP):

Approved: 
Sage Sangiacomo, City Manager

Agenda Item No: 13.a.

MEETING DATE/TIME: 2/21/2024

ITEM NO: 2024-1515

City of Ukiah

AGENDA SUMMARY REPORT

SUBJECT: Possible Approval of Joint Exercise of Powers Agreement for the Ukiah Valley Water Authority and if Approved Appoint Two Representatives to the Ukiah Valley Water Authority.

DEPARTMENT: Water Resources

PREPARED BY: Sean White, Water Resources Director

PRESENTER: Sean White, Water Resources Director.

ATTACHMENTS:

1. UVWA.JPA.Final 02142024

Summary: Council will consider approving the Joint Exercise of Powers Agreement for the Ukiah Valley Water Authority and appointing two representatives to the Ukiah Valley Water Authority.

Background: There are a number of governmental water service providers in the greater Ukiah Valley. Providers include: the City of Ukiah (City), Willow County Water District (Willow), Millview County Water District (Millview), Calpella County Water District (Calpella) and Redwood Valley County Water District (Redwood). The concept of consolidating these service providers into a single entity has been a long-term community goal. Potential benefits of consolidation are numerous and include a cohesive water policy for the region, maximization of water rights, more uniform water security and availability, staffing, expanded rate base and reduced litigation. There have been a number of past attempts at accomplishing this goal, most notably the Valley-wide Task Force initiated in 1990, as well as a number of Mendocino County Grand Jury Reports.

The Upper Russian River Water Agency (URRWA) was formed in 2014 with the intent of accomplishing these goals. URRWA is a Joint Powers Authority (JPA) "working together for the voluntary consolidation of Ukiah Valley's Water Districts". The board includes a single member from Willow County Water, Calpella County Water, Redwood Valley County Water, Millview County Water, and most recently the Ukiah Valley Sanitation District. UURWA's goals include creating a more logical form of governance over our water resources, coordinating the operations of our districts into one regional water agency, sharing resources to create a unified approach to consolidation, to provide economies of scale that keep rates affordable, and to ensure a reliable long-term water supply for all land uses. URRWA has made significant progress on many of these goals, but it has not significantly improved water supply reliability or streamlined governance. The URRWA model is commonly referred to as managerial consolidation, rather than complete consolidation. In this model there is a single operator, but multiple boards and decision-making bodies remain.

Discussion: Issues related to numerous, small agencies serving a single community are not unique to the Ukiah Valley. In an attempt to address similar issues state-wide, the State Water Resources Control Board (SWRCB) started the Safe and Affordable Funding for Equity and Resilience (SAFER) program in 2019. Since that time, the SWRCB has made consolidation of water providers through the SAFER program a top priority. Districts consolidating through the SAFER program are eligible for SWRCB grants and loans to facilitate the consolidation processes well as construct and update required infrastructure.

City Staff was contacted in the summer of 2022 by SAFER about participating in the program. City Staff then reached out to the members of URRWA to see if there was interest in consolidating through the SAFER Program. An ad hoc committee with members from the City, Willow, Millview, Calpella, and Redwood has been meeting regularly since October of 2022 to discuss the opportunity and develop a Joint Powers Authority

(Attachment 1) to serve as the vehicle for consolidation through the SAFER program.

The Ukiah Valley Water Authority JPA (UVWA) is the result of many staff meetings, ad hoc meetings, as well as counsel input from each of the entities. In some ways, the UVWA is similar to URRWA. It is different, however, in that it explicitly intends to go beyond "managerial consolidation" and to eventually achieve complete consolidation over time, which is the goal of the SAFER program.

Key points of the agreement (Attachment #1) are:

- JPA is a separate legal entity from members and is separately liable for its debts.
- The Agreement creates the Ukiah Valley Water Authority, a Joint Exercise of Powers Authority.
- Other initial members are Millview County Water District and Redwood Valley County Water District.
- Other public agencies may join. (See Section 14).
- UVWA will be run by the Water Executive Committee (Sections 5 and 6).
- Two representatives from each member serve on the Water Executive Committee.
- The Water Executive Committee sets an annual budget for the Combined Water System.
- The Water Executive Committee has the power to set rates and collect levies (Section 6.A).
- The City will provide management and O&M services to the JPA under contract.
- The City will hire any District employees who wish to be.
- City may be asked to provide services to additional non-parties (Section 9).
- The Parties commit to mutual cooperation.
- City to submit Out of Areas Service Agreements to LAFCo for services outside the City and the Districts.
- Districts will support the City Annexation of the entire territory of Districts when allowed by LAFCO law.
- A Party may withdraw with an effective date of July 1st on 90 days' notice. (Section 10).
- Upon withdrawal, withdrawing Party regains control of its assets; provided, however, that to the extent any asset has been improved for the benefit of other Parties, the withdrawing Party must continue to serve benefitted customers.
- Absent agreement, assets serving more than one Party remains part of Combined Water System.
- Grant funding in excess of $1m leads to change in organization when approved by LAFCO (Section 11.C).
- Modification of Water Rights (Section 12).
- Parties will work together to modify their existing water rights to allow for the provision of water service across footprint of UVWA.
- Robust mediation and dispute resolution provisions (Section 20).

- Key Exhibits

-Each Party's Water System.
-Ukiah's Cost Allocation Plan.
-Placement of District Employees in the City.

Recommended Action: Approve the Joint Exercise of Powers Agreement for the Ukiah Valley Water Authority and authorize the City Manager to execute the agreement on behalf of the City, and to make any modifications that do not make material, substantive changes to the agreement, including approval of Exhibits A-C thereto, and if approved appoint two representatives to the Ukiah Valley Water Authority.

BUDGET AMENDMENT REQUIRED: NA

CURRENT BUDGET AMOUNT: NA

PROPOSED BUDGET AMOUNT: NA

FINANCING SOURCE: NA

PREVIOUS CONTRACT/PURCHASE ORDER NO.: NA

COORDINATED WITH: Council Ad-hoc Crane & Orozco; Sage Sangiacomo, City Manager; David Rapport, City Attorney; Phillip Williams, Legal Counsel.

DIVERSITY-EQUITY INITIATIVES (DEI): **Goal 5** – Instill diversity, equity, and inclusion as essential core elements of policy-making, accountability, and delivery of City services.

CLIMATE INITIATIVES (CI): **7a** – Expand sustainable water practices.

GENERAL PLAN ELEMENTS (GP):GP-A1 - Land Use Element, GP-A2 - Economic Development Element; GP-A4 - Public Facilities, Services, and Infrastructure Element; GP A5 - Environment and Sustainability Element

Approved: 
Sage Sangiacomo, City Manager

JOINT EXERCISE OF POWERS AGREEMENT FOR THE UKIAH VALLEY WATER AUTHORITY

THIS JOINT EXERCISE OF POWERS AGREEMENT ("Agreement") becomes effective on the date ("Effective Date") it is executed on behalf of the last of the Parties to do so in Ukiah, California, among the City of Ukiah, a general law municipal corporation (the "City"), Millview County Water District ("Millview"), and Redwood Valley County Water District ("Redwood"), both County Water Districts formed pursuant to Division 12 of the California Water Code, commencing with Section 30000) (collectively the "Districts," when referring to Millview or Redwood, and the "Parties," when referring to the Districts and the City, and individually a "Party"), all of which are organized and existing under and by virtue of the Constitution and the laws of the State of California.

RECITALS:

1. The Parties are each empowered by law to acquire real property, construct, equip, staff, maintain, operate and lease public and private improved and unimproved real and personal property and related facilities, including, but not limited to, water sources and water rights, to provide water and wastewater collection and treatment services, set and collect fees for service, including connection fees and fees for permits and other purposes, and to borrow funds for said purposes. Each of the Parties is authorized and obligated to deliver a clean, safe, and reliable water supply to its customers and constituents.

2. Each of the Parties is a public agency, as defined in the Joint Exercise of Powers Act, Government Code Section 6500, et seq. (the "JEP Act") at Government Code Section 6500, authorized and empowered to contract for the joint exercise of common powers under the JEP Act.

3. The JEP Act provides that two or more public agencies may by agreement jointly exercise any powers common to the parties to the agreement, including, but not limited to, the authority to levy a fee, assessment, or tax. Under Government Code Section 6502, it shall not be necessary that any power common to the contracting parties be exercisable by each such contracting party with respect to the geographical area in which such power is to be jointly exercised.

4. The Parties recognize the benefits to each and all of them that will result from the coordinated use of their respective water resources and water systems before or without formal annexation or consolidation of the Parties into a single agency. The Parties enter into this Agreement to immediately maximize use of their respective and collective existing resources, create cost-saving opportunities, reduce duplication, maintain local control, and continue to deliver water services at a high level of service for the benefit of their customers and constituents.

5. The Parties desire to, and by this Agreement do, create a joint powers authority pursuant to the JEP Act that is named the Ukiah Valley Water Authority ("UVWA").

6. The Parties recognize the benefits to each and all of them that will result from the immediately combined administration, operation, and maintenance of their respective water systems as a single and integrated water system before or without formal annexation or consolidation of the Parties into a single agency. The Parties intend this Agreement in part to enable UVWA's receipt of much-needed State funding to improve and integrate water system infrastructure across the Parties' respective service areas. As any such funding becomes available, the Parties recognize UVWA or another local government agency will be responsible for obtaining and allocating such funds and implementing projects and improvements and integrating the Parties' respective water systems into a Combined Water System.

7. The Parties recognize that the coordination of water resources and combination of water services as

provided for in this Agreement will require the City to seek changes in organization as provided for by the Cortese-Knox-Hertzberg Local Government Reorganization Act of 2000 (the "CKH Act") and which changes in organization may need to be approved by the Mendocino Local Agency Formation Commission, and other local agencies.

8. The Parties desire to accomplish the aforesaid purposes by jointly exercising their common powers in the manner set forth in this Agreement.

9. The Parties have determined that the goal of this Agreement shall be to combine and coordinate the operations of their respective water systems to obtain efficiencies not otherwise available by operation as a Combined Water System in accordance with the terms of this Agreement before or without formal annexation or consolidation of the Parties into a single agency, except as the law may otherwise require, as they may otherwise subsequently agree, or as this Agreement provides otherwise.

10. Each Party shall retain ownership of its respective system as it exists on the Effective Date or as it may be modified, added to, or enlarged in the future, unless and until a change of organization affecting such ownership is approved pursuant to the CKH Act or other law, as may be required as a condition of grant funding.

11. Among the assets the Parties bring to the Combined System are water rights. Nothing in this Agreement shall be interpreted to transfer such a water right from a Party to UVWA or to another Party; any such transfers shall occur in the manner required by law. Other than as expressly addressed herein, this Agreement shall not be interpreted to require the use of a water right other than as currently permitted by law. Similarly, some assets are subject to liens for debt and other such claims. Nothing in this Agreement shall require or authorize any act in contravention of such third-party rights. However, it is the goal of this Agreement to achieve a Combined Water System and to obtain the right to serve water throughout the combined service areas of the Parties without respect to its source.

12. The approval of this Agreement is not a project subject to the California Environmental Quality Act (CEQA) because it does not require more than the operation of the Parties' respective Water Systems to serve their existing customers and will therefore have no reasonably foreseeable impact on the environment. (State CEQA Guidelines section 15378(b)(2), (4), (5); section 15061(b)(3) [the "common sense" exemption].) However, the implementation of this Agreement will likely involve "projects" within the meaning of CEQA, such as annexations under the Cortese-Knox-Hertzberg Act, the construction of water utility infrastructure, and the amendment of water rights. It is not presently possible to accurately foresee the details of such projects and evaluation of their impacts now would be unduly speculative. Accordingly, review of the environmental impacts of such projects is therefore appropriately undertaken when those projects are proposed, and their details better known. Such review shall be informed by applicable law, including these CEQA exemptions: CEQA Guidelines sections 15301 (existing facilities), 15302 (replacement or reconstruction), 15303 (new construction or conversion of small structures), 15319 (annexations of existing facilities), and 15320 (changes in organization of local governments).

AGREEMENT:

Based on the foregoing Recitals, which are incorporated in this Agreement by this reference, and the terms and conditions set forth below, the Parties, for and in consideration of the mutual benefits, promises, and agreements set forth herein, AGREE as follows:

Section 1. DEFINITIONS

For the purposes of this Agreement, the following terms shall have the meanings indicated below unless

the context shall plainly require otherwise:

"Collaborate" is defined in Section 5.B.4 below.

"Combined Water System" means two or more Parties' Water Systems and all the components thereof as may be altered, improved, constructed, or added to after the date the respective Party executes this Agreement, which have been operationally integrated in the performance of this Agreement.

"Effective Date" is defined in the introductory paragraph above.

"Legislative Body(ies)" means each District's Board of Directors and the City Council of the City.

"Representative" means a member of a Party's Legislative Body appointed by that Legislative Body to serve on the Water Executive Committee.

"Revenues" means any and all revenues produced by the Combined Water System and other operations authorized in this Agreement, including, but not limited to, revenues from fees and charges described in Sections 6.A.3, 6.A.4 and 6.A.5.

"Services" means the City's exercise of the joint powers conferred by this Agreement pursuant to Section 6.

"Services Start Date" means the first July 1 after the Effective Date unless the City and the Water Executive Committee otherwise agree in writing.

"Water Executive Committee" means the body comprised of two Representatives from each Party and the duties, authorities, and responsibilities of which as to the Combined Water System are defined in this Agreement.

"Water System" means a Party's infrastructure, components, and parts which are owned, operated, and/or used by that Party to capture, treat, deliver, and/or manage water for any use provided for by law. A description of each Party's respective Water System as of the Effective Date is attached hereto as Exhibit A. Rolling stock and other tangibles the City uses to provide the Services do not constitute part of any other Party's Water System.

"Water System Enterprise Fund" means the fund or funds established by the City to account for receipts and expenditures, assets, and liabilities for the Combined Water System in which all such Revenues are accounted.

Section 2. UVWA's MANNER OF EXERCISE OF POWERS.

A. UVWA is a public entity separate from the Parties.

B. The City shall file with the Secretary of State, State Controller, and the Mendocino Local Agency Formation Commission a notice in accordance with Government Code Sections 6503.5 and 6503.6, and shall file notices, as appropriate, in accordance with Government Code Section 53051 promptly following the Effective Date and upon any amendment to this Agreement. The City shall file a further report under Government Code Section 53051 upon each change in the membership of the Water Executive Committee.

C. For purposes of Government Code Section 6509, UVWA shall exercise its powers subject to the restrictions upon the manner of exercising such powers as are imposed upon the City of Ukiah, a general law city.

Section 2.1. OFFICERS, EMPLOYEES AND AGENTS; IMMUNITIES.

A. Any UVWA officer, employee, or agent may also be an officer, employee, or agent of any Party with the consent of all Parties. The Water Executive Committee's approval of the appointment or employment of such a person shall constitute a determination that the two positions are compatible.

B. All privileges and immunities from liability, all exemptions from laws, ordinances and rules, and all pension, relief, disability, workers' compensation, and other benefits which apply to the activities of officers, agents, or employees of a Party when performing their respective functions shall apply to them to the same degree and extent while engaged in the performance of any of the functions and duties under this Agreement.

C. No officer, agent, or employee directly employed by UVWA, if any, shall be deemed, by reason of that employment, to be employed by any Party or to be subject to any of the requirements of any Party.

Section 2.2. LIABILITIES; PENSION LIABILITY.

A. UVWA's debts, liabilities, and obligations shall be its debts, liabilities, and obligations alone and not those of the Parties except as they may otherwise agree by written contract.

B. During the effectiveness of Government Code Section 6508.2 or other law imposing liability on the Parties for unfunded liabilities due the California Public Employees' Retirement System or another pension provider to be paid upon termination of this Agreement and dissolution of UVWA, the Parties agree that any such liability shall be apportioned among them as they shall agree in writing when a contract with Cal PERS is approved or, failing such agreement, in proportion to the rate revenue from customers within the territory of each Party in the last fiscal year for which audited financial reports exist when the determination is made.

Section 2.3. EXERCISE OF JOINT POWERS.

This Agreement is made pursuant to the JEP Act to permit the joint exercise of powers common to the Parties. The purpose of this Agreement is to exercise these powers jointly by managing, equipping, maintaining, and operating the Combined Water System. Such purpose will be accomplished, and common powers exercised, in the manner set forth in this Agreement. The Parties may use the designation "Ukiah Valley Water Authority" to identify the provision of the services provided under this Agreement, including those on equipment, uniforms, buildings, letterhead, phone, and other directories. All pre-existing obligations, rights, and privileges of the Parties shall continue hereunder, subject to the terms and conditions of this Agreement.

Section 3. SERVICE LEVEL.

Commencing on Services Start Date, the City shall provide the Services to allow efficient, coordinated operation of Combined Water System inclusive of wells, storage facilities, pump stations, treatment facilities, distribution systems, and related managerial and administrative services and water rights, to the extent and in the manner consistent with this Agreement and annual budgets approved by the Water Executive Committee.

Section 4. TERM.

This Agreement shall commence on the Effective Date and shall be binding upon the Parties, and shall

continue in full force and effect until such time as the Parties agree to terminate the Agreement as set forth in Sections 10 or 11, or only one Party to the Agreement remains due to annexations, other changes of organization under the CKH Act, or other reasons. A Party may withdraw from this Agreement as provided in Section 10 below.

Section 5. WATER EXECUTIVE COMMITTEE.

A. The Water Executive Committee shall perform the duties set forth in Section 6.

B. MEETINGS OF THE WATER EXECUTIVE COMMITTEE.

1. The Water Executive Committee shall establish a schedule for its regular meetings, which must be at least monthly. The Water Executive Committee may call special meetings, as may be needed from time to time, and/or may cancel regular meetings if deemed appropriate.
2. A majority of the Water Executive Committee's members shall constitute a quorum for the transaction of business. A majority vote of the Water Executive Committee's members is required to take action, although a lesser number may adjourn for lack of a quorum.
3. The Water Executive Committee shall comply with the Ralph M. Brown Act, Gov. Code sections 54950, *et seq*.
4. For those duties of the Water Executive Committee requiring collaboration, "collaboration," "collaborate," or "collaborative" shall mean the meaningful and timely process of the Representatives each seeking, discussing, and carefully considering the information and views of each Party in a manner that is cognizant of all Parties' values, reasonably attempting to reach agreement through cooperative efforts for the mutual benefit of the Parties. Collaboration among the Representatives shall be conducted in a way that is mutually respectful of each District's authority and responsibilities as a County Water District and the City's authority and responsibilities as a general law city, and shall consider the views of a Party as expressed by its Representatives. A Representative need not engage in dialog with Legislative Bodies other than his or her own appointing authority.

C. VOTING RIGHTS. Each Party shall have two seats on the Water Executive Committee and each member of the Water Executive Committee shall have one vote, with these exceptions:

1. If a member is the sole representative of a Party at a meeting due to an absence or vacancy, he or she may cast all votes that Party is authorized to cast.
2. If a Party merges or consolidates into another, the successor agency shall acquire the votes of the merged or consolidated agency. So, for example, if a District is merged into the City, the City shall hold its own votes and the votes previously assigned that District.

D. TIE VOTES. Any tie vote of the Water Executive Committee shall be resolved as provided in Section 20 below unless the Water Executive Committee otherwise directs at the meeting at which the tie vote occurs.

Section 6. POWERS AND DUTIES OF THE WATER EXECUTIVE COMMITTEE.

A. DUTIES. The Water Executive Committee shall be the governing body of UVWA. The Water Executive Committee shall take any and all actions within the authorities specified in this Agreement which are necessary and appropriate to implement the purposes of this Agreement, including, but not limited to, any or all of the following:

1. To prepare and adopt budgets for the Water System Enterprise Fund in accordance with all applicable

legal requirements. The budgets shall include the annual expenses for the Services, including, but not limited to, costs of administration, operation, maintenance, repair of, and capital improvements to, the Combined Water System, including those included in Capital Improvement Plans, debt service on bonds, and any other costs of providing the Services;

2. To set rates to fund the Services in accordance with all applicable legal requirements, including the procedural and substantive requirements of California Constitution, Article XIII D, Section 6 ("Proposition 218") for property-related fees charged for the services of the Combined Water System, which rates shall be adopted with the same notice and right to object or protest provided to City and District ratepayers except as the law may otherwise require. Such rates may be adopted as to zones which reflect the boundaries of one or more Parties and shall neither exceed the reasonable cost of service provided to any such zone nor require ratepayers in one zone to subsidize the cost to serve another zone. To the extent rates cannot cover the cost of service in a zone, the difference mut be covered by grants, discretionary revenues, or other non-rate revenues. In particular, and without narrowing the foregoing, the Water Executive Committee's ratemaking in compliance with Proposition 218 and other law shall account for assets each Party brings to this Agreement as depicted in Exhibit A and will not charge that Party's customers to recreate the remaining utility of those assets
3. To establish connection and/or capacity fees for the temporary or permanent connection of residential, commercial, and industrial users to the Combined Water System except as the law may otherwise require;
4. To establish any other taxes, assessments, fees, or charges reasonably necessary to provide the Services, including fees for permits or inspections, provided that all such fees shall comply with this Agreement and applicable provisions of Proposition 218 and California Constitution, Article XIII C, section 1, subdivision (e) ("Proposition 26"), and other applicable law;
5. To adopt ordinances and regulations enforceable within the jurisdictional boundaries of each Party governing the Combined Water System and service to its users as required, and to the extent authorized, by law as necessary to provide the Services. The Parties shall collaborate to avoid conflicts or inconsistencies between ordinances or regulations adopted by a Party and ordinances or regulations adopted by the Water Executive Committee pursuant to this Agreement. No Party shall have any duty to enforce an ordinance or regulation other than its own; and
6. To maximize the availability of water to meet the collective needs of the Parties within the boundaries of each Party through the use of the collective water rights and supplies of each Party, subject to the terms and conditions of Section 12 of this Agreement.
7. All customers of the Parties, including agricultural customers, either before, after or absent consolidation or merger into the Combined Water System, shall have the same right and entitlement to water supplies and service that they enjoyed before the effective date of this Agreement, without discrimination or limitation. This reflects, but is not intended to alter, the legal principle that acquisition of a water supply on which users rely is subject to a duty to continue to serve them. (E.g., *Durant v. City of Beverly Hills* (1940) 39 Cal.App.2d 133.)
8. To accept grants, loans, and subventions which the Water Executive Committee shall appropriate consistently with the terms of those grants, loans, and subventions; applicable law, and the goal of this Agreement as reflected in the Recitals above.

