AGENDA

1960 Elgin Street
Oroville, CA 95966
530-533-2000
www.loapud.com

Board of Directors
Special Meeting
July 22, 2021 – 3:00 PM

Materials related to an item on the open meeting agenda that are provided to the Board of Directors, including those provided to the Board after distribution of the agenda packet, are available on the District website.

During this difficult time, we invite you to join today's scheduled meeting via Zoom by using your phone or computer to attend this meeting. Please call our District office at **(530)533-2000** for assistance in participating in the teleconference.

Dial in: 1-669-900-9128
Meeting ID: 834 1565 3928
Passcode: 750842

To ensure that our meetings are as orderly as possible, and to enable public participation at the proper times during the meeting, we are asking that everyone take a moment to ensure your line stays muted until public comment is invited. When it comes time for public comment, we will leave enough time for participants to unmute and speak to the entire group and our Board. Because attendees cannot see each other's mute status, we will simply need to be patient as we wait in between comments, and do our best not to speak over each other. Please state your name for the record before sharing comments. We are committed to keeping the public engaged throughout this crisis and appreciate your help in making that happen.

1. **SALUTE TO THE FLAG OF THE UNITED STATES OF AMERICA**

2. **MOMENT OF SILENCE**

3. **ROLL CALL AND ACKNOWLEDGEMENT OF VISITORS**
   Individuals will be provided the opportunity to address the Board regarding matters NOT scheduled on the agenda. No action will be taken by the Board on these matters; however, the Board may ask questions for clarification and refer to staff or other resources for information and request staff reports at a subsequent meeting. Comments on items scheduled on the agenda may be made as they are considered by the Board.

4. **REQUEST APPROVAL OF IMPROVEMENT PLANS FOR THE OPHIR LINCOLN LIFT STATION AND FORCE MAIN AND CONSIDER THE EXECUTION OF THE DEVELOPMENT AGREEMENT AND THE REIMBURSEMENT AGREEMENT FOR OPHIR LINCOLN FORCE MAIN AND LIFT STATION**

   The Board will review and consider approving the Improvement Plans for Ophir Lincoln Lift Station and Force Main and consider the execution of the Development Agreement and the Reimbursement Agreement for Ophir Lincoln Force Main and Lift Station.

   DISCUSSION WITH POSSIBLE ACTION

REPORTS AND CONSULTATIONS

ADJOURNMENT

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT

Manager's Report

To: Board of Directors

From: Scott McCutcheon, General Manager

Date: July 22, 2021, 3:00 PM SPECIAL MEETING

RE: Item No. 1 – Salute To The Flag Of The United States

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT

Manager's Report

To: Board of Directors

From: Scott McCutcheon, General Manager

Date: July 22, 2021, 3:00 PM SPECIAL MEETING

RE: Item No. 2 – Moment Of Silence

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT

Manager's Report

To: Board of Directors

From: Scott McCutcheon, General Manager

Date: July 22, 2021, 3:00 PM SPECIAL MEETING

RE: Item No. 3 – Roll Call And Acknowledgment Of Visitors

Manager's Report

To: Board of Directors

From: Scott McCutcheon, General Manager

Date: July 22, 2021, 3:00 PM SPECIAL MEETING

RE: Item No.4 –Approval of Improvement Plans for Ophir Lincoln Lift Station and Force Main and Execution of Development Agreement, and Reimbursement Agreement for Ophir Lincoln Lift Station and Force Main

The project documents and developer agreement documents for the Ophir Lincoln Lift Station and Force Main project are being presented separately from the River Ranch Project due to time constraints. The plans have been completed by Sauers Engineering and have been reviewed and approved by the District Engineer, and General Manager. The plans are being presented to the Board of Directors with recommendation for approval and execution of the Reimbursement Agreement and Development Agreement for the project.

Attachment Included

Recommended Action: Approve and Authorize the District Engineer and the General Manager to Sign as 'Approved for Construction' the Improvement Plans for Ophir Lincoln Lift Station and Force Main and Authorize the President of the Board of Directors to Execute the Development Agreement and Reimbursement Agreement for Ophir Lincoln Lift Station and Force Main

DEVELOPMENT AGREEMENT
for
CONSTRUCTION OF
OPHIR LINCOLN FORCE MAIN AND LIFT STATION

THIS AGREEMENT, made and entered into this _____ day of_____, by and between LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT, a local public agency, hereinafter referred to as "District", and_____, hereinafter referred to as "Developer";

WITNESSETH:

WHEREAS, Developer is the owner, in fee, of that certain real property more particularly described in Exhibit A, attached, and located within Butte County, California; and,

WHEREAS, Developer intends to develop said property as more particularly shown on Exhibit "B", attached hereto and made a part hereof (the "Project"); and,

WHEREAS, District owns a sanitary sewer collection system which conveys wastewater from throughout District's service area to the regional wastewater treatment facility; and,

WHEREAS, the Project is, or will be, included within the District's service area; and,

WHEREAS, in order to carry out said Project, Developer will be required to construct a Project Sewer System, in accordance with plans and specifications approved by District, which construction, together with all necessary lands, easements, and rights of way therefore, is hereinafter called "the Sewer System"; and,

WHEREAS, Developer will, upon completion of construction of the Sewer System, dedicate and convey it to District for purposes of ownership, operation, and maintenance; and,

WHEREAS, in order to carry out the Project, Developer will be required to construct a sewer main extension, force main discharge piping, gravity sewer piping, lift station and improvements, and all appurtenances thereto, which together with all necessary lands, easements, and permits, are hereinafter called "the Regional Facility"; and,

WHEREAS, Developer will, upon satisfactory completion of construction of the Regional Facility, dedicate and convey it to District for purposes of ownership, operation, and maintenance; and,

WHEREAS, in order to construct the Regional Facility in a manner which will permit its dedication to and acceptance by District, District has caused its engineer to prepare complete plans and specifications for the design and construction of the Regional Facility in accordance with District's Improvement Standards, Board Policies, and the requirements and conditions hereinafter agreed upon; and,

WHEREAS, Developer desires District to enter into this Agreement providing for the design, construction, and upon satisfactory completion, acceptance of the Regional Facility into District's maintained wastewater collection system.

NOW, THEREFORE, District and Developer agree as follows:

1. **PLANS AND SPECIFICATIONS:** District has prepared and provided to Developer the plans and specifications for the Regional Facility. A copy of those plans and specifications are attached as Exhibit H.

2. **CONSTRUCTION:** Developer will construct the Regional Facility in accordance with District's plans and specifications and any revisions thereto.

3. **REVISION OF PLANS:** Any changes in the approved plans and specifications requested by Developer shall be submitted by Developer to District and shall not be incorporated into the construction of the Regional Facility without the written approval of the Manager and District Engineer. Construction of changes absent such approval may result in a requirement to remove and replace such facilities. Developer shall be responsible for funding, in advance, District's expenses incurred in review of any changes in the approved plans and specifications.

4. **LAND, EASEMENTS, PERMITS and RIGHTS OF WAY:** Regional Facility will be constructed on Parcel A as described in Exhibit E and shown in Exhibit F. Prior to acceptance of the Regional Facility by District, Developer will provide to District, at no cost to District and in a form reasonably acceptable to the Manager and District Engineer, all land, easements, permits, and rights of way necessary for the installation, maintenance and operation, repair or replacement of the Regional Facility. Improvements located within streets included within the county-maintained road system, under county permit or authorization, on terms acceptable to District, will not require deeded easements.

5. **CONSTRUCTION:** Developer shall, without expense to District, construct the Regional Facility pursuant to the approved plans or any approved modification thereof, and the District Improvement Standard and shall:

   a. Guarantees**:** Developer shall provide that all contractor's and material supplier's guarantees and warranties shall be assignable to and inure to the benefit of District.

b. Payment Bond. Before the commencement of work, Developer's contractor shall file a payment bond with District. The bond shall be in a sum not less than one hundred percent (100%) of the estimated cost of construction. The bond shall bind the contractor and its surety to the District. The bond shall conform in all respects to the requirements of Civil Code section 9550 and following.

c. Insurance. Developer shall also require that the contractor's public liability and property damage insurance names District and its agents, officers and employees as additional insured. Before the commencement of work, Developer's contractor shall present evidence of liability insurance meeting the requirements set forth in Exhibit D, attached hereto.

6. **COMPLIANCE WITH REQUIREMENTS FOR PUBLIC WORKS:**

a. This is a public work. Developer's Contractors, hereinafter "Contractor" and any subcontractors, are subject to the requirements of Chapter 1, Part 7 of the Labor Code, commencing with section 1720, pertaining to public works, and they are responsible for ascertaining and applying those requirements. Any person who willfully violates Article 2 of Chapter 1 is guilty of a misdemeanor. (Labor Code § 1777). All contractors and subcontractors working on this Project must keep certified payroll records in accordance with Labor Code section 1776.

b. At the time of the award, and at all times while performing the work, Contractor and any subcontractors shall be, and shall remain, registered and qualified to perform public work, pursuant to Labor Code sections 1725.5and 1771.1. This Agreement is subject to cancellation by District, and Contractor is subject to an assessment of penalties under section 1771.1, upon determination that Contractor or any subcontractor is not in compliance with the provisions of those sections.

This Project is subject to compliance monitoring and enforcement by the Department of Industrial Relations, as required by Labor Code section 1771.4. Contractor shall post job site notices, as prescribed by regulation. Contractor shall furnish the records specified in Labor Code section 1776 directly to the Labor Commissioner.

c. Not less than the general prevailing rate of per diem wages for work of a similar character in the locality in which the work is performed, and not less than the general prevailing rate of per diem wages for holiday and overtime work fixed as provided in Chapter 1, Part 7 of the Labor Code, shall be paid for each craft, classification, or type of worker needed to execute the Project work.

d. Copies of the prevailing rates of per diem wages are on file at District's office and shall be made available on request. Alternatively, said rates are accessible on

the INTERNET under the heading "General Prevailing Wage Determination made by the Director of Industrial Relations pursuant to California Labor Code Part 7, Chapter 1, Article 2, Sections 1770, 1773 and 1773.1". The Internet address is http://www.dir.ca.gov/**.**

e. A copy of the prevailing rate of per diem wages shall be posted at the worksite. Contractor, and any subcontractor under it, shall pay not less than the prevailing rates of wages to all workers employed in the execution of this Project work. Contractor, and any subcontractor under it, shall be subject to penalties under Labor Code section 1775 for paying less than the prevailing wage rates.

f. Contractor and any subcontractors shall keep accurate payroll records showing the name, address, social security number, work classification, straight time and overtime hours worked each day and week, and the actual per diem wages paid to each journeyman, apprentice, worker, or other employee employed by it in connection with the Project work, and shall certify and make those records available for inspection and otherwise comply with the provisions of Labor Code sections 1776 and 1812. Contractor's failure to comply is a misdemeanor, as provided in Labor Code section 1777.

g. Contractor shall be subject to the provisions of Labor Code section 1777.5 pertaining to the employment of apprentices. Contractor shall pay every apprentice employed in the execution of the Project work the prevailing rate of per diem wages for apprentices in the trade to which he or she is registered, and shall otherwise comply with the provisions of that section.

h. Contractor warrants that neither it nor any of its subcontractors is ineligible to work on public works projects pursuant to Section 1777.1 or 1777.7 of the Labor Code. Contractor is prohibited from performing the Project work with an ineligible subcontractor.

i. The time of service of any worker employed in the execution of the Project work is limited and restricted to eight (8) hours during any one (1) calendar day, and forty (40) hours during any one calendar week, except that work performed by Contractor 's or subcontractor's employees in excess of eight (8) hours per day, and forty (40) hours during any one week, shall be permitted upon compensation for all hours worked in excess of eight (8) hours per day at not less than one and one-half (1 ½) times the basic rate of pay, or at any higher rate of overtime pay that may be required pursuant to a Department of Industrial Relations prevailing wage determination. Contractor, or any subcontractor working under it, shall be subject to penalties under Labor Code section 1813 for violations of these limitations.

j. Contractor and its subcontractors shall not discriminate in the employment of

persons upon public works on any basis listed in subdivision (a) of Section 12940 of the Government Code, as those bases are defined in Sections 12926 and 12926.1 of the Government Code, except as otherwise provided in Section 12940 of the Government Code. Every contractor for public works who violates this section is subject to all the penalties imposed for a violation of this chapter.

k. Contractor shall secure the payment of worker's compensation to its employees performing the work, in accordance with the provisions of Sections 1860 and 3700 of the Labor Code and, in case any such work is sublet, the Contractor shall require its subcontractors similarly to comply with those provisions.

l. Developer shall ensure that any construction contract entered into by it shall require compliance with the requirements of California Labor Code, Division 2, Part 7, Chapter 1, commencing with Section 1720.

m. Pursuant to Labor Code section 1773.3, Developer shall provide notice to the Department of Industrial Relations of contracts awarded for the construction of improvements that will be conveyed to District under this Agreement within thirty (30) days of the award, but in no event later than the first day in which a contractor has workers employed upon the public work.

7. **INSPECTION OF CONSTRUCTION:** Throughout the course of construction, Manager, the District Engineer, or their designee may inspect the construction of the Regional Facility to ensure that the works are installed in accordance with the approved plans and specifications. Said inspection shall be funded by an Inspection Fee in the initial amount of **$20,000.00**. Said Fee shall be subject to redeposit and adjustment on a monthly basis per District Rules and Regulations, based on actual costs of inspection incurred. The Manager or District Engineer may notify Developer as to any deviation or failure to construct pursuant to the approved plans and specifications, and Developer shall correct such deviation or failure. Failure of the Manager or the District's Engineer to observe and/or to report such deviation shall not relieve Developer of the obligation to cure, at Developer's expense, all defects in material and workmanship and deviations from the approved plans and specifications.

8. **NO DUTY TO INSPECT:** Any inspections and observations of the work by District are for the sole purpose of providing notice of stage and character of the work. The District does not undertake any duty to Developer, Developer's contractor, or any other person to inspect construction, nor does it assume any liability for a failure to inspect. Any failure of District to discover defects in construction or to note variances in the work from the plans and specifications does not excuse Developer from complying with all terms of the plans and specifications. The fact that District inspects the construction of work and notifies Developer of deviations or failures to construct them pursuant to the approved plans and specifications shall not be deemed a representation or acknowledgment by District that the works have been built in accordance with therewith.

9. **INDEMNIFICATION:** Developer shall defend, indemnify, and hold District harmless against claims, actions, or liability for injury, damage, or loss to other persons, including Developer's employees and those of its contractors, and for violations of federal, state, or local law or regulation, arising out of or relating to (a) a breach by Developer of its obligations under this Agreement, (b) a failure of the Regional Facility to comply with the plans and specifications prepared by the District and be free from defect in workmanship or materials, and (c) the errors, acts and omissions of its contractors, including, without limitation, any claims relating to the foregoing matters for damages or penalties and actions for declaratory or injunctive relief. Notwithstanding the foregoing, the indemnification set forth in this paragraph shall not extend to claims that may be brought by District for a breach of the warranty provided by Developer under Section 11 below, and shall not serve to extend such warranty beyond the twelve (12) month Warranty Period described in Section 11 below. Developer's obligations under this section survive acceptance of the Regional Facility by District. They are not limited to or by the availability of liability insurance. Nothing in this section alters any limitations period for actions provided by statute

10. **CONVEYANCE:** Within ninety (90) days after completion of construction of the Regional Facility in accordance with this Agreement, the approved plans and specifications, and District's Improvement Standards:

    a. Developer shall offer to convey to District, by grant deed acceptable to District, fee title to Parcel A of River Ranch Subdivision Phase 1, as described in Exhibit E and shown on Exhibit F, attached.

    b. Developer shall offer to dedicate the completed works and associated lands, easements, permits, and rights of way to District without cost and free and clear of all liens and encumbrances, by Offer of Dedication attached as Exhibit C and such other documents of conveyance satisfactory to District. Conveyance by Developer shall not be complete, nor shall service from the Regional Facility be provided, until acceptance by the Board of Directors.

    c. Developer shall provide District with one set of 24"x 36" reproducible record drawings of the completed project, including street centerline station ties to house service line/main line connection points, on matte mylar (5 mil minimum);

    d. Developer shall furnish to District a bond, irrevocable letter of credit, cash deposit, or other form of surety meeting District's approval in the amount of TBD, being 25% of the actual cost of the Regional Facility (TBD) as determined by the District Engineer, protecting District against any failure of the work due to faulty materials, poor workmanship, or defective equipment, occurring within a period of one (1) year after acceptance of the Regional Facility by the District's Board of Directors. Any bond shall name Developer as Principal and District as Obligee.

e. District shall accept conveyance of title of the completed Regional Facility only by action of its Board and with such action will include the Regional Facility as part of its District's maintained system, and shall thereafter operate the Regional Facility, subject to Developer's duty to correct defects set forth herein. Provided, however, Developer's satisfactory completion the Sewer System, in accordance with District approved plans and specifications, and its conveyance thereof to the District, is a condition precedent to District's acceptance of the Regional Facility.

11. **CORRECTION OF DEFECTS IN MATERIAL AND WORKMANSHIP:**

a. Developer warrants that the Regional Facility will be constructed in accordance with plans and specifications and free of defects in material and workmanship, for a period of twelve (12) months following acceptance of the Regional Facility by District (the "Warranty Period"). Developer shall, without delay and upon notice from District, repair or replace, as required, all defects in materials or workmanship appearing during the Warranty Period. District may, at its option demand that Developer cure such defects at Developer's sole cost and expense with Developer's crews and equipment, or District may undertake such repairs and Developer shall reimburse District for the costs thereof within thirty (30) days of invoicing by District. Notwithstanding the twelve (12) month Warranty Period, and the term of the bond described in Paragraph 10(d) above, nothing herein will limit the otherwise applicable statute of limitations allowed under California Law related to actions by District for breach of this Agreement.

b. Developer will include, or cause to be included, in all contracts for the construction of the Regional Facility the warranty and correction period terms set forth in Engineers Joint Contract Documents Committee, Standard General Conditions of the Construction Contract (EJCDC C-700, Rev. 1), sections 7.17 (Contractor's General Warranty and Guarantee) and 15.08 (Correction Period) (the "Standard General Conditions"), or equivalent, for the benefit of both Developer and District. The contracts for construction of the Regional Facility must state, "As used in, and for the purposes of, the warranty and correction period Standard General Conditions, only, the term "Engineer" includes Lake Oroville Area Public Utility District's Engineer. Lake Oroville Area Public Utility District is expressly named as an intended third-party beneficiary of these warranty and correction period provisions." Developer will provide reasonable assistance to District in pursuing any warranty or call-back claims against any such contractor. Developer advises District that the warranty provided by such contractors will exclude damage or defects caused by abuse or modifications to equipment by the District and not authorized by the contractor, improper or insufficient maintenance, improper operation, or normal wear and tear, and will state that testing will not be construed as operation.

12. **APPLICATION FOR SEWERAGE SERVICE:** No sewage shall be delivered to or conveyed by or through the Regional Facility, other than for testing purposes, until (i) the Regional Facility is conveyed to District and formally accepted by District as specified in Paragraph 9, above, and, (ii) proper applications for sewer service have been filed with and accepted by District.

13. **OBLIGATION FOR PIPELINE AND/OR FACILITIES:** District shall be under no obligation to provide additional pipelines and/or facilities in order to serve the Project. Upon acceptance of the Regional Facility by District, it shall become the sole property of District and shall be used and operated at District's sole discretion.

14. **RESPONSIBILITY FOR RATES, FEES AND CHARGES FOR SERVICE:** All sanitary sewer service made available by District to users of the Sewer System shall be at the established rates and charges as fixed by District's Board of Directors from time to time, including all applicable connection fees and capacity charges, periodic service charges, and surcharges required to retire the loan to the District made by the USDA Rural Development. Prior to connecting any residential structure or other structure requiring wastewater discharge to the Sewer System, payment of District's Sewer Connection Fee ($200/EDU or the prevailing rate at time of connection), District's Capacity Charge ($4,777/EDU or the prevailing rate at the time of connection) and Sewage Commission Oroville Region's (SC-OR) Regional Facility Charge ($6,638/EDU or prevailing rate at time of connection) shall be made.

15. **NOTICES:** Notices or requests from any party to this Agreement to the remaining parties thereof shall be in writing and delivered or mailed, postage prepaid, to the following addresses:

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
1960 Elgin Street
Oroville, California 95966
Attention: Scott McCutcheon, General Manager

DEVELOPER
River Ranch Oroville LLC
2998 Douglas Blvd., Suite 125
Roseville, CA 95661

16. **SUCCESSORS AND ASSIGNS:** This Agreement shall be binding upon and inure to the benefit of the successors and assigns of both parties. Developer shall not assign any of his rights, duties or obligations under this Agreement without the prior written consent of District, which consent shall not be unreasonably withheld.

17. **DISTRICT POWERS:** Nothing in this Agreement shall be deemed to limit, restrict, or modify any right, duty, or obligation given, granted, or imposed upon District by the laws of

the State of California now in effect, or hereafter adopted, nor to limit or restrict the power or authority of District, including the enactment of any rules, regulations, resolutions or ordinances, and in the event that any part of provision of this Agreement, be found to be illegal or unconstitutional by a court of competent jurisdiction, such findings shall not affect the remaining parts, portions, or provisions hereof.

18. **TERMINATION:** District may, in its sole discretion, terminate this Agreement if District determines that construction of the Regional Facility has not commenced within twelve (12) months from the date of this Agreement, or if the work is not completed within thirty-six (36) months of the date of this Agreement. Developer shall be solely responsible to request extension of said twelve (12) and [insert] month periods, the grant of which shall be in the sole discretion of the Board. Termination of the Agreement does not relieve Developer of its obligation to pay District's expenses incurred in the review and approval of plans and specifications or the inspection of the work.

19. **REIMBURSEMENT AGREEMENT:** Concurrently herewith, District and Developer enter into a Reimbursement Agreement, a copy of which is attached hereto as Exhibit G and the terms of which are incorporated herein.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement on the day and year first above written.

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT:

_____
By: President

ATTEST:

_____
By: General Manager

DEVELOPER:

RIVER RANCH OROVILLE LLC,
a California limited liability company

By: W&R Wedgewood Apartments,
a California corporation,
its Manager

By: _____
Name: _____
Title: _____

EXHIBIT A

LEGAL DESCRIPTION OF THE PROPERTY

Real property in the unincorporated area of the County of Butte, State of California, described as follows:

THE NORTHEAST QUARTER OF SECTION 32, TOWNSHIP 19 NORTH, RANGE 4 EAST, M.D.B. & M.

EXCEPTING THEREFROM THE NORTH 660 FEET THEREOF AND THE SOUTH 1100 FEET THEREOF.

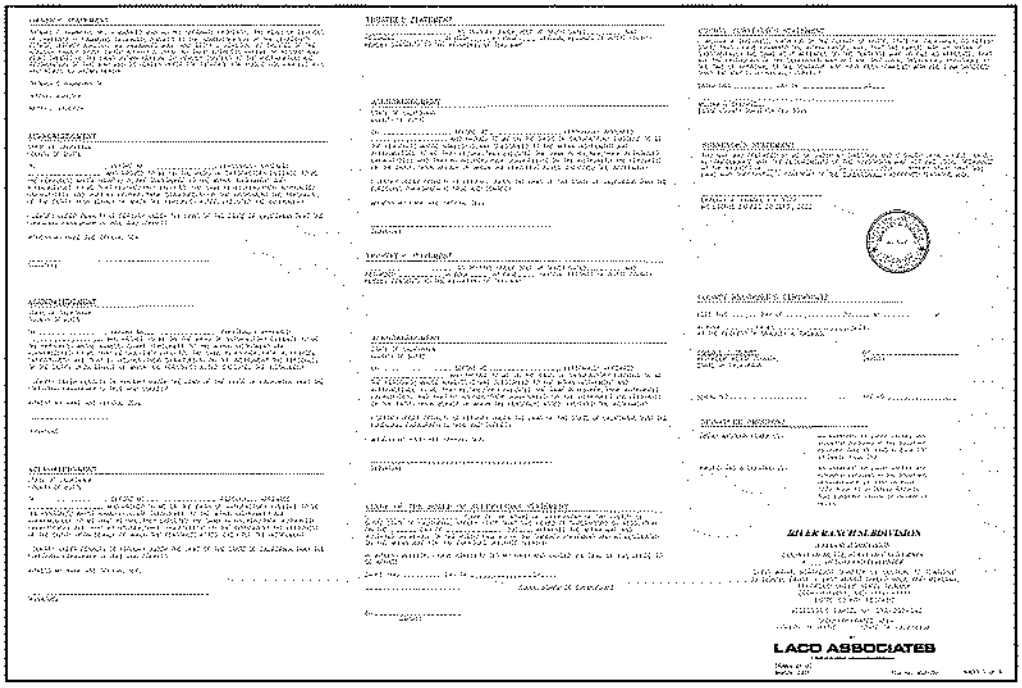
ALSO EXCEPTING THEREFROM THE FOLLOWING DESCRIBED PARCEL OF LAND, AS CONVEYED TO THE COUNTY OF BUTTE BY GRANT DEED, RECORDED AUGUST 30, 1982, IN BOOK 2751, PAGE 299, OFFICIAL RECORDS:

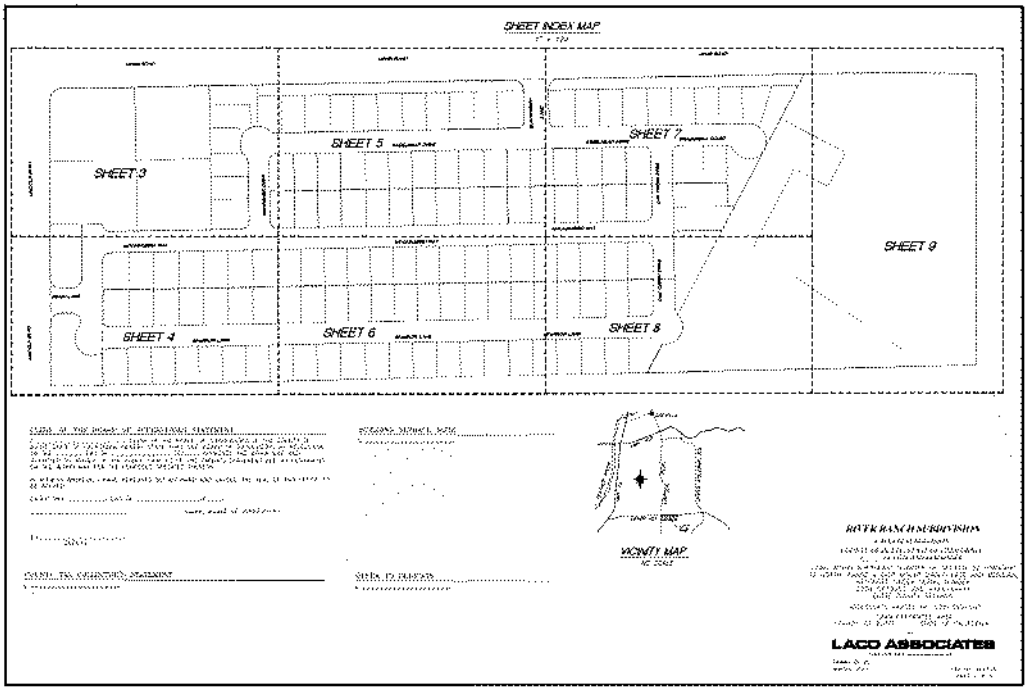
BEGINNING AT A POINT ON THE EAST LINE OF SECTION 32, FROM WHICH THE NORTHEAST CORNER OF SAID SECTION 32 BEARS NORTH 00 DEG. 01' 29" WEST, 660.10 FEET; THENCE FROM THE POINT OF BEGINNING, SOUTH 88 DEG. 58' 03" WEST, 2670.72 FEET TO A POINT IN THE CENTERLINE OF LINCOLN BLVD.; THENCE SOUTHERLY ALONG SAID CENTERLINE OF LINCOLN BLVD., SOUTH 00 DEG. 04' 44" EAST, 894.80 FEET; THENCE LEAVING SAID CENTERLINE NORTH 88 DEG. 41' 30" EAST, 40.01 FEET; THENCE NORTH 00 DEG. 04' 44" WEST, 820.87 FEET; THENCE ALONG A TANGENT CURVE CONCAVE SOUTHEASTERLY HAVING A RADIUS OF 30 FEET, A CENTRAL ANGLE OF 88 DEG. 57' 12" THE ARC LENGTH OF WHICH IS 46.58 FEET; THENCE NORTH 88 DEG. 52' 28" EAST, 2601.28 FEET TO THE EAST LINE OF SAID SECTION 32; THENCE NORTHERLY ALONG SAID EAST LINE NORTH 00 DEG. 01' 29" WEST, 40.01 FEET TO THE POINT OF BEGINNING.

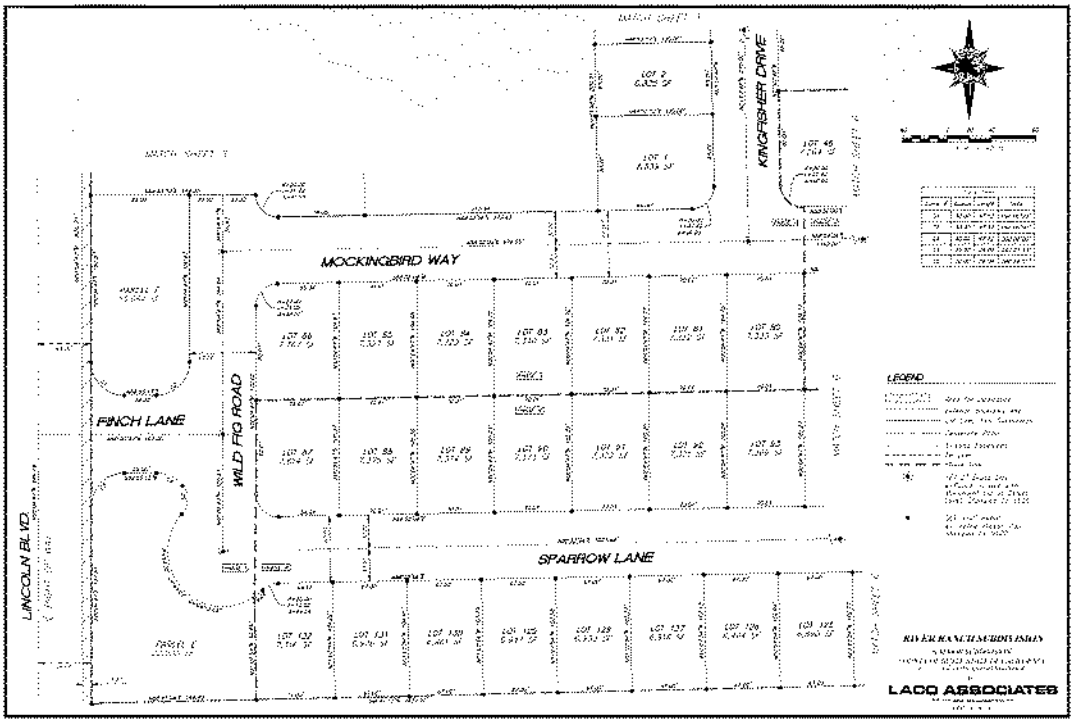
APN: 078-090-043 and 078-090-044

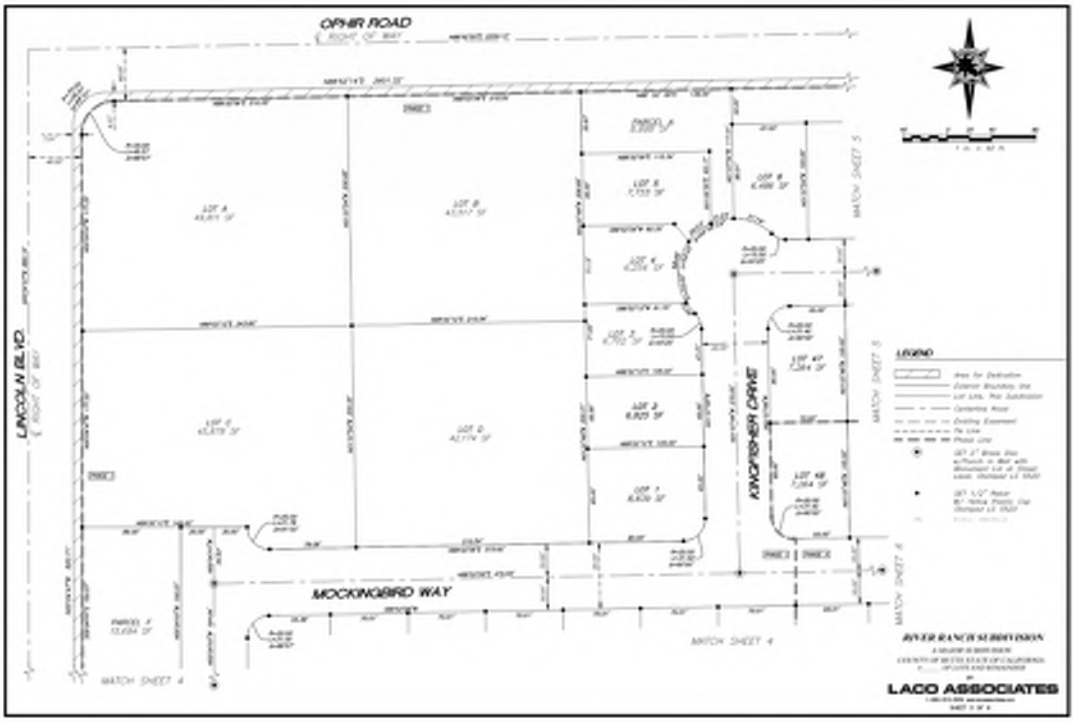
EXHIBIT B

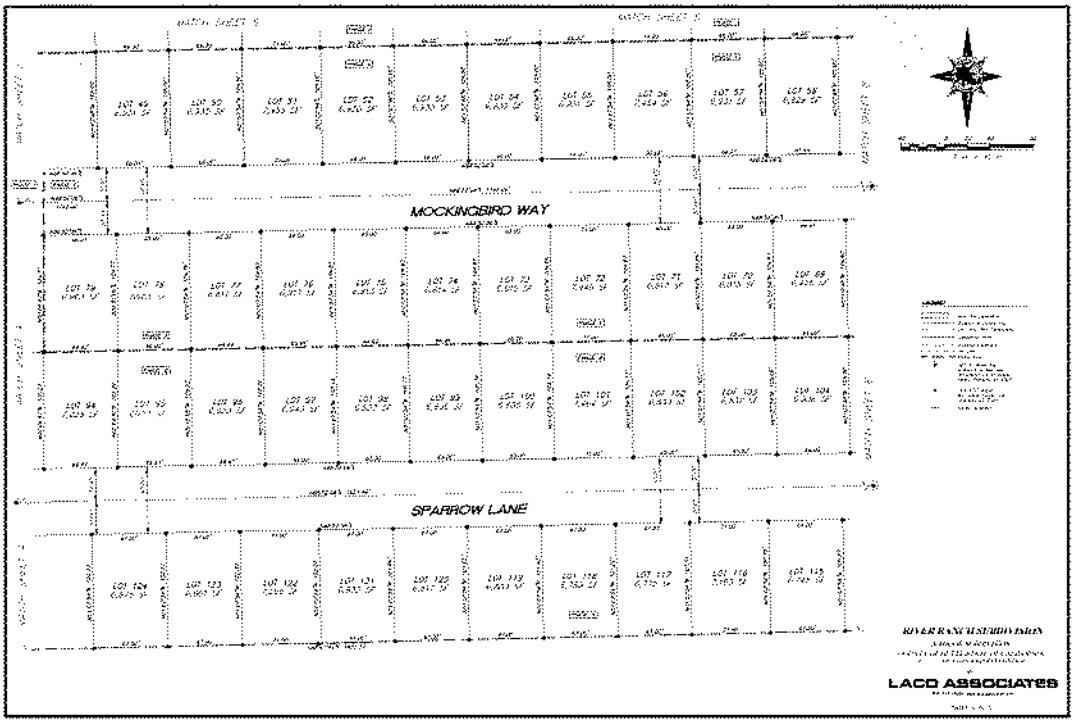
DEPICTION OF THE PROJECT

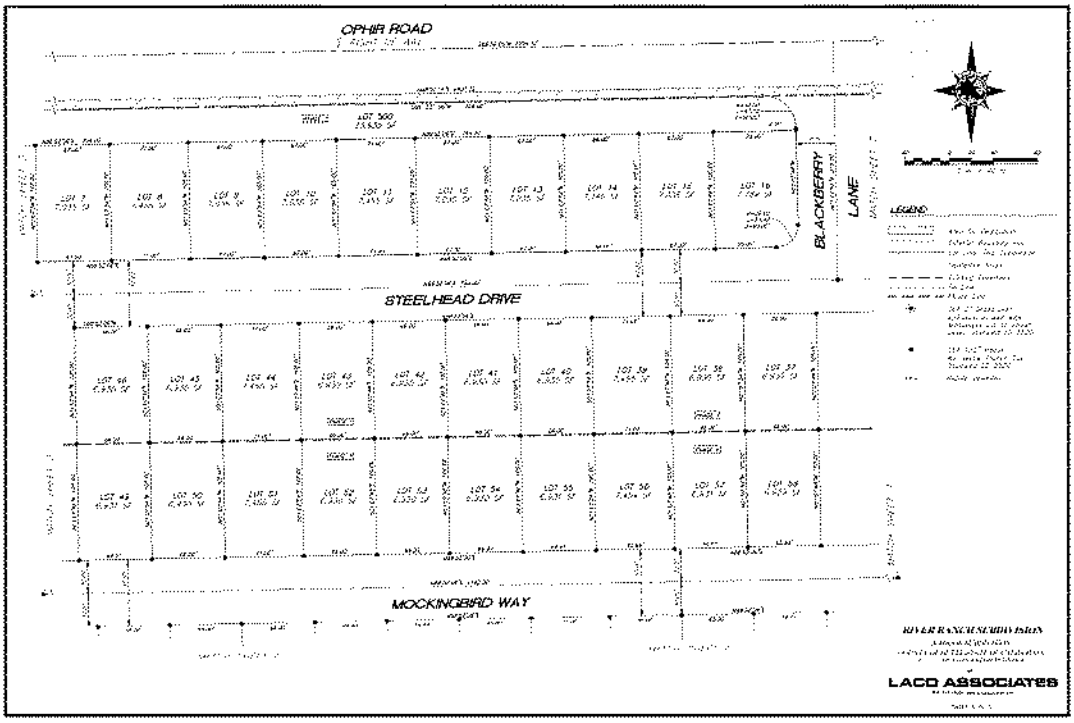


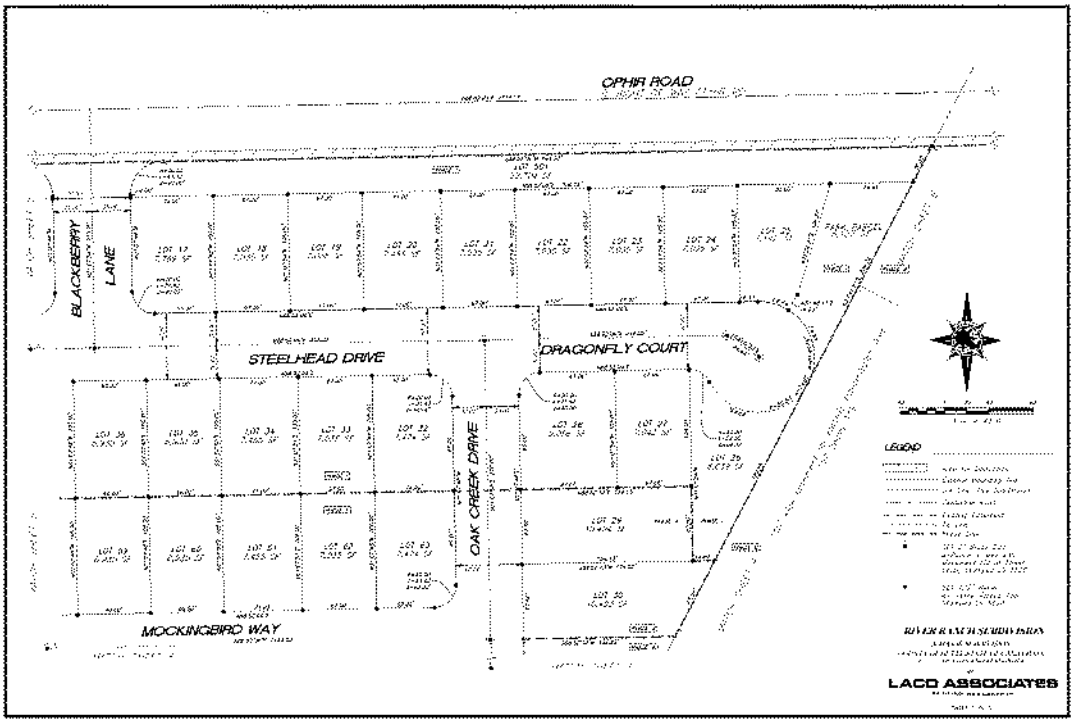


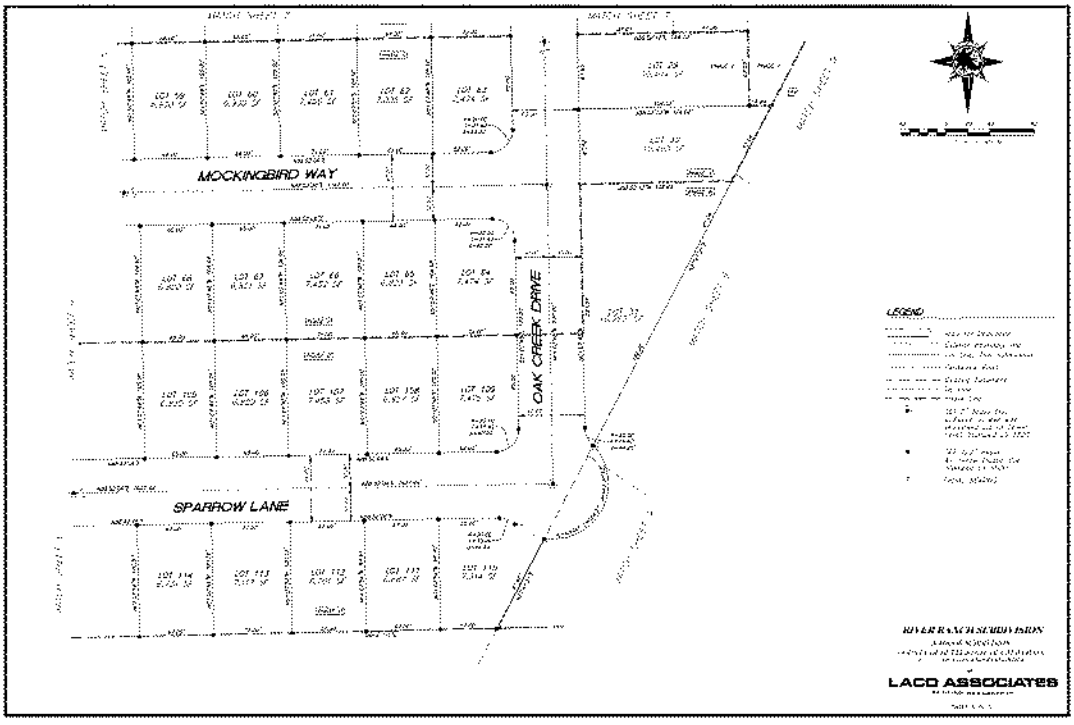

KINGFISHER DRIVE
MOCKINGBIRD WAY
FINCH LANE
WILD FIG ROAD
LINCOLN BLVD.
SPARROW LANE
LEGEND
LACO ASSOCIATES


ORNER ROAD
LINCOLN BLVD.
KINGFISHER DRIVE
MOCKINGBIRD WAY
LEGEND
LACO ASSOCIATES


MOCKINGBIRD WAY
SPARROW LANE
RIVER RANCH SUBDIVISION
LACO ASSOCIATES


OPHIR ROAD
BLACKBERRY LANE
STEELHEAD DRIVE
MOCKINGBIRD WAY
RIVER RANCH SUBDIVISION
LACO ASSOCIATES


OPHIR ROAD
BLACKBERRY LANE
STEELHEAD DRIVE
DRAGONFLY COURT
OAK CREEK DRIVE
MOCKINGBIRD WAY
LEGEND
RIVER RANCH SUBDIVISION
LACO ASSOCIATES


MOCKINGBIRD WAY
OAK CREEK DRIVE
SPARROW LANE
LEGEND
RIVER RANCH SUBDIVISION
LACO ASSOCIATES

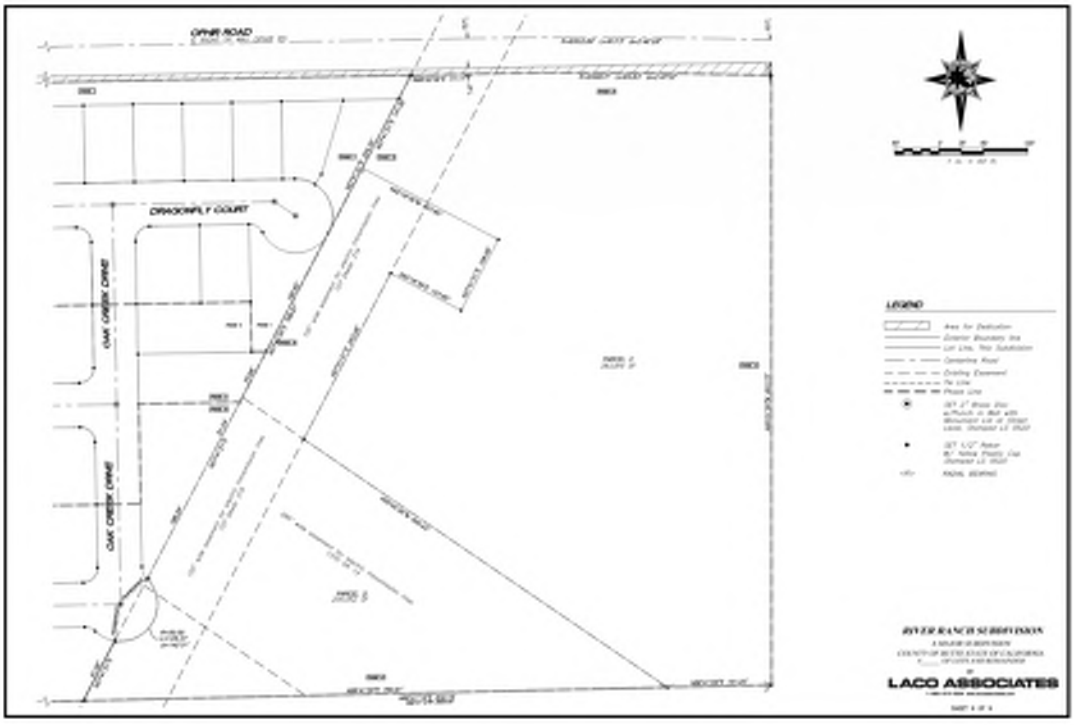

OPAH ROAD
DRAGONFLY COURT
OAK CREEK DRIVE
OAK CREEK DRIVE
LEGEND
RIVER RANCH SUBDIVISION
LACO ASSOCIATES

EXHIBIT "C"

OFFER OF DEDICATION

TO: LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
1960 Elgin Street
Oroville, California 95966

I/We hereby offer to convey, transfer and dedicate all right, title and interest in and to that certain Regional Facility including sewer main extension, force main discharge piping, gravity sewer piping, lift station and improvements, and all appurtenances thereto together with all necessary lands, easements, and permits age system and appurtenances, including all necessary rights of access and easements required for District to have unrestricted right and access to own, operate, maintain, repair and replace said system, as described in the Development Agreement for Construction of Ophir Lincoln Force Main and Lift Station said system and appurtenances more particularly described in Exhibit "B", attached to the Development Agreement by and between Lake Oroville Area Public Utility District and_____, for _____ _____dated _____ , a copy of which is on file in the District office located at the address noted above; to Lake Oroville Area Public Utility District.

The undersigned further warrant to said District that the Regional Facility is free and clear of all liens, encumbrances and other expenses and that it has been constructed in accordance with the Plans and Specifications approved by the District and is free of defect in workmanship and materials.

Dated: _____

DEVELOPER/OWNERS:

By:_____
for Developer

EXHIBIT "D"

INSURANCE REQUIREMENTS

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 and the results of that work by the Contractor, its agents, representatives, employees or subcontractors.

MINIMUM SCOPE AND LIMIT OF INSURANCE

Coverage shall be at least as broad as:

1. **Commercial General Liability (CGL):** Insurance Services Office Form CG 00 01 covering CGL on an "occurrence" basis, including products and completed operations, property damage, bodily injury and personal & advertising injury with limits no less than
   $2,000,000 per occurrence. If a general aggregate limit applies, either the general aggregate limit shall apply separately to this project/location (ISO CG 25 03 or 25 04) or the general aggregate limit shall be twice the required occurrence limit.
2. **Automobile Liability:** ISO Form Number CA 00 01 covering any auto (Code 1), or if Contractor has no owned autos, hired, (Code 8) and non-owned autos (Code 9), with limit no less than **$1,000,000** per accident for bodily injury and property damage.
3. **Workers' Compensation:** as required by the State of California, with Statutory Limits, and Employer's Liability Insurance with limit of no less than **$1,000,000** per accident for bodily injury or disease.

If the Contractor maintains broader coverage and/or higher limits than the minimums shown above, Lake Oroville Area Public Utility District ("District") requires and shall be entitled to the broader coverage and/or the higher limits maintained by the Contractor. Any available insurance proceeds in excess of the specified minimum limits of insurance and coverage shall be available to the District.

Other Insurance Provisions

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

Additional Insured Status

The District, its officers, officials, employees, and volunteers are to be covered as additional insureds on the CGL policy 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 (at least as broad as ISO Form CG 20 10 11 85 or if not available, through the addition of **both** CG 20 10, CG 20 26, CG 20 33, or CG 20 38; **and** CG 20 37 if a later edition is used).

Primary Coverage

Contractor's insurance coverage shall be primary coverage at least as broad as ISO CG 20 01 04 13 as respects the District, its officers, official employees, and volunteers. Any insurance or self-insurance

maintained by the District, its officers, officials, employees, or volunteers shall be excess of the Contractor's insurance and shall not contribute with it.

Notice of Cancellation

Each insurance policy required above shall provide that coverage shall not be canceled, except with notice to the District.

Waiver of Subrogation

Contractor hereby grants to District a waiver of any right to subrogation which any insurer of said Contractor may acquire against the District by virtue of the payment of any loss under such insurance. Contractor agrees to obtain any endorsement that may be necessary to affect this waiver of subrogation, but this provision applies regardless of whether or not the District has received a waiver of subrogation endorsement from the insurer.

Self-Insured Retentions

Self-insured retentions must be declared to and approved by the District. The District may require the Contractor to purchase coverage with a lower retention or provide proof of ability to pay losses and related investigations, claim administration, and defense expenses within the retention. The policy language shall provide, or be endorsed to provide, that the self-insured retention may be satisfied by either the named insured or District.

Acceptability of Insurers

Insurance is to be placed with insurers authorized to conduct business in the state with a current A.M. Best's rating of no less than A:VII, unless otherwise acceptable to the District.

Verification of Coverage

Contractor shall furnish the District with original Certificates of Insurance including all required amendatory endorsements (or copies of the applicable policy language effecting coverage required by this clause) and a copy of the Declarations and Endorsement Page of the CGL policy listing all policy endorsements to District before work begins. However, failure to obtain the required documents prior to the work beginning shall not waive the Contractor's obligation to provide them. The District reserves the right to require complete, certified copies of all required insurance policies, including endorsements required by these specifications, at any time.

Renewal

If any of the required coverages expire during the term of this agreement, the Contractor shall deliver the renewal certificate(s) including the general liability additional insured endorsement to the Lake Oroville Area Public Utility District at least ten (10) days prior to the expiration date.

Signature of Contractor’s Authorized Official:

_____

EXHIBIT E

LEGAL DESCRIPTION OF PARCEL 'A'

EXHIBIT "A"

Legal Description

All that certain real property situated in the unincorporated area of the County of Butte, State of California, and being a portion of the Northeast one quarter of Section 32, Township 19 North, Range 4 East, Mount Diablo Base and Meridian being more particularly described as follows:

Parcel "A" of the River Ranch Subdivision Phase I, as delineated on Garden Oaks Subdivision Map TSM18-0003 as filed in the Office of the Recorder of the County of Butte in Book_____ of Maps, at Pages _____.