B. AUTHORITIES RETAINED BY THE PARTIES.

Notwithstanding the foregoing, the Parties retain all their respective authorities to the extent the exercise of those authorities does not directly conflict with the duties and authorities granted to the Water Executive Committee. No Party shall exercise its authorities in a way that directly contravenes the purposes of this Agreement.

Section 7. KEY MANAGEMENT SERVICES.

The City shall provide the Services described in this Section 7 commencing on the Services Start Date. To provide the Services described herein, the City shall hire all the Districts' respective employees with a start date of no earlier than the Service Start Date. The employees of the Districts who wish to continue employment and the bargaining unit of the City to which each will be assigned are identified in Exhibit C to this Agreement. The City hereby waives the right to subject these new employees to probationary periods. Those employees' rights vis-à-vis the City will otherwise be governed by the City's collective bargaining agreements with its bargaining units; its current policies, procedures, and ordinances; and applicable law. The management and personnel services identified in Subsections A and B below ("Key Management Services") shall be provided by the City in accordance with this Agreement.

A. OPERATION AND MAINTENANCE OF THE COMBINED WATER SYSTEM.

1. Other than duties and obligations of the Water Executive Committee, and in consultation with the Water Executive Committee, the City shall provide general administration, operation, and oversight of UVWA all in accordance with this Agreement, applicable statutes, regulations, and applicable ordinances, adopted by the Water Executive Committee consistently with this Agreement. The following are examples of activities and deliverables the City shall provide in performing under this Agreement:
   a. Read the meters in the service area;
   b. Perform all necessary sampling, including for purposes of water quality;
   c. Complete all required and routine reports;
   d. Respond to all service calls;
   e. Schedule a minimum of one on-call service personnel to respond to all after-hours and weekend calls in all service areas covered by this Agreement and/or any contract authorized under this Agreement; and
   f. Any other levels of service as requested by the Water Executive Committee and funded in the annual budget.
2. Other than duties and obligations of the Water Executive Committee, and in consultation with the Water Executive Committee, the City may exercise on behalf of the Parties the following powers, and any other powers exercised by a general law city, as needed to perform under Section 7.A.1:
   a. To manage, operate, maintain, and repair the Combined Water System, including any buildings, works or improvements comprising part of the systems and located either inside or outside the boundaries of the Parties, in accordance with sound engineering and accounting practices and with all applicable local, state, and federal laws and regulations; provided that the City and UVWA need not enforce any local ordinances but their own;
   b. To implement the budgets approved by the Water Executive Committee.
   c. The City cannot increase the total amount of the approved expenditure budget without prior approval of the Water Executive Committee, except as: (i) warranted for an urgent and/or emergency provision of water or sewer service which shall be reported to the Water Executive Committee before its next regular meeting following the expenditure of the funds; or (ii) to services within the City to be funded by rates levied for those services or other City revenues;
   d. To contract for the provision of personal or professional services in connection with providing Services;
   e. To enforce ordinances and regulations of the Combined Water System for the Parties and UVWA, including the use of the Combined Water System;
   f. To bill for and collect revenue measures established under this Agreement, including the

authority of a general law city to terminate water service or other utility services contained in the same bill for nonpayment in accordance with the Public Utilities Code;

g. To allocate and assign water rights and water supplies of each Party within the boundaries of the Parties, as necessary for the efficient and cost-effective supply of water to the customers of the Parties, subject to the terms and conditions of Section 12 of this Agreement.

h. With the approval of the Water Executive Committee and at City's sole election, to use any statutory power available to the City under the JEP Act and any other applicable laws, whether heretofore or hereinafter enacted or amended, for issuance and sale of any revenue bonds or other evidences of indebtedness necessary or desirable to finance the exercise of any Services of the City under Section 7, and to borrow from any source including, without limitation, the federal or state governments, for these purposes:

1. To contract for the provision of personal or professional services in connection with providing the Services for the Parties;
2. To contract for the installation or construction of capital improvements to the Combined Water System;
3. To acquire, lease, hold, and dispose of such equipment as may be reasonably necessary or appropriate to the proper operation, maintenance, administration, and management of the Combined Water System or the provision of Services;
4. To file reports associated with the operation, maintenance, administration and management of the Combined Water System and the provision of Services;
5. To implement all requirements of laws and ordinances, applicable to the provision of Services, including, but not limited to, permitting, inspections, monitoring, reporting, and enforcement activities; and
6. To provide City staff or contractors to support UVWA or the Parties in performing functions and responsibilities as requested by the Water Executive Committee.

B. FINANCIAL AND GENERAL SERVICES.

1. The City agrees to provide the Services to UVWA and the Parties for the term of the Agreement, including accounts payable, procurement, billing and accounts receivable, general accounting and reporting, budget development and monitoring, and other general services such as human resources and city clerk services as the City reasonably deems necessary to provide the Services at the level requested by the Water Executive Committee and as can be funded by the budget approved by the Water Executive Committee.
2. The City will perform these services pursuant to any applicable state and federal law and pursuant to City policies and regulations, unless the City and the Water Executive Committee otherwise agree in writing. The City shall perform procurement, contracting and personnel services in accordance with laws applicable to California cities, including, but not limited to, the Uniform Construction Cost Accounting Act. The City is not performing these services as the Parties' agent, but as a service provider, and the Parties agree that the City does not assume a fiduciary duty to the Parties in the performance of these financial and general services. Nor need the City provide Services beyond what can be funded by the budget approved by the Water Executive Committee.
3. The Parties shall compensate the City for the Services consistently with the annual budget approved by the Water Executive Committee. The City shall have the right to withhold performance of a particular level of service if it considers the funding in an approved budget insufficient to cover the City's cost in providing that level of service; provided, however, that nothing in this sentence detracts from the City's obligation to maintain service as provided in Section 6.A.7 of this Agreement.
4. The City's cost to provide the Services includes indirect costs, such as general administration and

overhead. Unless the City and the Water Executive Committee agree otherwise in writing, the City shall charge indirect costs of the Services consistently with Exhibit B.

Section 8. MUTUAL COOPERATION.

A. OUT OF AREA SERVICE AGREEMENT ("OASA"). The City may prepare OASAs on the recommendation of the Water Executive Committee to serve areas outside the boundaries of the Parties but within the City's sphere of influence, where development could occur with the provision of water services. The City shall submit such OASAs to the Water Executive Committee for review and approval before filing with LAFCo. This Agreement and any OASA-related tax sharing agreement with Mendocino County shall be attached to and incorporated by reference into any OASA submitted to LAFCo under this Agreement.

B. As long as this Agreement remains in effect and the Parties comply with Sections 8 and 10.B, the City agrees that it will not apply to LAFCo for detachment of District Parties' territory from the Districts' boundaries when that territory is annexed to the City unless and until all of the territory of a District is annexed to the City.

C. The Districts agree to support City Annexations and to work cooperatively with the City regarding revisions to the City's General Plan, Municipal Service Review ("MSR") and Sphere of Influence ("SOI") necessary or advisable to enable City Annexations and not to propose or seek LAFCo approval for or support proposed provisions in a District's MSR or SOI that would inhibit, conflict with, or prevent such City Annexations and/or reorganizations, as described in this Agreement.

D. Pursuant to Government Code Section 57105 or other applicable provisions of state law, the Districts will support LAFCo either designating a District as a subsidiary district of the City or merger of a District with the City at such time as 70% or more of registered voters in a District are within the City limits and 70% of the area of land within a District is within the City's jurisdictional boundaries or when those reorganizations are otherwise authorized by state law.

E. The Districts will support and cooperate with the City in seeking legislation to amend the Cortese-Knox-Hertzberg Local Government Reorganization Act of 2000 ("CKH Act") to authorize merger of a District with the City or the establishment of a District as a subsidiary district of the City when 70% or more of registered voters in a District are within the City limits without regard to the area of a District's land that is within the City.

Section 9. SERVICES TO OTHER AGENCIES.

The Water Executive Committee may recommend that the City provide water services to agencies not party to this Agreement. Such services may be provided with the concurrence of all Parties and upon execution of an amendment to this Agreement by all Parties or upon execution of a contract authorized by all Parties. The charges for such services shall be determined by the Water Executive Committee in accordance with the budget provisions of this Agreement. The City retains the power to provide services to other agencies on terms of its choosing provided that its doing so does not impair its ability to provide the Services.

Section 10. WITHDRAWAL; TERMINATION.

A. A Party may withdraw from this Agreement with a July 1st effective date on 90 days' notice to the Water Executive Committee and all Parties. Such withdrawing Party shall perform all obligations under this Agreement until the agreed upon date of withdrawal. A withdrawing Party shall remain obligated to perform obligations, including financial obligations, arising before the withdrawal date, even after the date

of withdrawal.

B. Upon withdrawal from UVWA, a departing Party shall regain control of, and responsibility for, its Water System as it existed as of the Effective Date, to the extent feasible. The Parties acknowledge that a Party's Water System as of a withdrawal date may differ from that in existence on the Effective Date. Any infrastructure, such as tanks, pipes, pumps, treatment facilities, and water rights, that UVWA uses only to serve that Party shall be the withdrawing Party's property as of the withdrawal date. If any infrastructure serves more than one Party, the withdrawing Party shall recover ownership and control of that infrastructure upon agreement of the other Party or Parties it serves, but will remain obligated to serve all customers of other Parties served by such infrastructure and water supplies at the time of withdrawal, with appropriate compensation paid by UVWA or the Par(ies) benefitted by such service. Absent such agreement, infrastructure serving more than one Party shall remain part of the Combined Water System and operated by the City until the Parties served by that infrastructure reach an agreement or the dispute is resolved pursuant to Section 20 of this Agreement or otherwise.

C. In negotiating the disposition of infrastructure which serves more than one Party, these general principles shall inform discussion:

1. The primary obligation shall be to provide uninterrupted service to all customers of the Combined Water System.
2. All other things being equal, a withdrawing Party should resume possession and control of infrastructure which was part of its Water System on the Effective Date.
3. Any infrastructure acquired, constructed, or improved with grant or other funds available only by virtue of this Agreement should not be separated from the Combined Water System unless it is necessary to do so to allow a Party to withdraw and will allow both uninterrupted service to all customers of the Combined Water System and compliance with grant, loan, and other conditions on the use of the infrastructure.

Section 11. DISSOLUTION/REORGANIZATION.

A. The Agreement shall terminate if the number of parties to this Agreement becomes less than two, or if the Parties unanimously agree to terminate it. If the Parties have accumulated any assets relating to the shared management of water services before termination, such assets shall be distributed among the Parties in proportion to their respective contributions, unless the Parties agree otherwise. Any dispute as to the disposition of such assets shall be resolved as provided in Section 20 of this Agreement.

B. The CKH Act shall govern any change of organization or reorganization of a District. This Agreement is intended to allow for the administration and operation of a Combined Water System on behalf of the Parties, until:

i. City annexations result in 70% of a District's territory and 70% of the registered voters of a District being within the City's limits; or
ii. satisfaction of other provisions of the CKH Act or other provisions of state law authorize a merger of the District with the City or establishing the District as a subsidiary district of the City;

in which event this Agreement will be deemed to be the affected Parties' joint request to LAFCO, pursuant to Government Code Sections 56078 and 57105, to either merge the District with the City or establish the District as a subsidiary district of the City with the City Council serving as the Board of Directors of the District.

C. If any of the Parties to this Agreement receives grant funding of $1,000,000 or more to develop capital assets to serve more than one of those Parties, the City shall apply to LAFCO to combine the Parties to benefit from the capital asset into a new or existing public entity to own and operate that asset, if and as required by the terms of the grant. If the Cortese-Knox-Hertzberg Act does not authorize the City to make the application, the City shall invite LAFCO to exercise its own authority to initiate the change of organization. Each of the Parties to this Agreement agrees to support such a change of organization and, by making this Agreement, authorizes the City to propose such changes of organization on its behalf.

Section 12. TRANSFER, MODIFICATION, AND USE OF WATER RIGHTS.

To achieve the goal of applying and using the water rights of all Parties collectively to serve the customers of all Parties, and the eventual customers of the Combined Water System, without limit or restriction, and in recognition of the eventual need to operate, maintain, and administer the Parties' water resources and transmission and treatment systems as a Combined Water System, the Parties agree to the following:

A. Within 60 days of the execution of this Agreement, each Party shall identify and disclose (1) all water rights it currently holds and uses, (2) how it must modify or amend the water rights to allow a Combined Water System to use the water rights, (3) to the extent possible, the process and procedure each Party must undertake to allow a different entity to use of the water rights as part of a Combined Water System, including any necessary approvals, and (4) a plan and estimated time period to modify and transfer such water rights.

B. The Parties shall take any and all actions which are necessary and appropriate to modify, amend or transfer the water rights of the Parties to UVWA, the City, or other entity that will own or operate the Combined Water System, for the collective use of such water rights within the service areas of all Parties, if possible. Each Party shall support and cooperate with the other Parties to effectuate the modification, amendment to, or transfer of, its water rights, including, but not limited to, granting approvals, signing agreements, meeting and working with local and state officials and regulators, responding to and defending against protests, objections, and legal challenges to the modification, amendment, or transfer of water rights, and the Parties agree to separately or collectively conduct and support any required environmental review in support of the modification, amendment to, or transfer of, the water rights of the Parties.

C. While the Parties are undertaking efforts to modify, amend, or transfer their water rights, each Party will, as necessary to effectuate the purpose of this Agreement and to the extent feasible, allow its water rights to be used collectively, even if on a temporary or short-term basis, by the Combined Water System. Each Party, however, will still have the primary right and authority to continue to use its respective water rights within its current service areas and for the benefit of its current customers, up to the time that the rights are transferred to, or obtained for the benefit of, the Combined Water System.

D. The Parties agree to initiate, fund, and pursue all efforts necessary to modify, amend, or transfer the water rights of the Parties for use in the Combined Water System, but UVWA and all Parties will ultimately be responsible for costs, expenses and fees associated with and arising out of such efforts, and the Parties will have the right to seek reimbursement from UVWA for recovery of such costs, expenses, and fees.

E. If a Party withdraws from this Agreement, the Agreement is terminated, or the Combined Water

System ceases to function or exist, the affected Party or Parties will retain all of its or their water rights, or if necessary the rights shall revert to the original right holder, and the Parties will take any and all actions which are necessary and appropriate and shall support and cooperate with the other Parties to return or restore the water rights to the Party that formerly held such rights. The water rights of a withdrawing Party shall remain dedicated and committed to the Combined Water System until the later of the withdrawal date or the date those rights may be lawfully used by the withdrawing Party alone.

F. Notwithstanding any other provision of this Agreement, the Parties agree, represent, and confirm that they will endeavor to and will take any and all reasonable and necessary steps to ensure that the customers of each Party will continue to receive a clean, safe, and reliable water supply at all times, without delay or disruption.

G. Notwithstanding the foregoing, this Agreement does not and shall not be interpreted to authorize or require the use of a water right or related asset other than as permitted by law, nor shall this Agreement require or authorize any act in contravention of any third-party rights, to the extent any of the water rights or other assets of the Parties are subject to liens for debt and other such claims.

Section 13. AMENDMENT TO AGREEMENT.

The Water Executive Committee may recommend an amendment to this Agreement. This Agreement may only be amended by approval of all the Parties to this Agreement. The Water Executive Committee shall forward a proposed amendment with its recommendation to the legislative body of each Party. The proposal shall be adopted, properly executed, and returned to the Water Executive Committee if the Party approves the amendment. This Section 13 shall not prevent the Parties from adopting an amendment to this Agreement that is not recommended by the Water Executive Committee.

Section 14. ADDITIONAL PARTIES TO THE AGREEMENT.

A public agency, as that term is defined in the JEP Act (Government Code section 6500), located in Mendocino County may become a Party to this Agreement upon:

1. Its approval and execution of this Agreement as required by law, and;
2. Approval of the Water Executive Committee.

Section 15. NOTICES.

Whenever notice or other communication is permitted or required by this Agreement, it shall be deemed given when (i) personally delivered or (ii) when received, if delivered by overnight courier or email (if email receipt is acknowledged in writing), or (iii) 48 hours after it is deposited in the United States mail with proper first-class postage affixed thereto and addressed as follows:

To City:

City of Ukiah
Attn: Mayor and City Manager
300 Seminary Ave.
Ukiah, CA 95482
Email: swhite@cityofukiah.com

To Millview County Water District:
Millview County Water District
Attn: Mr. Tim Price
151 Laws Ave.
Ukiah, CA 95482
Email: jwalker@willowcwd.org

To Redwood Valley County Water District:
Redwood Valley County Water District
Attn: Mr. Tom Schoeneman
151 Laws Ave.
Ukiah, CA 95482
Email: jwalker@willowcwd.org

A Party may change the address and email address to which notices shall be sent by giving notice of the change as provided herein.

Section 16. SEVERABILITY.

Except as otherwise provided in this Section 16, should any part, term, portion, or provision of this Agreement or the application thereof to any person or circumstances be in conflict with any state or federal law, or otherwise be rendered unenforceable or ineffectual, including by amendment or repeal of a statute, the validity of the remaining parts, terms, portions or provisions, or the application thereof to other persons or circumstances shall be deemed severable and shall not be affected thereby, provided such remaining portions or provisions can be construed in substance to continue to constitute the Agreement that the Parties intended to enter into in the first instance. The City's promise to provide Services is dependent on and not severable from the validity and enforceability of Sections 7, 8 and 10.B.

Section 17. HOLD HARMLESS AND INDEMNITY.

To the fullest extent permitted by law, each of UVWA and the Parties (the "Indemnifying Party") agrees to save, indemnify, defend and hold harmless UVWA and each other Party and its officers, agents and employees ("Indemnified Parties") from any liability, claims, suits, actions, arbitration proceedings, administrative proceedings, regulatory proceedings, losses, expenses, or costs of any kind, whether actual, alleged or threatened, including reasonable and actual attorney fees and costs, court costs, interest, defense costs, and expert witness fees, which arise out of, or are in any way attributable in whole or in part to, negligent or intentional acts or omissions of an Indemnifying Party or its employees except such losses as arise from the sole negligence or intentional act of an Indemnified Party.

Section 18. LEGAL REPRESENTATION AND ADVICE.

In the course of performing this Agreement, each Party shall seek legal advice from its own counsel. If a legal matter or issue relates to two or more Parties where the Parties involved will benefit from joint representation, the Parties may choose to be represented by the same legal counsel so long as no conflict of interest arises by such representation and the representation is permitted by the Rules of Professional Conduct of the California State Bar. In that event, the Parties may agree on an apportionment of costs, if applicable, as allowed by law. Under any circumstances when two or more Parties are represented by the same legal counsel, no Party may bind the others to a settlement agreement without the written consent of the other Parties to be bound.

Section 19. INSURANCE.

A. Each Party shall be responsible for maintaining a program of insurance that shall cover each Party's indemnification obligations; provided funding is provided in a budget approved by the Water Executive Committee to pay the premiums for said insurance or the Water Executive Committee elects to provide insurance coverage for all Parties. While the City provides the Services pursuant to Section 6 of this Agreement under rates adopted pursuant to Section 5: (i) no District need fund insurance at its own expense and (ii) the Water Executive Committee shall maintain or, at its option, fund directors and officer's liability coverage for each of the Districts.

B. Without in any way affecting the indemnity herein provided and in addition thereto, unless the Executive Committee provides insurance to cover the Parties, each Party shall secure and maintain throughout the Agreement the following types of insurance:

1. WORKERS' COMPENSATION.
   A program of Workers' Compensation Insurance or a state-approved self-insurance in an amount and form to meet all applicable requirements of the Labor Code of the State of California, including Employer's Liability with $250,000 limits covering all persons providing services on behalf of each Party and all risks to such persons under this Agreement. This coverage may be waived if a Party's legislative body certifies that the Party has no employees and does not treat volunteers as employees for worker's compensation purposes.