Prepared by,

Bradley A. Thomas, PLS 5520
My License Expires: 9/30/2022
File No. 9627.00
16 June 2021

EXHIBIT F

DEPICTION OF PARCEL 'A

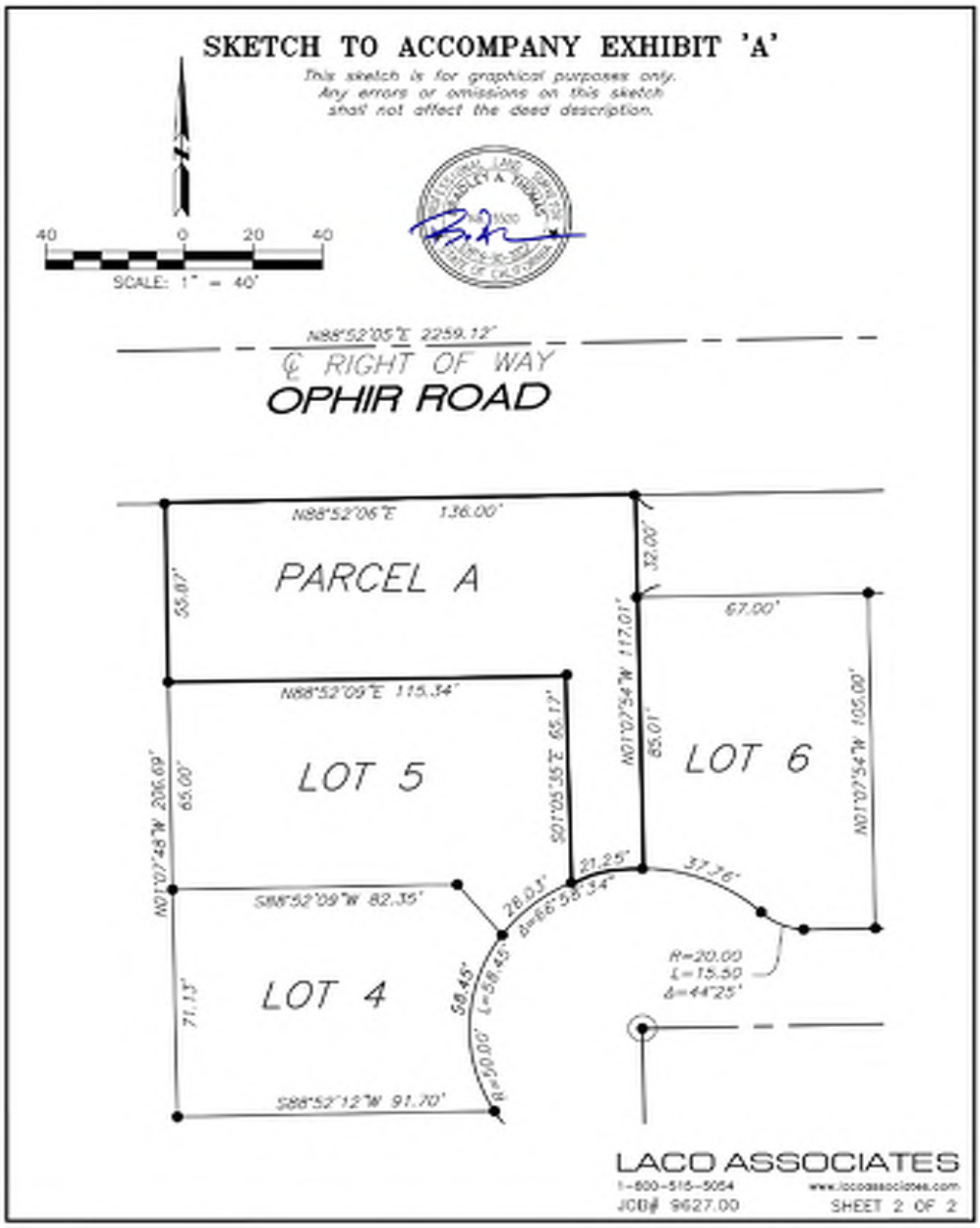


EXHIBIT G

REIMBURSEMENT AGREEMENT

EXHIBIT G Regional Facility-Reimbursement Agreement 7-20-21.pdf-10 Pages

EXHIBIT G

Recording requested by: Lake Oroville Area Public Utility District **After Recording Return to:** Lake Oroville Area Public Utility District 1960 Elgin Street Oroville CA 95966	
	(SPACE ABOVE THIS LINE RESERVED FOR RECORDER

REIMBURSEMENT AGREEMENT BETWEEN
LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
And
RIVER RANCH OROVILLE LLC
For Ophir Lincoln Lift Station and Force Main (Regional Facility]

THIS AGREEMENT, made and entered into this _____ day of_____, by and between LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT, a local public agency of the State of California, hereinafter referred to as "District", and _____, hereinafter referred to as "Developer".

WITNESSETH

WHEREAS, Developer is the owner, in fee, of that certain real property more particularly described in Exhibit “A”, attached, and located within Butte County, California; and,

WHEREAS, Developer intends to develop said property as more particularly shown on Exhibit "B", attached hereto and made a part hereof (the “Project”); and,

WHEREAS, Developer and District have, on the date of this Agreement, made a separate agreement titled ‘Development Agreement for Construction of Ophir Lincoln Lift Station and Force Main’ (the Regional Facility), the terms of which are incorporated herein; and,

WHEREAS, the Regional Facility will have not only the capacity to provide service to Developer’s Project, but also the capacity to provide service to persons outside of the Project who hereafter apply to District for sewer service and who are determined by District to benefit from the Regional Facility (Other Persons); and,

WHEREAS, Developer and District desire to enter into an agreement for reimbursement to Developer for a portion of its cost to construct the Regional Facility, on the terms set forth below.

NOW, THEREFORE, District and Developer agree as follows:

1. The Effective Date of this Agreement is the date of acceptance of the Regional Facility by District, in accordance with the terms of the Development Agreement, or two years after the date that this Agreement is made and entered, whichever first occurs.

2. The Term of this Agreement is ten years. The Term will commence on the Effective Date and end ten years thereafter. The Term will not be extended for any reason, including the occurrence of a force majeure, absent the express, written agreement of District and Developer.

3. Upon acceptance of the Regional Facility by District, as provided in the Development Agreement, and provided that Developer has satisfactorily performed all of its obligations under the Development Agreement, District will pay to Developer the sum of **two hundred and fifty thousand dollars and zero cents ($250,000.00)**.

4. Upon acceptance of the Regional Facility by District, and for the balance of the Term of this Agreement, District will impose on Other Persons a Reimbursement Fee in the amount of **one thousand four hundred sixty-five dollars and eleven cents ($1,465.11)** per Equivalent Dwelling Unit. The Reimbursement Fee will be due and payable by Other Persons prior to connecting a residential structure or other structure requiring wastewater discharge to the Regional Facility.

5. District will make reasonable effort to collect Reimbursement Fees from Other Persons. It is not required to initiate or defend legal action, to place or enforce liens, or to take other extraordinary action for collection purposes. The collected fees, **less 10% for District administrative costs,** will be remitted to Developer annually, on each anniversary of the Effective Date, during the Term of this Agreement.

6. The maximum total Reimbursement Fees payable to Developer is **one million seven hundred fourteen thousand one hundred and seventy-nine dollars and seventy cents ($1,714,179.70).**

7. The District's payment provided for in section 4, the Reimbursement Fee provided for in section 5, and total Reimbursement Fee provided for in section 6 each assume a total Regional Facility construction cost in the amount of **two million three hundred fifty-nine thousand seven hundred and sixty dollars and zero cents ($2,359,760.00)**. Upon completion of the Regional Facility, Developer shall provide District satisfactory evidence of the actual cost of construction. If the actual cost construction is less than **two million three hundred fifty-nine thousand seven hundred and sixty dollars and zero cents ($2,359,760.00)**, the payments provided for in sections 4, 5, and 6 will be reduced by a percentage equal to the percentage reduction in construction cost. Overpayments will be refunded or credited to District.

8. Except as provided in paragraph 3, above, nothing in this Agreement requires District to pay Developer unless or until Reimbursement Fees are collected by District.

9. Nothing in this Agreement limits District's discretion to deny or condition sewer service for Other Persons or to determine the facilities to be used in serving current customers or future applicants for sewer service.

10. Developer shall defend and indemnify District from any and all claims, causes of action demands and charges (Claims) by third parties, including but not limited to Claims by any public agency, Claims made by applicants for sewer service, arising directly or indirectly out of the construction of the Project or the Regional Facility, or the administration of this Agreement, and any actions for declaratory or injunctive relief challenging the construction of the Project or the Regional Facility, or the administration of this Agreement.

11. Each of the parties to this Agreement has had an equal opportunity to review this Agreement and, if desired, to consult with legal counsel. Therefore, the usual construction of agreements under California law, where an agreement is construed against the party drafting the agreement, shall not apply to this Agreement.

12. Each and every provision of this Agreement shall be binding upon and shall inure to the benefit of the respective successors and assigns of the parties, in the same manner as if such parties had been expressly named herein.

13. Notices or requests from any party to this Agreement to the remaining parties thereof shall be in writing and delivered or mailed, postage prepaid, to the following addresses:

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
1960 Elgin Street
Oroville, California 95966
Attention: Scott McCutcheon, General Manager

DEVELOPER
River Ranch Oroville LLC
2998 Douglas Blvd., Suite 125
Roseville, CA 95661

14. Failure by a party to insist upon strict performance of any of the provisions of this Agreement by the other party, or the failure of a party to exercise its rights upon the default of the other party, shall not constitute a waiver of such rights.

15. The parties entering into this Agreement do not intend to create any agency, partnership, joint venture, trust, or other relationship with duties or incidents different from those of parties to an arms-length contract.

16. This Agreement shall be construed in accordance with and governed by the laws of the State of California. Any actions brought to enforce any provisions of this Agreement shall be brought in Butte County.

17. This Agreement shall be recorded with the Butte County Recorder.

18. The Recitals set forth at the beginning of this Agreement are incorporated into this Agreement as if fully set forth herein.

19. This Agreement, including the Development Agreement attached as Exhibit C, constitutes the entire understanding of the parties regarding the subject matter. The Agreement may be amended only by writing executed by both parties.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement on the day and year first above written.

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT:

_____
By: President

ATTEST:

_____
By: General Manager

DEVELOPER:

RIVER RANCH OROVILLE LLC,
a California limited liability company

By: W&R Wedgewood Apartments,
a California corporation,
its Manager

By: _____
Name: _____
Title: _____

EXHIBIT A

LEGAL DESCRIPTION OF THE PROPERTY

Real property in the unincorporated area of the County of Butte, State of California, described as follows:

THE NORTHEAST QUARTER OF SECTION 32, TOWNSHIP 19 NORTH, RANGE 4 EAST, M.D.B. & M.

EXCEPTING THEREFROM THE NORTH 660 FEET THEREOF AND THE SOUTH 1100 FEET THEREOF.

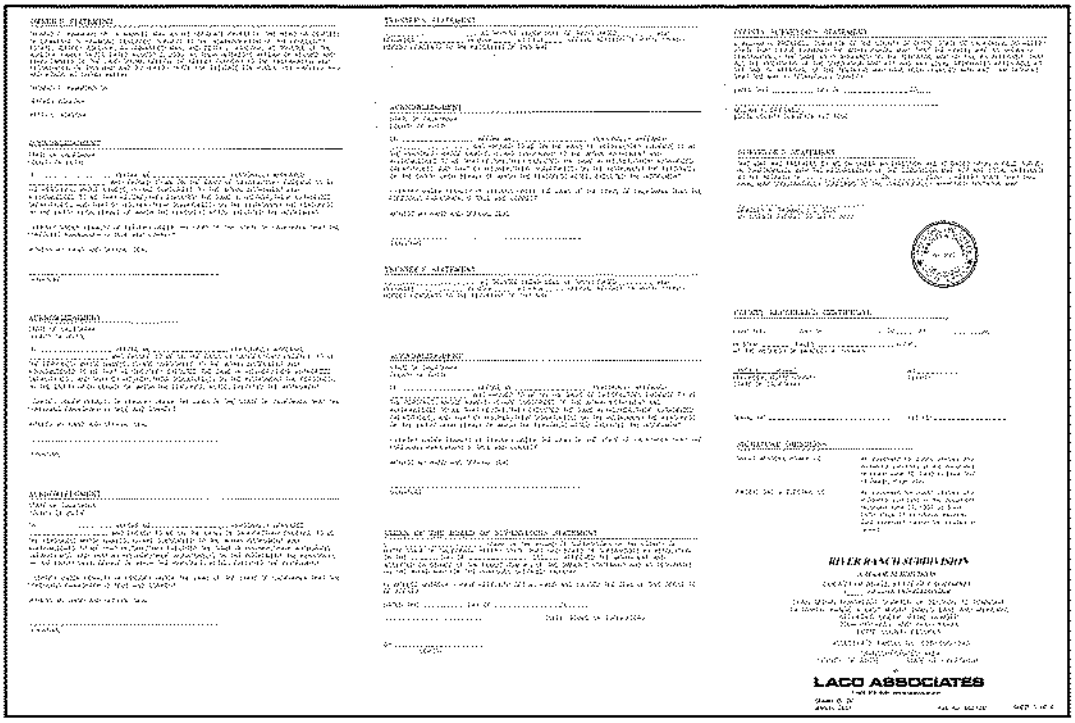
ALSO EXCEPTING THEREFROM THE FOLLOWING DESCRIBED PARCEL OF LAND, AS CONVEYED TO THE
COUNTY OF BUTTE BY GRANT DEED, RECORDED AUGUST 30, 1982, IN BOOK 2751, PAGE 299,
OFFICIAL RECORDS:

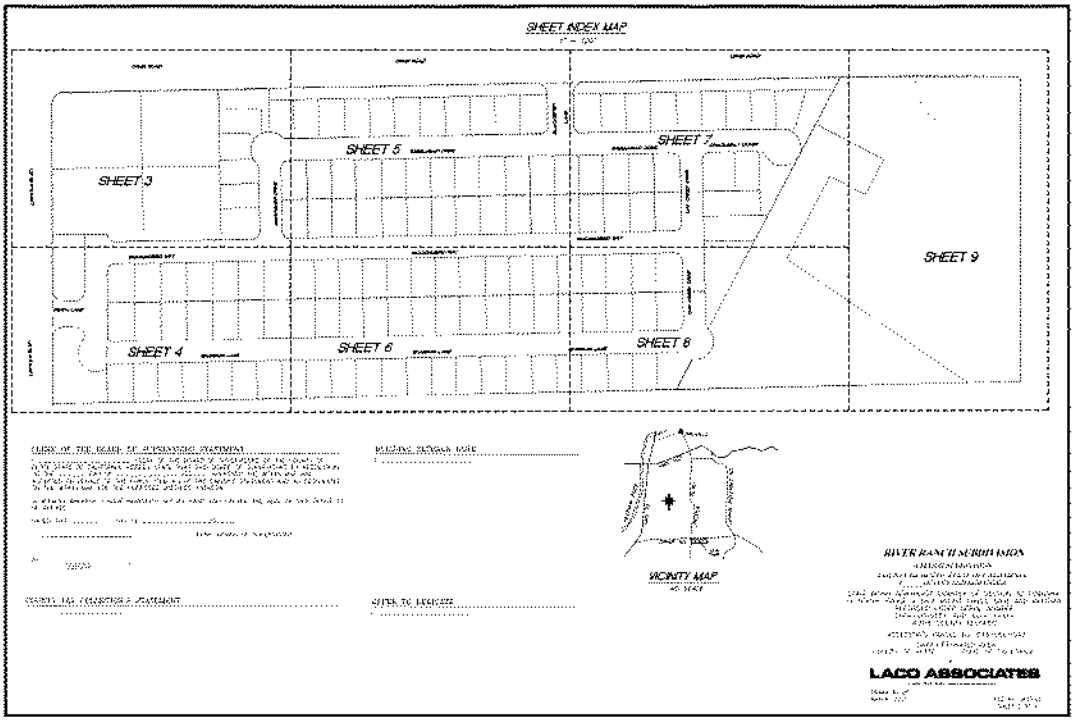
BEGINNING AT A POINT ON THE EAST LINE OF SECTION 32, FROM WHICH THE NORTHEAST CORNER
OF SAID SECTION 32 BEARS NORTH 00 DEG. 01' 29" WEST, 660.10 FEET; THENCE FROM THE POINT
OF BEGINNING, SOUTH 88 DEG. 58' 03" WEST, 2670.72 FEET TO A POINT IN THE CENTERLINE OF
LINCOLN BLVD.; THENCE SOUTHERLY ALONG SAID CENTERLINE OF LINCOLN BLVD., SOUTH 00 DEG.
04' 44" EAST, 894.80 FEET; THENCE LEAVING SAID CENTERLINE NORTH 88 DEG. 41' 30" EAST, 40.01
FEET; THENCE NORTH 00 DEG. 04' 44" WEST, 820.87 FEET; THENCE ALONG A TANGENT CURVE
CONCAVE SOUTHEASTERLY HAVING A RADIUS OF 30 FEET, A CENTRAL ANGLE OF 88 DEG. 57' 12" THE
ARC LENGTH OF WHICH IS 46.58 FEET; THENCE NORTH 88 DEG. 52' 28" EAST, 2601.28 FEET TO THE
EAST LINE OF SAID SECTION 32; THENCE NORTHERLY ALONG SAID EAST LINE NORTH 00 DEG. 01' 29"
WEST, 40.01 FEET TO THE POINT OF BEGINNING.