2. COMPREHENSIVE GENERAL AND AUTOMOBILE LIABILITY INSURANCE.
   This coverage is to include contractual coverage and automobile liability coverage for owned, hired, and non-owned vehicles. The policy or self-insurance shall have combined single limits for bodily injury and property damage of not less than two million dollars ($2,000,000.00). This requirement can be waived by the Water Executive Committee, if the Board of Directors of a District certifies that it has no vehicles and that no non-owned, uninsured vehicles are used on District business.

3. ADDITIONAL NAMED INSURED.
   All policies, and/or memoranda of coverage, except Workers' Compensation, shall contain additional endorsements naming each Party and its officers, employees, and agents as additional named insureds with respect to liabilities arising out of each Party's performance hereunder.

4. POLICIES PRIMARY AND NON-CONTRIBUTORY.
   All policies required above are to be the primary and non-contributory with any insurance or self-insurance carried or administered by each Party.

Section 20. MEDIATION AND DISPUTE RESOLUTION.

A. Except as otherwise provided in Sections 10.B and 11.A, if (1) any dispute arises at any time between or among the Parties regarding interpretation or implementation of this Agreement that does not concern a decision of the Water Executive Committee, or (2) if a minority of members of the Water Executive Committee file a written appeal with the Water Executive Committee within 14 days of a decision or action of the Water Executive Committee, or (3) if one or more Parties fails or refuses to follow the order or direction of the Water Executive Committee or breaches this Agreement, the Parties will, in the first instance, attempt in good faith to meet to discuss and informally resolve the dispute through their representatives or their designees. The Parties must give written notice of the existence and subject of a dispute, which notice shall commence the dispute resolution process of this Agreement.

B. If, within 30 days of service of notice of a dispute, the Parties cannot resolve the disputed issue through informal mediation, unless extended by mutual agreement of all Parties, the matter shall be submitted to JAMS, or a comparable mediation service, or a mutually agreeable mediator, for formal mediation by a single mediator who should have technical or legal expertise or experience with water resources and supplies, utility services, or local government agencies. The mediator will be selected by unanimous consent of the Parties, but if unanimous consent cannot be obtained, the mediator will be selected at random from a list of mediators maintained by the Water Executive Committee based on the qualifications set forth in this paragraph.

C. Any Party may commence formal mediation by providing to the mediator and the other Parties a written request for mediation, setting forth the subject of the dispute and the relief requested. If the formal mediation process has not concluded or has not resolved the dispute within 60 days of a written request for mediation, the mediation process will be deemed completed, unless the Parties extend the 60-day period in writing.

D. If the dispute is not resolved by informal or formal mediation, each Party will be free to pursue whatever legal or equitable remedies may be available. No Party shall be permitted to file a legal action without first complying with the requirements of this Section 20. This provision shall not waive or otherwise affect the applicable provisions of law governing claims against a public entity or the applicable statutes of limitation.

E. The fees and expenses incurred as a result of any dispute resolution activities, including attorney fees, mediator fees and costs, expert costs, and other expenses, shall be borne solely by the Parties involved in the dispute and participating in the mediation. The Parties involved in the dispute will share the mediator's expenses on an equal basis. No Party shall be deemed the prevailing party for purposes of recovery of fees, costs, or expenses.

Section 21. ADDITIONAL DOCUMENTS AND AGREEMENTS.

The Parties agree to cooperate in the execution of any additional documents or agreements that may be required to carry out the terms of this Agreement.

Section 22. SUCCESSORS.

This Agreement shall bind and inure to the benefit of all successors and assigns of the Parties and their respective directors, officers, agents, servants, and employees, and the successors and assigns of each of them, separately and collectively.

Section 23. WARRANTY OF LEGAL AUTHORITY.

The Parties' Legislative Bodies have each authorized execution of this Agreement, as evidenced by the signatures below. Those who sign below warrant for the benefit of the Parties for which they do not sign that they have actual authority to execute this Agreement and to bind to it the Party for which they sign.

Section 24. ASSIGNMENT / DELEGATION.

No Party shall assign, sublet, or transfer any interest in this Agreement or any duty hereunder without written consent of the other Parties, and no assignment shall be of any force or effect whatsoever unless and until the other Parties shall have so consented.

Section 25. NO THIRD-PARTY BENEFICIARY.

This Agreement is only for the benefit of UVWA and the Parties as municipal or public entities and shall not be construed or deemed to operate as an agreement for the benefit of any third party and no third party shall have any right of action or obtain any right to benefits or position of any kind by reason of this Agreement.

Section 26. GOVERNING LAW.

This Agreement shall be governed by and construed in accordance with the laws of the State of California.

Section 27. AGREEMENT CONTROLLING.

In the event of a conflict between the text of this Agreement and any attachment to it, the text shall prevail.

Section 28. ENTIRE AGREEMENT; COUNTERPARTS.

This Agreement, including its attachments, is intended both as the final expression of the Agreement among the Parties with respect to the included terms and as a complete and exclusive statement of the terms of the Agreement. This Agreement may be transmitted electronically and executed in counterparts, each such executed electronic copy shall be admissible for any purpose and in any judicial or administrative proceeding as evidence of the agreement between the Parties. Signatures may be exchanged by emailed pdf or other electronic form with the same force as original signatures.

Section 29. EXHIBITS.

All exhibits to which reference is made are incorporated into this Agreement as though fully set forth at length, whether or not actually attached.

IN WITNESS THEREOF, the Parties hereto have caused this Agreement to be executed and attested by their proper officers thereunto duly authorized as of the day and year first above written.

CITY OF UKIAH

By: _____
_____, Mayor

Approved to Form:

_____
City Attorney

Attest:

_____
Kristine Lawler, City Clerk

MILLVIEW COUNTY WATER DISTRICT

By: _____
_____, Board President

Approved to Form:

_____
District Counsel

Attest:

_____
District Secretary

REDWOOD VALLEY COUNTY WATER DISTRICT

By: _____
_____, Board President

Approved to Form:

_____
District Counsel

Attest:

_____
District Secretary

Exhibits
A: Each Party's Water System As of the Effective Date
B: Ukiah's cost allocation plan in effect as of the Effective Date
C: District Employees to be hired by City and Bargaining Units to which they are to be assigned

TERM SHEET

Proposed Purchase or Lease-Purchase of Willow Capital Assets

Parties
Buyer/Lessee: City of Ukiah ("City")
Seller/Lessor: Willow County Water District ("District")

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1. Purpose

This Term Sheet outlines the principal terms and conditions for the City's acquisition of certain capital assets currently owned by the District (collectively, the "Equipment"). The acquisition may occur through either (a) an outright cash purchase, or (b) a five-year lease-purchase agreement with a bargain purchase option, as described below.

---

2. Equipment

The Equipment subject to this transaction consists of the capital assets listed below, along with the agreed values as documented in Exhibit A. The total amount to be settled between the City and the District for all equipment is **$219,670.00**.

Asset	Agreed Value
2018 Multiquip Whisperwatt DCA25SSIU4F Generator	$12,800.00
2010 Airman PDS185S Compressor	$12,000.00
1987 John Deere 310C Backhoe	$12,000.00
2019 Kubota Z411 Mower	$4,899.00
2019 Kubota L4701 Tractor with Attachments	$30,000.00
2018 Ford F650 SD Dump Truck	$59,000.00
2010 Ford Ranger Regular Cab Pickup	$5,405.00
2005 Ford F250 Super Duty Super Cab Pickup	$6,312.00
2013 Ford F150 Regular Cab Pickup	$5,063.00
2016 Ford F150 Regular Cab Pickup	$9,760.00
2019 Ford F150 Regular Cab Pickup (Unit 3301)	$16,250.00
2020 Ford F150 Regular Cab Pickup (Unit 3304)	$16,506.00

Asset	Agreed Value
2019 Ford F150 Regular Cab Pickup (Unit 3305)	$14,392.00
2016 Ford F150 Regular Cab Pickup (Unit 3306)	$5,796.00
2016 Ford F150 Regular Cab Pickup (Unit 3307)	$9,487.00

Total Agreed Value: $219,670.00

---

3. Purchase Price

- The total purchase price for the Equipment shall be **$219,670.00**, representing the aggregate of the agreed values for each item listed in Section 2 and Exhibit A.
- This amount shall be accepted by both parties as the fair market value for purposes of the sale or lease-purchase transaction.
- The total of $219,670.00 shall serve as the principal amount under any lease-purchase arrangement.

---

4. Payment Structure

Cash Purchase:

- The City shall pay the total agreed purchase price of **$219,670.00** in full upon execution of the purchase agreement.
- Payment shall be made in cash or by wire transfer to the District within thirty (30) days of approval by both governing bodies.

---

5. Maintenance, Operation, and Insurance

- The City shall be responsible for all maintenance, operation, registration, and insurance of the Equipment during the lease term.
- The City shall have full right to use, operate, and maintain the Equipment for all municipal purposes.

---

6. Title and Risk of Loss

- Title shall remain with the District during the lease term and shall transfer to the City upon final payment and exercise of the purchase option.
- The City shall bear all risk of loss, theft, or damage during the lease period.

---

7. Improvements and Modifications

The City may make capital improvements, repairs, or modifications to any Equipment in its discretion. Any such improvements shall become part of the Equipment and property of the City upon completion of the purchase.

---

8. Termination and Purchase Option

The City may terminate the lease-purchase agreement at any time by purchasing the Equipment for the total stated value less all principal payments made to date.

---

9. Representations and Warranties

All Equipment is sold or leased "as is," "where is," without warranty, express or implied, except as specifically set forth in the final purchase or lease-purchase agreement.

---

10. Conditions Precedent

- Approval by the City Council of Ukiah and the District Board of Directors.
- Execution of a definitive Purchase Agreement or Lease-Purchase Agreement consistent with this Term Sheet.

---

11. Exhibits

Exhibit A: Willow Equipment List and Valuations (Pages 1–16)

Acknowledged and Agreed:
(non-binding, subject to formal approval)

City of Ukiah
By: _____
Name: _____
Title: _____
Date: _____

Willow County Water District
By: _____
Name: _____
Title: _____
Date: _____

2018 MULTIQUIP WHISPERWATT DCA25SSIU4F 8217








USD **USD $12,800**

Machine Location: 2017 RAWLEY ROAD Augusta, Georgia 30906

Seller Information

Herc Rentals

Contact: Sales Department

Phone: **(833) 251-8018**

(833) 251-8018

Video Chat

Hide Thumbnails

Description

20KW GENERATOR DSL All prices and availability are subject to change without notice and are subject to applicable sales tax. Title to all goods listed remain with the seller until the purchase price is fully paid. Equipment is purchased as is, where is, without warranty unless otherwise specified. Engine hours are actual hours as of the date of this posting and are not guaranteed. Equipment pictured may contain attachments and/or accessories not priced in this offer. Contact your Herc Rentals sales professional or the listed branch for details.

Specifications

Year	2018	**Manufacturer**	MULTIQUIP WHISPERWATT
Model	DCA25SSIU4F	**Serial Number**	7155243
Hours	482	**Condition**	Used
Stock Number	800223562		

Show As Paragraph

6320

2010 AIRMAN PDS185S



USD **USD $12,000**

Machine Location: Gainesville, Georgia 30501

Seller Information

Coker Equipment

Contact: Sales Staff

Phone: **+1 770-462-7687**

Gainesville, Georgia 30503

+1 770-462-7687

Video Chat



Hide Thumbnails

Description

125 psi Working Pressure, Nissan TD27 4 Cylinder 55hp 2.66 L Diesel, low hours, blows hard, no drips or leaks, have others available if you would like to purchase a package.

Specifications

Year	2010	**Manufacturer**	AIRMAN
Model	PDS185S	**Hours**	2,470
Serial Number	B4-6C12762	**Condition**	Used

Show As Paragraph

1310

1987 DEERE 310C

USD **USD $12,000**

Machine Location: 4300 HWY M40 Holland, Michigan 49423

Seller Information

West Michigan Tractor Sales

Contact: Tom Olsen

Phone: **(616) 421-8552**

Holland, Michigan 49423

Visit Our Website

(616) 421-8552

WhatsApp

Video Chat

Description

Enclosed Cab with Heat, 2 Wheel Drive, Standard Hoe, 65 Horsepower, 85% Tires, 24" Backhoe Bucket, 14' 3" Backhoe Depth, 2 Stick Backhoe Controls.

Specifications

Year	1987	**Manufacturer**	DEERE
Model	310C	**Serial Number**	T0310CA741849
Condition	Used	**Outriggers**	Yes
ROPS	Enclosed	**Heater**	Yes
Horsepower	65 HP	**Drive**	2WD

Show As Paragraph

5421

2019 KUBOTA Z411



USD **USD $4,899**

Machine Location: 167 Lawson Drive Rose Hill, Virginia 24281

Seller Information

Lawson Building Supply, Inc.

Contact: Chris Lawson

Phone: **(276) 227-7011**

Rose Hill, Virginia 24281

(276) 227-7011

Video Chat



Hide Thumbnails

Specifications

Year	2019	**Manufacturer**	KUBOTA
Model	Z411	**Serial Number**	15616
Condition	Used		

Show As Paragraph

1424

2019 KUBOTA L4701



USD **USD $30,000**

Machine Location: 21730 LaGrange Rd Frankfort, Illinois 60423

Seller Information

McCullough Kubota

Contact: Frankfort Sales

Phone: (219) 552-1032

Frankfort, Illinois 60423

(219) 552-1032

Video Chat





Hide Thumbnails

Description

KUBOTA L4701 W/ LA765 LOADER - LANDPRIDE RCR1872 ROTOARY CUTTER - LANDPRIDE RB3596 REAR BLADE - CLAMP ON PALLET FORKS 48"

Specifications

Year	2019	**Manufacturer**	KUBOTA
Model	L4701	**Serial Number**	52835
Condition	Used	**Stock Number**	126363
Hours	300	**Loader**	Yes

2019 FORD F650 XL



USD **USD $59,900**

Truck Location: 1919 American Ct Neenah, Wisconsin 54956

Seller Information

Melchert Sales LLC

Contact: Waylon Melchert

Phone: **(920) 487-1007**

Neenah, Wisconsin 54956

(920) 487-1007

Video Chat



Hide Thumbnails

Description

2019 FORD F650 REG CAB, CHASSIE CAB, XL, DUMP TRUCK, 6.7L POWER STROKE TURBO DIESEL, 6-SPEED AUTOMATIC TRANSMISSION, RWD, 25,900 GVW, 160″ WB, 9′ CONTRACTORS BED, BACK UP CAMERA, SYNC, 110V OUTLET, BUYERS 24″ THRU BEHIND CAB TOOL BOX, BRAKE CONTROLLER, TRANSPOWER TAKE OFF, 22.5″ FACTORY WHEELS WITH GOOD YEAR TIRES. THIS IS A SUPER CLEAN WELL MAINTAINED RUST FREE DUMP TRUCK WITH ONLY 28,584 MILES AND A CLEAN CAR FAX. Motor is a 6.7L Power Stroke Turbo Diesel, 6-speed automatic transmission, exhaust brake, RWD, 22.5″ White Steel wheels with 11R22.5 Good Year Load Range G tires. Exterior is Oxford White, Interior is Medium Earth Gray

Heavy Duty vinyl, bucket seating with folding arm rest with built in storage compartments, power windows and power door locks, tilt and telescoping wheel, cruise control, air conditioning, AM/FM stereo, MP3 player, dual power point, driver's information center, Bluetooth capabilities, SYNC, multi-function steering wheel controls, compass/temperature/mileage display in dash, automatic headlights, side air bags, heated extendable folding tow mirrors, transpower take off, up-fitter switches, 50 gallon fuel tank, towing package with receiver, trailer wiring and 8″ black steps. EXTRAS: 9'x8′ SH Electric Contractors Dump body with tarp, Buyers 24″x4′ Thru Behind cab tool box, Buyer 4'x 18″x18″ under body tool box, Rostra 6.5″ back up camera and Heavy duty spring hitch. This is a Very Clean Well Maintained Rust Free 1 Owner Dump Truck That is Ready for Work! Trade ins Welcome!

Specifications

Year	2019	**Manufacturer**	FORD
Model	F650 XL	**Mileage**	28,584 mi
VIN	1FDWF6DC4KDF12383	**Condition**	Used
Stock Number	F12383	**Engine Displacement**	6.7 l
Fuel Type	Diesel	**Transmission**	Automatic
Number of Speeds	6 Spd	**Drive**	4x2
Gross Vehicle Weight Rating	Class 6: 19,501 - 26,000 pounds	**Gross Vehicle Weight**	25,900 lb
Wheels	All Steel	**Wheelbase**	160 in
Drive Side	Left Hand Drive		

Show As Paragraph

3112

2010 Ford Ranger Regular Cab Pricing Report

Style: XL Pickup 2D 6 ft

Mileage: 166,731

KBB.com Consumer Rating: 4.4/5

Vehicle Highlights

Fuel Economy: City 19/Hwy 24/Comb 21 MPG

Engine: 4-Cyl, 2.3 Liter

Transmission: Automatic, 5-Spd w/Overdrive

Drivetrain: 2WD

Country of Assembly: United States

Country of Origin: United States

EPA Class: Small Pickup Trucks

Max Seating: 3

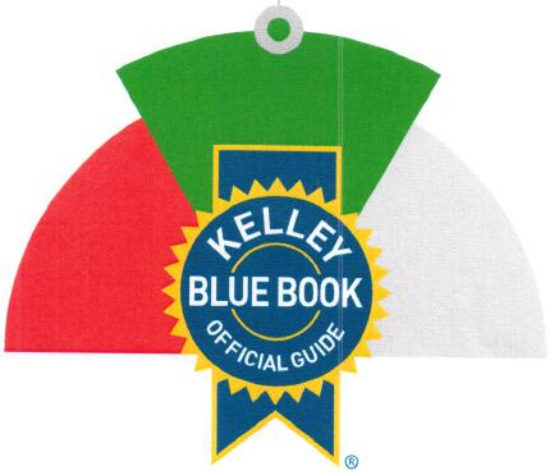
Doors: 2

Body Style: Pickup

Sell to Private Party

Private Party Range
$3,759 - $7,050

Private Party Value
$5,405



Valid for **ZIP code 95482** through **06/25/2025**

2643

2005 Ford F250 Super Duty Super Cab Pricing Report

Style: XL Pickup 4D 8 ft

Mileage: 142,335

KBB.com Consumer Rating: 4.3/5

Vehicle Highlights

Fuel Economy: N/A

Engine: V8, 5.4 Liter

Transmission: Automatic

Drivetrain: 2WD

Country of Assembly: United States

Country of Origin: United States

EPA Class: Standard Pickup Trucks

Max Seating: 6

Doors: 4

Body Style: Pickup

Sell to Private Party

Private Party Range
$4,219 - $8,404

Private Party Value
$6,312

Valid for **ZIP code 95482** through **06/25/2025**

3302

2013 Ford F150 Regular Cab Pricing Report

Style: XL Pickup 2D 6 1/2 ft

Mileage: 150,433

KBB.com Consumer Rating: 4.5/5

Vehicle Highlights

Fuel Economy: City 17/Hwy 23/Comb 19 MPG

Engine: V6, Flex Fuel, 3.7 Liter

Transmission: Automatic, 6-Spd

Drivetrain: 2WD

Country of Assembly: United States

Country of Origin: United States

EPA Class: Standard Pickup Trucks

Max Seating: 3

Doors: 2

Body Style: Pickup

Sell to Private Party

Private Party Range
$3,861 - $6,264

Private Party Value
$5,063

Valid for **ZIP code 95482** through **06/25/2025**

3303

2016 Ford F150 Regular Cab Pricing Report

Style: XL Pickup 2D 6 1/2 ft

Mileage: 116,051

KBB.com Consumer Rating: 4.5/5

Vehicle Highlights

Fuel Economy: City 18/Hwy 24/Comb 19 MPG

Engine: V6, Flex Fuel, 3.5 Liter

Transmission: Automatic, 6-Spd

Drivetrain: 2WD

Country of Assembly: United States

Country of Origin: United States

EPA Class: Standard Pickup Trucks

Max Seating: 3

Doors: 2

Body Style: Pickup

Sell to Private Party



Valid for **ZIP code 95482** through **06/25/2025**

3301

2019 Ford F150 Regular Cab Pricing Report

Style: XL Pickup 2D 6 1/2 ft

Mileage: 92,893

KBB.com Consumer Rating: 4.5/5

Vehicle Highlights

Fuel Economy: City 19/Hwy 25/Comb 22 MPG

Drivetrain: 2WD

Transmission: Automatic, 6-Spd w/SelectShift

Engine: V6, Flex Fuel, 3.3 Liter

Country of Assembly: United States

Country of Origin: United States

EPA Class: Standard Pickup Trucks

Max Seating: 3

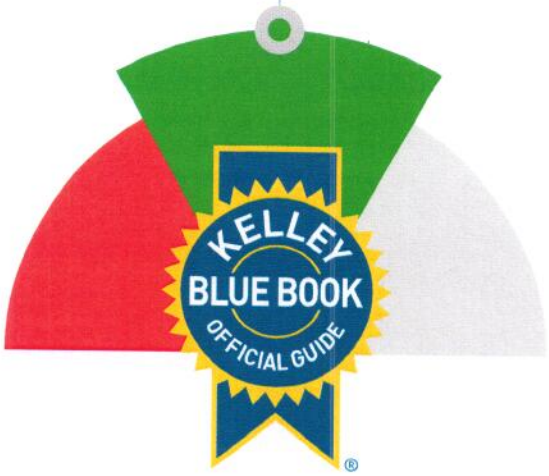
Doors: 2

Body Style: Pickup

Sell to Private Party

Private Party Range
$14,811 - $17,688

Private Party Value
$16,250



Valid for **ZIP code 95482** through **06/25/2025**

3304

2020 Ford F150 Regular Cab Pricing Report

Style: XL Pickup 2D 6 1/2 ft

Mileage: 92,334

KBB.com Consumer Rating: 4.5/5

Vehicle Highlights

Fuel Economy: City 19/Hwy 25/Comb 22 MPG

Transmission: Automatic, 6-Spd w/SelectShift

Engine: V6, Flex Fuel, 3.3 Liter

Drivetrain: 2WD

Country of Assembly: United States

Country of Origin: United States

EPA Class: Standard Pickup Trucks

Max Seating: 3

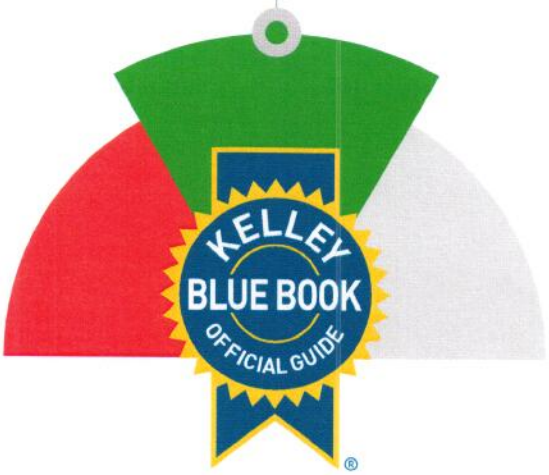
Doors: 2

Body Style: Pickup

Sell to Private Party

Private Party Range
$15,072 - $17,939

Private Party Value
$16,506



Valid for **ZIP code 95482** through **06/25/2025**

3305

2019 Ford F150 Regular Cab Pricing Report

Style: XL Pickup 2D 6 1/2 ft

Mileage: 113,577

KBB.com Consumer Rating: 4.5/5

Vehicle Highlights

Fuel Economy: City 19/Hwy 25/Comb 22 MPG

Drivetrain: 2WD

Transmission: Automatic, 6-Spd w/SelectShift

Engine: V6, Flex Fuel, 3.3 Liter

Country of Assembly: United States

Country of Origin: United States

EPA Class: Standard Pickup Trucks

Max Seating: 3

Doors: 2

Body Style: Pickup

Sell to Private Party

Private Party Range
$12,953 - $15,830

Private Party Value
$14,392

Valid for **ZIP code 95482** through **06/25/2025**

Kelley Blue Book
THE TRUSTED RESOURCE

3306

2016 Ford F150 Regular Cab Pricing Report

Style: XL Pickup 2D 6 1/2 ft

Mileage: 190,929

KBB.com Consumer Rating: 4.5/5

Vehicle Highlights

Fuel Economy: City 18/Hwy 24/Comb 19 MPG

Engine: V6, Flex Fuel, 3.5 Liter

Transmission: Automatic, 6-Spd

Drivetrain: 2WD

Country of Assembly: United States

Country of Origin: United States

EPA Class: Standard Pickup Trucks

Max Seating: 3

Doors: 2

Body Style: Pickup

Sell to Private Party

Private Party Range
$4,669 - $6,922

Private Party Value
$5,796



Valid for **ZIP code 95482** through **06/25/2025**

3307

2016 Ford F150 Regular Cab Pricing Report

Style: XL Pickup 2D 6 1/2 ft

Mileage: 105,812

KBB.com Consumer Rating: 4.5/5

Vehicle Highlights

Fuel Economy: City 18/Hwy 24/Comb 19 MPG

Engine: V6, Flex Fuel, 3.5 Liter

Transmission: Automatic, 6-Spd

Drivetrain: 2WD

Country of Assembly: United States

Country of Origin: United States

EPA Class: Standard Pickup Trucks

Max Seating: 3

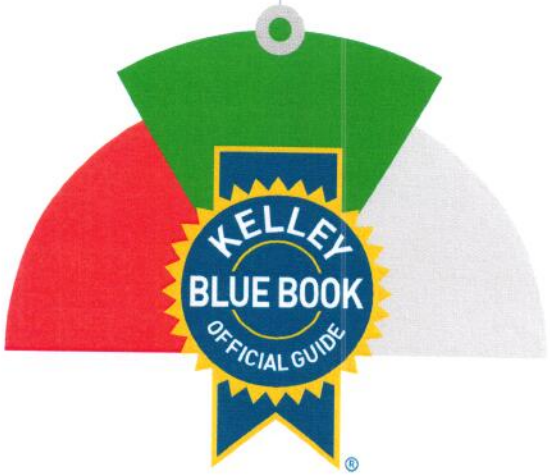
Doors: 2

Body Style: Pickup

Sell to Private Party

Private Party Range
$8,360 - $10,613

Private Party Value
$9,487



Valid for **ZIP code 95482** through **06/25/2025**

Agenda Item No: 8.f.

MEETING DATE/TIME: 11/19/2025

ITEM NO: 2025-1307

City of Ukiah

AGENDA SUMMARY REPORT

SUBJECT: Adoption of Resolution Authorizing the City of Ukiah to Submit a Regional Payment Program Application on Behalf of Itself as Lead Participant and All Non-Lead Participants for All City/County Payment Programs with CalRecycle.

DEPARTMENT: Public Works

PREPARED BY: Seth Strader, Administrative Analyst

PRESENTER: Tim Eriksen, Director of Public Works/City Engineer

ATTACHMENTS:

1. Proposed Resolution

Summary: Council will consider approving and adopting a resolution authorizing the City of Ukiah to submit a Regional Payment Program Application on behalf of itself as lead participant and all non-lead participants for all City/County payment programs with CalRecycle.

Background: CalRecycle offers different annual payment programs to assist jurisdictions in the collection and disposal of recyclable waste. These funds can be used for drop-off programs, public education, litter prevention and cleanup, infrastructure for businesses and to support existing recycling programs. Cities and counties are eligible for funds based on population.

Discussion: This resolution will allow the City of Ukiah to apply for these funds and act as the lead participant for a regional application, which allows for one application to be submitted on the behalf of other program participants to allow for efficient allocation of program efforts and grant funds.

Historically, the County of Mendocino acted as the lead participant and these program funds were then distributed to the Mendocino Solid Waste Management Authority (MSWMA), a local Joint Powers Authority (JPA) made up of the County of Mendocino and the cities of Fort Bragg, Willits, and Ukiah. With the City of Ukiah now performing the administrative work for MSWMA, this resolution is needed for City staff to be able to apply for these funds for the JPA members. These funds will continue to be used for programs and clean-up efforts performed and contracted by MSWMA.

Staff recommends approving and adopting the resolution (Attachment 1) to authorize the City of Ukiah to submit a Regional Payment Program Application on behalf of itself as lead participant and all non-lead participants for all City/County payment programs with CalRecycle.

Recommended Action: Adopt resolution authorizing the City of Ukiah to submit a Regional Payment Program Application on behalf of itself as lead participant and all non-lead participants for all City/County payment programs with CalRecycle.

BUDGET AMENDMENT REQUIRED: N/A

CURRENT BUDGET AMOUNT: N/A

PROPOSED BUDGET AMOUNT: N/A

FINANCING SOURCE: N/A

REVENUE: N/A **GRANT:** N/A

PREVIOUS CONTRACT/PURCHASE ORDER NO.:

COORDINATED WITH: Tim Eriksen, Director of Public Works/City Engineer

STRATEGIC PLAN (SP): **SP 3B** - Analyze and consider opportunities for regional partnerships that support or improve the delivery of municipal services.

CLIMATE INITIATIVES (CI): **CI-3a** – Continue to lead the way in solid waste diversion including the diversion of compostable food.

GENERAL PLAN ELEMENTS (GP): GP-A5 - Environment and Sustainability Element

Approved: Sage Sangiacomo, City Manager

RESOLUTION NO. 2025-

RESOLUTION OF THE CITY COUNCIL OF THE CITY OF UKIAH AUTHORIZING SUBMITTAL OF REGIONAL PAYMENT PROGRAM APPLICATIONS AND RELATED AUTHORIZATIONS FOR ALL PAYMENT PROGRAMS

WHEREAS:

1. The California Public Resources Code authorizes the Department of Resources Recycling and Recovery (CalRecycle) to administer various Payment Programs; and

2. In furtherance of this authority, CalRecycle is required to establish procedures governing the administration of the Payment Programs; and

3. The Payment Program allows regional participation; and

4. CalRecycle's procedures for administering Payment Programs require, among other things, a Regional Applicant's governing body to declare by resolution certain authorizations related to the administration of the Payment Programs.

NOW, THEREFORE, BE IT RESOLVED that:

1. The City Council of the City of Ukiah authorizes City of Ukiah to submit a Regional Payment Program application on behalf of itself as Lead Participant and all Non-Lead Participants for all Payment Programs**.**

2. The Signature Authorities identified below, are hereby authorized to determine and submit a list of the Non-Lead Participants in accordance with CalRecycle requirements.

3. The City Manager, or their designee, are hereby authorized as Signature Authority to execute on behalf of all participants all documents necessary to implement and close out the programs.

4. These authorizations are effective until rescinded by this governing body.

PASSED AND ADOPTED this 19th day of November, 2025, by the following roll call vote:

AYES:
NOES:
ABSENT:
ABSTAIN:

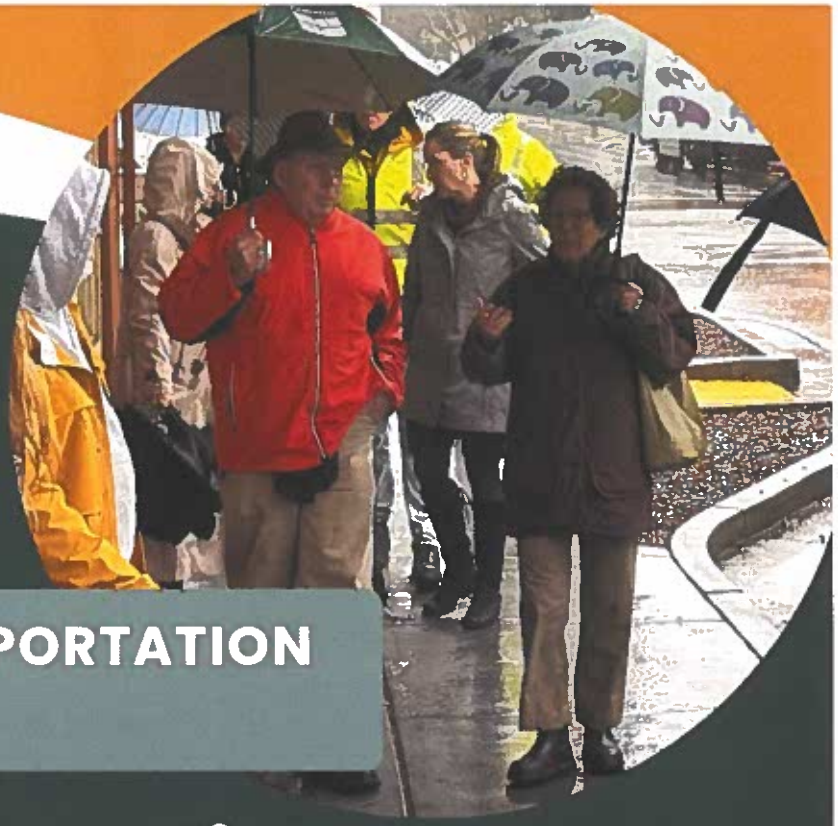
_____
Douglas F. Crane, Mayor

ATTEST

_____
Kristine Lawler, City Clerk

Handout from Shannon Riley for City Manager reports

School Street



MULTIMODAL TRANSPORTATION CORRIDOR STUDY

Walking Audit

Date: Thursday, December 11

Time: 3:45 PM – 5:00 PM

Location: Ukiah Valley Conference Center, 200 S School Street

Community Workshop

Date: Thursday, December 11

Time: 5:30 PM – 7:00 PM

Location: Ukiah Valley Conference Center, 200 S School Street

Help us preserve and enhance what we love about School Street!

Scan to visit the website or contact **sarah@bluezones.com** for more information.

City of Ukiah GHD BLUE ZONES

Agenda Item No: 12.a.

MEETING DATE/TIME: 11/19/2025

ITEM NO: 2025-1306

City of Ukiah

AGENDA SUMMARY REPORT

SUBJECT: Review and Consider Introduction by Title Only of an Ordinance Adding Chapter 9 to Division 2 of Ukiah City Code to Regulate Sidewalk Vending on Public Property and in the Public Right-of-Way.

DEPARTMENT: Community Development

PREPARED BY: Darcy Vaughn, Assistant City Attorney, Jesse Davis, Chief Planning Manager

PRESENTER: Darcy Vaughn, Assistant City Attorney and Jesse Davis, AICP/Chief Planning Manager

ATTACHMENTS:

1. Sidewalk Vending Ordinance
2. Senate Bill 946, Safe Sidewalk Vending Act

Summary: This public hearing is for Council to review and consider introduction by title only of an Ordinance adding a new Chapter 9 to Division 2 of the Ukiah City Code to regulate sidewalk vending on public property and within the public right-of-way. At this time, however, Staff is recommending the Council review and provide input on the Ordinance for introduction at a future date not yet certain.

Background: In recent years, the City of Ukiah has experienced a steady increase in sidewalk vending activity, particularly in public spaces including commercial corridors, street intersections, and residential neighborhoods. Unauthorized vending activity has also increased during annual City events (e.g., Sunday Concerts in the Park and Pumpkin Fest). This trend has underscored the need for a balanced, enforceable regulatory framework that accounts for the interdisciplinary nature of enforcement between the Ukiah Police Department and Community Development Department Code Enforcement Division, the use of public property, and efficient licensing procedures for street vendors, in particular.

In June 2025, the City convened an interdepartmental working group that included the Ukiah Police Department Chief, the Chief Building Official, the Community Development Director, the Project and Grant Administrator within the City Manager's Office, and the Community Services Supervisor, as well as the City Attorney's Office, to develop an Ordinance (Attachment 1) to address these related street-vending issues. The enforcement framework developed is substantially based on the regulatory scope authorized under Senate Bill 946 (Attachment 2), the Safe Sidewalk Vending Act, which permits local governments to impose time, place, and manner restrictions on sidewalk vending activities only when those restrictions are directly tied to objective health, safety, or welfare concerns. All proposed limitations on sidewalk vending set forth in this Ordinance, including spacing requirements, sidewalk clearance standards, and sanitary requirements, were structured to meet this statutory threshold.

As part of the development process, the team conducted a comparative review of sidewalk vending ordinances adopted by the Cities of Dublin, Hayward, Alameda, Santa Cruz, Pacifica, Santa Monica, and Santa Rosa. These peer jurisdictions provide practical models for regulating sidewalk vending, as they were recently adopted and reflect the requirements of SB 946. SB 946 decriminalized sidewalk vending statewide and established the legal framework within which cities and counties may regulate sidewalk vending activities. The legislation is intended to promote economic inclusion, particularly for low income and immigrant communities, while preserving the authority of local governments to adopt objective health, safety, and welfare regulations. Under SB 946, local regulations must be narrowly tailored, not unduly restrictive, and may not

impose criminal penalties solely for vending without a permit. Although SB 946 was heavily shaped by street vending conditions in larger metropolitan areas, the statute applies uniformly to all California cities and counties, including smaller and more rural jurisdictions such as Ukiah.

Discussion: In drafting this Ordinance, Staff intentionally avoided restrictions and regulations prohibited by SB 946, including regulations based on economic competition, community preference, or generalized neighborhood bans on sidewalk vending. Instead, operational conditions are narrowly tailored to ensure legal compliance while maintaining safe and accessible public spaces.

This Ordinance establishes operational standards and location restrictions to govern vending activities that take place on public sidewalks, pedestrian paths, and other components of the public right-of-way. These rules apply uniformly across the City and are aligned with state law, specifically Government Code Sections 51036 to 51039 (SB 946).

The Ordinance is applicable to all individuals engaged in the sale of goods or food items from non-permanent setups, including roaming and stationary sidewalk vendors. It mandates that vendors obtain and display a City-issued sidewalk vending permit and business license and, where applicable, a Mendocino County Health Permit and a California Seller's Permit. The Ordinance also holds vendors accountable for maintaining public health and safety standards, complying with Americans with Disabilities Act accessibility requirements, and avoiding obstructions to pedestrian or vehicular traffic.

Key operational limitations include prohibiting vending near fire hydrants, driveways, emergency exits, transit stops, schools during operational hours, and at or near special events or certified farmers' markets without appropriate authorization to participate in the events.

The primary intent behind this Ordinance is to comply with SB 946 while striking a balance between allowing economic opportunities for small vendors and protecting public spaces, ensuring that vending does not compromise safety, accessibility, public health, or effective transportation corridors. It also enables effective enforcement by outlining a penalty structure for violations, establishing a permit revocation process, and providing for appeals for vending permits and licenses. This regulatory approach provides the City with the tools to manage sidewalk vending in a manner that supports economic inclusion while preserving public resources and quality of life.

During the final preparation of this Ordinance, Staff realized additional details still need to be analyzed and determined. Such details include, but are not necessarily limited to, the preparation of a mobile (sidewalk) vendor permit application, development of a process for the permitting and inspection of sidewalk vendors, and the establishment of a sidewalk vendor permit fee. Staff is therefore recommending that Council review and provide input on the Ordinance, with introduction of the Ordinance to be scheduled at a future date not yet certain.

Recommended Action: Review and provide input on the Ordinance adding a new Chapter 9 to Division 2 of the Ukiah City Code to regulate sidewalk vending on public property and within the public right-of-way. Introduce and possibly adopt the Ordinance at a future date not yet certain.

BUDGET AMENDMENT REQUIRED: N/A

CURRENT BUDGET AMOUNT: N/A

PROPOSED BUDGET AMOUNT: N/A

FINANCING SOURCE: N/A

REVENUE: No GRANT: No

PREVIOUS CONTRACT/PURCHASE ORDER NO.:N/A

COORDINATED WITH: Ukiah Police Department; Community Services Department; Community Development Department Code Enforcement Division

STRATEGIC PLAN (SP): SP 4A - Economic Opportunities

CLIMATE INITIATIVES (CI): N/A

GENERAL PLAN ELEMENTS (GP): Policy ED-1.1 - Interagency - Coordinate with local agencies, jurisdictions, and tribes; and other groups and organizations working to promote Ukiah's economic development.

Approved: 
Sage Sangiacomo, City Manager

ORDINANCE NO.

ORDINANCE OF THE CITY COUNCIL OF THE CITY OF UKIAH ADDING A NEW CHAPTER 9 TO DIVISION 2 OF THE CITY CODE TO REGULATE SIDEWALK VENDING ON PUBLIC PROPERTY AND IN THE PUBLIC RIGHT OF WAY.

The City Council of the City of Ukiah hereby ordains as follows:

SECTION ONE. FINDINGS

1. Unregulated sidewalk vending has the potential to create obstructions in the public right-of-way, endanger pedestrians, and impede access for emergency services, necessitating additional municipal oversight and enforcement.
2. Sidewalk vending involving food sales can introduce health and sanitation risks if not properly regulated. Requiring appropriate health permits and on-site trash disposal ensures the cleanliness and safety of public spaces.
3. Maintaining minimum clear path widths on sidewalks is essential for compliance with the Americans with Disabilities Act (ADA) and ensures that all individuals, including those with mobility challenges, have safe access to public walkways.
4. Restricting sidewalk vending in residential zones and near sensitive uses such as schools and emergency infrastructure protects the character and function of these areas.
5. The Ordinance preserves fair and equitable access to public space, ensuring that vending activities do not conflict with permitted events, farmers markets, or parades.

SECTION TWO.

Chapter 9 is hereby added to Division 2 of the Ukiah City Code and shall read as follows:

CHAPTER 9 SIDEWALK VENDING

§ 2750 PURPOSE AND INTENT

The purpose of this Chapter is to set forth specific regulations to govern the vending of various goods from locations which are not permanent and that are temporarily located in the public right of way. In addition, this Chapter is intended to protect against unsafe conditions and health, safety, or welfare concerns of the community that result from the operation of sidewalk vendors on public sidewalks or a pedestrian path, consistent with the provisions of Government Code §§ 51036—51039. The requirements set forth in this Chapter are intended to protect the public's health, safety, and welfare by ensuring that vendors on public property provide safe and sanitary conditions for consumers and the general public, are adequately insured, and are properly licensed or permitted with the City and licensed with other agencies.