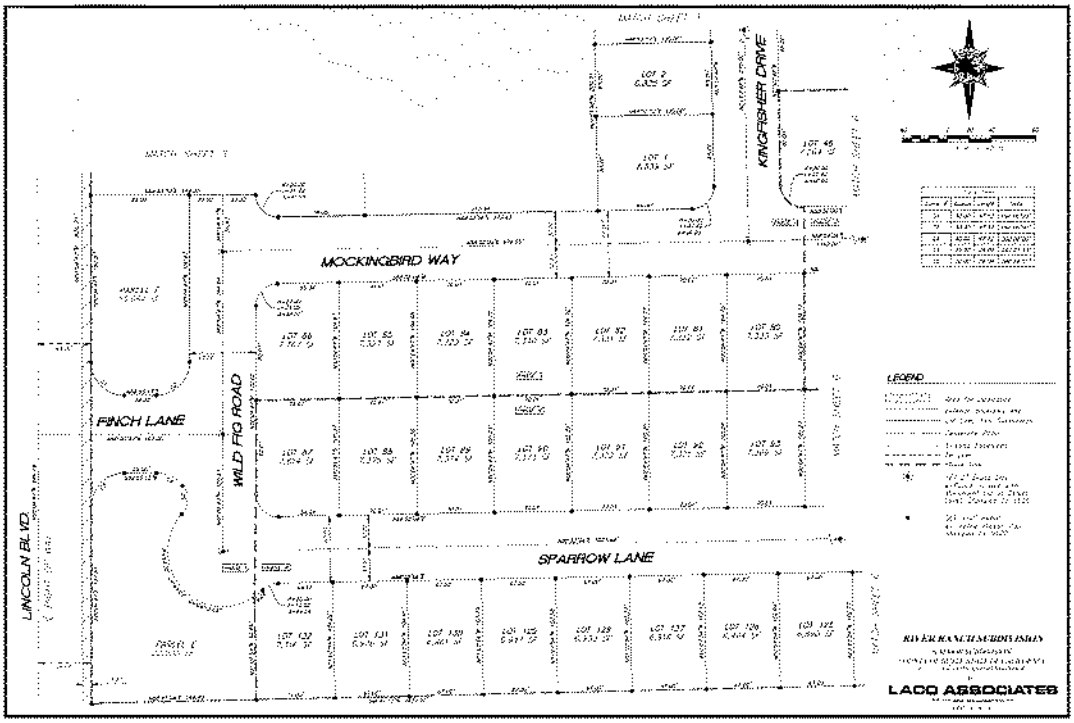
APN: 078-090-043 and 078-090-044

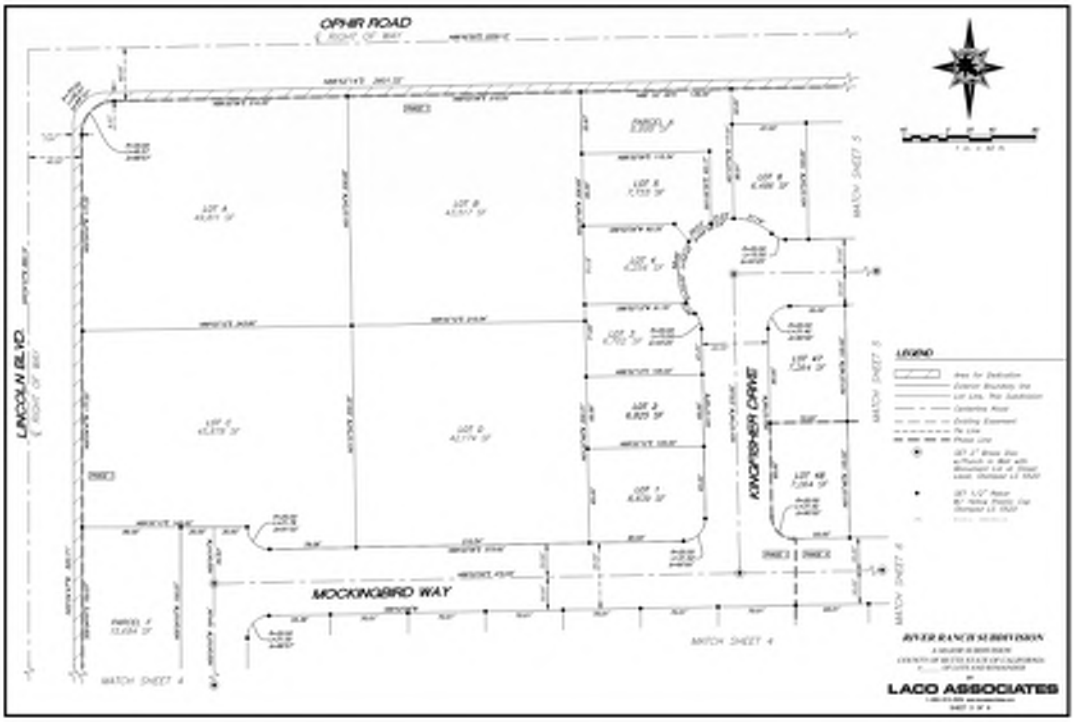
EXHIBIT B

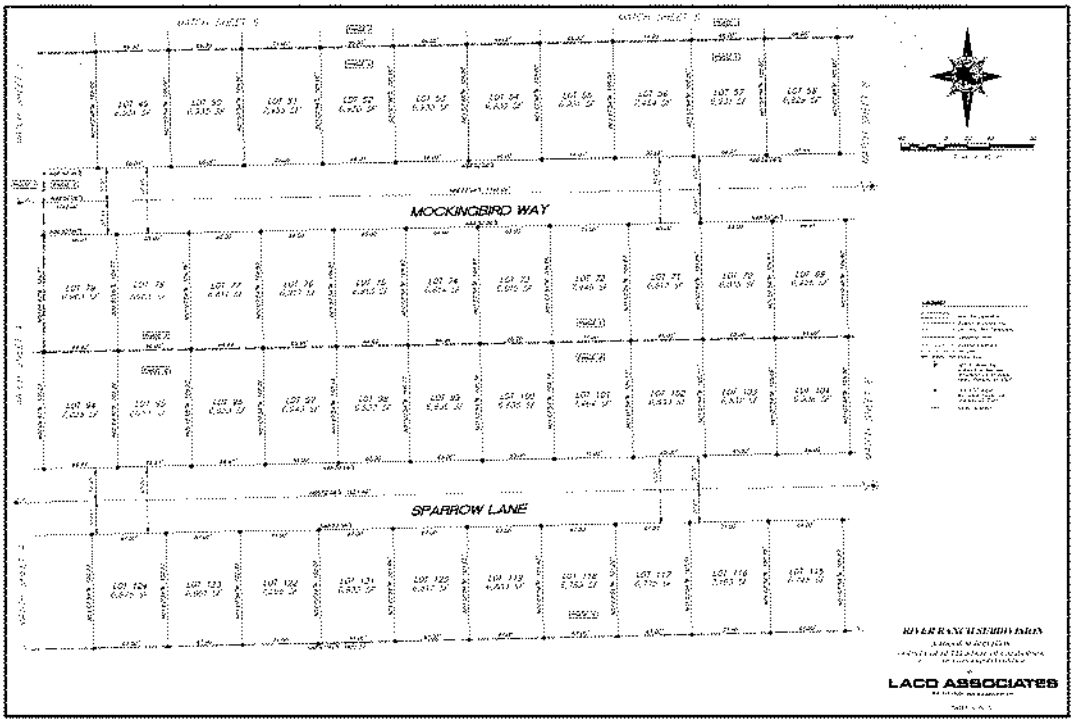
DEPICTION OF THE PROJECT

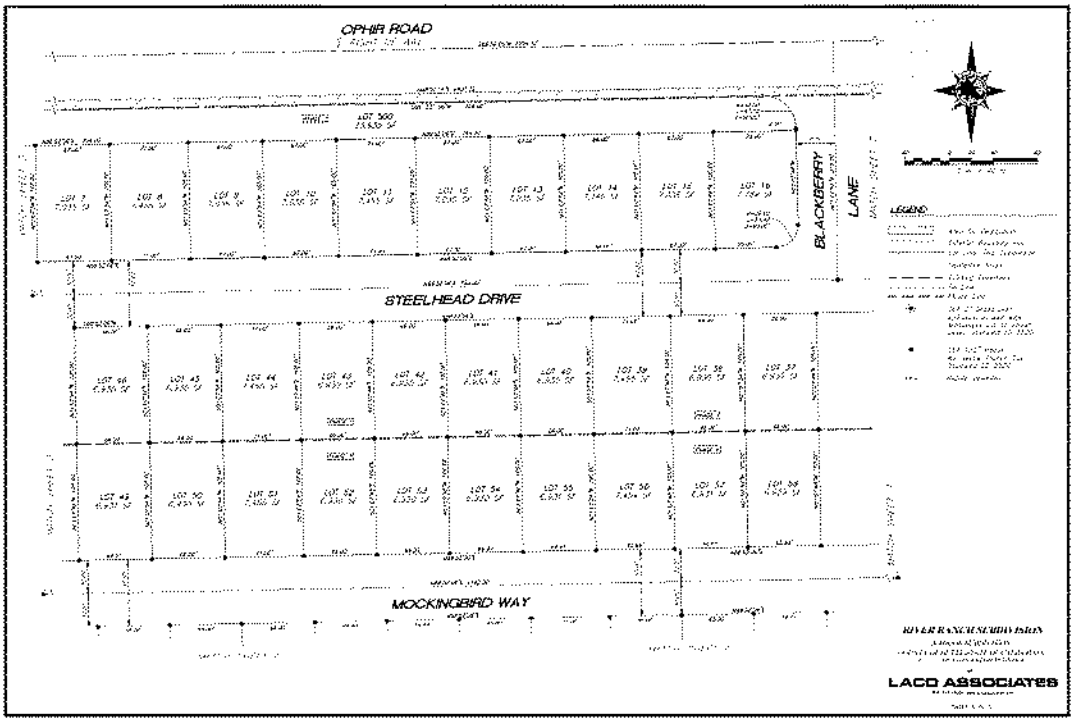


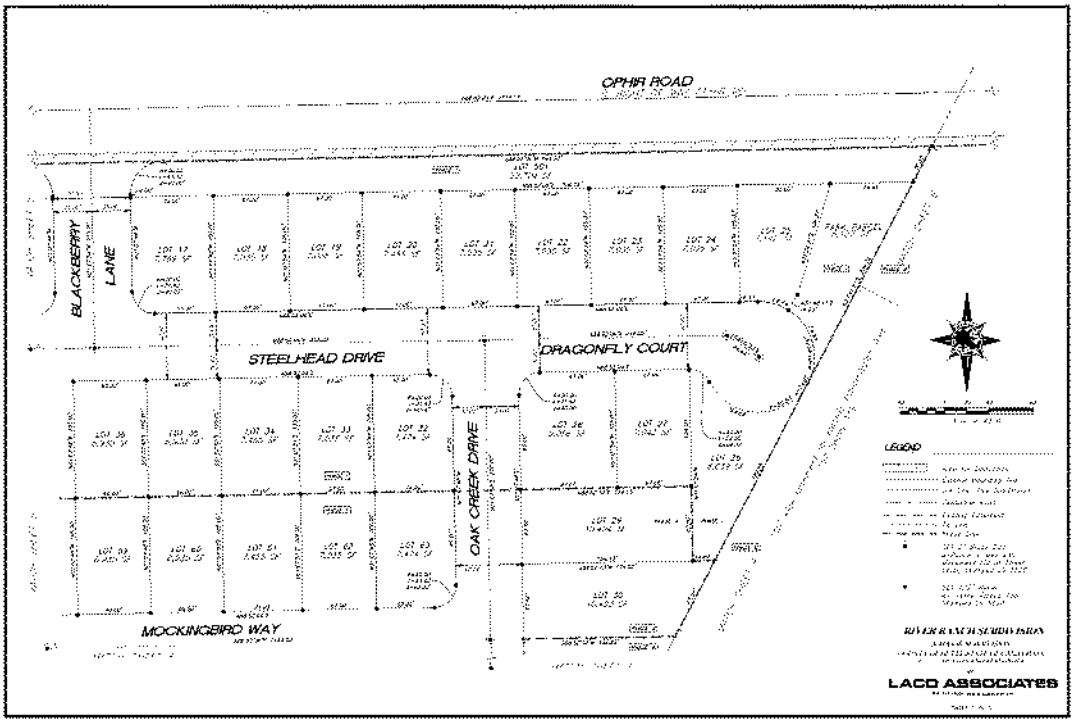



KINGFISHER DRIVE
MOCKINGBIRD WAY
WILD FIG ROAD
FINCH LANE
LINCOLN BLVD.
SPARROW LANE
LEGEND
LACO ASSOCIATES


ORNER ROAD
LINCOLN BLVD.
KINGFISHER DRIVE
MOCKINGBIRD WAY
LEGEND
LACO ASSOCIATES


MOCKINGBIRD WAY
SPARROW LANE
LACO ASSOCIATES


OPHIR ROAD
BLACKBERRY LANE
STEELHEAD DRIVE
MOCKINGBIRD WAY
LACO ASSOCIATES


OPHIR ROAD
BLACKBERRY LANE
STEELHEAD DRIVE
DRAGONFLY COURT
OAK CREEK DRIVE
MOCKINGBIRD WAY
LEGEND
RIVER RANCH SUBDIVISION
LACO ASSOCIATES

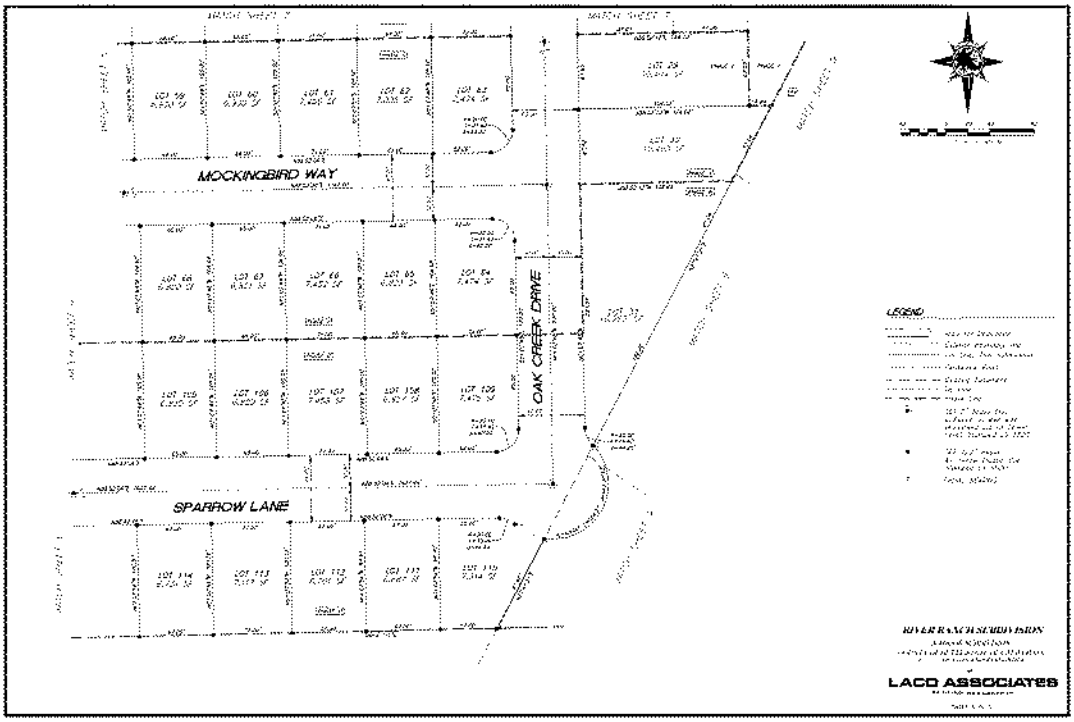

MOCKINGBIRD WAY
OAK CREEK DRIVE
SPARROW LANE
LEGEND
RIVER RANCH SUBDIVISION
LACO ASSOCIATES

EXHIBIT G

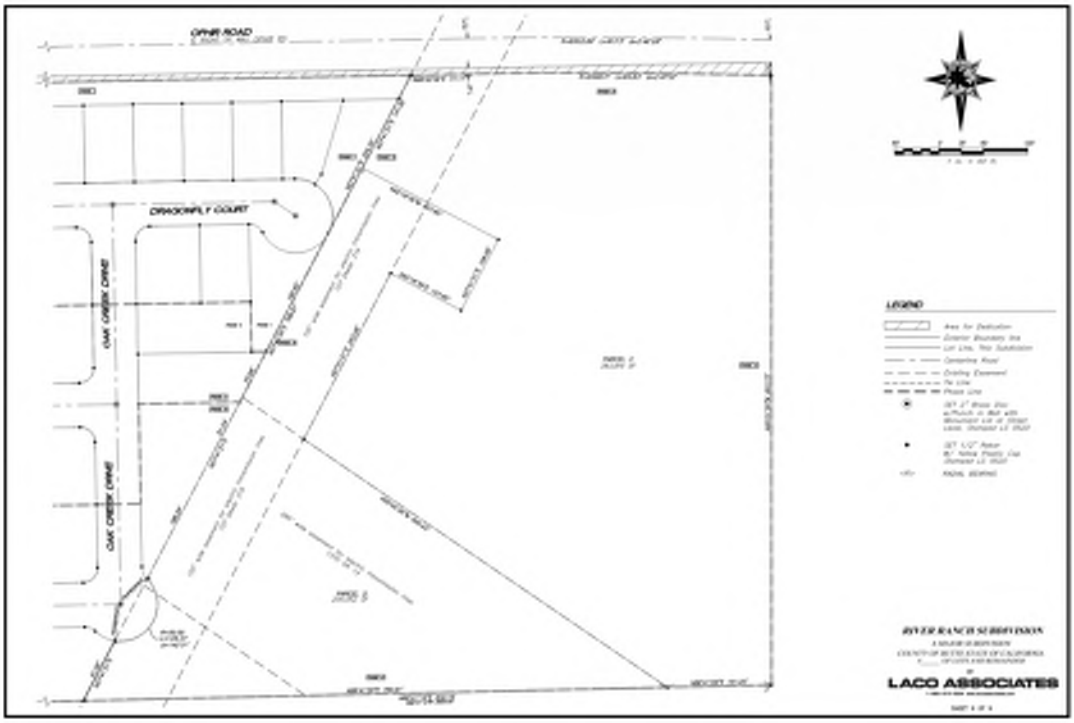

OPHIR ROAD
DRAGONFLY COURT
OAK CREEK DRIVE
OAK CREEK DRIVE
LEGEND
LACO ASSOCIATES

EXHIBIT H

DEPICTION OF REGIONAL FACILITY

EXHIBIT H.1 Ophir Lincoln LS and FM Plans 7-20-21.pdf-26 PAGES
EXHIBIT H.2 Ophir Lincoln LS and FM Tech Specs 7-20-21.pdf-315 PAGES

EXHIBIT H.1

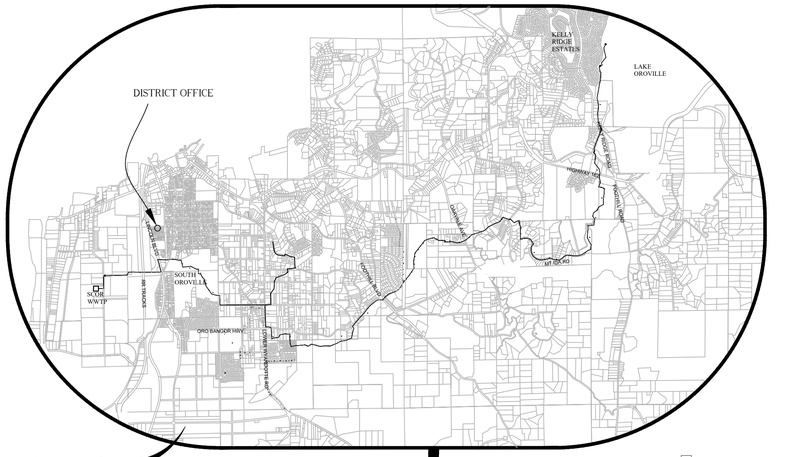
LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT

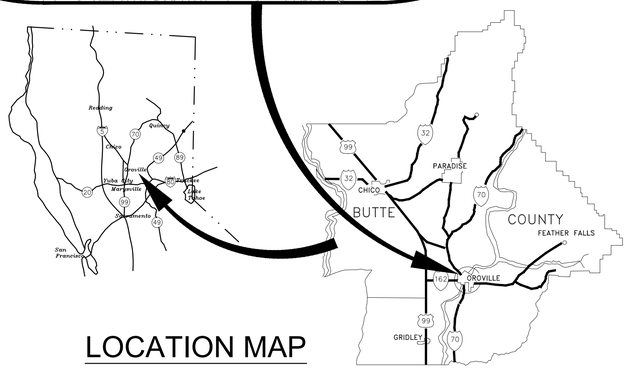
1960 ELGIN STREET
OROVILLE, CA 95966

TEL. (530) 533-2000

OPHIR LINCOLN
LIFT STATION AND FORCE MAIN
FINAL DESIGN DRAWINGS

March 15, 2021





LOCATION MAP
OF
PROJECT AREA

SHEET INDEX		
Sht. No.	Page	Sheet Title
1	G1	Cover
2	C1	Lift Station Site Plan
3	C2	Grading / Drainage Plan
4	M1	Wet Well and Valve Vault Details
5	M2	Overflow Tanks Connections and Details
6	P1	Force Main P&P. Sta 10+00-20+00
7	P2	Force Main P&P. Sta 20+00-30+00
8	P3	Force Main P&P. Sta 30+00-40+00
9	P4	Force Main P&P. Sta 40+00-50+00
10	P5	Force Main P&P. Sta 50+00-60+00
11	P6	Force Main P&P. Sta 60+00-70+00
12	P7	Force Main P&P. Sta 70+00-80+00
13	P8	Force Main P&P. Sta 80+00-90+00
14	P9	Force Main P&P. Sta 90+00-94+32
15	P10	Gravity Pipe P&P. Sta 100+00-110+40
16	D1	Details 1
17	D2	Structural Details
18	D3	Pipeline Details 1
19	D4	Pipeline Details 2
20	E1	Electrical Symbols, Abbreviations & Notes
21	E2	Electrical Site Plan & Conduit Schedule
22	E3	Electrical Single Line Diag., Elev., & Load Calcs
23	E4	Control Wiring Diagrams
24	E5	Electrical Details 1
25	E6	Electrical Details 2
26	E7	P&ID, Sewage Pumps

Prepared Under Direction Of:

Keith S. Knibb

REGISTERED PROFESSIONAL ENGINEER KEITH S KNIBB No. C 51290 Exp. 3-31-22 civil STATE OF CALIFORNIA

March 15, 2021
Date

Approved By:

Scott McCutcheon, General Manager *Date*

LEGEND:

TOP OF CUT	EXISTING WATER LINE
TOE OF FILL	SEWER LINE
FLOWLINE	CREEK FLOWLINE
FENCE	EDGE OF PAVEMENT
OVERHEAD ELECTRICAL	EDGE OF DIRT/GRAVEL ROAD

JP	JUNCTION POLE	17+00	PIPE STATION NUMBER
WV	WATER VALVE	TP	TELEPHONE POLE
VB	WATER VALVE BOX	GUY	GUY WIRE (POLE ANCHOR)
WM	WATER METER	FH	FIRE HYDRANT
	FOUND 3/4" I.P., LS 3959	PRV	PRESSURE REDUCING VALVE
			GATE VALVE
	CONTROL/BENCHMARK	SVC	SERVICE METER
3006.04 top	EXISTING ELEVATION POINT		FIRE HYDRANT

REV | DATE | REVISIONS | INITIAL

OPHIR - LINCOLN
LIFT STATION AND FORCE MAIN

COVER SHEET

1960 ELGIN STREET
OROVILLE, CA 95966
TEL. (530) 533-2000

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT

CALIFORNIA

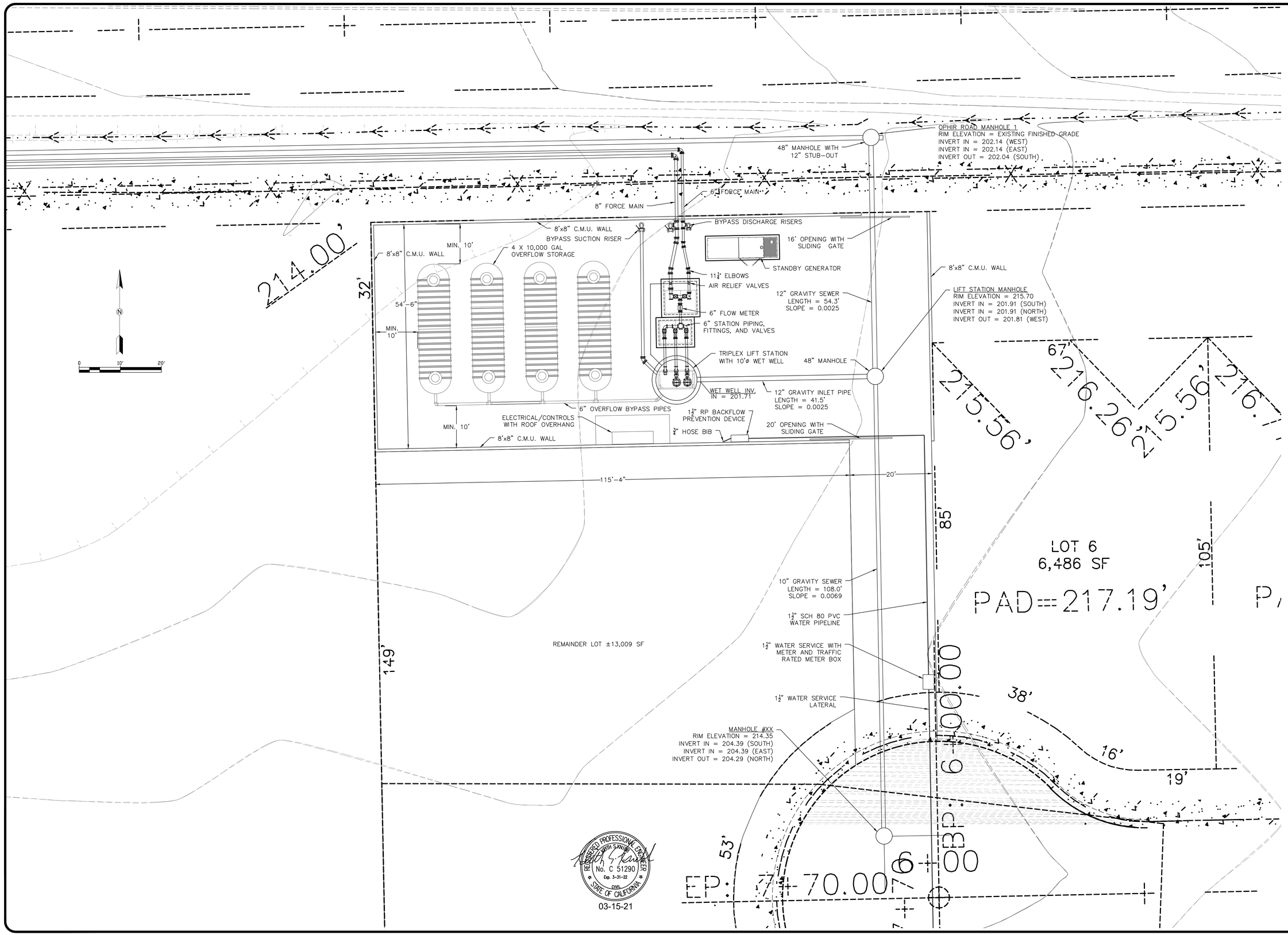
BUTTE COUNTY

Sauers Engineering, Inc.
Civil & Environmental Engineers
105 Providence Mine Rd, Suite 202, Nevada City, CA 95959
tel (530) 265-8021 www.sauerseng.com

0 1
BAR IS ONE INCH ON ORIG. DRAWING
IF BAR DOES NOT MEASURE ONE INCH,
ADJUST SCALES ACCORDINGLY

PROJECT NUMBER:	00-001-70
DESIGN BY:	KSK
DRAFTING BY:	KEM
CHECKED BY:	KSK
FILE PATH:	
DATE:	
SCALES: NA HORIZONTAL	G1
NA VERTICAL	SHEET: 1 of 26

EXHIBIT H.1



REGISTERED PROFESSIONAL ENGINEER
KEITH S. KNUDSEN
No. C 51290
Exp. 3-31-22
CIVIL
STATE OF CALIFORNIA

03-15-21

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN
LIFT STATION AND FORCE MAIN

LIFT STATION SITE PLAN

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
1960 ELGIN STREET
OROVILLE, CA 95966
TEL. (530) 533-2000

CALIFORNIA

BUTTE COUNTY

Sauers Engineering, Inc.
Civil & Environmental Engineers
105 Providence Mine Rd, Suite 202, Nevada City, CA 95959
tel (530) 265-8021 www.sauerseng.com

0 1
BAR IS ONE INCH ON ORIG. DRAWING
IF BAR DOES NOT MEASURE ONE INCH, ADJUST SCALES ACCORDINGLY

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DRAFTING BY:	KEM
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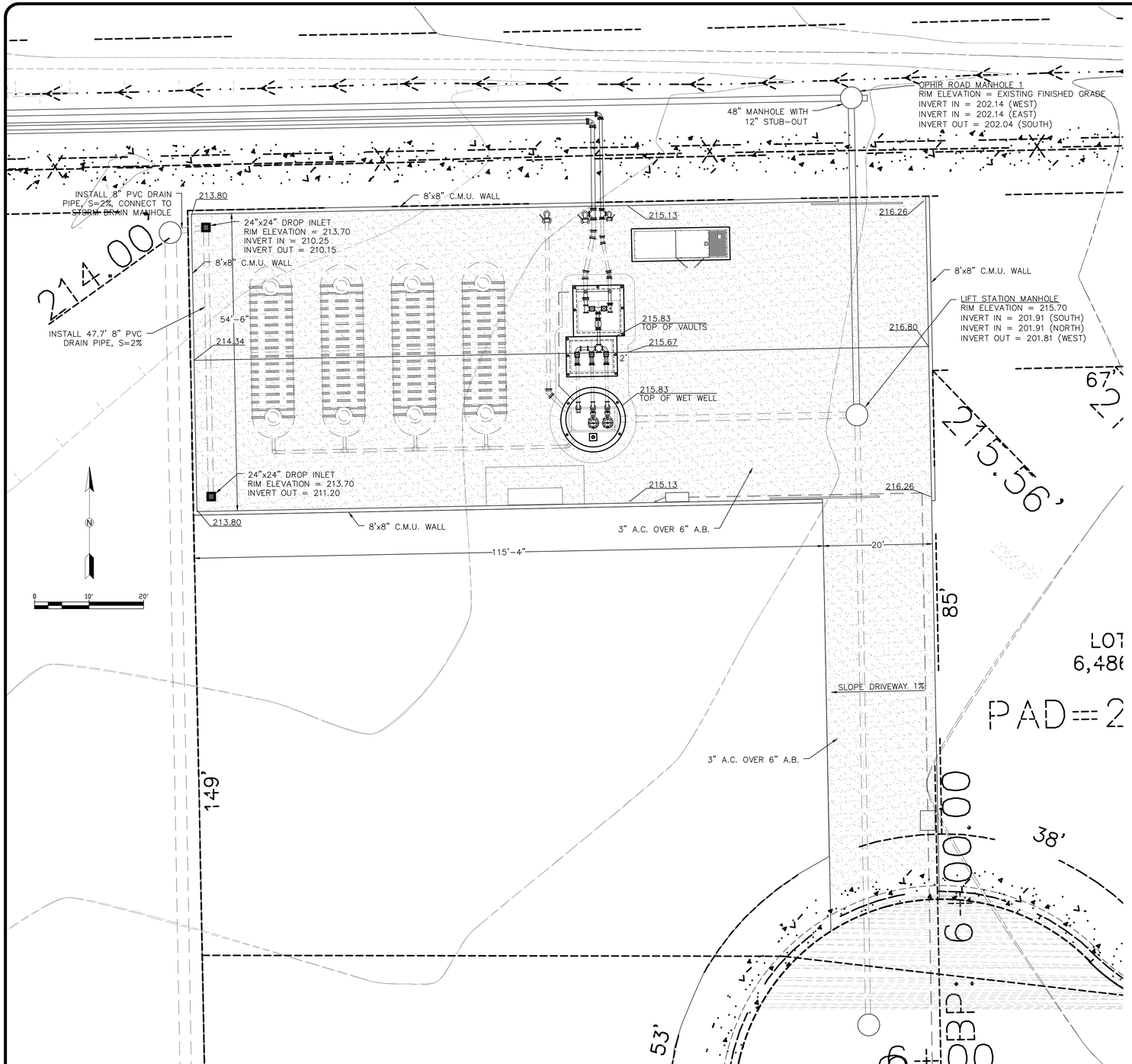
VERTICAL	SHEET: 2 of 26

EXHIBIT H.1



REVISIONS

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN
LIFT STATION AND FORCE MAIN

GRADING/DRAINAGE PLAN

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT

1960 ELGIN STREET
OROVILLE, CA 95966
TEL. (530) 533-2000

BUTTE COUNTY CALIFORNIA

Sauers Engineering, Inc.
Civil & Environmental Engineers
105 Providence Mine Rd. Suite 202, Nevada City, CA 95959
tel (530) 265-8021 www.sauerseng.com