Nothing in the Chapter shall be construed to limit the City's ability to enforce, or remedies for enforcing, laws of general applicability or other provisions of this Code against sidewalk vendors, or

to take any other enforcement actions against sidewalk vendors that are not prohibited by state or federal law, or which are allowed by this Code.

The provisions of this Chapter are not intended to apply to the permitting process and regulations for food vendors permitted at special events in the City.

§ 2751 DEFINITIONS

A. Any words or phrases not defined within this Chapter shall be defined as set forth in current dictionaries. If no dictionary defines a particular term, the City Community Development Director shall have the authority to define the term or equate it to a defined term that is similar in nature.

B. For purposes of this Chapter, the words and phrases set out herein shall have the following meanings:

CART means any pushcart, stand, display, pedal-driven cart, wagon, showcase, rack, or other non-motorized conveyance, and includes a stationary cart or a roaming cart.

MENDOCINO COUNTY HEALTH PERMIT means any and all licenses, permits, certifications, and courses required and issued by the Mendocino County Environmental Health Services Division to vend food within the city in accordance with this Chapter.

ROAMING SIDEWALK VENDOR has the same meaning as set forth in Government Code section 51036(b) and as may be amended from time to time, and includes a sidewalk vendor who moves from place to place and stops only to complete a transaction.

SIDEWALK means any paved surface in the public right-of-way provided for the use of pedestrians and includes pedestrian paths.

SIDEWALK VENDING means the sale of food or merchandise from a pushcart, stand, display, pedal-driven cart, wagon, showcase, rack, or other non-motorized conveyance, or from one's person, upon a public sidewalk or other pedestrian path.

SIDEWALK VENDOR has the same meaning as set forth in Government Code section 51036(a) and as may be amended from time to time, and includes a person who sells food or merchandise from a pushcart, stand, display, pedal-driven cart, wagon, showcase, rack, or other non-motorized conveyance, or from one's person, upon a public sidewalk or other pedestrian path.

STATIONARY SIDEWALK VENDOR has the same meaning as set forth in Government Code section 51036(c) and as may be amended from time to time, and includes a sidewalk vendor who vends from a fixed location.

VEND OR VENDING means the sale of any goods, wares, merchandise, prepared, pre-packaged; or unprepared, unpackaged food or food stuff of any kind.

VENDING PERMIT means a permit issued by the Business Services Division of the City of Ukiah Community Development Department to undertake sidewalk vending within the city in accordance with this Chapter.

§ 2752 LICENSING AND PERMITS

All sidewalk vendors are required to obtain:

A. A Business License pursuant to Division 2, Chapter 1 of this Code.

B. A Vending Permit issued pursuant to this Chapter. Sidewalk vendors must comply with the terms and conditions set forth in the Vending Permit.

C. A Seller's Permit issued by the California Department of Tax and Fee Administration ("CDTFA") and any additional licenses from state or local agencies to the extent required by law.

D. A Mendocino County health permit for food-related vending, if applicable.

§ 2753 OPERATIONAL REQUIREMENTS

A. Each cart used by a sidewalk vendor must display a valid Business License, Vending Permit, Seller's Permit, and, if applicable, a Mendocino County Health Permit.

B. No stationary sidewalk vendor may operate in any residential zone.

C. In order to prevent obstructions of the public right-of-way, the total display area footprint of the cart, including the cart itself and any accompanying display, signage, or related items, shall not exceed a length of 72 inches, a width of 54 inches, or a height, including roof, awning, or canopy, of 78 inches. The area of any roof, awning, or canopy must not exceed the area footprint of the cart.

D. In order to comply with the Americans with Disabilities Act (ADA) regulations and with the accessibility requirements set forth in the California Building Code, the total display area footprint of the cart must allow for 48 inches, or as the law updates, of clear width walking space of any sidewalk where the cart is located.

E. Sidewalk vendors may not set up tables, chairs, or other structures, unless otherwise authorized by the City in the conditions to the Vending Permit.

F. Sidewalk vendors may not access a City power source without authorization from the City, nor a private power source without authorization from such private property owner or agent.

G. In order to preserve sanitary conditions in all public rights-of-way, all sidewalk vendors shall provide a trash receptacle for customers and must ensure proper disposal of customer and vendor trash. The trash receptacle must be large enough to accommodate customer trash without resort to existing trash receptacles located on any block for use by the general public. A sidewalk vendor may not dispose of customer trash in existing trash receptacles on sidewalks.

H. In order to preserve sanitary conditions in all public rights-of-way, all sidewalk vendors shall maintain a clean and trash-free area, including a sanitized and neat appearing cart, within a ten-foot radius around the vendor's cart during hours of operation and shall ensure that such area is clean and trash-free before relocating or closing.

I. In order to prevent damage to public property and prevent obstructions of the public right-of-way, no cart may be chained or fastened to any pole, sign, tree, or other object in the public right-of-way.

J. In order to preserve the safety of the public, and prevent misuse of carts, no cart may be left unattended at any time.

K. In order to preserve the safety of the public, to prevent misuse of carts, and to prevent obstructions of the public right-of-way, no cart may be stored, parked, or left overnight on any public street or right-of-way, or in any public park or other public property.

L. In order to preserve the safety of vehicular travelers, no sidewalk vendor may solicit business from or conduct business with persons in motor vehicles.

M. In order to preserve the safety of vehicular travelers and pedestrians, and to preserve public peace and welfare, no cart may be outfitted with any equipment, signage, or mechanism that endangers or detracts from the health, safety, or welfare of the public by causing an excessive distraction to motorists or interfering with nearby residences, business, or pedestrians including, but not limited to, sound amplification, flashing lights, smoke, steam, bubbles, gas-powered generators, or excessive fumes.

N. In order to preserve the safety of vehicular travelers and pedestrians, any cart operated before sunrise or after sunset, or in location with insufficient lighting, shall be equipped with sufficient lighting or reflectors to alert pedestrians and vehicular travelers to the presence of the cart.

O. In order to prevent obstructions of the public right-of-way, all signage related to the vending operation shall be affixed to the cart.

P. In order to prevent obstructions of the public right-of-way, all merchandise sold by a sidewalk vendor must be stored within that vendor's cart or attached receptacle or other receptacle approved by the City.

Q. In order to preserve sanitary conditions in all public rights-of-way, all sidewalk vendors shall immediately clean up any food, grease, or other fluid or item related to their sidewalk vending activities that are spilled or discharged. Disposal of trash, food, grease, or other materials to any storm drain, creek, or waterway is prohibited. Vendors shall not dump, drain, or discard any fouled, spoiled, or unused product, which includes draining ice coolers, drink containers, and/or miscellaneous containers on the ground.

R. In order to preserve sanitary conditions in all public rights-of-way, all sidewalk vendors shall comply with all applicable state, county, and city health and safety regulations and permitting and licensing requirements. In particular, if food is prepared and/or sold, sidewalk vendors must comply with the California Retail Food Code set forth at Part 7 of Division 104 of the California Health and Safety Code (commencing at Section 113700).

S. In order to preserve the safety of the public, all sidewalk vendors shall not use an open flame on or within any cart. Any sidewalk vendor using cooking equipment shall have a fire extinguisher. Propane, natural gas, or butane cylinder tanks must be 20-gallon tanks or less, stored in an upright position during use and positioned in such a way to prevent falling, tipping, and tampering, be

properly ventilated, and must contain a shut-off valve and a pressure regulator, having a hose of a type approved for use by the manufacturer with the equipment.

§ 2753 VENDING PERMITS

A. To apply for or renew a Vending Permit, the sidewalk vendor applicant must file an application with the Business Services Division of the Community Development Department, accompanied by an application or renewal fee in an amount established by resolution of the City Council. The application or renewal shall be in a form prescribed by the Director of the Community Development Department and shall contain the following:

1. Valid identification, such as a State of California driver's license or identification number, an individual taxpayer identification number, or a municipal identification number, or any other government-issued identification card.

2. The name, address, e-mail address, and telephone number of the sidewalk vendor.

3. Proposed hours and days of operation.

4. Whether the sidewalk vendor intends to operate a stationary vending cart or a roaming vending cart.

5. Proposed location of operation.

a. An application for placement of a stationary vending cart in a commercial or industrial area of the city must contain the proposed location, marked by major cross streets, and a photo or sketch of such location.

b. An application for a roaming vending cart in a residential area of the city must contain a sketch or description of the route the sidewalk vendor will travel.

c. If a cart will be used, a description of the cart including dimensions.

6. The type of merchandise or food offered for sale or exchange.

7. Proof of a valid Business License issued pursuant to this Code.

8. A valid CDTFA Seller’s Permit and any additional licenses from state or local agencies to the extent required by law.

9. Proof of a policy or policies of comprehensive general liability insurance, in an amount as approved by the City, against any injury, death, loss, or damage as a result of wrongful or negligent acts or omissions by the permittee, with an endorsement naming the City as an additional insured.

10. A Mendocino County health permit for food-related vending, if applicable.

11. A certificate of completion of a food handler course, if applicable.

12. A declaration that the information provided to the city is true and correct.

13. Any other information as may be required by the Administrator.

B. Vending Permits will expire one year after the date of issuance and will be subject to renewal.

C. A Vending Permit shall only permit the operation of one vending cart or other type of conveyance at any one time.

D. Vending Permits are not transferable.

E. In accordance with Government Code § 51038, personally identifiable information, as defined in Section 51038, will be confidential and will not be disclosed and shall be exempt from disclosure under the California Public Records Act.

F. The Director of Community Development may require inspection of the cart or other conveyance as a condition of Permit issuance.

G. If there is any prior history of violations under this chapter, the Director of Community Development may review any such violations in its review of renewal requests and consider those violations when imposing conditions on a renewal Permit.

H. The Director of Community Development or their designee may revoke a Vending Permit for a fourth or subsequent violation of this Chapter within a twenty-four-month period.

I. A person whose Vending Permit is revoked pursuant to this Chapter may not renew their Vending Permit for one year.

J. Persons who are denied Vending Permits or whose Vending Permits have been revoked pursuant to this Chapter may appeal by filing a written notice of appeal with the City's Hearing Officer. The appeal must be filed with the Chief Code Enforcement Official within ten work days after receipt of the notice of denial or revocation. The appeal hearing shall be conducted pursuant to the appeal hearing procedure set forth in Section 3456 of this Code for appeals to the Hearing Officer. The Hearing Officer shall hear and determine the final appeal and the decision of the Hearing Officer shall be final.

§ 2754 LOCATION LIMITATIONS

In order to ensure access to public rights-of-way by pedestrians and emergency personnel, and avoid interference with vehicular traffic, certified farmers' markets, swap meets, and City-permitted special events, sidewalk vendors shall not operate in the following areas of the public right-of-way:

A. Any area other than a public sidewalk or pedestrian path.

B. Within 15 feet of a fire hydrant, fire call box, or other emergency facility.

C. Within five feet of an entrance to or emergency exit of any building or business during the hours that the building or business is open to the public.

D. Within ten feet of the outer edge of a driveway or driveway apron.

E. Within ten feet of a transit stop.

F. Adjacent to any marked loading zone or bus zone.

G. Within five feet of a curb return.

H. Any location that would impede entering or exiting a parked vehicle.

I. Any location or pathway that impedes the flow of pedestrian traffic by reducing the clear space to less than four feet or impedes access to or the use of abutting property, including, but not limited to, residences and places of business.

J. Within 100 feet in any direction of the nearest vendor or concessionaire participating in a certified farmers' market or City-hosted community yard sale during the operating hours of the certified farmers' market or City-hosted community yard sale unless vendor has been issued a Vending Permit that authorizes them to vend as part of the certified farmers' market or City-hosted community yard sale.

K. Within 100 feet of a City-permitted special event including, but not limited to, parades, concerts, and street fairs, unless vendor has received a permit to vend as part of the event. For moving events, vending shall be prohibited within 100 feet of any portion of the approved event route. For stationary events, vending shall be prohibited within 100 feet of the parcel and/or site boundary for the location of the event.

L. Within 300 feet of the property line of any public or private school grounds between 7:00 a.m. and 6:00 p.m. on school days, and while the same is in use, including for afterschool childcare, enrichment classes and sports.

M. Upon or within any roadway, median strip, or dividing section.

N. Any public sidewalk location when the straight path would not allow for 48 inches, or as the law updates, of clear width walking space of any sidewalk to comply with the Americans with Disabilities Act (ADA) regulations and with the accessibility requirements set forth in the California Building Code.

O. Any public sidewalk where there is a 180 degree turn path for sidewalk ramps and corner curbs when the location would not allow for 42 inches approaching the turn, 48 inches at the turn, and 42 inches leaving the turn, or as the law updates, of clear width walking space of any sidewalk to comply with ADA regulations.

P. Stationary sidewalk vendors shall not vend within 150 feet of another stationary sidewalk vendor.

Q. Sidewalk vendors are prohibited from entering or encroaching onto private property while engaging in sidewalk vending activities.

R. No sidewalk vendor shall operate within 100 feet of any structure that is abandoned, vacant, declared hazardous, or posted with a notice of violation or subject to a building, fire, or safety-related permit restricting occupancy or access.

§ 2755 VENDING IN CITY PARKS

Sidewalk vendors vending in parks must comply with the following additional requirements:

A. No stationary sidewalk vendor may operate in a City-owned or City-operated park if the operator of the park has signed an agreement for concessions that exclusively permits the sale of food or merchandise by the concessionaire.

B. Sidewalk vendors shall stop vending upon the designated closing time of the park.

C. Vending is permitted between 8:00 am and sunset in parks where there is no designated closing time.

§ 2756 ENFORCEMENT AND PENALTIES

A. It shall be the duty of the Director of Community Development to enforce each and all of the provisions of this Chapter. The Director may delegate this authority to the Chief Code Enforcement Official. Every member of the Code Enforcement Division of the Community Development Department is directed to assist the Director and Official in the enforcement of this Chapter.

B. Unless otherwise provided, any violation of any of the provisions of this Chapter by a sidewalk vendor who has a valid sidewalk vending permit from the City shall be punishable by an administrative fine according to the following provisions:

1. An administrative fine of $100 for a first violation.

2. An administrative fine of $200 for a second violation within one year of the first violation.

3. An administrative fine of $500 for each additional violation within one year of the first violation.

4. Possible revocation a sidewalk vending permit for a fourth or subsequent violation of this Chapter within a twenty-four-month period as set forth in Section 2753.

C. Unless otherwise provided, a person engaged in sidewalk vending without a valid city sidewalk Vending Permit shall be issued an administrative fine according to the following provisions:

1. An administrative fine of $250 for a first violation.

2. An administrative fine of $500 for a second violation within one year of the first violation.

3. An administrative fine of up to $1000 for each additional violation within one year of the first violation.

D. Failure to pay an administrative fine shall not be punishable as an infraction or misdemeanor.

E. Additional fines, fees, assessments, or any other financial conditions beyond those authorized in this Section shall not be assessed.

F. When assessing an administrative fine pursuant to this Section, the City shall take into consideration the person's ability to pay the fine. The City shall provide the person with notice of his or her right to request an ability-to-pay determination and shall make available instructions or other materials for requesting an ability-to-pay determination at adjudication or while the judgment remains unpaid, including when a case is delinquent or has been referred to a comprehensive collection program.

G. If the person meets the criteria described in subdivision (a) or (b) of Section 68632 of the Government Code, the City shall accept, in full satisfaction, twenty percent (20%) of the administrative fine, or may offer the following alternatives:

1. Community service in lieu of paying the total administrative fine.

2. Waiver of the administrative fine.

3. An alternative disposition.

SECTION THREE.

1. Publication: Within fifteen (15) days after its adoption, this Ordinance shall be published once in a newspaper of general circulation in the City of Ukiah. In lieu of publishing the full text of the Ordinance, the City may publish a summary of the Ordinance once 5 days prior to its adoption and again within fifteen (15) days after its adoption.

2. Effective Date: The ordinance shall become effective thirty (30) days after its adoption.

3. Severability: If any section, subsection, subdivision, paragraph, sentence, clause or phrase of this Ordinance, or its application to any person or circumstance, is for any reason held to be invalid or unenforceable, such invalidity or unenforceability shall not affect the validity or enforceability of the remaining sections, subsections, subdivisions, paragraphs, sentences, clauses or phrases of this Ordinance, or its application to any other person or circumstance. The City Council of the City of Ukiah hereby declares that it would have adopted each section, subsection, subdivision, paragraph, sentence, clause or phrase hereof, irrespective of the fact that any one or more other sections, subsections, subdivisions, paragraphs, sentences, clauses or phrases hereof be declared invalid or unenforceable.

Introduced by title only on , 2025, by the following roll call vote:

AYES:
NOES:
ABSENT:
ABSTAIN:

Adopted on , 2025, by the following roll call vote:

AYES:
NOES:
ABSENT:
ABSTAIN:

_____
Douglas F. Crane, Mayor

ATTEST:

_____
Kristine Lawler, CMC/City Clerk

SB-946 Sidewalk vendors. (2017-2018)

SHARE THIS:

Date Published: 09/17/2018 09:00 PM

Senate Bill No. 946

CHAPTER 459

An act to add Chapter 6.2 (commencing with Section 51036) to Part 1 of Division 1 of Title 5 of the Government Code, relating to sidewalk vendors.

[Approved by Governor September 17, 2018. Filed with Secretary of State September 17, 2018.]

LEGISLATIVE COUNSEL'S DIGEST

SB 946, Lara. Sidewalk vendors.

Existing law authorizes a local authority, by ordinance or resolution, to adopt requirements for the public safety regulating any type of vending and the time, place, and manner of vending from a vehicle upon a street.

This bill would prohibit a local authority, as defined, from regulating sidewalk vendors, except in accordance with the provisions of the bill. The bill would provide that a local authority is not required to adopt a new program to regulate sidewalk vendors if the local authority has established an existing program that substantially complies with the provisions of the bill. The bill would apply these provisions to a chartered or general law city, county, or city and county.

The bill would require a local authority that elects to adopt a sidewalk vending program to, among other things, not require a sidewalk vendor to operate within specific parts of the public right-of-way, except when that restriction is directly related to objective health, safety, or welfare concerns, and not restrict sidewalk vendors to operate only in a designated neighborhood or area, except as specified. The bill would authorize a local authority to, by ordinance or resolution, adopt additional requirements regulating the time, place, and manner of sidewalk vending, as specified, if the requirements are directly related to objective health, safety, or welfare concerns. The bill would also authorize a local authority to prohibit sidewalk vendors in areas located within the immediate vicinity of a permitted certified farmers' market and a permitted swap meet, as specified, and to restrict or prohibit sidewalk vendors within the immediate vicinity of an area designated for a temporary special permit issued by the local authority, as specified. A violation would be punishable only by an administrative fine, as specified, pursuant to an ability-to-pay determination, and proceeds would be deposited in the treasury of the local authority.

The bill would require the dismissal of any criminal prosecutions under any local ordinance or resolution regulating or prohibiting sidewalk vendors that have not reached final judgment. The bill would also authorize a

person who is currently serving, or who completed, a sentence, or who is subject to a fine, for a conviction of a misdemeanor or infraction for sidewalk vending, as specified, to petition for dismissal of the sentence, fine, or conviction.

Existing constitutional provisions require that a statute that limits the right of access to the meetings of public bodies or the writings of public officials and agencies be adopted with findings demonstrating the interest protected by the limitation and the need for protecting that interest.

This bill would make legislative findings to that effect.
Vote: majority Appropriation: no Fiscal Committee: no Local Program: no

THE PEOPLE OF THE STATE OF CALIFORNIA DO ENACT AS FOLLOWS:

SECTION 1. (a) The Legislature finds and declares all of the following:

(1) Sidewalk vending provides important entrepreneurship and economic development opportunities to low-income and immigrant communities.

(2) Sidewalk vending increases access to desired goods, such as culturally significant food and merchandise.

(3) Sidewalk vending contributes to a safe and dynamic public space.

(4) The safety and welfare of the general public is promoted by encouraging local authorities to support and properly regulate sidewalk vending.

(5) The safety and welfare of the general public is promoted by prohibiting criminal penalties for violations of sidewalk vending ordinances and regulations.

(6) This act applies to any city, county, or city and county, including a charter city. The criminalization of small business entrepreneurs, and the challenges that those entrepreneurs face as a result of a criminal record, are matters of statewide concern. Further, unnecessary barriers have been erected blocking aspiring entrepreneurs from accessing the formal economy, harming California's economy in the process, and disrupting the regulation of business, which is a matter of statewide concern. Moreover, California has an interest in the regulation of traffic, a matter of statewide concern, whether in ensuring the appropriate flow of traffic or in ensuring the safety of pedestrians on the road or the sidewalk.

(b) It is the intent of the Legislature to promote entrepreneurship and support immigrant and low-income communities.

SEC. 2. Chapter 6.2 (commencing with Section 51036) is added to Part 1 of Division 1 of Title 5 of the Government Code, to read:

CHAPTER 6.2. Sidewalk Vendors

51036. For purposes of this chapter, the following definitions apply:

(a) "Sidewalk vendor" means a person who sells food or merchandise from a pushcart, stand, display, pedal-driven cart, wagon, showcase, rack, or other nonmotorized conveyance, or from one's person, upon a public sidewalk or other pedestrian path.

(b) "Roaming sidewalk vendor" means a sidewalk vendor who moves from place to place and stops only to complete a transaction.

(c) "Stationary sidewalk vendor" means a sidewalk vendor who vends from a fixed location.

(d) "Local authority" means a chartered or general law city, county, or city and county.

51037. (a) A local authority shall not regulate sidewalk vendors except in accordance with Sections 51038 and 51039.

(b) Nothing in this chapter shall be construed to affect the applicability of Part 7 (commencing with Section 113700) of Division 104 of the Health and Safety Code to a sidewalk vendor who sells food.

(c) Nothing in this chapter shall be construed to require a local authority to adopt a new program to regulate sidewalk vendors if the local authority has established an existing program that substantially complies with the requirements in this chapter.

51038. (a) A local authority may adopt a program to regulate sidewalk vendors in compliance with this section.

(b) A local authority's sidewalk vending program shall comply with all of the following standards:

(1) A local authority shall not require a sidewalk vendor to operate within specific parts of the public right-of-way, except when that restriction is directly related to objective health, safety, or welfare concerns.

(2) (A) A local authority shall not prohibit a sidewalk vendor from selling food or merchandise in a park owned or operated by the local authority, except the local authority may prohibit stationary sidewalk vendors from vending in the park only if the operator of the park has signed an agreement for concessions that exclusively permits the sale of food or merchandise by the concessionaire.

(B) Notwithstanding subparagraph (A), a local authority may adopt additional requirements regulating the time, place, and manner of sidewalk vending in a park owned or operated by the local authority if the requirements are any of the following:

(i) Directly related to objective health, safety, or welfare concerns.

(ii) Necessary to ensure the public's use and enjoyment of natural resources and recreational opportunities.

(iii) Necessary to prevent an undue concentration of commercial activity that unreasonably interferes with the scenic and natural character of the park.

(3) A local authority shall not require a sidewalk vendor to first obtain the consent or approval of any nongovernmental entity or individual before he or she can sell food or merchandise.

(4) (A) A local authority shall not restrict sidewalk vendors to operate only in a designated neighborhood or area, except when that restriction is directly related to objective health, safety, or welfare concerns.

(B) Notwithstanding subparagraph (A), a local authority may prohibit stationary sidewalk vendors in areas that are zoned exclusively residential, but shall not prohibit roaming sidewalk vendors.

(5) A local authority shall not restrict the overall number of sidewalk vendors permitted to operate within the jurisdiction of the local authority, unless the restriction is directly related to objective health, safety, or welfare concerns.

(c) A local authority may, by ordinance or resolution, adopt additional requirements regulating the time, place, and manner of sidewalk vending if the requirements are directly related to objective health, safety, or welfare concerns, including, but not limited to, any of the following:

(1) Limitations on hours of operation that are not unduly restrictive. In nonresidential areas, any limitations on the hours of operation for sidewalk vending shall not be more restrictive than any limitations on hours of operation imposed on other businesses or uses on the same street.

(2) Requirements to maintain sanitary conditions.

(3) Requirements necessary to ensure compliance with the federal Americans with Disabilities Act of 1990 (Public Law 101-336) and other disability access standards.

(4) Requiring the sidewalk vendor to obtain from the local authority a permit for sidewalk vending or a valid business license, provided that the local authority issuing the permit or business license accepts a California driver's license or identification number, an individual taxpayer identification number, or a municipal identification number in lieu of a social security number if the local authority otherwise requires a social

security number for the issuance of a permit or business license, and that the number collected shall not be available to the public for inspection, is confidential, and shall not be disclosed except as required to administer the permit or licensure program or comply with a state law or state or federal court order.

(5) Requiring the sidewalk vendor to possess a valid California Department of Tax and Fee Administration seller's permit.

(6) Requiring additional licenses from other state or local agencies to the extent required by law.

(7) Requiring compliance with other generally applicable laws.

(8) Requiring a sidewalk vendor to submit information on his or her operations, including, but not limited to, any of the following:

(A) The name and current mailing address of the sidewalk vendor.

(B) A description of the merchandise offered for sale or exchange.

(C) A certification by the vendor that to his or her knowledge and belief, the information contained on the form is true.

(D) The California seller's permit number (California Department of Tax and Fee Administration sales tax number), if any, of the sidewalk vendor.

(E) If the sidewalk vendor is an agent of an individual, company, partnership, or corporation, the name and business address of the principal.

(d) Notwithstanding subdivision (b), a local authority may do both of the following:

(1) Prohibit sidewalk vendors in areas located within the immediate vicinity of a permitted certified farmers' market or a permitted swap meet during the limited operating hours of that certified farmers' market or swap meet. A "certified farmers' market" means a location operated in accordance with Chapter 10.5 (commencing with Section 47000) of Division 17 of the Food and Agricultural Code and any regulations adopted pursuant to that chapter. A "swap meet" means a location operated in accordance with Article 6 (commencing with Section 21660) of Chapter 9 of Division 8 of the Business and Professions Code, and any regulations adopted pursuant to that article.

(2) Restrict or prohibit sidewalk vendors within the immediate vicinity of an area designated for a temporary special permit issued by the local authority, provided that any notice, business interruption mitigation, or other rights provided to affected businesses or property owners under the local authority's temporary special permit are also provided to any sidewalk vendors specifically permitted to operate in the area, if applicable. For purposes of this paragraph, a temporary special permit is a permit issued by the local authority for the temporary use of, or encroachment on, the sidewalk or other public area, including, but not limited to, an encroachment permit, special event permit, or temporary event permit, for purposes including, but not limited to, filming, parades, or outdoor concerts. A prohibition of sidewalk vendors pursuant to this paragraph shall only be effective for the limited duration of the temporary special permit.

(e) For purposes of this section, perceived community animus or economic competition does not constitute an objective health, safety, or welfare concern.

51039. (a) (1) A violation of a local authority's sidewalk vending program that complies with Section 51038 is punishable only by the following:

(A) An administrative fine not exceeding one hundred dollars ($100) for a first violation.

(B) An administrative fine not exceeding two hundred dollars ($200) for a second violation within one year of the first violation.

(C) An administrative fine not exceeding five hundred dollars ($500) for each additional violation within one year of the first violation.

(2) A local authority may rescind a permit issued to a sidewalk vendor for the term of that permit upon the fourth violation or subsequent violations.

(3) (A) If a local authority requires a sidewalk vendor to obtain a sidewalk vending permit from the local authority, vending without a sidewalk vending permit may be punishable by the following in lieu of the administrative fines set forth in paragraph (1):

(i) An administrative fine not exceeding two hundred fifty dollars ($250) for a first violation.

(ii) An administrative fine not exceeding five hundred dollars ($500) for a second violation within one year of the first violation.

(iii) An administrative fine not exceeding one thousand dollars ($1,000) for each additional violation within one year of the first violation.

(B) Upon proof of a valid permit issued by the local authority, the administrative fines set forth in this paragraph shall be reduced to the administrative fines set forth in paragraph (1), respectively.

(b) The proceeds of an administrative fine assessed pursuant to subdivision (a) shall be deposited in the treasury of the local authority.

(c) Failure to pay an administrative fine pursuant to subdivision (a) shall not be punishable as an infraction or misdemeanor. Additional fines, fees, assessments, or any other financial conditions beyond those authorized in subdivision (a) shall not be assessed.

(d) (1) A violation of a local authority's sidewalk vending program that complies with Section 51038, or a violation of any rules or regulations adopted prior to January 1, 2019, that regulate or prohibit sidewalk vendors in the jurisdiction of a local authority, shall not be punishable as an infraction or misdemeanor, and the person alleged to have violated any of those provisions shall not be subject to arrest except when permitted under law.

(2) Notwithstanding any other law, paragraph (1) shall apply to all pending criminal prosecutions under any local ordinance or resolution regulating or prohibiting sidewalk vendors. Any of those criminal prosecutions that have not reached final judgment shall be dismissed.

(e) A local authority that has not adopted rules or regulations by ordinance or resolution that comply with Section 51037 shall not cite, fine, or prosecute a sidewalk vendor for a violation of any rule or regulation that is inconsistent with the standards described in subdivision (b) Section 51038.

(f) (1) When assessing an administrative fine pursuant to subdivision (a), the adjudicator shall take into consideration the person's ability to pay the fine. The local authority shall provide the person with notice of his or her right to request an ability-to-pay determination and shall make available instructions or other materials for requesting an ability-to-pay determination. The person may request an ability-to-pay determination at adjudication or while the judgment remains unpaid, including when a case is delinquent or has been referred to a comprehensive collection program.

(2) If the person meets the criteria described in subdivision (a) or (b) of Section 68632, the local authority shall accept, in full satisfaction, 20 percent of the administrative fine imposed pursuant to subdivision (a).

(3) The local authority may allow the person to complete community service in lieu of paying the total administrative fine, may waive the administrative fine, or may offer an alternative disposition.

(g) (1) A person who is currently serving, or who completed, a sentence, or who is subject to a fine, for a conviction of a misdemeanor or infraction for sidewalk vending, whether by trial or by open or negotiated plea, who would not have been guilty of that offense under the act that added this section had that act been in effect at the time of the offense, may petition for dismissal of the sentence, fine, or conviction before the trial court that entered the judgment of conviction in his or her case.

(2) Upon receiving a petition under paragraph (1), the court shall presume the petitioner satisfies the criteria in paragraph (1) unless the party opposing the petition proves by clear and convincing evidence that the petitioner does not satisfy the criteria. If the petitioner satisfies the criteria in paragraph (1), the court shall

grant the petition to dismiss the sentence or fine, if applicable, and dismiss and seal the conviction, because the sentence, fine, and conviction are legally invalid.

(3) Unless requested by the petitioner, no hearing is necessary to grant or deny a petition filed under paragraph (1).

(4) If the court that originally sentenced or imposed a fine on the petitioner is not available, the presiding judge shall designate another judge to rule on the petition.

(5) Nothing in this subdivision is intended to diminish or abrogate any rights or remedies otherwise available to the petitioner.

(6) Nothing in this subdivision or related provisions is intended to diminish or abrogate the finality of judgments in any case not falling within the purview of this chapter.

SEC. 3. The Legislature finds and declares that Section 2 of this act, which adds Section 51038 to the Government Code, imposes a limitation on the public's right of access to the meetings of public bodies or the writings of public officials and agencies within the meaning of Section 3 of Article I of the California Constitution. Pursuant to that constitutional provision, the Legislature makes the following findings to demonstrate the interest protected by this limitation and the need for protecting that interest:

The Legislature finds and declares that in order to protect the privacy of a sidewalk vendor with regard to his or her California driver's license or identification number, individual taxpayer identification number, or municipal identification number, when that number is collected in lieu of a social security number for purposes of the issuance of a permit or business license, it is necessary that the sidewalk vendor's number be confidential, except as provided in this act.

Agenda Item No: 13.a.

MEETING DATE/TIME: 11/19/2025

ITEM NO: 2025-1317

City of Ukiah

AGENDA SUMMARY REPORT

SUBJECT: Status Report from Owner of the Palace Hotel.

DEPARTMENT: City Manager / Admin

PREPARED BY: Shannon Riley, Deputy City Manager

PRESENTER: Tom Carter, Palace Hotel Owner

ATTACHMENTS:

1. Palace Hotel Presentation

Summary: The owner of the Palace Hotel will provide the City Council with a status update of his project.

Background: Tom Carter purchased the Palace Hotel approximately one year ago.

Discussion: Mr. Carter will provide the City Council with a verbal status update on the Palace Hotel project.

Recommended Action: Receive report.

BUDGET AMENDMENT REQUIRED: n/a

CURRENT BUDGET AMOUNT: n/a

PROPOSED BUDGET AMOUNT: n/a

FINANCING SOURCE: n/a

REVENUE: No GRANT: No

PREVIOUS CONTRACT/PURCHASE ORDER NO.:

COORDINATED WITH: n/a

STRATEGIC PLAN (SP):

CLIMATE INITIATIVES (CI):

GENERAL PLAN ELEMENTS (GP):