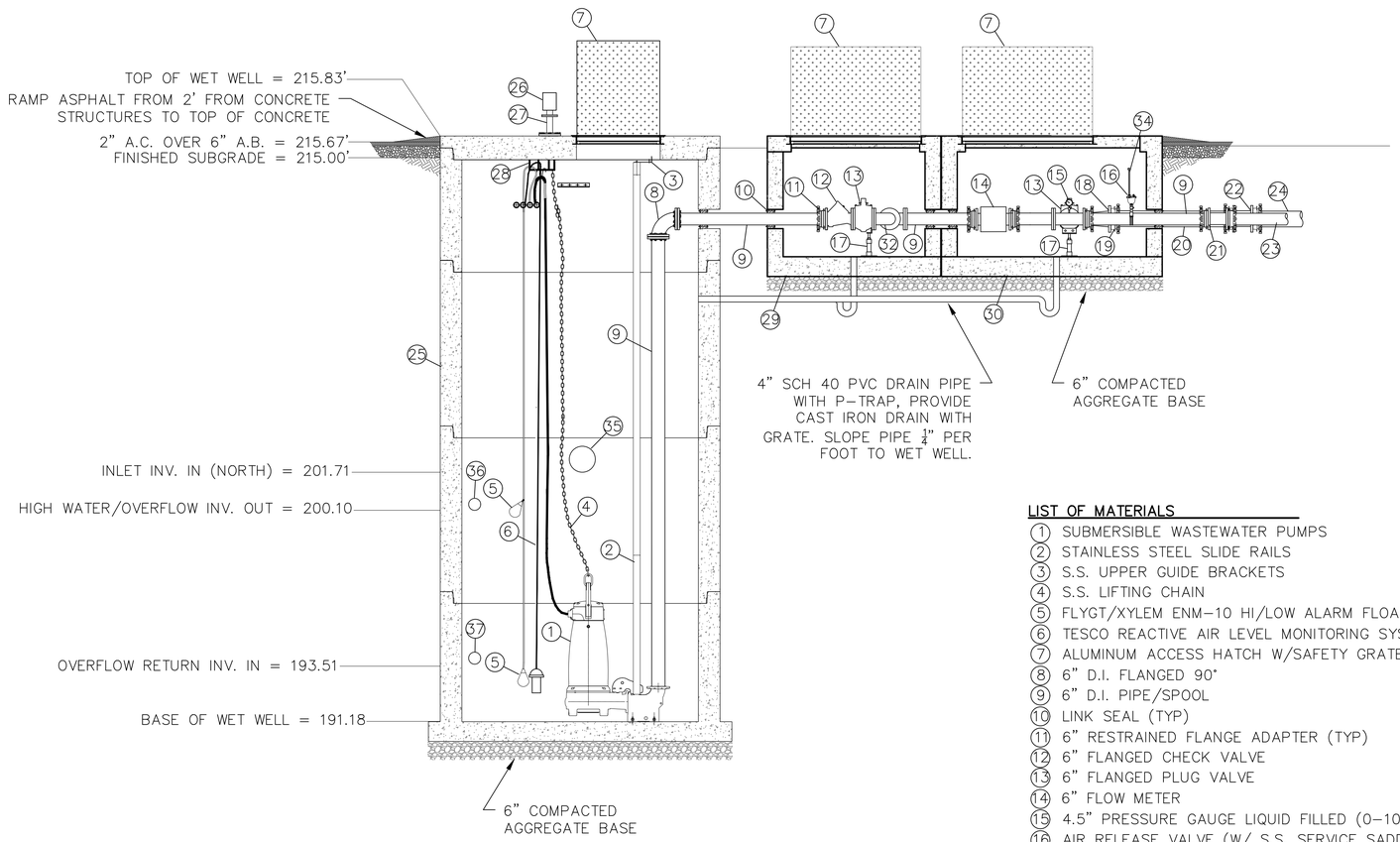
REGISTERED PROFESSIONAL ENGINEER
KEITH S. KAWTER
No. C 51290
Exp. 3-31-22
CIVIL
STATE OF CALIFORNIA

03-15-21

0 1
BAR IS ONE INCH ON ORIG. DRAWING
IF BAR DOES NOT MEASURE ONE INCH,
ADJUST SCALES ACCORDINGLY

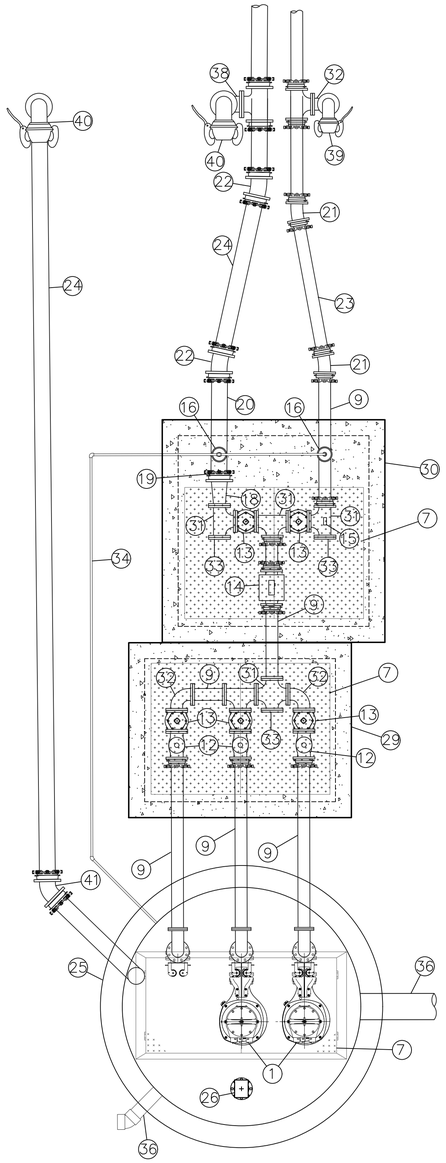
PROJECT NUMBER:	00-001-70
DESIGN BY:	KSK
DRAFTING BY:	KEM
CHECKED BY:	KSK
FILE PATH:	
DATE:	
SCALES: HORIZONTAL	C2
VERTICAL	SHEET: 3 of 26

EXHIBIT H.1



1 M1 WET WELL AND VALVE VAULTS PROFILE

Scale: 1"=3'



2 M1 WET WELL AND VALVE VAULTS PLAN VIEW

Scale: 1"=3'

LIST OF MATERIALS

1. SUBMERSIBLE WASTEWATER PUMPS
2. STAINLESS STEEL SLIDE RAILS
3. S.S. UPPER GUIDE BRACKETS
4. S.S. LIFTING CHAIN
5. FLYGT/XYLEM ENM-10 HI/LOW ALARM FLOATS
6. TESCO REACTIVE AIR LEVEL MONITORING SYSTEM
7. ALUMINUM ACCESS HATCH W/SAFETY GRATE
8. 6" D.I. FLANGED 90°
9. 6" D.I. PIPE/SPOOL
10. LINK SEAL (TYP)
11. 6" RESTRAINED FLANGE ADAPTER (TYP)
12. 6" FLANGED CHECK VALVE
13. 6" FLANGED PLUG VALVE
14. 6" FLOW METER
15. 4.5" PRESSURE GAUGE LIQUID FILLED (0-100 PSI)
16. AIR RELEASE VALVE (W/ S.S. SERVICE SADDLE AND SHUT OFF VALVE)
17. PIPE SUPPORTS (@ EACH PLUG VALVE)
18. 6"x8" FLANGED D.I. ENLARGER
19. 8" RESTRAINED FLANGE ADAPTER (TYP)
20. 8" D.I. PIPE/SPOOL
21. 6" D.I. FLANGED 11-1/4° ELBOW
22. 8" D.I. FLANGED 11-1/4° ELBOW
23. 6" C-900 P.V.C. PIPE
24. 8" C-900 P.V.C. PIPE
25. 10'ø PRECAST CONCRETE WET WELL
26. PEACEMAKER ODOR FILTER
27. 4"ø STEEL VENT LINE, FUSION BONDED EPOXY LINED AND COATED
28. STAINLESS STEEL CHAIN AND CABLE HOLDER
29. 6'x8' I.D. PRECAST CONCRETE VAULT
30. 8'x8' I.D. PRECAST CONCRETE VAULT
31. 6" D.I. FLANGED CROSS
32. 6" D.I. FLANGED 90° ELBOW
33. 6" D.I. BLIND FLANGE
34. 3/4" SCH 80 P.V.C. AIR RELEASE RETURN LINE
35. 12" GRAVITY SEWER INLET PIPE
36. 6" OVERFLOW OUTLET PIPE
37. 6" OVERFLOW RETURN PIPE WITH TIDEFLEX CHECK VALVE
38. 8" D.I. FLANGED 90° ELBOW
39. 6" BAUER HK FLANGED BEND 90° WITH BALL
40. 8" BAUER HK FLANGED BEND 90° WITH BALL
41. 8" D.I. FLANGED 45° ELBOW

REGISTERED PROFESSIONAL ENGINEER — No. C 51290 — Exp. 3-31-22 — CIVIL — STATE OF CALIFORNIA

03-15-21

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN
LIFT STATION AND FORCE MAIN

WET WELL AND VALVE VAULT DETAILS

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
1960 ELGIN STREET
OROVILLE, CA 95966
TEL. (530) 533-2000

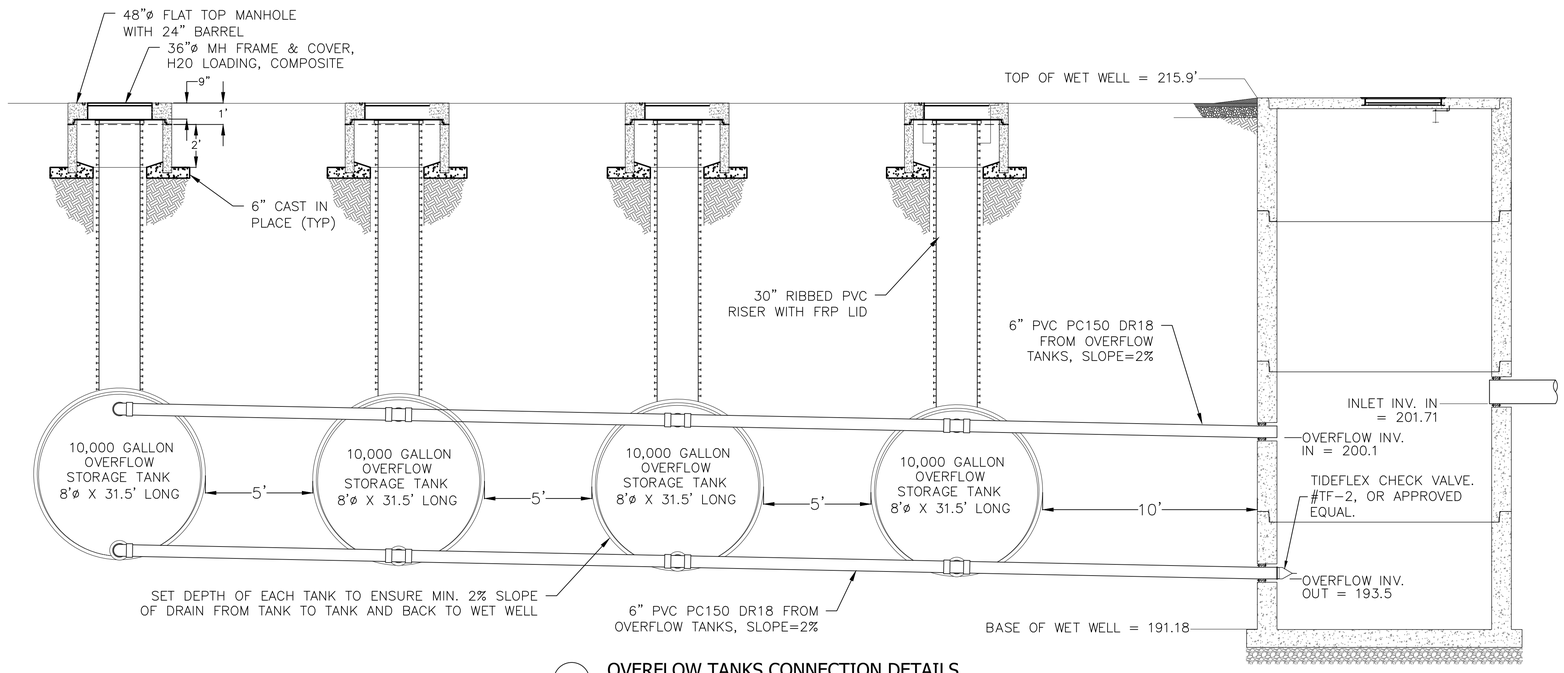
BUTTE COUNTY CALIFORNIA

Sauers Engineering, Inc.
Civil & Environmental Engineers
105 Providence Mine Rd. Suite 202, Nevada City, CA 95959
tel (530) 265-8021 www.sauerseng.com

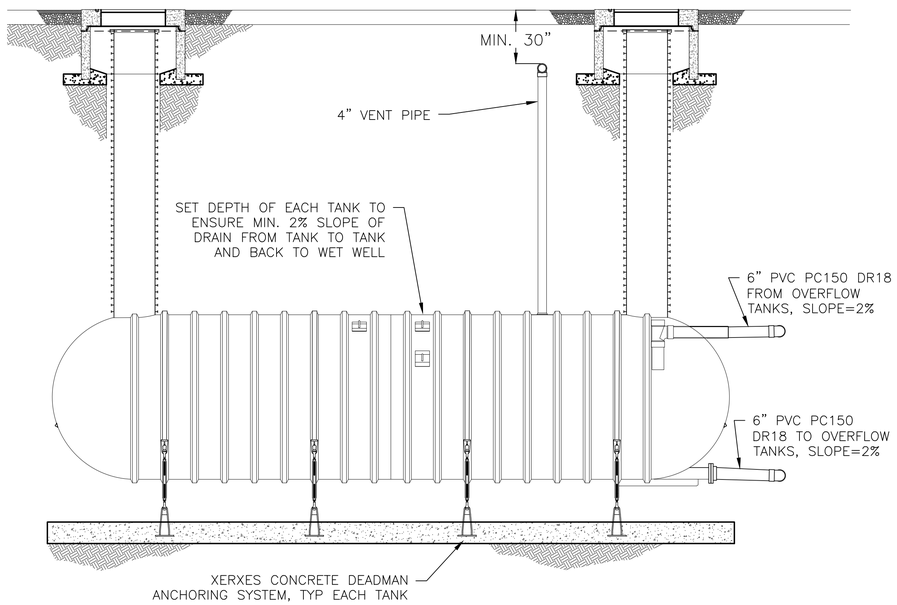
0 1
BAR IS ONE INCH ON ORIG. DRAWING
IF BAR DOES NOT MEASURE ONE INCH, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER:	00-001-70
DESIGN BY:	KSK
DRAFTING BY:	KEM
CHECKED BY:	KSK
FILE PATH:	
DATE:	
SCALES: HORIZONTAL / VERTICAL	M1
SHEET:	4 of 26

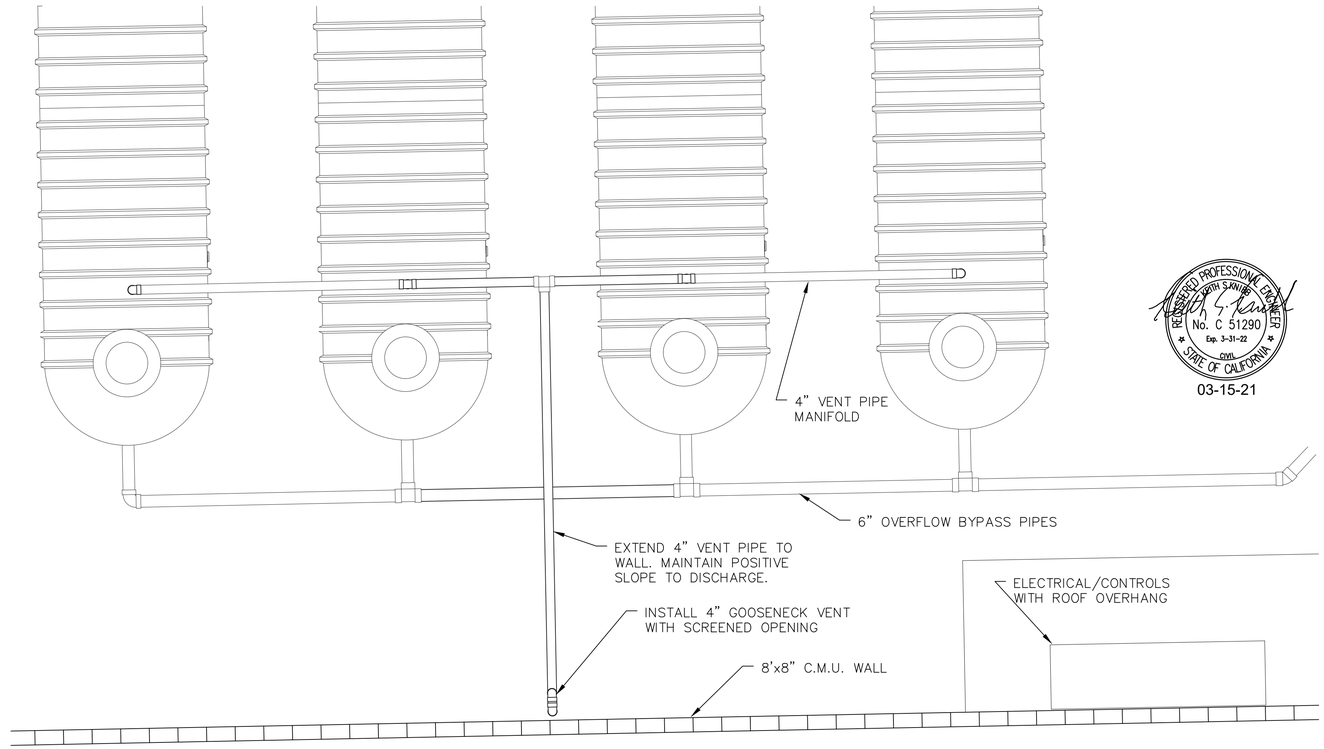
EXHIBIT H.1



M2 OVERFLOW TANKS CONNECTION DETAILS
Scale: 1" = 4'



M2 OVERFLOW TANK INSTALLATION DETAILS
Scale: 1" = 4'



M2 OVERFLOW TANK VENTING DETAILS
Scale: 1" = 4'

REGISTERED PROFESSIONAL ENGINEER
KEITH S. KNIGHT
No. C 51290
Exp. 3-31-22
CIVIL
STATE OF CALIFORNIA
03-15-21

REVISIONS

REV	DATE	INITIAL

OPHIR - LINCOLN
LIFT STATION AND FORCE MAIN

OVERFLOW TANKS
CONNECTIONS AND DETAILS

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DESIGN BY:	KSK
DRAFTING BY:	KEM
CHECKED BY:	KSK

FILE PATH:

DATE:

SCALES:
HORIZONTAL
VERTICAL

M2

SHEET: 5 of 26

EXHIBIT H.1

STA 20+00 MATCH LINE
SHT P1/P2

COMM CABLE.
DIRECT BURIED, 1200X

TV BOX

TELE MH

COMM CABLE. 8-4" PVC.

LOCATIONS OF COMM CABLES
AND CONDUITS ARE ESTIMATED.
CALL 811 FOR ACCURATE LOCATIONS.

COMM CABLE. DIRECT BURY
OR IN CONDUIT. 12 PAIRS.
RETIRED IN PLACE.

COMM CABLE. 1-2" PVC.

COMM CABLE. 8-4" PVC.

LINCOLN BLVD

7'WX4'H CONC BOX CULV.
FL CENTER = 207.23'

7'WX4'H CONC BOX CULV.
FL CENTER = 207.28'

NORTH OPHIR ROAD MANHOLE
RIM ELEVATION = ±212.1'
INVERT IN = 203.30 (WEST)
INVERT IN = 203.30 (NORTH)
INVERT IN = 203.30 (EAST)
INVERT OUT = 203.20 (SOUTH)

INSTALL 12" GRAVITY SEWER
LENGTH = ±80'
SLOPE = 0.0025

INSTALL 12"ø GRAVITY SEWER
LENGTH = ±379'
S=0.0025

OPHIR ROAD

7'WX4'H CONC BOX CULV.
FL CENTER = 207.23'

7'WX4'H CONC BOX CULV.
FL CENTER = 207.22'

INSTALL NEW 6' & 8'
C900 PVC FORCE MAIN

OPHIR ROAD MANHOLE 2
RIM ELEVATION = ±212.3'
INVERT IN = 203.00 (WEST)
INVERT IN = 203.00 (NORTH)
INVERT OUT = 202.90 (EAST)

OPHIR ROAD MANHOLE 1
RIM ELEVATION = ±213.8'
INVERT IN = 202.14 (WEST)
INVERT IN = 202.14 (EAST)
INVERT OUT = 202.04 (SOUTH)

0 40' 80'

NOTES:
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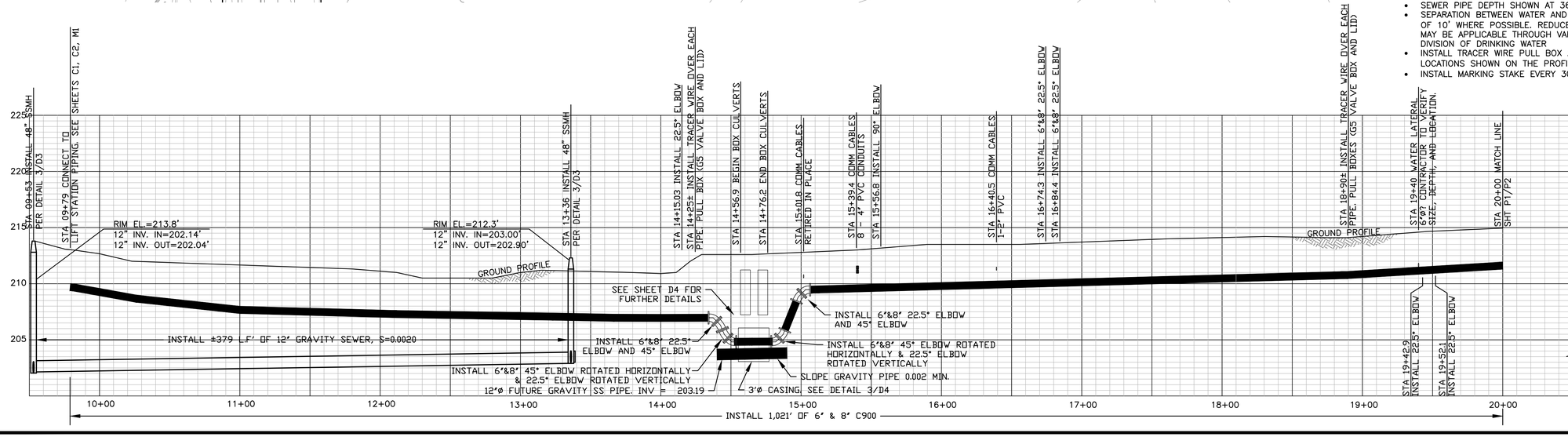

REGISTERED PROFESSIONAL ENGINEER
KEITH S. MARTIN
No. C 51290
Exp. 3-31-22
CIVIL
STATE OF CALIFORNIA
04-15-21

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN
LIFT STATION AND FORCE MAIN

SEWER FORCE MAINS
PLAN & PROFILE
STA. 10+00 - 20+00

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
1960 ELGIN STREET
OROVILLE, CA 95966
TEL. (530) 533-2000

BUTTE COUNTY CALIFORNIA

Sauers Engineering, Inc.
Civil & Environmental Engineers
105 Providence Mine Rd. Suite 202, Nevada City, CA 95959
tel (530) 265-8021 www.sauerseng.com

0 1
BAR IS ONE INCH ON ORIG. DRAWING
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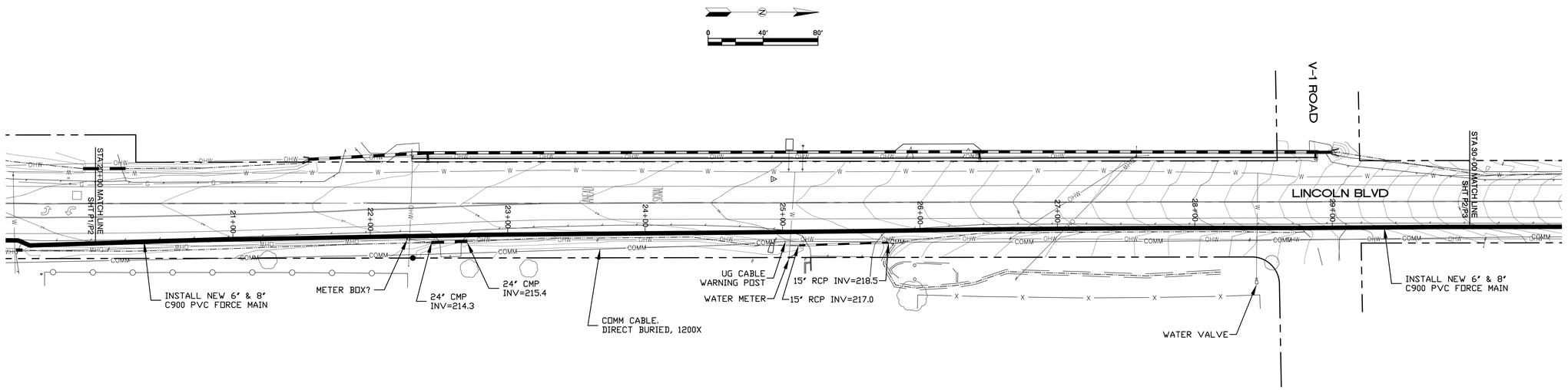
ADJUST SCALES ACCORDINGLY

PROJECT NUMBER:	00-001-70
DESIGN BY:	KSK
DRAFTING BY:	KEM
CHECKED BY:	KSK
FILE PATH:	
DATE:	
SCALES: HORIZONTAL	P1
VERTICAL	
SHEET:	6 of 26

EXHIBIT H.1



LOCATIONS OF COMM CABLES
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CALL 811 FOR ACCURATE LOCATIONS.