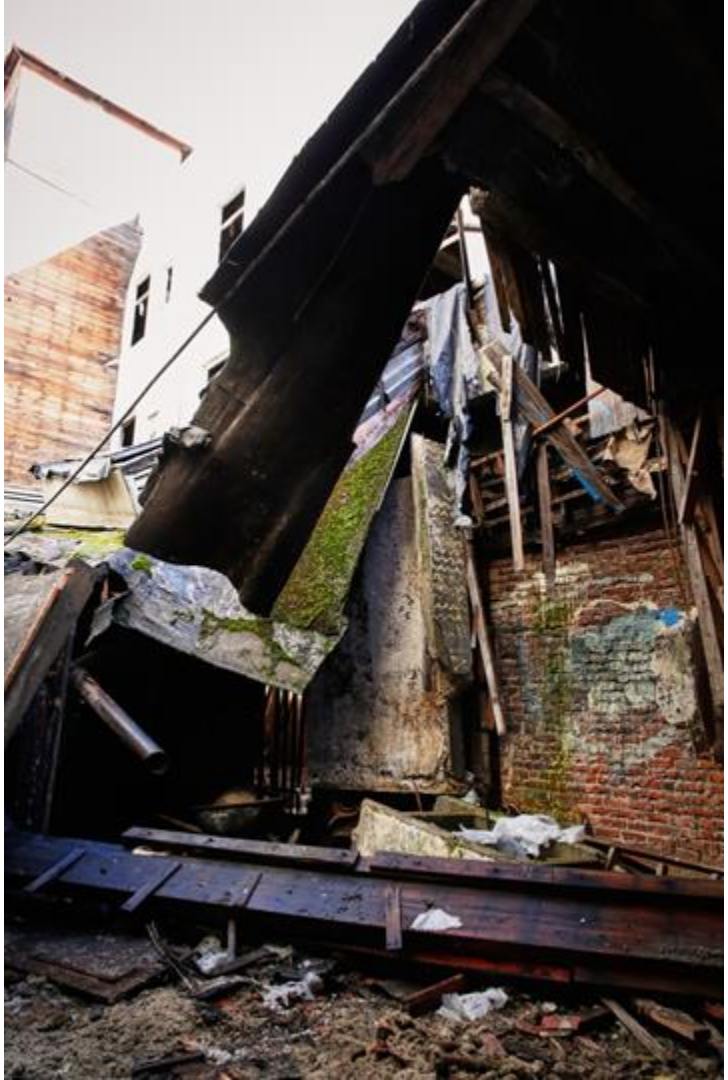
Approved: Sage Sangiacomo, City Manager

Palace Hotel Ukiah, CA

Progress Report - November 2025

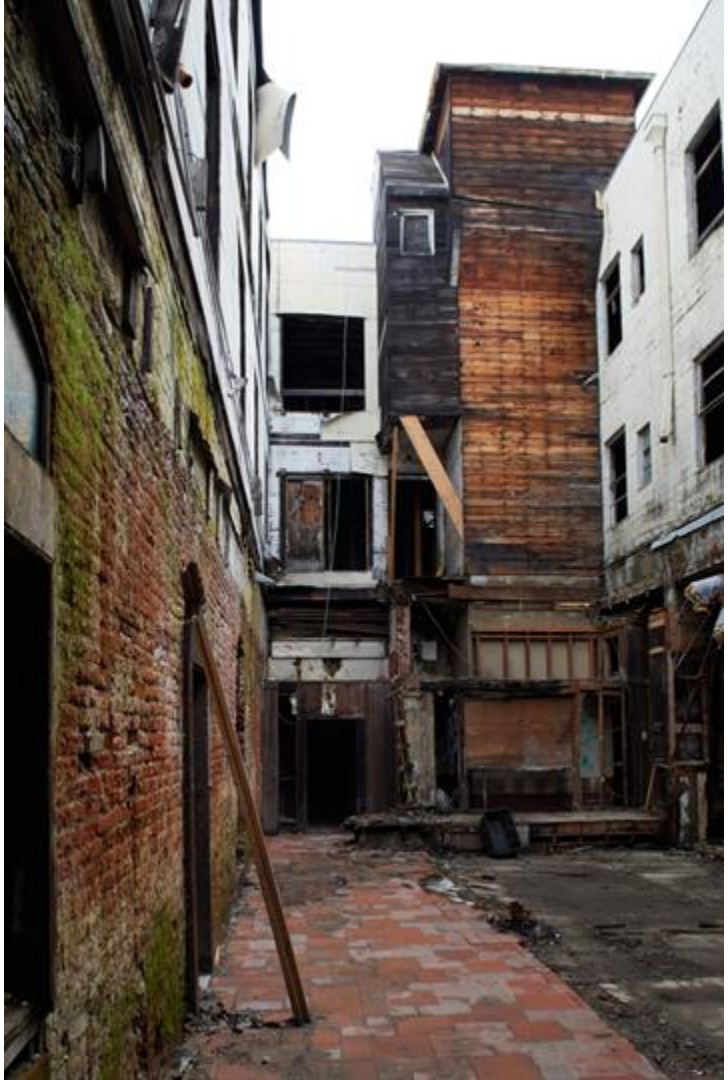


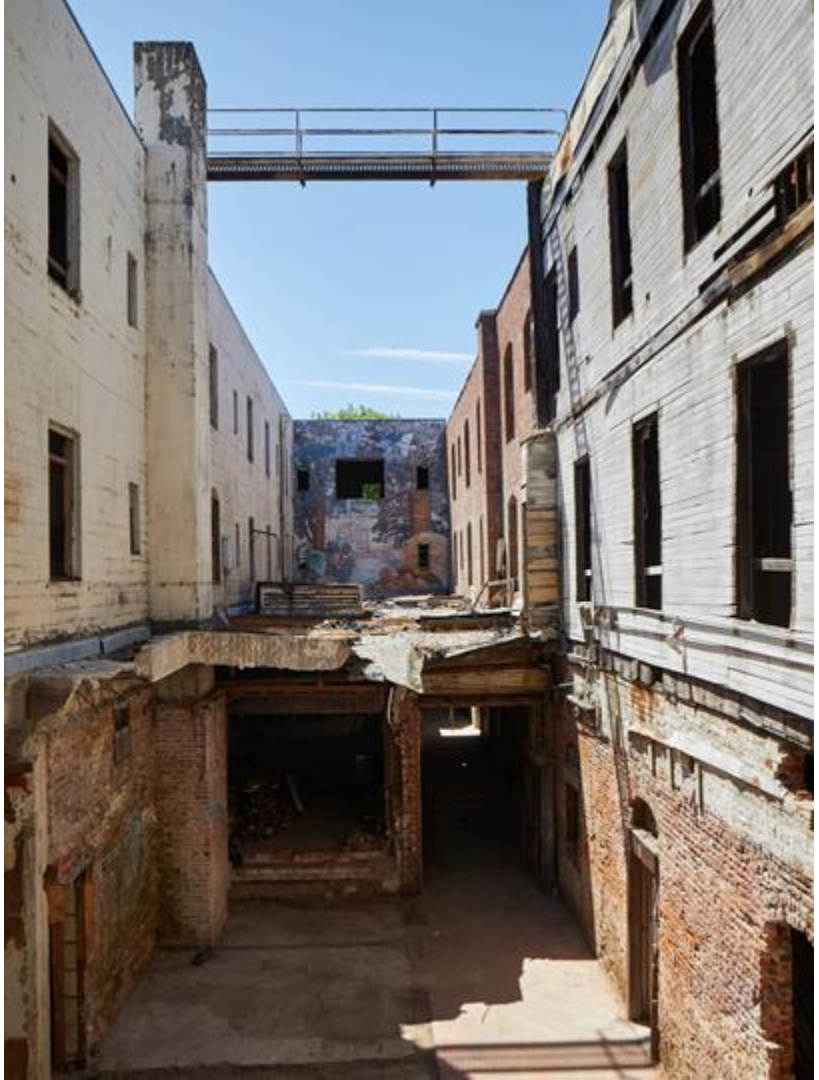












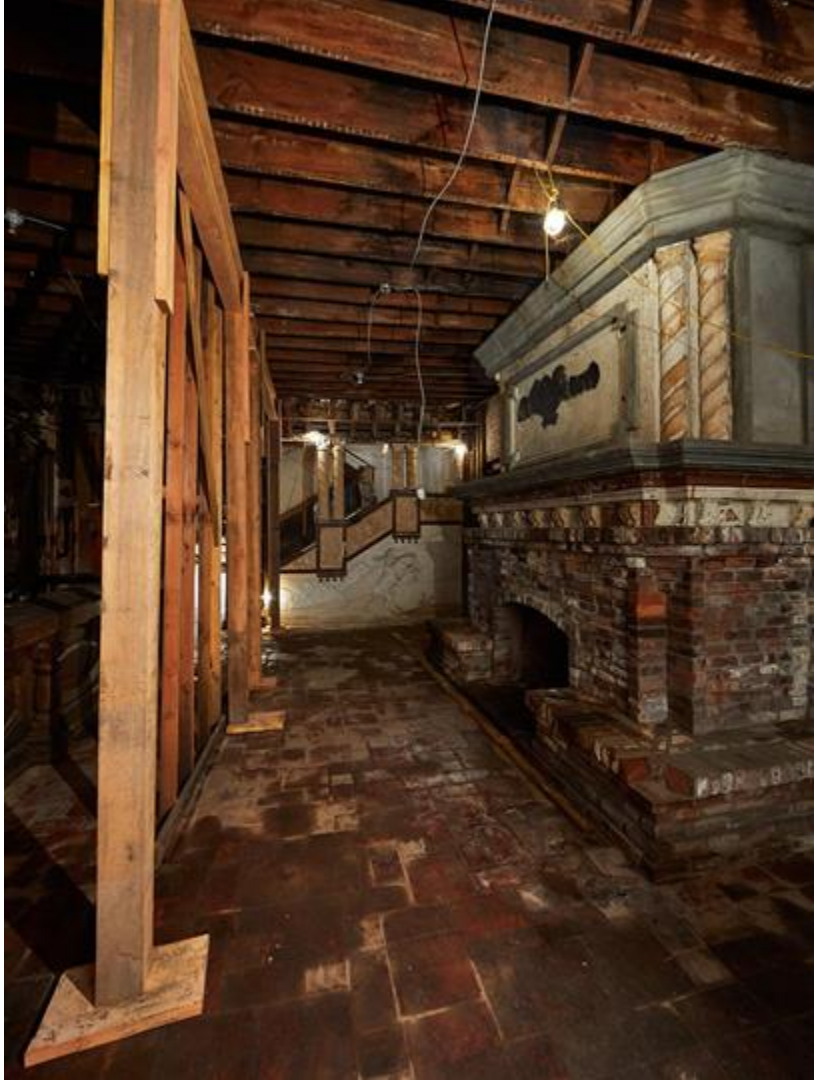














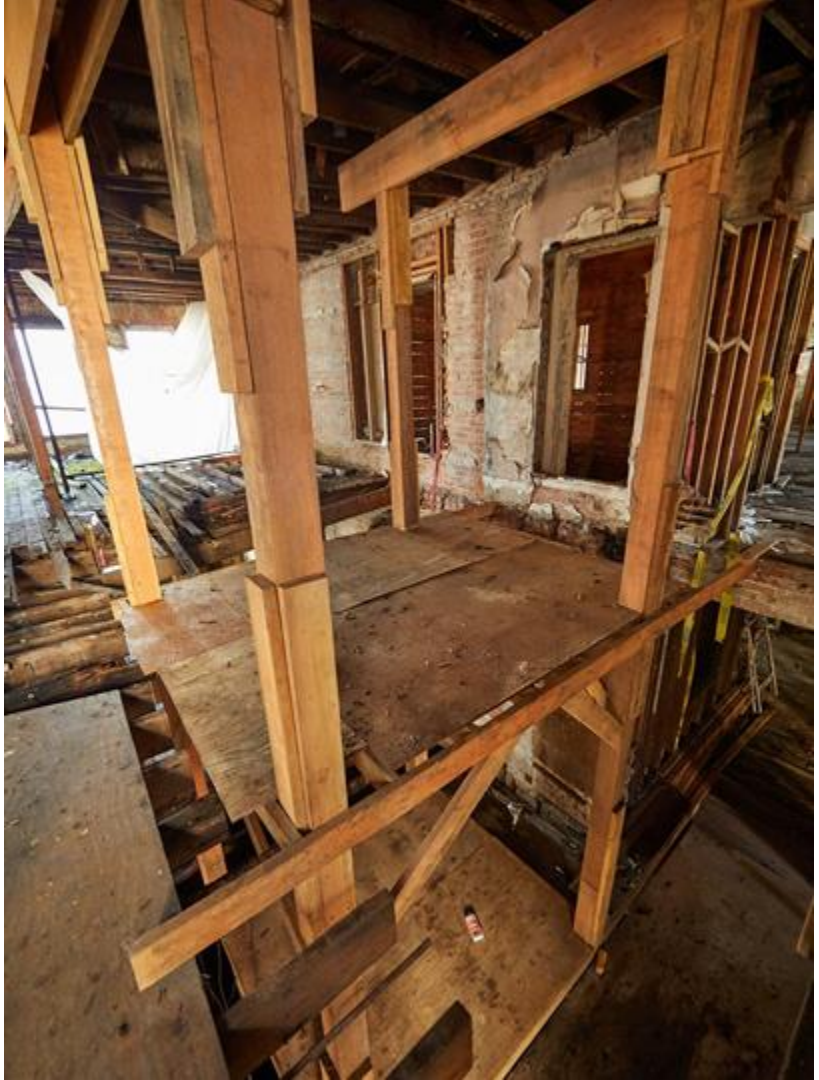


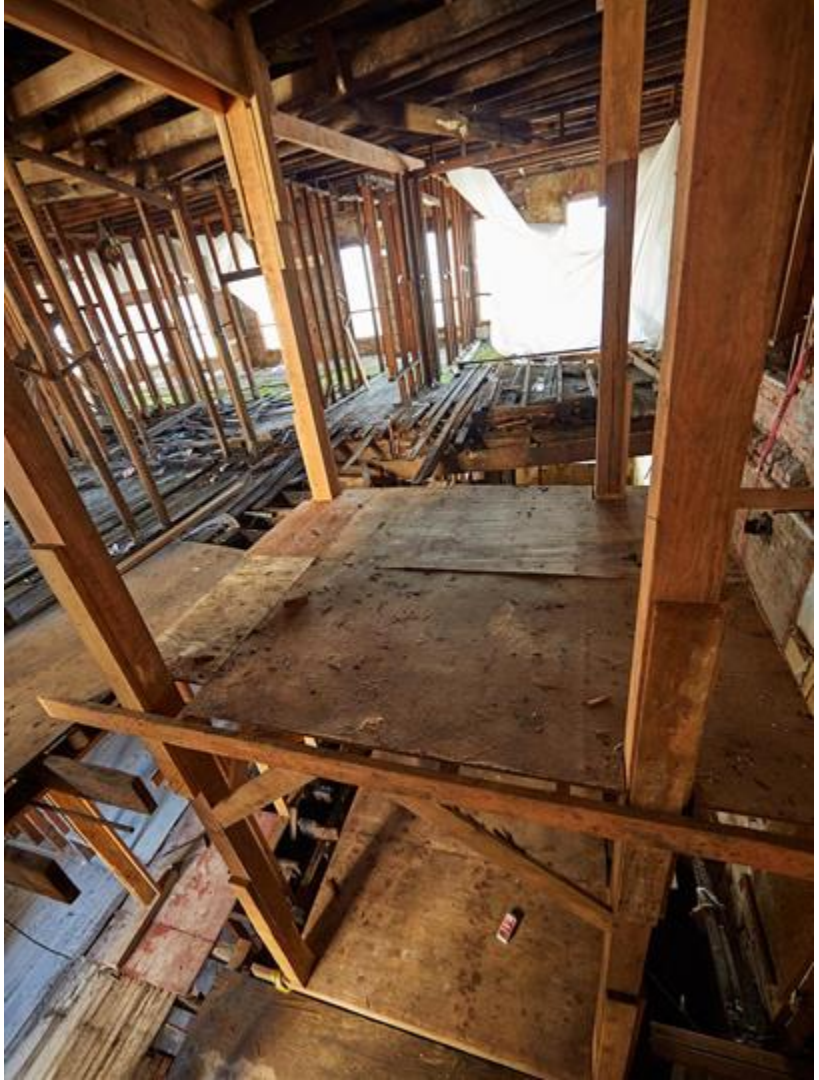





CAUTION
WATCH
YOUR STEP














55








PALACE
SQUARE




Maga



















Agenda Item No: 14.a.

MEETING DATE/TIME: 11/19/2025

ITEM NO: 2025-1286

City of Ukiah

AGENDA SUMMARY REPORT

SUBJECT: Receive Presentation on 2025 Ukiah Valley Fire Authority Fuels Crew Accomplishments and Authorize the City Manager to Negotiate and Execute a Memorandum of Understanding Between the City of Ukiah and the Mendocino County Fire Safe Council for the Use of the Ukiah Valley Fire Authority Fuels Crew.

DEPARTMENT: Fire

PREPARED BY: Justin Buckingham, Battalion Chief

PRESENTER: Justin Buckingham, Battalion Chief, UVFA

ATTACHMENTS:

1. Draft UVFA-MCFSC MOU
2. UVFA Fuels Crew Accomplishments

Summary: Council will receive a presentation on 2025 Ukiah Valley Fire Authority Fuels Crew accomplishments and consider authorizing the City Manager to negotiate and execute a Memorandum of Understanding between the City of Ukiah and the Mendocino County Fire Safe Council for the use of the Ukiah Valley Fire Authority Fuels Crew.

Background: In 2024, the City of Ukiah received a grant from the United States Department of Agriculture (USDA) to establish a dedicated Fuels Crew within the Ukiah Valley Fire Authority (UVFA). The primary objective of this program is to conduct wildfire mitigation and vegetation management work throughout Mendocino County. Under the terms of the grant, the City is required to treat a minimum of **200 acres** of hazardous fuels during the performance period.

The Mendocino County Fire Safe Council has a long-standing record of implementing state and federally funded wildfire mitigation projects across the region. To improve coordination and streamline project delivery, the Fire Safe Council has proposed establishing a Memorandum of Understanding (MOU) with the City of Ukiah. This agreement would allow the UVFA Fuels Crew to perform work on approved Fire Safe Council projects, contributing directly to the City's USDA grant performance metrics.

Discussion: The proposed MOU (Attachment 1) provides a framework for UVFA and the Fire Safe Council to collaborate on turnkey projects identified through approved grant programs. Under the agreement, UVFA will provide labor and equipment as available, while the Fire Safe Council will oversee project coordination, site selection, and compliance with grant requirements.

The MOU specifies that there will be **no exchange of funds** between the two parties. In alignment with USDA grant and City priorities, the UVFA Crew's project work will initially be concentrated in areas adjacent to the Ukiah Valley, and then expand to include high-priority projects throughout Mendocino County. Work performed by the UVFA Fuels Crew will occur during active grant periods, ensuring all activities align with the scope and intent of the USDA grant and the Fire Safe Council's project objectives.

This partnership supports regional wildfire resilience, enhances interagency coordination, and maximizes the impact of grant-funded fuel reduction efforts throughout Mendocino County.

Staff requests Council receive a presentation on 2025 Ukiah Valley Fire Authority Fuels Crew accomplishments (Attachment 2) and authorize the City Manager to negotiate and execute a Memorandum of

Understanding (Attachment #1) between the City of Ukiah and the Mendocino County Fire Safe Council for the use of the Ukiah Valley Fire Authority Fuels Crew.

Recommended Action: Receive Presentation on 2025 Ukiah Valley Fire Authority Fuels Crew Accomplishments and authorize the City Manager to negotiate and execute Memorandum of Understanding between the City of Ukiah and the Mendocino County Fire Safe Council for the use of the Ukiah Valley Fire Authority Fuels Crew.

BUDGET AMENDMENT REQUIRED: No

CURRENT BUDGET AMOUNT: N/A

PROPOSED BUDGET AMOUNT: N/A

FINANCING SOURCE: USDA Grant

REVENUE: No GRANT: Yes

PREVIOUS CONTRACT/PURCHASE ORDER NO.: N/A

COORDINATED WITH: Traci Boyl, Senior Analyst, Darcy Vaughn, Esq.

STRATEGIC PLAN (SP): SP 3B,

CLIMATE INITIATIVES (CI): CI-10a

GENERAL PLAN ELEMENTS (GP): GP-A6

Approved: Sage Sangiacomo, City Manager

MEMORANDUM OF UNDERSTANDING BETWEEN
CITY OF UKIAH
AND
MENDCOCINO COUNTY FIRE SAFE COUNCIL

This Memorandum of Understanding (MOU) is made and entered into by and between the City of Ukiah (City) and the Mendocino County Fire Safe Council (MCFSC).

WHEREAS, Ukiah Valley Fire Authority (UVFA) is the name under which the City operates fire, medical, and other emergency and non-emergency services, including fuels reduction, in the City and in the boundaries of the Ukiah Valley Fire District; and

WHEREAS, UVFA's Fuels Reduction Crew (UVFA Crew), funded by its Ukiah Valley and Mendocino Hazardous Fuels Reduction Project, Community Wildfire Defense Grant, is intended (among other things) to "increase fire resiliency in the Ukiah Valley area and throughout Mendocino County, California, which are at-risk local communities; and

WHEREAS, in alignment with grant and City priorities, the UVFA Crew's project work will initially be concentrated in areas adjacent to the Ukiah Valley but will then branch out to high-priority projects throughout Mendocino County; and

WHEREAS, project locations and activities will be selected by the Fire Chief in consultation with the Mendocino County Fire Safe Council; and

WHEREAS, MCFSC has identified such projects and has obtained landowner permission for needed fuel reduction work by crews that are subcontracted to MCFSC; and

WHEREAS, the MCFSC has a need for assistance in performing such projects,

The parties agree as follows:

A. When the UVFA agrees to assign UVFA Crew to work on a project proposed by the MCFSC, MCFSC agrees to:

    1. Pay any project costs pre-specified in writing by UVFA and agreed to by MCFSC (e.g., onsite potra potty facilities) that directly related to and necessitated by such projects, except for wages, salaries, and other remuneration paid to UVFA employees, or UVFA Crew, and the cost of their equipment and support, and that are not otherwise covered by UVFA's Fuel Crew Grant Funding.

    2. Demonstrate the availability of adequate plans and specifications, sufficient funds, materials, supplies, and equipment, adequate technical supervision, and any special labor requirements to complete such projects.

    3. Obtain the approvals, notification, and permits required by any state, federal, or local agency necessary to commence construction, fuels management, or operation of such projects.

    4. Hold an orientation meeting with UVFA Crew at the commencement of such projects to explain the technical aspects, execution of, and need for such projects.

B. From proposals submitted by the MCFSC, UVFA shall select those projects meeting the priorities and resources of UVFA. UVFA shall submit evaluations to MCFSC that set forth any special requirements or conditions related to the projects. By so doing, with reference to any such

evaluations subsequently approved by MCFSC, UVFA agrees to provide labor, crew, supervision, normal transportation, food, and such tools as UVFA determines to be available. Upon receipt of MCFSC's acceptance of such evaluations, projects shall be assigned to UVFA Crew management where they will be scheduled in accordance with the priorities and resources of UVFA.

C. Timing

1. MCFSC recognizes that fire suppression, other emergency activities, or other fuel reduction projects may have priority over any other work for UVFA Crew.

2. MCFSC further recognizes that the resources of UVFA Crew are limited and work requirements of UVFA Crew may be altered in priority from time to time.

3. Projects will be performed within the rules and regulations of UVFA which may require temporary suspension or permanent cessation of projects due to emergency conditions as defined by such rules and regulations.

4. The Parties agree that any justified delays by either party shall be excused and costs caused by such delays shall be borne by the party incurring such costs.

D. Work performed under this MOU will be under the immediate supervision of UVFA officials. However, UFVA Crew will be instructed to also follow basic MCFSC contractor guidelines for fuel reduction projects. The MCFSC will provide such operation supervision, technical assistance, guidance, and inspection, as it considers necessary to properly complete the work.

E. Work performed on behalf of MCFSC does not in any way convey to UVFA or UVFA Crew or any persons working with UFVA in the performance of said work, employee status that would extend to them the benefits afforded to permanent employees of MCFSC.

F. Upon start of each project, or any phase thereof, permission is hereby granted to UVFA to place upon the project site a sign or emblem consistent in size and design to its surroundings, indicating the participation of UVFA and as is consistent with UVFA's grant obligations.

G. Neither party shall use the name of the other party in any form or manner in advertisements nor other information released to the public without the prior written approval of the other party. This Section is not intended to prohibit either party from legally complying with the California Public Records Act (PRA).

H. Each party, to the extent permitted by law, agrees to indemnify and hold harmless the other party, its officers, agents, and employees from all claims, demands, or liability arising out of the indemnifying party's performance under this MOU except where such injury or damage arose from the sole negligent or intentional acts or omissions of the other party.

I. Neither party may assign this MOU or any interest herein without the written consent of the other party.

J. Subject to the provisions herein, all remedies allowed by law are available to either party for enforcement of this MOU. Any waiver of rights by either party on any matter related to this MOU shall not be deemed to be a waiver on any other matter relating to the MOU.

K. All provisions of this MOU constitute essential elements of the agreed exchange that is the subject matter of this MOU. Accordingly, if any of these provisions are determined to be invalid, illegal, or

unenforceable in any material respect, the remainder of this MOU is not enforceable against either of the Parties except as may be necessary to effect payment for services already rendered.

L. This MOU may be modified by mutual written agreement of the parties.

M. This MOU takes effect shall remain in effect until December 31, 2028, unless terminated prior to that date by 60 days written notice from one party to the other.

By signing below, I CERTIFY that I fully reviewed and agreed to the contents of the Memorandum of Understanding.

CITY OF UKIAH	**MENDOCINO COUNTY FIRE SAFE COUNCIL**
By: _____ [Print name]	By: _____
Its: _____	Its: _____

Ukiah Valley Fire Authority - Fire Fuels Crew 2025

Fuels Mitigation Accomplishments and Partnerships

Introduction

- The UVFA Fire Fuels Crew was established to reduce wildfire risk, enhance defensible space, and support regional fire resilience.
- Since the start of 2025, the crew has completed projects across multiple high-risk areas, contributing to public safety and community protection.

Project Overview

- Total Projects Completed: 5 Major Areas
- Total Acres: 50 (30 in the western hills)
- Project Areas:
- 1. Low Gap Park
- 2. Russian River Estates
- 3. Great Redwood Trail
- 4. Airport Property
- 5. CAL FIRE Collaboration Projects

Low Gap Park Project

- Created shaded fuel breaks and cleared overgrown vegetation along park trails and perimeter zones.
- Reduced ladder fuels and improved defensible space along the homes in the western hills.








UFD
UKIAH VALLEY
1876
UVFD
FIRE AUTHORITY
1940


UFD
UKIAH VALLEY
1876
UVFD
FIRE AUTHORITY
1940






CITY VIEW
TRAIL

Russian River Estates Project

- Conducted defensible space clearing around access roads.
- Targeted high-density fine dead fuels adjacent to the only road into/out of the development.


UFD
UKIAH VALLEY
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UVFD
FIRE AUTHORITY
1940


UFD
UKIAH VALLEY
1876
UVFD
FIRE AUTHORITY
1940

Great Redwood Trail Project

- Improved visibility and access along trail corridors.
- Removed encroaching brush, hazardous trees, and annual grasses.
- Created buffers along the buildings adjacent to the railroad right-of-way.

Airport Property Project

- Cleared dead and hazard trees around runway perimeters.
- Reduced fine fuel loads to mitigate ignition potential near flight operations.



CAL FIRE Collaborative Projects

Supported CAL FIRE with prescribed burns and pile ignition operations.

Gained valuable field experience in controlled fire operations and interagency coordination.


UFD
UKIAH VALLEY
1876
UVFD
FIRE AUTHORITY
1940





Summary & Acknowledgements

- Over 50 acres treated since inception.
- Multiple agency partnerships established.
- Tangible improvements to community fire resilience.
- Acknowledgements:
- - Ukiah Valley Fire Authority
- - City of Ukiah
- - CAL FIRE

Building a More Resilient Ukiah Valley and Mendocino County

- Thank you to our crew members, partners, and community for the continued support.

Agenda Item No: 14.b.

MEETING DATE/TIME: 11/19/2025

ITEM NO: 2025-1298

City of Ukiah

AGENDA SUMMARY REPORT

SUBJECT: Receive Updates on City Council Committee and Ad Hoc Assignments, and, if Necessary, Consider Modifications to Assignments and/or the Creation/Elimination of Ad Hoc(s); Including the Possible Disbandment of the Zoning Reform Ad Hoc, and the Creation of an Airport Infill Policy Ad Hoc.

DEPARTMENT: City Clerk **PREPARED BY:** Kristine Lawler, City Clerk

PRESENTER: Mayor Crane and Various Councilmembers

ATTACHMENTS:

1. 2025 City Council Special Assignments and Ad Hocs

Summary: City Council members will provide reports and updates on their committee and ad hoc assignments. If necessary, the Council may consider modifications.

Background: City Council members are assigned to a number of committees and ad hoc activities. These assignments are included as Attachment 1.

Discussion: Previously, the City Council discussed having more time allocated to reporting on committee and ad hoc activities. Often, the Council Reports section of the regular agenda is rushed due to impending business (i.e., public hearings), and not enough time is afforded for reports beyond community activities.

In an effort to foster regular updates on committee and ad hoc assignments, this item is being placed on the agenda to provide the City Council members an expanded opportunity to report on assignments and modify assignments as necessary.

The Community Development Department has two recommendations: 1) to disband the Zoning Reform Ad Hoc, as the Ad Hoc's work has concluded (note the Downtown Zoning Code Ad Hoc, which is separate from the Zoning Reform Ad Hoc, is still active and meeting on a regular basis); and 2) to create a new Airport Infill Policy Ad Hoc. Per direction within Section 3.3.5 (f) of the Ukiah Municipal Airport Land Use Compatibility Plan (UKIALUCP) that “the preference of this policy is that all parcels eligible for Infill nonresidential development be identified at one time by the Local Agency” [City], the purpose of this new Ad Hoc would be to work with Staff to fulfill this objective. Once this is accomplished, Staff would present the identified parcels to the Mendocino County Airport Land Use Commission for review and consideration.

Recommended Action: Receive report(s). The Council will consider modifications to committee and ad hoc assignments along with the creation/elimination ad hoc(s); including the disbandment of the Zoning Reform Ad Hoc, and the creation and appointment of an Airport Infill Policy Ad Hoc.

BUDGET AMENDMENT REQUIRED: N/A

CURRENT BUDGET AMOUNT: N/A

PROPOSED BUDGET AMOUNT: N/A

FINANCING SOURCE: N/A

REVENUE: No **GRANT:** No

PREVIOUS CONTRACT/PURCHASE ORDER NO.: N/A

COORDINATED WITH: N/A

STRATEGIC PLAN (SP): N/A

CLIMATE INITIATIVES (CI): N/A

GENERAL PLAN ELEMENTS (GP): N/A

Approved: Sage Sangiacomo, City Manager

LOCAL / UKIAH VALLEY	MTG DATE/TIME	MEETING LOCATION	MAILING ADDRESS/CONTACT	COMMITTEE FUNCTION	ASSIGNED TO	PRINCIPAL STAFF SUPPORT
City Broadband Project	TBD	TBD	Civic Center 300 Seminary Ave. Ukiah, CA 95482	to evaluate the Request for Proposal (RFP) for the Internet Service Provider (ISP) for the California's Public Utilities Commission (CPUC) Last Mile Broadband	**Orozco**	**Jim Robbins,** Grants Manager, 463-6708; jrobbins@cityofukiah.com
Investment Oversight Committee	Varies	Civic Center 300 Seminary Ave. Ukiah, CA 95482	Civic Center 300 Seminary Ave. Ukiah, CA 95482	Reviews City investments, policies, and strategies	**Crane** **Orozco - Alternate** **Alan Carter,** Treasurer	**Dan Buffalo,** Director of Finance; 463-6220 dbuffalo@cityofukiah.com
Disaster Council	Shall meet a minimum of once a year at a time and place designated upon call of the chair	Place designated upon call of the chair or, if she/he is unavailable or unable to call such meeting, the first vice chair and then the City Manager or her/his designee.	Office of Emergency Management 300 Seminary Ave. Ukiah, CA 95482 467-5720 - Traci Boyl	Develop any necessary emergency and mutual aid plans, agreements, ordinances, resolutions, rules, and regulations.	**Orozco** **Criss - Alternate**	**Traci Boyl,** City Manager's Office Management Analyst; 467-5720; tboyl@cityofukiah.com
Greater Ukiah Business & Tourism Alliance (GUPTA)	4th Monday of month, 10 a.m.	200 S School St. Ukiah, CA 95482	200 S School St. Ukiah, CA 95482	Promotes tourism and works to strengthen and promote the historic downtown and businesses within the greater Ukiah area	**Marianne Davison -** *Community Services Department Staff* **Orozco - Alternate**	**Shannon Riley,** Deputy City Manager; 467-5793 sriley@cityofukiah.com
Mendocino County Inland Water and Power Commission (IWPC)	2nd Thursday of month, 6:00 p.m.	Civic Center 300 Seminary Avenue conference room 5	IWPC Staff P.O. Box 1247 Ukiah, CA 95482 391-7574 - Candace Horsley	Develops coordination for water resources and current water rights: Potter Valley project - Eel River Diversion	**Rodin** **Orozco - Alternate**	**Sean White,** Director of Water Resources; 463-5712 swhite@cityofukiah.com
North Coast Opportunities (NCO)	4th Wednesday of month, 2 p.m.	Alternating locations - Ukiah and Lakeport	Governing Board Chair North Coast Opportunities 413 North State Street Ukiah, CA 95482	Assist low income and disadvantaged people to become self reliant	**Neil Davis**	Neil Davis, Community Services Director; 467-5764 ndavis@cityofukiah.com
Sun House Guild ex officio	2nd Tuesday of month, 10:30 a.m.	Sun House 431 S. Main St. Ukiah, CA	431 S. Main Street Ukiah, CA 95482 467-2836	Support and expand Grace Hudson Museum	**Orozco, Sher** **Neil Davis - Alternate**	**David Burton**, Museum Director; 467-2836 dburton@cityofukiah.com
Ukiah Valley Basin Groundwater Sustainability Agency (GSA)	2nd Thursday of month, 1:30 p.m.	Board of Supervisors Chambers; 501 Low Gap Road Ukiah, CA	County Executive Office 501 Low Gap Rd., Rm. 1010 Ukiah, CA 95482 463-4441	GSA serves as the Groundwater Sustainability Agency in the Ukiah Valley basin	**Crane** **N/A - Alternate**	**Sean White,** Director of Water Resources; 463-5712 swhite@cityofukiah.com

MENDOCINO COUNTY	MTG DATE/TIME	MEETING LOCATION	MAILING ADDRESS/CONTACT	COMMITTEE FUNCTION	ASSIGNED TO	PRINCIPAL STAFF SUPPORT
City Selection Committee	Called as required by the Clerk of the Board	BOS Conference Room 501 Low Gap Rd. Rm. 1090 Ukiah, CA	C/O: BOS 501 Low Gap Rd., Rm 1090 Ukiah, CA 95482 463-4441	Makes appointments to LAFCO and Airport Land Use Commission *(Mayor - Primary; Vice Mayor - Alternate)*	**Mayor Crane** **Vice Mayor Sher**	**Kristine Lawler,** City Clerk; 463-6217 klawler@cityofukiah.com
Economic Development & Financing Corporation (EDFC)	2nd Thursday of month, 2:00 p.m.	Primarily 631 S. Orchard Street (location varies)	Executive Director 631 South Orchard Avenue Ukiah, CA 95482 467-5953	Multi-agency co-op for economic development and business loan program	**Riley** (appointed 12/19/18)	**Shannon Riley,** Deputy City Manager; 467-5793 sriley@cityofukiah.com
Library Advisory Board	3rd Wednesdays of alternate months; 1:00 p.m.	Various Mendocino County Libraries	Ukiah County Library 463-4491	Review library policy and activities	**Sher** **Rodin - Alternate**	**Kristine Lawler,** City Clerk; 463-6217; klawler@cityofukiah.com
Mendocino County 1st District Liaison	Monthly; TBD	Civic Center Annex conference room #5 411 West Clay St. Ukiah, CA 95482	Civic Center 300 Seminary Ave. Ukiah, CA 95482	To coordinate activities and policy development with the City's 1st District Supervisor	**Crane** **Rodin - Alternate**	**Sage Sangiacomo,** City Manager; 463-6221; ssangiacomo@cityofukiah.com
Mendocino County 2nd District Liaison	1st Wednesdays of month, 8:00 a.m.	Civic Center Annex conference room #5 411 West Clay St. Ukiah, CA 95482	Civic Center 300 Seminary Ave. Ukiah, CA 95482	To coordinate activities and policy development with the County's 2nd District Supervisor	**Criss** **Rodin - Alternate**	**Shannon Riley,** Deputy City Manager; 467-5793 sriley@cityofukiah.com
Mendocino Council of Governments (MCOG)	1st Monday of month, 1:30 p.m.	Board of Supervisors Chambers 501 Low Gap Road Ukiah, CA	Executive Director 367 N. State Street, Ste. 206 Ukiah, CA 95482 463-1859	Plan and allocate State funding, transportation, infrastructure and project County wide	**Criss** **Sher - Alternate**	**Tim Eriksen,** Public Works Director/City Engineer; 463-6280 teriksen@cityofukiah.com **Craig Schlatter,** Community Development Director; 463-6219; cschlatter@cityofukiah.com
Mendocino County Airport Land Use Commission	As needed	BOS Conference Room 501 Low Gap Rd., Rm. 1090, Ukiah, CA	Mendocino County Executive Office 501 Low Gap Rd. Rm. 1010 Ukiah, CA 95482	To formulate a land use compatibility plan, provide for the orderly growth of the airport and the surrounding area, and safeguard the general welfare of the inhabitants within the vicinity	**Liaisons: Owen/Schlatter**	**Greg Owen**, Airport Manager; 467-2855; gowen@cityofukiah.com **Craig Schlatter**, Director of Community Development; 463-6219; cschlatter@cityofukiah.com
Mendocino County Local Area Formation Commission (LAFCO)	1st Monday of month, 9:00 a.m.	Board of Supervisors Chambers	Executive Director 200 S. School Street, Ste. 2 Ukiah, CA 95482 463-4470	Required by legislation - planning spheres of influence, annexation, service areas, and special districts	**Rodin** **Crane** - Alternate for both city seat members on Commission	**Craig Schlatter,** Director of Community Development; 463-6219; cschlatter@cityofukiah.com

MENDOCINO COUNTY Continued	MTG DATE/TIME	MEETING LOCATION	MAILING ADDRESS/CONTACT	COMMITTEE FUNCTION	ASSIGNED TO	PRINCIPAL STAFF SUPPORT
Mendocino Solid Waste Management Authority (MSWMA)	3rd Thursday of every other month (varies), 10:00 a.m.	Willits Council Chambers	Solid Waste Director 3200 Taylor Drive Ukiah, CA 95482 468-9710	County-wide Solid Waste JPA	**Crane** **Sher - Alternate**	**Tim Eriksen,** Public Works Director/City Engineer; 463-6280 teriksen@cityofukiah.com
Mendocino Transit Authority (MTA) Board of Directors	Last Wednesday of month, 1:30 p.m.	Alternating locations - Ukiah Conference Center or Fort Bragg, or Point Arena	Executive Director 241 Plant Road Ukiah, CA 95482 462-1422	County-wide bus transportation issues and funding	**Sher** **Rodin - Alternate**	**Tim Eriksen, Public Works Director/City Engineer;** 463-6280 teriksen@cityofukiah.com
Mendocino Youth Project JPA Board of Directors	3rd Wednesday of month, 7:45 a.m.	776 S. State Street Conference Room	Mendocino Co. Youth Project 776 S. State Street, Ste. 107 Ukiah, CA 95482 707-463-4915	Targets all youth with a focus on drug and alcohol prevention, healthy alternatives and empowering youth to make healthy choices	**Criss** **Max Brazill, Admin Lieutenant - Alternate**	**Tom Corning**, Police Chief; 463-6254; tcorning@cityofukiah.com
Russian River Flood Control District (RRFCD) Liaison	1st Monday of month, 5:30 p.m.	151 Laws Ave.,Suite D Ukiah, CA	151 Laws Ave., Ukiah, CA 95482; rrfc@pacific.net; 462-5278	Proactively manage the water resources of the upper Russian River for the benefit of the people and environment of Mendocino County	**White/Orozco**	**Sean White,** Director of Water Resources; 463-5712 swhite@cityofukiah.com
Ukiah Players Theater Board of Directors	3rd Tuesday of month, 6:00 p.m	1041 Low Gap Rd Ukiah, CA 95482 462-1210	1041 Low Gap Rd Ukiah, CA 95482 462-1210	To oversee the activities, organization and purpose of the Ukiah Players Theater	**Greg Owen,** Airport Manager (appointed 12/19/18)	**Kristine Lawler,** City Clerk; 463-6217 klawler@cityofukiah.com
Ukiah Unified School District (UUSD) Committee	Quarterly	511 S. Orchard, Ste. D Ukiah, CA 95482	511 S. Orchard Ukiah, CA 95482	Information exchange with UUSD Board Chair, Mayor, Superintendent, and City Manager	**Orozco, Criss** **Sage Sangiacomo, City Manager** **Cedric Crook, Police Chief**	**Sage Sangiacomo,** City Manager; 463-6221 ssangiacomo@cityofukiah.com
REGIONAL	**MTG DATE/TIME**	**LOCATION**	**MAILING ADDRESS/CONTACT**	**COMMITTEE FUNCTION**	**ASSIGNED TO**	**PRINCIPAL STAFF SUPPORT**
Great Redwood Trail Agency (GRTA)	Bi-monthly, 3rd Thursdays, 10:30 a.m.	Various Locations - announced	419 Talmage Road, Suite M Ukiah, CA 95482 463-3280	Provides a unified and revitalized rail infrastructure meeting the freight and passenger needs of the region	**Rodin** **Sher- Alternate**	**Neil Davis,** Community Services Director 467-5764 ndavis@cityofukiah.com
League of California Cities Redwood Empire Legislative Committee	Prior to Division Meetings, meets 3x in person and then via conference call	Various locations that are announced	Redwood Empire League President; Public Affairs Program Manager (916) 658-8243	Elected city officials and professional city staff attend division meetings throughout the year to share what they are doing and advocate for their interests in Sacramento	**Orozco** **Criss - Alternate**	**Sage Sangiacomo,** City Manager; 463-6221 ssangiacomo@cityofukiah.com
Russian River Watershed Association (RRWA)	4th Thursday of month, 9:00 a.m. (only 5 times a year)	Windsor Town Hall 9291 Old Redwood Hwy, #400 Windsor, CA 95492 707-838-1000	Russian River Watershed Association 2235 Mercury Way, Suite 105 Santa Rose, CA 95407 info@rrwatershed.org 707-508-3670 (message only)	Consider issues related to Russian river - plans projects and funding requests	**Rodin** **Sher - Alternate**	**Tim Eriksen,** Public Works Director/City Engineer; 463-6280 teriksen@cityofukiah.com
Northern California Power Agency (NCPA) - Commission	4th Thursday of month, 9:00 a.m. *(see NCPA calendar)*	Roseville, CA and other locations	651 Commerce Drive Roseville, CA 95678 916-781-4202	Pool of State and local power utilities developing and operating power generation, providing scheduling and related energy services and providing regulatory and legislative support.	**Crane - Commissioner** **Sher - City Council Alternate** **Sauers - Alternate and Commissioner in absence of Commissioner Crane**	**Cindi Sauers -** Electric Utility Director; 463-6286 csauers@cityofukiah.com
Northern California Power Agency (NCPA) – Lodi Energy Center (LEC) Appointment	2nd Monday of month, 10:00 AM	Lodi, CA and other locations	651 Commerce Drive Roseville, CA 95678 916-781-4299	Committee oversees the operation, maintenance and expenditures of the LEC 300 MW generating project.	**Sauers** – Project Participate Appointee	**Cindy Sauers,** Electric Utility Director, 463-6286, csauers@cityofukiah.com
Transmission Agency of Northern California (TANC)	4th Wednesday of month, 10 a.m.	35 Iron Point Circle Suite 225 Folsom, CA	35 Iron Point Cir #225 Folsom, CA 95630 916-852-1673; info@tanc.us	Provide electric transmission to its Member utilities through transmission line ownership or contract arrangements.	**Crane** **Sauers - Alternate**	**Cindi Sauers -** Electric Utility Director; 463-6286 csauers@cityofukiah.com C
STANDING COMMITTEES	**MTG DATE/TIME**	**LOCATION**	**MAILING ADDRESS/CONTACT**	**COMMITTEE FUNCTION**	**ASSIGNED TO**	**PRINCIPAL STAFF SUPPORT**
Diversity and Equity	TBD	Virtual Meeting Room (link to be created)	Civic Center 300 Seminary Ave. Ukiah, CA 95482	Improve diversity and equity in the City's workforce and municipal services	**Orozco/Criss**	**Traci Boyl,** City Manager's Office Management Analyst; 467-5720; tboyl@cityofukiah.com
Fire Executive Committee	2nd Tue, every other month beginning in January; 5:00 p.m.	Ukiah Valley Conference Center, 200 S. School Street Ukiah, CA	Civic Center 300 Seminary Ave. Ukiah, CA 95482 sabba@cityofukiah.com	Per the recently adopted agreement between the City of Ukiah and the Ukiah Valley Fire Protection District	**Orozco/Sher** **Alternates: Criss**	**Doug Hutchison,** Fire Chief; 463-6263; dhutchison@cityofukiah.com
Countywide Oversight Board to the RDA Successor Agencies	4th Thursday of January, 4:00 p.m.; meets annually	Ukiah Valley Conference Center, 200 S. School Street Ukiah, CA	City of Ukiah ATTN: City Clerk 300 Seminary Ave. Ukiah, CA 95482	Oversee and direct the Successor Agencies of the former redevelopment agencies	**Crane**	**Dan Buffalo**, Director of Finance; 463-6220 dbuffalo@cityofukiah.com **Kristine Lawler**, City Clerk; 463-6217, klawler@cityofukiah.com
Water Executive Committee (Ukiah Valley Water Authority)	1st Tue of each month at 6:00 p.m.	Ukiah Valley Conference Center, 200 S. School Street Ukiah, CA	City of Ukiah ATTN: Sean White 300 Seminary Ave. Ukiah, CA 95482	Oversight of UVWA; set annual budget for the combined water system; Manage rates and collect levies; modify existing water rights for the provision of water service; mediation and dispute resolution;	**Crane/Orozco**	**Sean White,** Director of Water Resources; 463-5712 swhite@cityofukiah.com

2025 AD HOC COMMITTEES		
COMMITTEE	**ASSIGNED TO**	**PRINCIPAL STAFF SUPPORT**
Electric Grid Operational Improvements	**Crane/Orozco**	**Cindy Sauers, Electric Utility Director**; 463-6286 csauers@cityofukiah.com
Trench Cut Policy Development	**Crane**	**Tim Eriksen, Public Works Director/City Engineer**; 463-6280 teriksen@cityofukiah.com
Advance Planning & Policy for Annexation Applications	**Crane/Rodin**	**Craig Schlatter, Community Development Director** 463-6219 cschlatter@cityofukiah.com
UVSD/ City Relations *Ad hoc committee to address specific issues with the Ukiah Valley Sanitation District, including discussion of overall sewer system service delivery policies, operating policy revisions, potential revisions to the current Operating Agreement, and cost sharing*	**Crane/Orozco**	**Dan Buffalo, Director of Finance;** 463-6220 dbuffalo@cityofukiah.com **Sean White, Water Resources Director** 463-5712 swhite@cityofukiah.com
Orr Street Bridge Corridor	**Rodin/Sher**	**Tim Eriksen, Public Works Director/City Engineer**; 463-6280 teriksen@cityofukiah.com
Complete Streets	**Rodin/Crane**	**Tim Eriksen, Public Works Director/City Engineer**; 463-6280 teriksen@cityofukiah.com **Shannon Riley, Deputy City Manager** 467-5793 sriley@cityofukiah.com **Neil Davis, Community Services Director** 467-5764 ndavis@cityofukiah.com
Special Districts (Water District Consolidation)	**Orozco/Crane**	**Shannon Riley, Deputy City Manager** 467-5793 sriley@cityofukiah.com
Corp Yard Planning	**Crane/Orozco**	**Jason Benson, Senior Civil Engineer** 463-6284 jbenson@cityofukiah.com
Mendocino County Courthouse Project and Reuse	**Sher/Orozco**	**Shannon Riley, Deputy City Manager** 467-5793 sriley@cityofukiah.com
City's 150-Year Anniversary Planning	**Orozco/Rodin**	**Shannon Riley, Deputy City Manager** 467-5793 sriley@cityofukiah.com
Zoning Reform *Function is to explore creation of a new ministerial zoning permit and identify additional zoning streamlining and reform efforts to provide better and more consistent development outcomes*	**Crane/Orozco**	**Craig Schlatter, Community Development Director** 463-6219 cschlatter@cityofukiah.com
Community Health Needs Assessment (CHNA) Steering Committee *assist in the creation of the 2025 CHNA Report for the communities served by the three Adventist Health hospitals in Mendocino County. providing insight, identifying, gathering and analyzing the health needs of our community. Additionally*	**Rodin/Sher**	**Jeremy Malin, NP** Director of Community Health Analytics Adventist Health Howard Memorial Adventist Health Ukiah Valley Adventist Health Mendocino Coast 978-289-3330; malinjr@ah.org
Parks & Recreation Special District Exploration	**Rodin/Orozco**	**Neil Davis, Community Services Director** 467-5764 ndavis@cityofukiah.com
Downtown Zoning code	**Crane/Rodin**	**Craig Schlatter, Community Development Director** 463-6219 cschlatter@cityofukiah.com
Tourism Advisory Committee	**Rodin/Sher**	**Shannon Riley, Deputy City Manager** 467-5793 sriley@cityofukiah.com
Historic Preservation Code	**Sher/Criss**	**Craig Schlatter, Community Development Director** 463-6219 cschlatter@cityofukiah.com
Fire Severity	**Rodin/Orozco**	**Craig Schlatter, Community Development Director** 463-6219 cschlatter@cityofukiah.com
CalPERS	**Crane/Orozco**	**Dan Buffalo, Director of Finance;** 463-6220 dbuffalo@cityofukiah.com
City Council Handbook Review and Update	**Sher**	**Kristine Lawler, City Clerk** 463-6217; klawler@cityofukiah.com

*Note: Changing the composition of an existing ad-hoc among current councilmembers after work has begun presents potential Brown Act issues. Requests for fully filled ad-hocs are represented on the draft, but staff does not recommend changes except to fill vacated assignments. The current requests on the sheet for fully composed ad-hocs are primarily intended to convey interest in topics covered by these ad-hoc committees for possible future consideration of new assignments.