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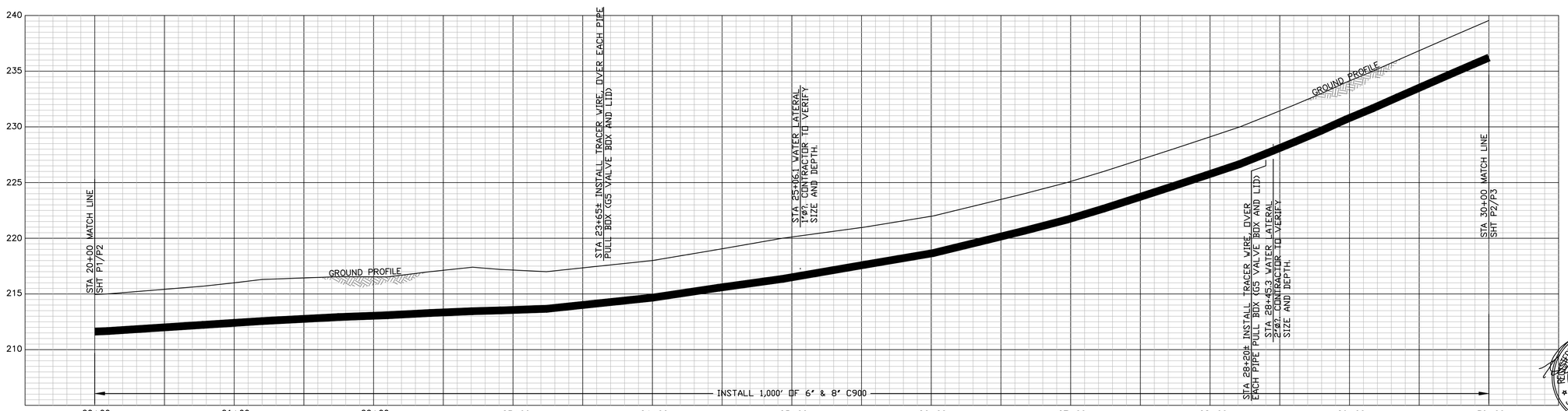

REGISTERED PROFESSIONAL ENGINEER
KEITH SAUERS
No. C 51290
Exp. 3-31-22
CIVIL
STATE OF CALIFORNIA

04-15-21

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN
LIFT STATION AND FORCE MAIN

SEWER FORCE MAINS
PLAN & PROFILE
STA. 20+00 - 30+00

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
1960 ELGIN STREET
OROVILLE, CA 95966
TEL. (530) 533-2000

BUTTE COUNTY CALIFORNIA

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0 1
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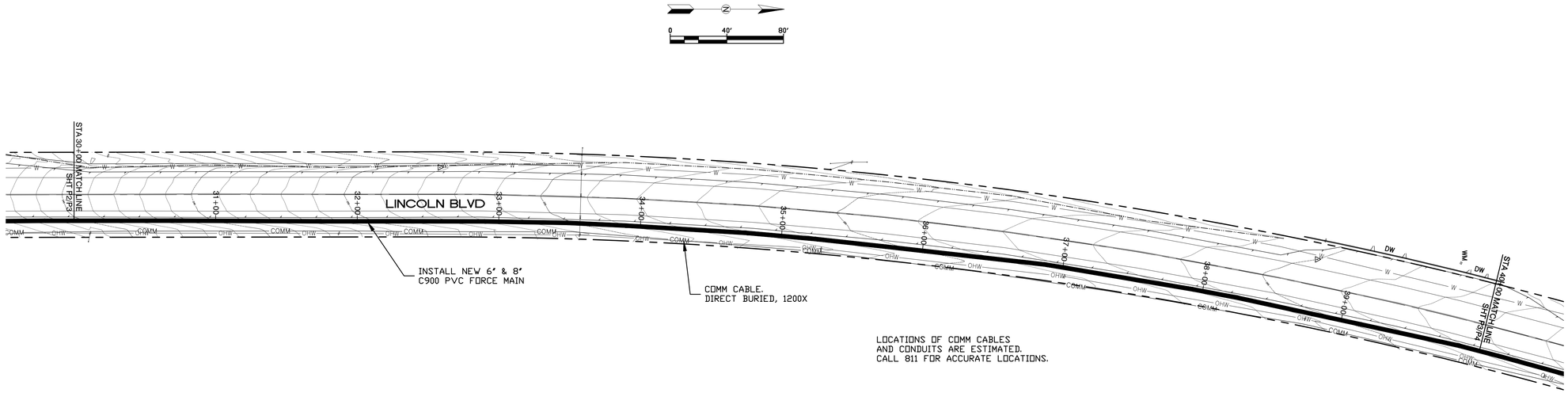
PROJECT NUMBER:	00-001-70
DESIGN BY:	KSK
DRAFTING BY:	KEM
CHECKED BY:	KSK
FILE PATH:	
DATE:	
SCALES: HORIZONTAL	P2
VERTICAL	
SHEET:	7 of 26

EXHIBIT H.1



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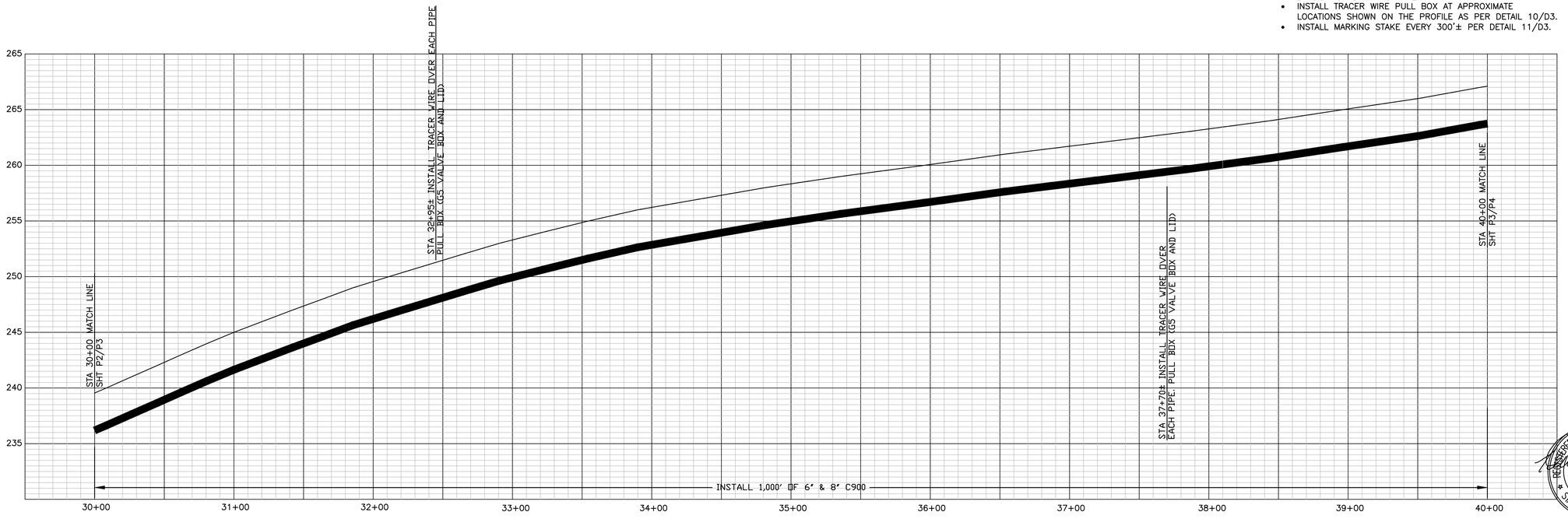

04-15-21

REVISIONS

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN LIFT STATION AND FORCE MAIN

SEWER FORCE MAINS PLAN & PROFILE STA. 30+00 - 40+00

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
1960 ELGIN STREET
OROVILLE, CA 95966
TEL. (530) 533-2000
CALIFORNIA
BUTTE COUNTY

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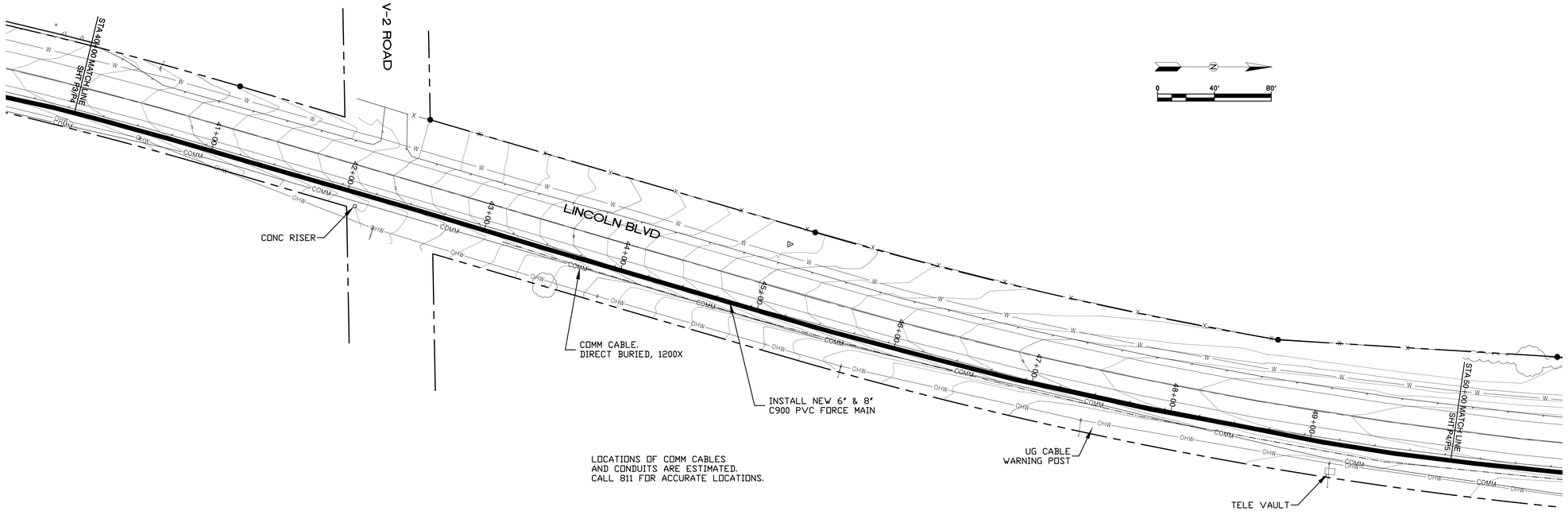
PROJECT NUMBER:	00-001-70
DESIGN BY:	KSK
DRAFTING BY:	KEM
CHECKED BY:	KSK
FILE PATH:	
DATE:	
SCALES: HORIZONTAL	P3
VERTICAL	SHEET: 8 of 26

REGISTERED PROFESSIONAL ENGINEER
KEITH S. KNAPP
No. C 51290
Exp. 3-31-22
CIVIL
STATE OF CALIFORNIA

EXHIBIT H.1



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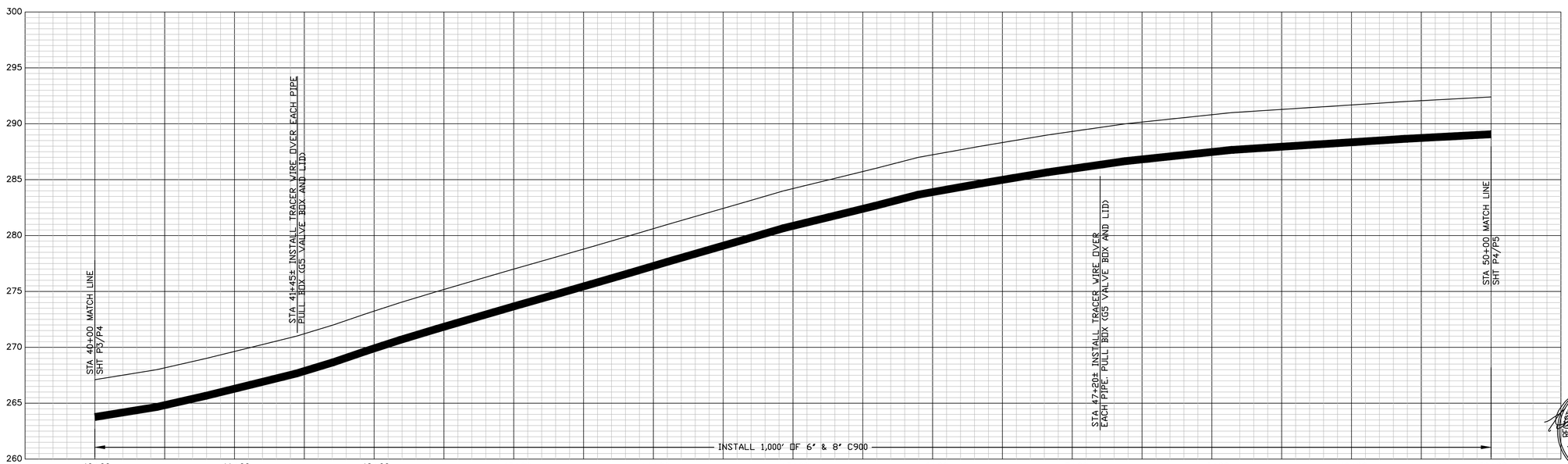

REGISTERED PROFESSIONAL ENGINEER
KEITH S. KNIGHT
No. C 51290
Exp. 3-31-22
CIVIL
STATE OF CALIFORNIA

04-15-21

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN LIFT STATION AND FORCE MAIN

SEWER FORCE MAINS PLAN & PROFILE STA. 40+00 - 50+00

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
1960 ELGIN STREET
OROVILLE, CA 95966
TEL. (530) 533-2000

BUTTE COUNTY CALIFORNIA

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0 1
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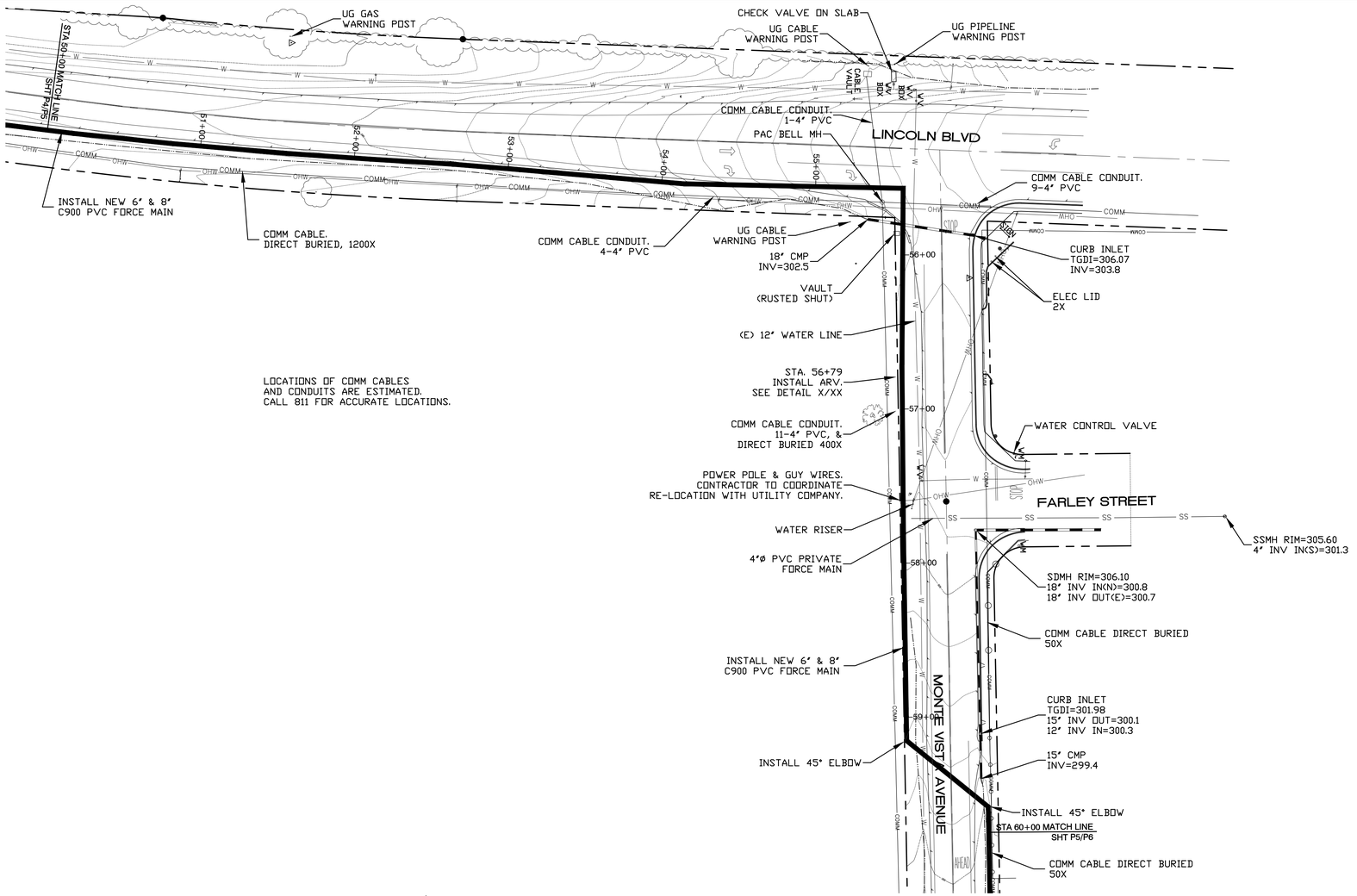
PROJECT NUMBER:	00-001-70
DESIGN BY:	KSK
DRAFTING BY:	KEM
CHECKED BY:	KSK
FILE PATH:	
DATE:	
SCALES: HORIZONTAL	P4
VERTICAL	
SHEET:	9 of 26

EXHIBIT H.1



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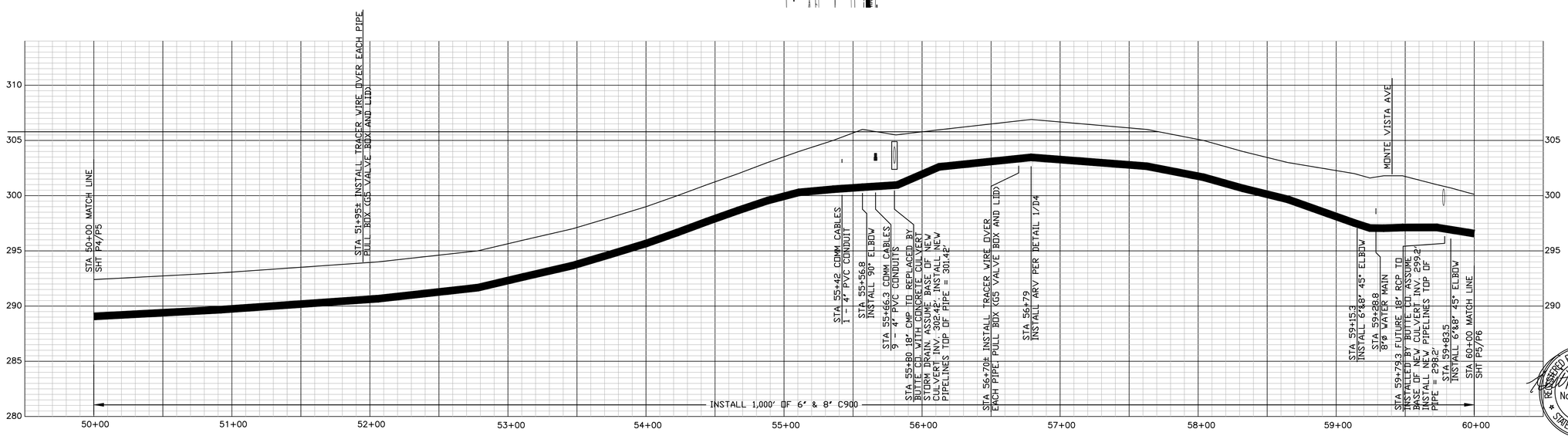

04-15-21

REVISIONS

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN LIFT STATION AND FORCE MAIN

SEWER FORCE MAINS PLAN & PROFILE STA. 50+00 - 60+00

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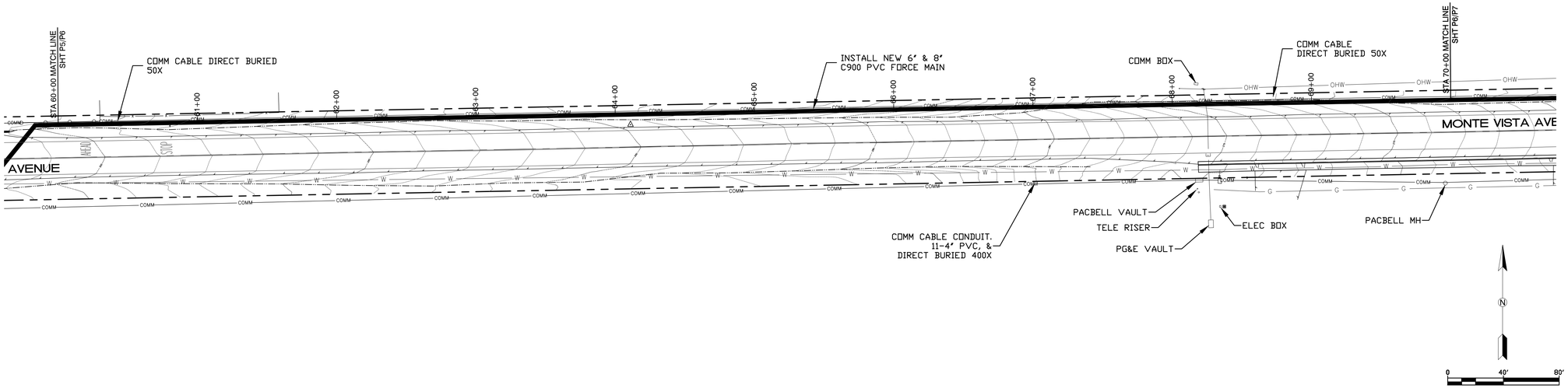
PROJECT NUMBER:	00-001-70
DESIGN BY:	KSK
DRAFTING BY:	KEM
CHECKED BY:	KSK
FILE PATH:	
DATE:	
SCALES: HORIZONTAL	P5
VERTICAL	
SHEET:	10 of 26

REGISTERED PROFESSIONAL ENGINEER
KEITH S. KNUDSEN
No. C 51290
Exp. 3-31-22
CIVIL
STATE OF CALIFORNIA

EXHIBIT H.1

NOTE: BUTTE COUNTY DEPARTMENT OF PUBLIC WORKS IS PLANNING TO CONSTRUCT CURB, GUTTER, SIDEWALK, AND STORM DRAIN IMPROVEMENTS ALONG MONTE VISTA AVE. A STORM DRAIN PIPELINE WILL BE CONSTRUCTED ALONG THE NORTH SHOULDER APPROXIMATELY 8' SOUTH OF THE RIGHT-OF-WAY LINE. CONSTRUCTION OF THE FORCE MAIN PIPELINES MUST BE NO MORE THAN 7' FROM THE RIGHT-OF-WAY LINE TO ALLOW A MINIMUM OF 1' SEPARATION FOR THE FUTURE STORM DRAIN.



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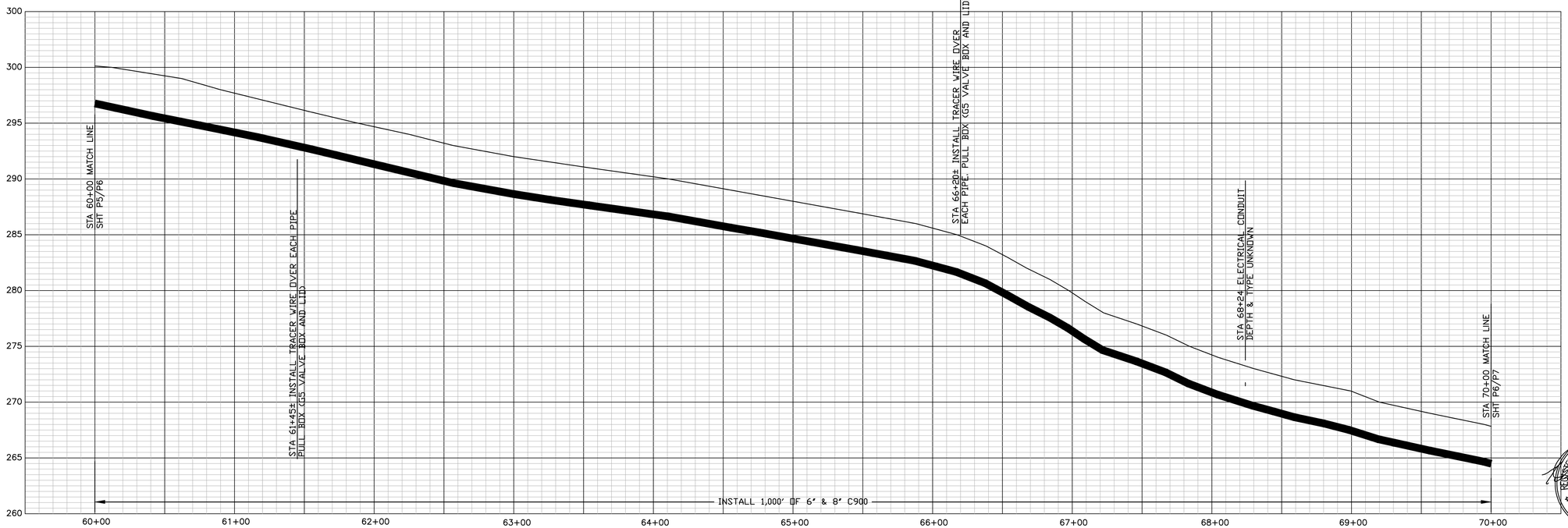


REGISTERED PROFESSIONAL ENGINEER KEITH SAWYER No. C 51290 Exp. 3-31-22 CIVIL STATE OF CALIFORNIA

04-15-21

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN LIFT STATION AND FORCE MAIN

SEWER FORCE MAINS PLAN & PROFILE STA. 60+00 - 70+00

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
1960 ELGIN STREET
OROVILLE, CA 95966
TEL. (530) 533-2000
CALIFORNIA
BUTTE COUNTY

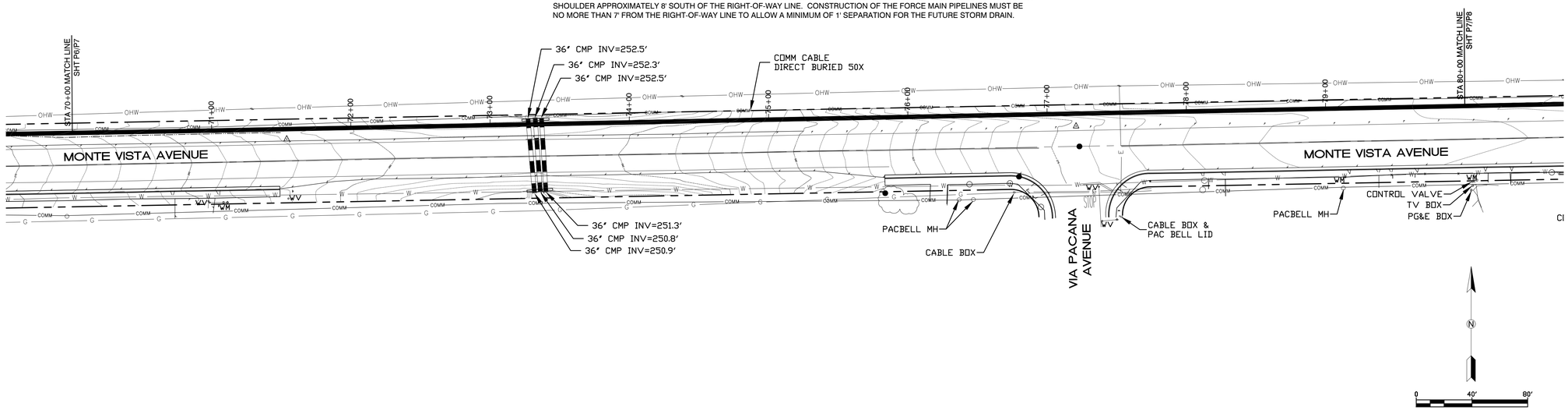
Sauers Engineering, Inc.
Civil & Environmental Engineers
105 Providence Mine Rd. Suite 202, Nevada City, CA 95959
tel (530) 265-8021 www.sauerseng.com

BAR IS ONE INCH ON ORIG. DRAWING
IF BAR DOES NOT MEASURE ONE INCH, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER:	00-001-70
DESIGN BY:	KSK
DRAFTING BY:	KEM
CHECKED BY:	KSK
FILE PATH:	
DATE:	
SCALES: HORIZONTAL / VERTICAL	P6
SHEET:	11 of 26

EXHIBIT H.1

NOTE: BUTTE COUNTY DEPARTMENT OF PUBLIC WORKS IS PLANNING TO CONSTRUCT CURB, GUTTER, SIDEWALK, AND STORM DRAIN IMPROVEMENTS ALONG MONTE VISTA AVE. A STORM DRAIN PIPELINE WILL BE CONSTRUCTED ALONG THE NORTH SHOULDER APPROXIMATELY 8' SOUTH OF THE RIGHT-OF-WAY LINE. CONSTRUCTION OF THE FORCE MAIN PIPELINES MUST BE NO MORE THAN 7' FROM THE RIGHT-OF-WAY LINE TO ALLOW A MINIMUM OF 1' SEPARATION FOR THE FUTURE STORM DRAIN.



NOTES:

- FINAL DEPTH OF PIPE WILL VARY DEPENDING UPON FIELD VERIFICATION OF EXISTING UTILITIES. DEPTH IS SHOWN AS 36" TO TOP OF PIPE. MINIMUM DEPTH SHALL BE 36" UNLESS OTHERWISE APPROVED BY ENGINEER OR AS OTHERWISE SHOWN ON THE PROFILE.
- CONTRACTOR TO VERIFY PIPE DIAMETER AND DEPTH OF ALL CROSSING UTILITIES AND CULVERTS AND MAINTAIN 12" SEPARATION.
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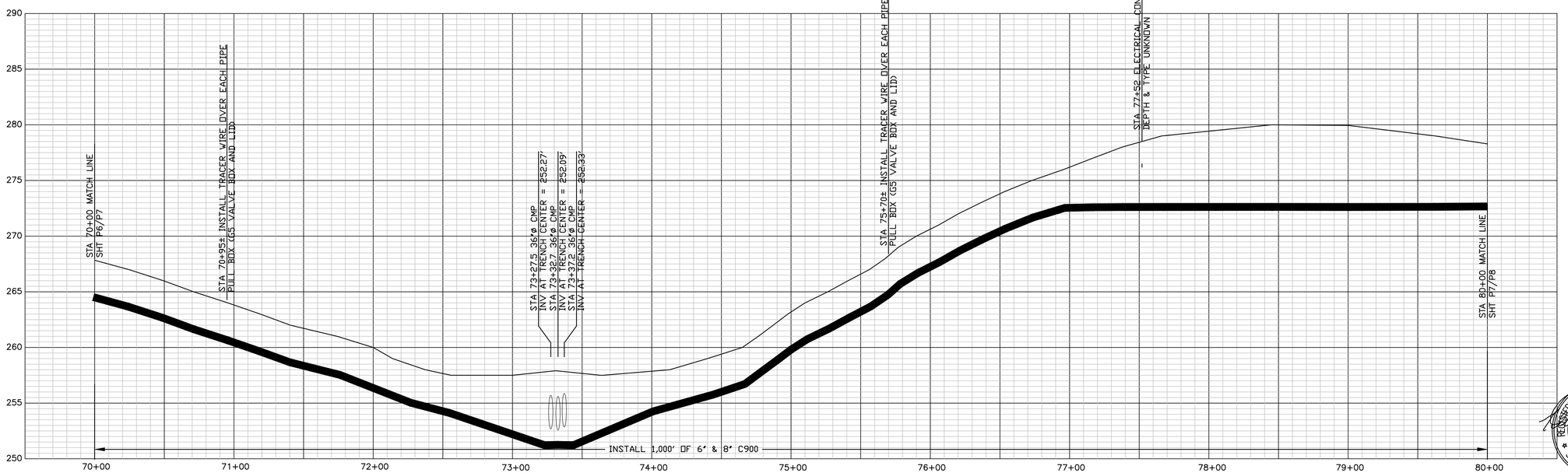
- INSTALL TRACER WIRE PULL BOX AT APPROXIMATE LOCATIONS SHOWN ON THE PROFILE AS PER DETAIL 10/D3.
- INSTALL MARKING STAKE EVERY 300'± PER DETAIL 11/D3.



REGISTERED PROFESSIONAL ENGINEER KEITH K. SAUERS No. C 51290 Exp. 3-31-22 CIVIL STATE OF CALIFORNIA

04-15-21

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN LIFT STATION AND FORCE MAIN

SEWER FORCE MAINS PLAN & PROFILE STA. 70+00 - 80+00

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0 1
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CHECKED BY:	KSK
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DATE:	
SCALES: HORIZONTAL	P7
VERTICAL	
SHEET:	12 of 26

EXHIBIT H.1

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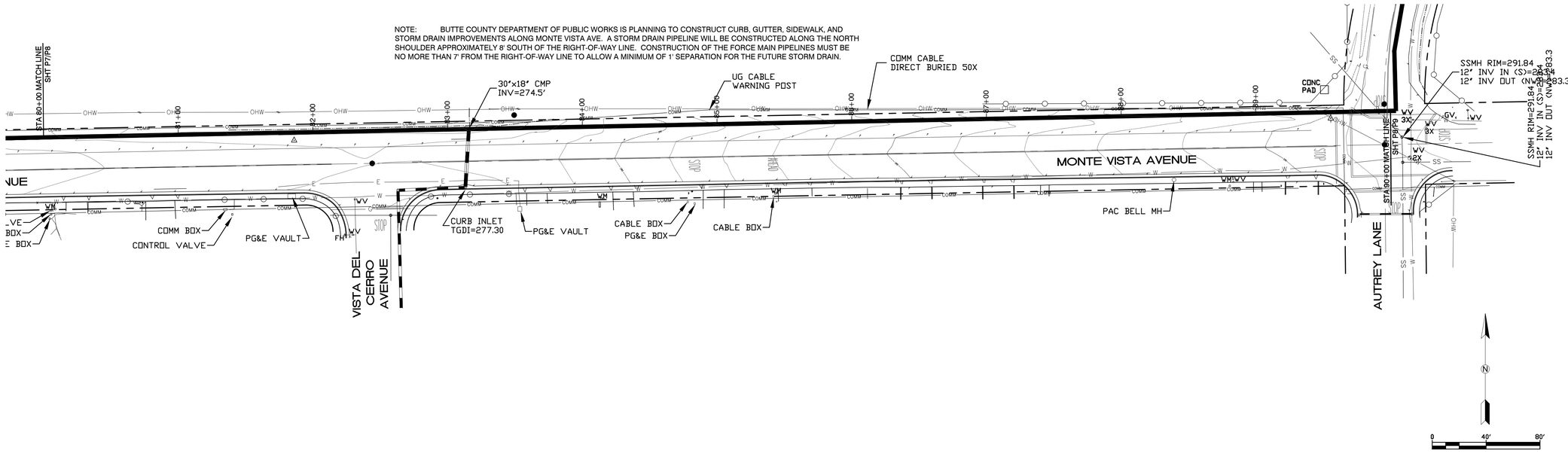

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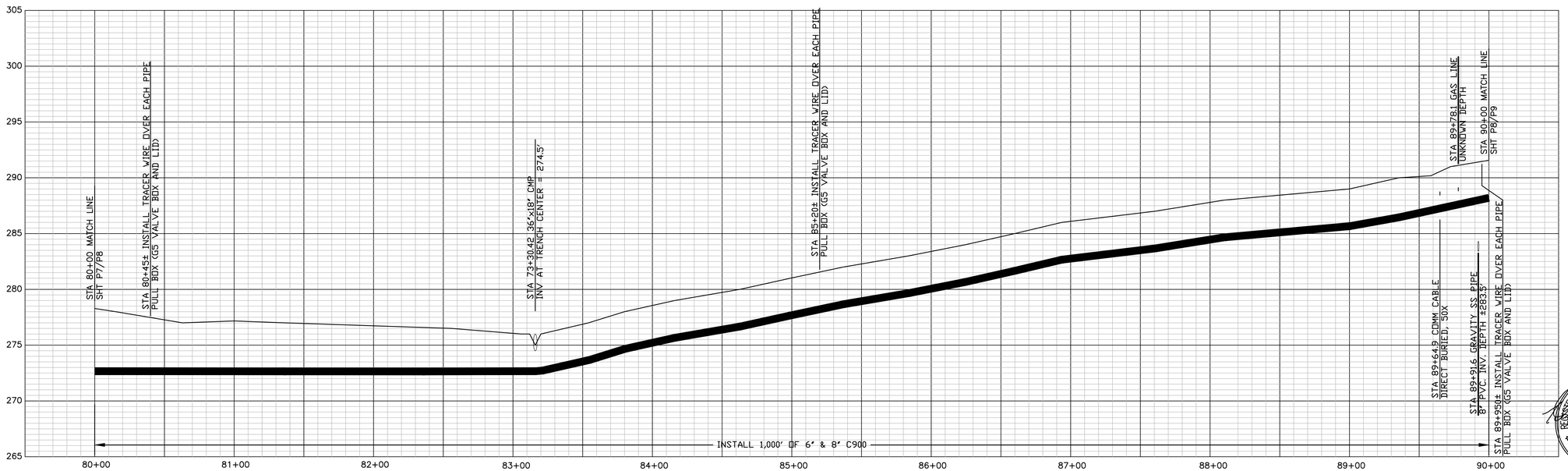

REGISTERED PROFESSIONAL ENGINEER
KEITH S. KNIER
No. C 51290
Exp. 3-31-22
CIVIL
STATE OF CALIFORNIA

04-15-21

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN LIFT STATION AND FORCE MAIN

SEWER FORCE MAINS PLAN & PROFILE STA. 80+00 - 90+00

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0 1
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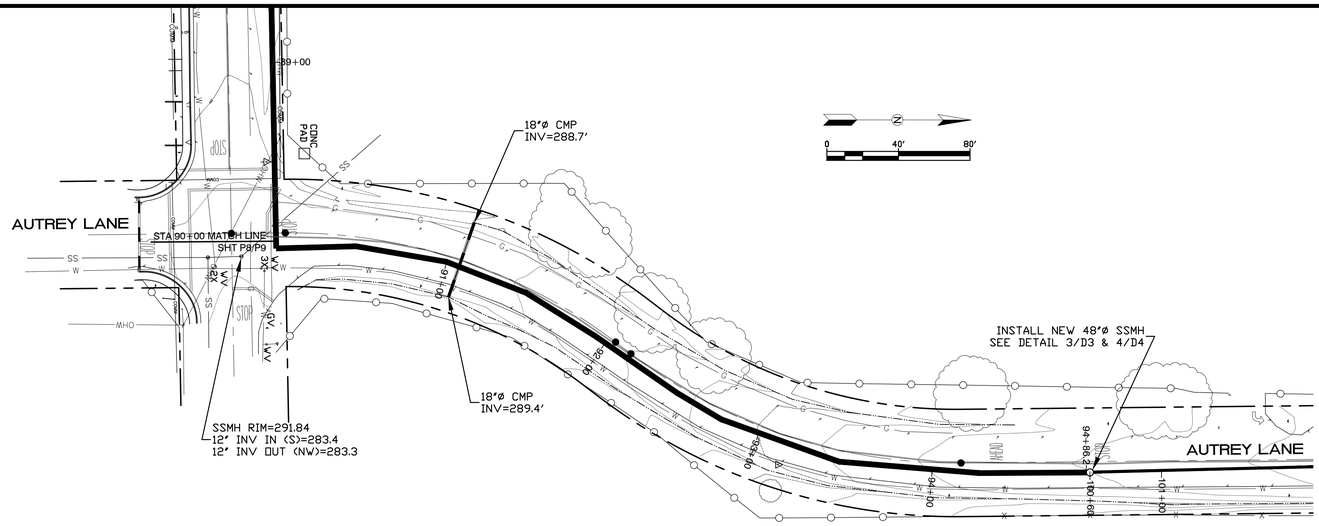
DESIGN BY:	KSK
DRAFTING BY:	KEM
CHECKED BY:	KSK
FILE PATH:	
DATE:	
SCALES: HORIZONTAL	P8
VERTICAL	
SHEET:	13 of 26

EXHIBIT H.1



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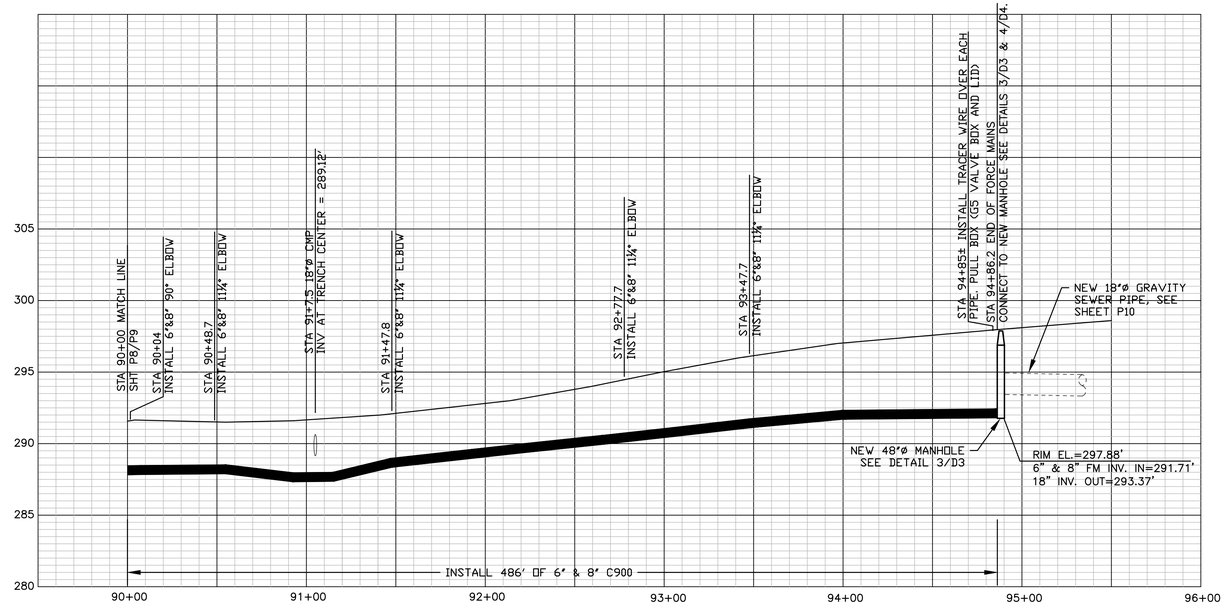

04-15-21

REGISTERED PROFESSIONAL ENGINEER
KEITH S. KNUDSEN
No. C 51290
Exp. 3-31-22
CIVIL
STATE OF CALIFORNIA

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN LIFT STATION AND FORCE MAIN

SEWER FORCE MAINS PLAN & PROFILE STA. 90+00 - 94+32

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
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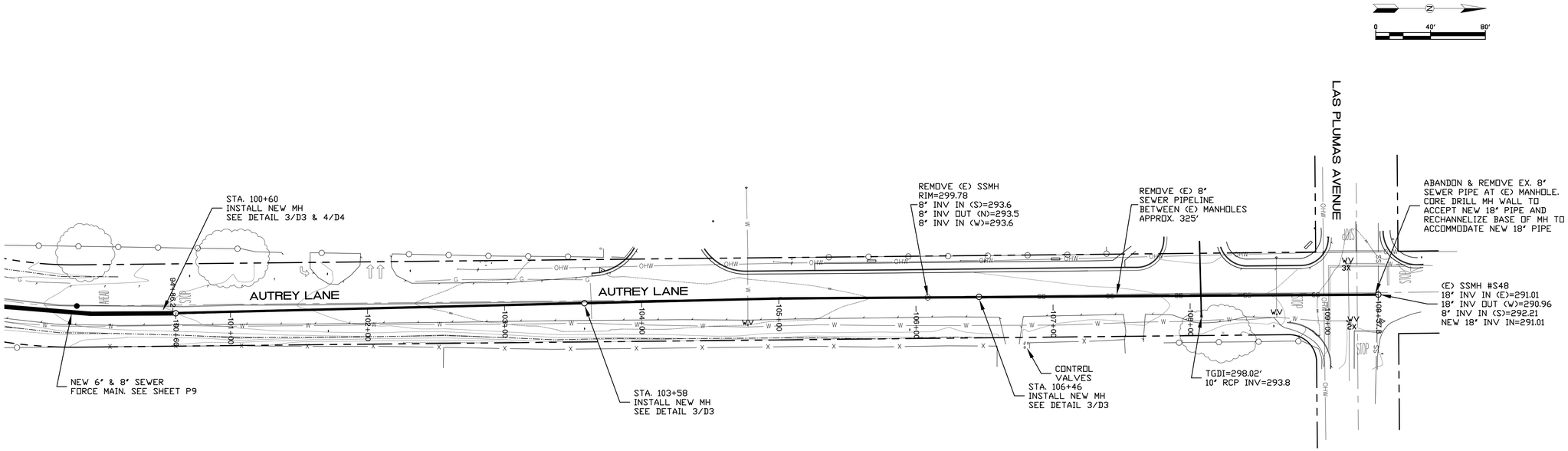
PROJECT NUMBER:	00-001-70
DESIGN BY:	KSK
DRAFTING BY:	KEM
CHECKED BY:	KSK
FILE PATH:	
DATE:	
SCALES: HORIZONTAL	P9
VERTICAL	SHEET: 14 of 26

EXHIBIT H.1



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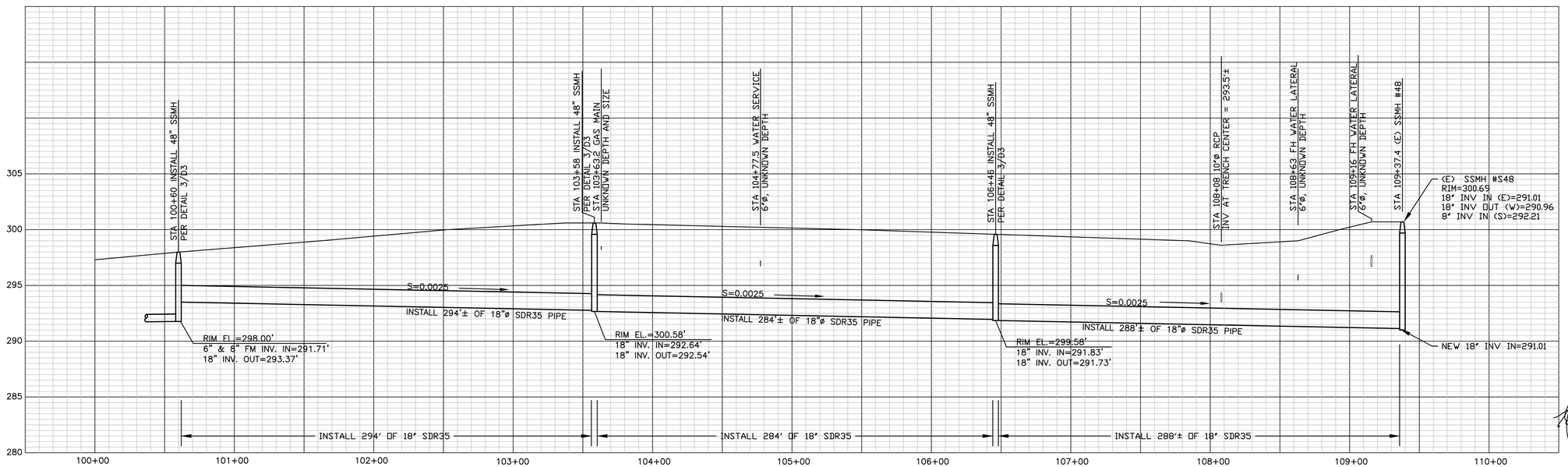

REGISTERED PROFESSIONAL ENGINEER
KEITH SAUERS
No. C 51290
Exp. 3-31-22
CIVIL
STATE OF CALIFORNIA

04-15-21

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN LIFT STATION AND FORCE MAIN

GRAVITY PIPELINE PLAN & PROFILE STA. 100+00 - 109+37

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
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CHECKED BY:	KSK

FILE PATH:

DATE:

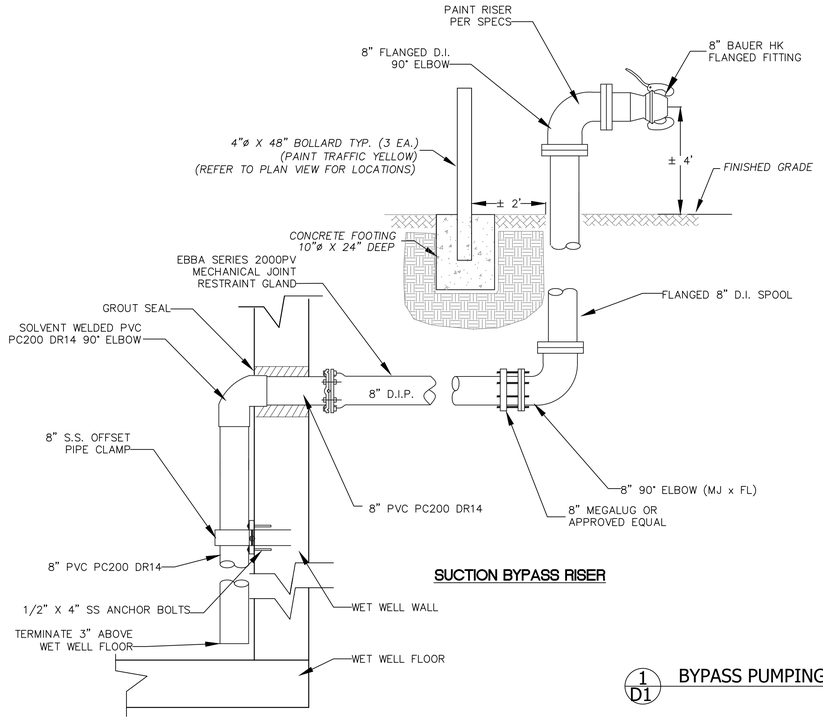
SCALES:

HORIZONTAL

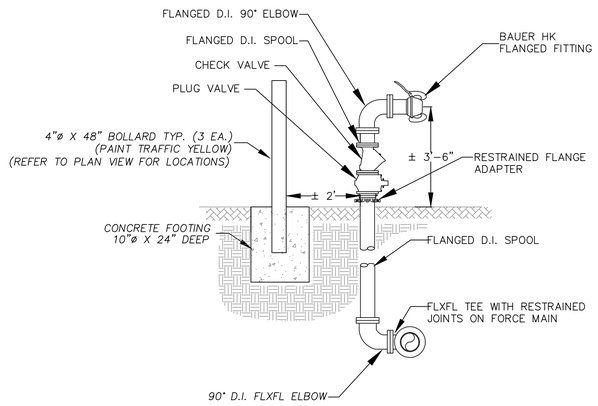
VERTICAL

P10

SHEET: 15 of 26

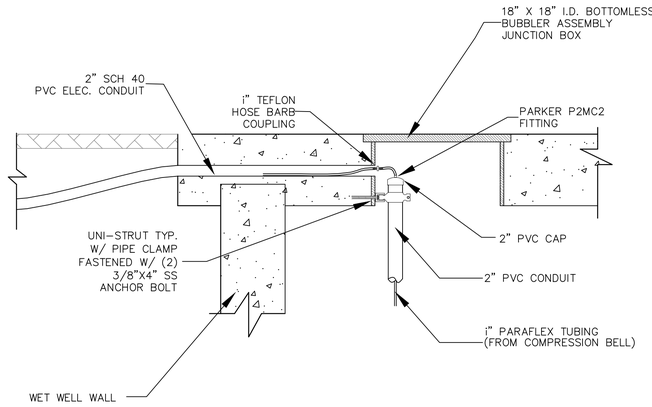


SUCTION BYPASS RISER



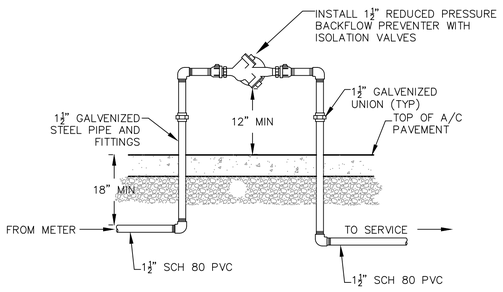
NOTES:
FOR 6" FORCE MAIN USE 6" PIPE, VALVES, AND FITTINGS. FOR 8" FORCE MAIN USE 8" PIPE, VALVES, AND FITTINGS.

DISCHARGE BYPASS RISER/ FM CONNECTION



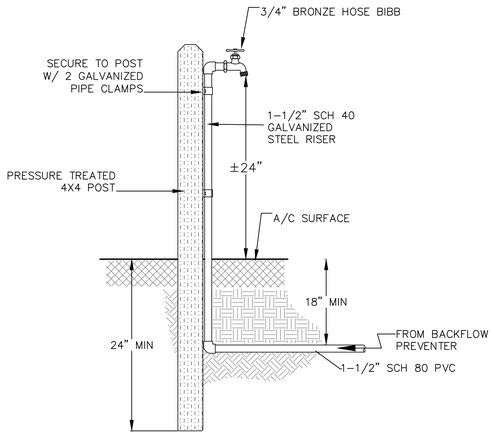
2 / D1 BUBBLER TUBE DETAIL
Scale: N.T.S.

1 / D1 BYPASS PUMPING CONNECTION DETAILS
Scale: N.T.S.



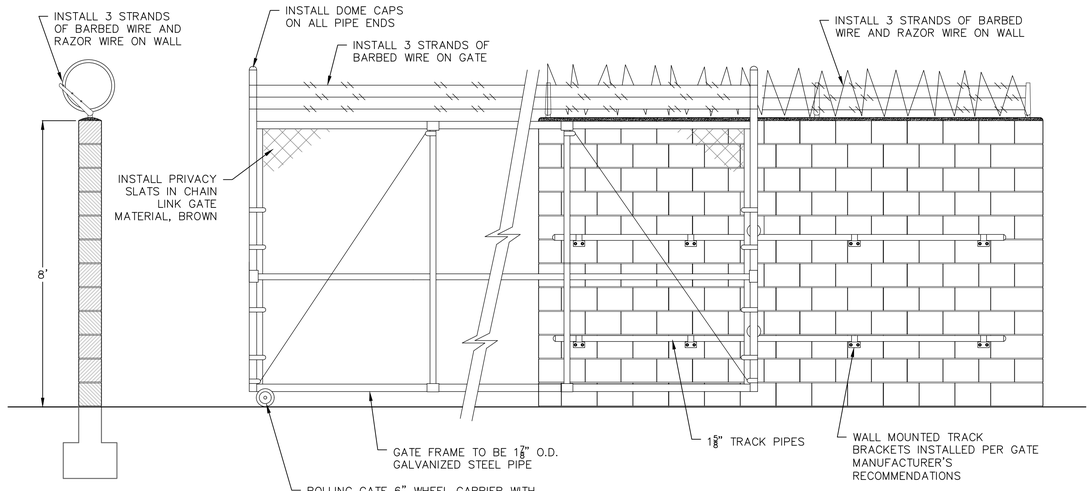
REDUCED PRESSURE BACKFLOW PREVENTER

NOTES:
1. REDUCED PRESSURE BACKFLOW PREVENTER SHALL BE BRONZE BODY WITH QUARTER TURN ISOLATION VALVES, WATTS SERIES 009 OR APPROVED EQUAL.
2. ALL BURIED STEEL PIPES SHALL BE WRAPPED WITH 6 MIL. POLYETHYLENE ENCASEMENT OR 10 MIL POLYETHYLENE TAPE.

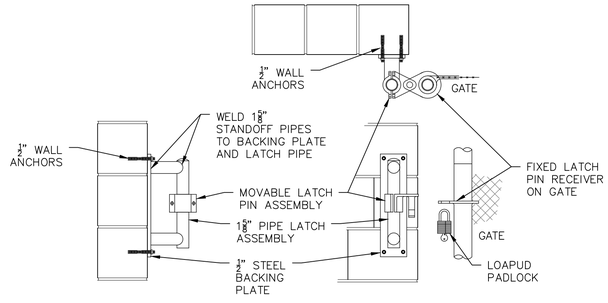


WATER SPIGOT

3 / D1 WATER SERVICE DETAILS
Scale: N.T.S.



4 / D1 ROLLING GATE DETAILS
Scale: N.T.S.



5 / D1 GATE LATCH DETAILS
Scale: N.T.S.

REGISTERED PROFESSIONAL ENGINEER — KEITH S. KNIGHT — No. C 51290 — Exp. 3-31-22 — CIVIL — STATE OF CALIFORNIA

03-15-21

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN
LIFT STATION AND FORCE MAIN

DETAILS 1

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
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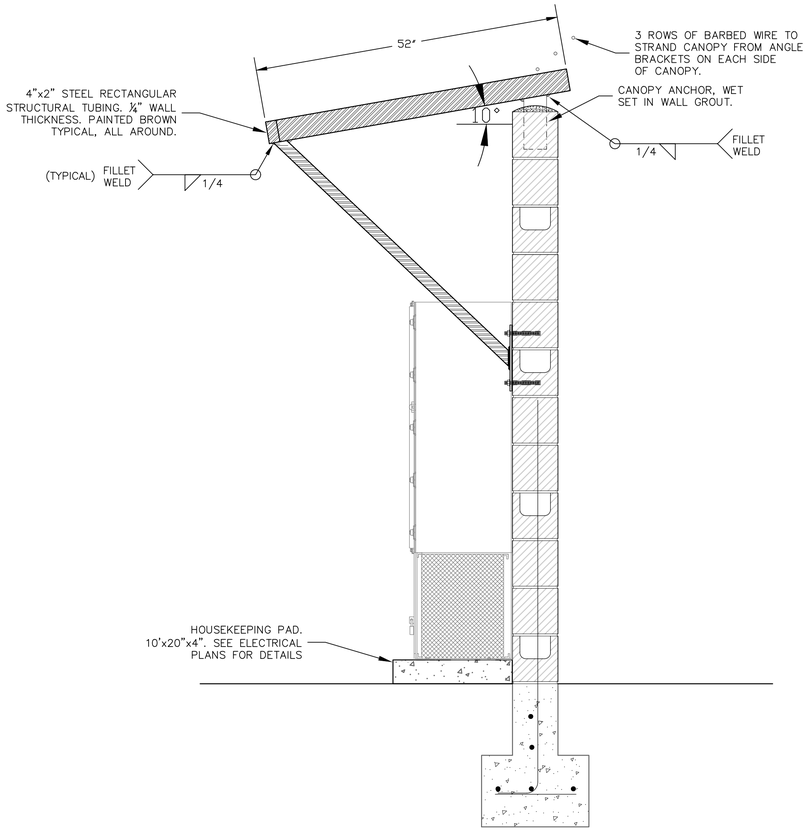
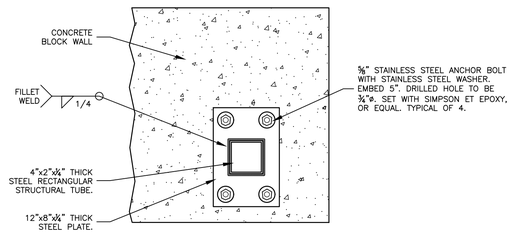
FILE PATH:	
DATE:	
SCALES: HORIZONTAL	D1
VERTICAL	

EXHIBIT H.1



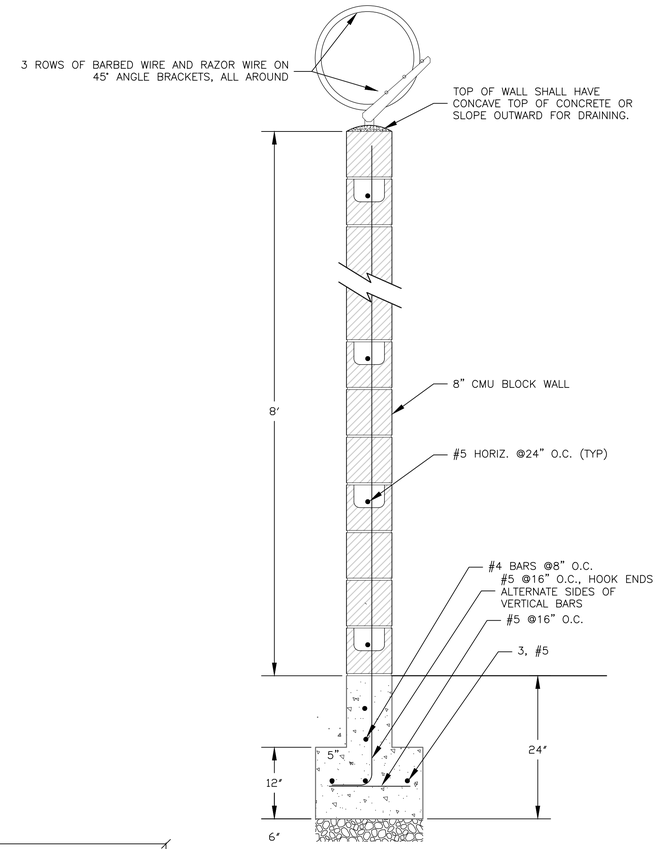
1 D2 ELECTRICAL EQUIPMENT CANOPY DETAILS

Scale: 1"=1'



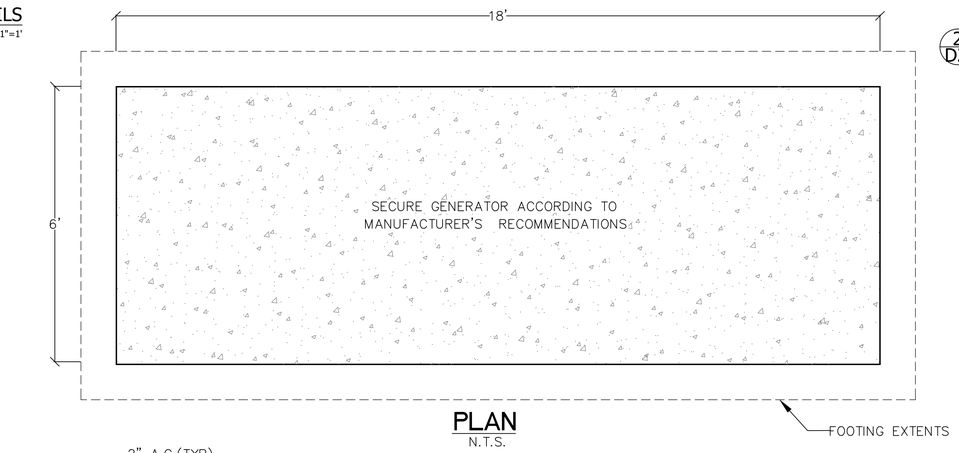
3 D2 CANOPY SUPPORT ARM CONNECTION TO WALL

Scale: N.T.S.



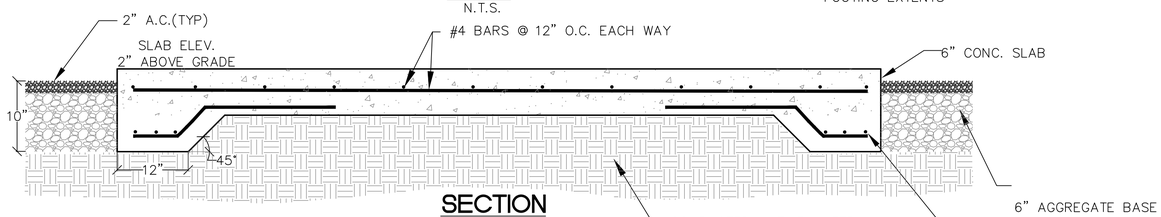
2 D2 CONCRETE SLAB & BLOCK WALL DETAILS

Scale: 1"=1'



PLAN

N.T.S.



SECTION

N.T.S.

4 D2 GENERATOR SLAB DETAIL

Scale: N.T.S.

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN
LIFT STATION AND FORCE MAIN

STRUCTURAL DETAILS

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
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FILE PATH:	
DATE:	
SCALES: HORIZONTAL	D2
VERTICAL	
SHEET:	17 of 26

REGISTERED PROFESSIONAL ENGINEER
KEITH S. KAWABE
No. C 51290
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CIVIL
STATE OF CALIFORNIA

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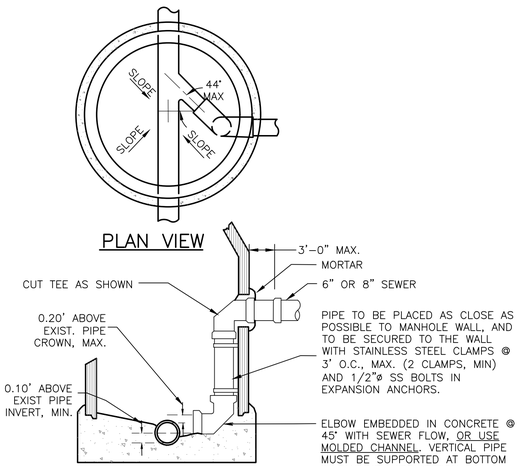
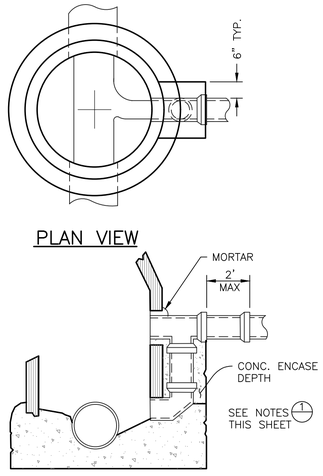
EXHIBIT H.1



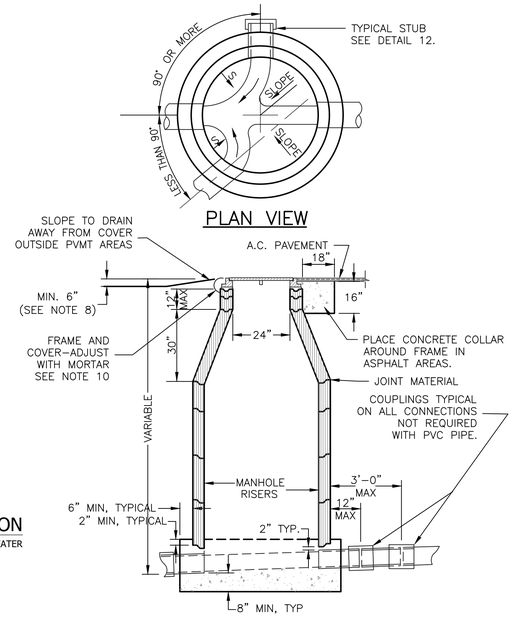
1 D3 INSIDE DROP MANHOLE CONNECTION

SUITABLE FOR P.V.C. INSTALLATION



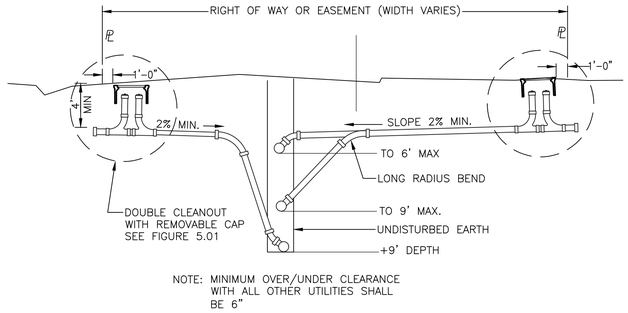
3 D2 OUTSIDE DROP MANHOLE CONNECTION

SUITABLE FOR PIPES 10" OR GREATER



3 D3 STANDARD MANHOLE CONNECTION

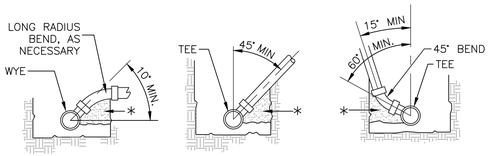
N.T.S.



NOTE: MINIMUM OVER/UNDER CLEARANCE WITH ALL OTHER UTILITIES SHALL BE 6"

4 D3 SEWER SERVICE GEOMETRY

N.T.S.



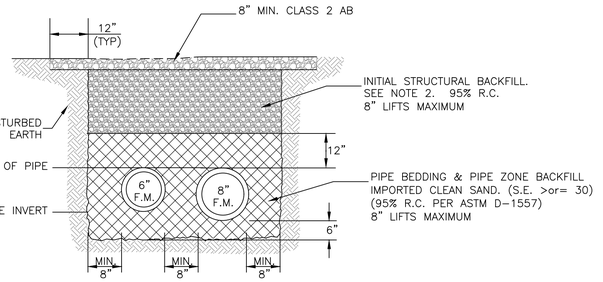
*PLACE WELL COMPACTED BEDDING MATERIAL 18" WIDE UNDER WYE BRANCH, FITTING AND UNSUPPORTED PIPE. WHEN BEDDING MATERIAL IS USED, PLACE ADDITIONAL MATERIAL ON TOP OF BEND, THE FULL WIDTH OF THE TRENCH.

5 D3 CONNECTION DETAILS FOR SEWER LATERALS

N.T.S.

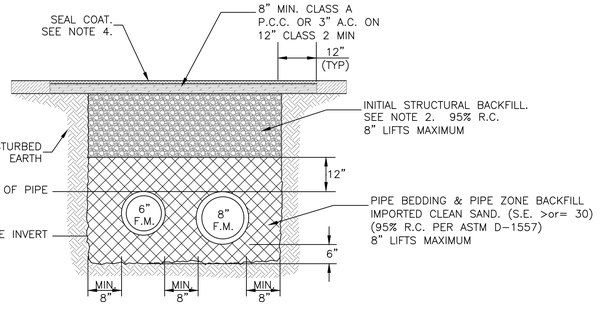
GENERAL NOTES

1. PIPE ZONE BEDDING AND BACKFILL SHALL BE CLEAN SAND, OR IN CASE OF EXCESS WATER IN TRENCH, ¾" PEA GRAVEL. COMPACT SAND BEDDING AT OPTIMUM MOISTURE TO 95% R.C. PER ASTM D-1557.
2. ALL EXCAVATIONS WITHIN PUBLIC RIGHT OF WAY SHALL BE BACKFILLED IN ACCORDANCE WITH SECTION 19-3 OF THE STANDARD SPECIFICATIONS. MIN. SE = 30, 95% R.C. FULL DEPTH.
3. AREAS ADJACENT TO THE TRENCH SHALL BE LEFT IN A CONDITION EQUAL TO OR BETTER THAN THAT EXISTING PRIOR TO CONSTRUCTION.
4. SEAL COAT-BITUMINOUS BINDER SHALL BE COVERED WITH EITHER SAND OR SCREEENINGS TO MATCH EXISTING SURFACE.
5. ASPHALT CONCRETE SHALL BE TYPE "A", ¾" MAXIMUM MEDIUM GRADING.
6. AGGREGATE BASE SHALL BE CLASS 2, ¾" MAXIMUM GRADING.
7. CONNECTIONS OF PIPE TO MANHOLES SHALL UTILIZE A-LOK PIPE OR APPROVED EQUAL. FOR PRECAST BASES, CONNECTION OF THE PIPE TO THE MANHOLE SHALL UTILIZE A RESILIENT CONNECTOR CONFORMING TO ASTM C923 SUCH AS A-LOK, KOR-N-SEAL, OR EQUAL.
8. TEMPORARY CLEAN OUT SHALL BE IDENTICAL TO STANDARD CLEAN OUT ASSEMBLY. TEMPORARY CLEAN OUTS ARE REQUIRED ON ALL SEWERS WHICH HAVE SERVICE LATERALS AND ARE PLANNED FOR EXTENSION IN THE FUTURE. TEPORARY CLEANOUT ASSEMBLYS SHALL INCLUDE LOCATOR WIRE SUFFICIENT FOR DETECTION.
9. A TRENCH PLUG OR DAM OF CLAYEY MATERIAL MAY BE REQUIRED TO SERVE AS A WATERSTOP PREVENTING MOVEMENT OF WATER IN THE TRENCH. LENGTH AND SPECIFIC TYPE OF MATERIAL TO BE SPECIFIED BY L.O.A.P.U.D ENGINEER. CONCRETE EROSION PROTECTION COLLARS MAY BE REQUIRED ON STEEP SLOPES.
10. PIPE SHALL STOP AT INSIDE FACE OF MANHOLE OR SHALL BE CONTINOUS THROUGH MANHOLE. IF PIPE LAID CONTINUOUS, TOP HALF SHALL BE REMOVED AFTER BASE IS POURED.
11. USE OF ECCENTRIC CONES OR SHALLOW (FLAT TOP) MANHOLES SUBJECT TO APPROVAL BY L.O.A.P.U.D. ENGINEER.
12. USE OF PRECAST MANHOLE BASES SUBJECT TO APPROVAL BY L.O.A.P.U.D. ENGINEER. NO FIBERGLASS MANHOLES WILL BE PERMITTED.
13. MANHOLE LIDS SHALL EXTEND 12" ABOVE HIGHWATER LINE WHERE SEWER FOLLOWS DRAINAGE COURSE.
14. COUPLINGS MAY BE FERNCO STRONGBACK RC SERIES OR APPROVED EQUAL. PIPE MAY BE LAID THRU AND CUT BY SAW OR CHAIN TYPE BREAKER AFTER POUR, IN ORDER TO FACILITATE MAINTENANCE OF GRADE DURING POURING OF MANHOLE BASE.
15. MORTAR SHALL BE PLACED OUTSIDE AROUND THE JOINT BETWEEN CASTING AND THE TOP GRADE RING TO FORM ADDITIONAL SUPPORT AGAINST JOINT FRACTURE DO TO VIBRATION.
16. TEST WYES AT PROPERTY LINE ON SERVICE LATERALS SHALL HAVE SUFFICIENT METAL ATTACHED TO CAPS TO PROVIDE FOR DETECTION.
17. ALL CONSTRUCTION TO CONFORM TO L.O.A.P.U.D. STANDARDS.
18. SIX (6) INCHES OF 3/4" CRUSHED GRAVEL BEDDING IS REQUIRED UNDER ALL MANHOLE BASES.
19. STRUCTURAL SECTION ELEMENTS MAY BE INCREASED WHERE REQUIRED BY THE AGENCY HAVING JURISDICTION, DUE TO SOIL CONDITIONS AND TRAFFIC CONSIDERATIONS. THE REPLACEMENT STRUCTURAL SECTION SHALL EQUAL THE EXISTING STRUCTURAL SECTION AS A MINIMUM REQUIREMENT. THE SECTION SHOWN IS AN ABSOLUTE MINIMUM.
20. THE RELATIVE DENSITY REQUIREMENTS FOR ASPHALT RESURFACING ARE AS FOLLOWS: FOR THE TOP 5': 95% UNDER ROADWAY, 95% OUTSIDE OF THE TRAVELED WAY (SUCH AS INTERSECTIONS, CROSSOVERS, TURNOUTS, ETC.), 95% SHOULDER PAVEMENT. FOR 5' BELOW GRADE TO TRENCH BOTTOM: 90% RELATIVE COMPACTION. ALL COMPACTION TESTING IS IN ACCORDANCE WITH ASTM TEST METHOD D-1557.



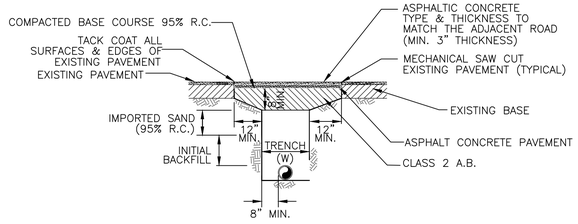
6 D3 TYPICAL SEWER PIPE TRENCH (OUTSIDE OF CO. ROADWAY)

Scale: N.T.S.



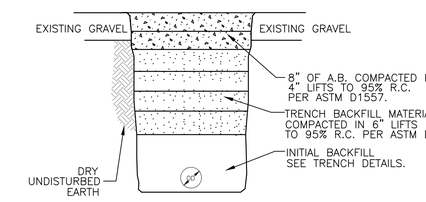
7 D3 TYPICAL SEWER PIPE TRENCH (WITHIN CO. ROADWAY)

Scale: N.T.S.



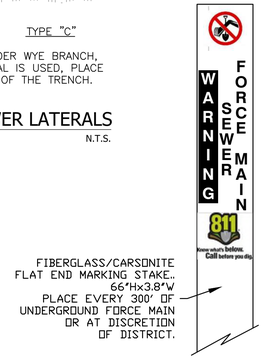
8 D3 TYPICAL A.C. SURFACE RESTORATION

Scale: N.T.S.



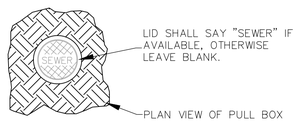
9 D3 GRAVEL SURFACE RESTORATION

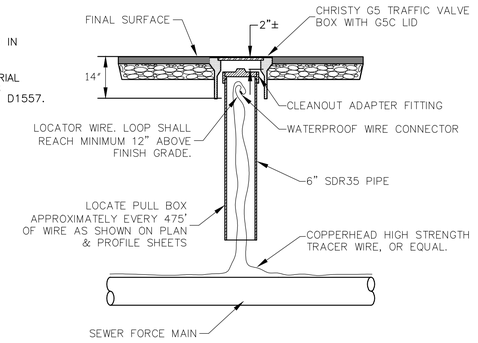
Scale: N.T.S.



11 D3 PIPE MARKING STAKE

Scale: N.T.S.





10 D3 TRACER WIRE PULL BOX DETAIL

Scale: N.T.S.

REGISTERED PROFESSIONAL ENGINEER
KEITH S. KNUDSEN
No. C 51290
Exp. 3-31-22
civil
STATE OF CALIFORNIA

04-15-21

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN
LIFT STATION AND FORCE MAIN

PIPELINE DETAILS 1

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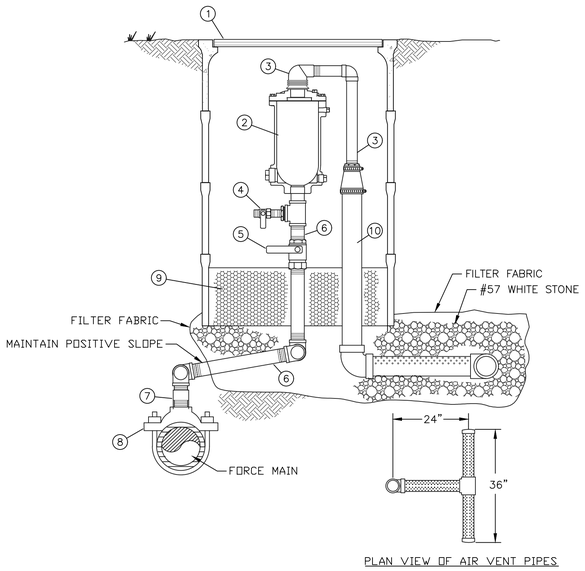
0 1
BAR IS ONE INCH ON ORIG. DRAWING
IF BAR DOES NOT MEASURE ONE INCH, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER:	00-001-70
DESIGN BY:	KSK
DRAFTING BY:	KEM
CHECKED BY:	KSK
FILE PATH:	
DATE:	
SCALES: HORIZONTAL	D3
VERTICAL	
SHEET:	18 of 26



PLAN VIEW OF AIR VENT PIPES

1 D4 AIR RELEASE VALVE DETAIL

Scale: N.T.S.

LIST OF MATERIALS

1. CONCRETE ENCLOSURE WITH EXTENSIONS AS NEEDED. CHRISTY, JENSEN 17x30, WITH TRAFFIC LID
2. WASTEWATER AIR RELEASE VALVE. 2-INCH
3. PVC OUTLET PIPING.. FITTINGS AS REQUIRED TO TERMINATE AT AND CONNECT TO VENT PIPES AS SHOWN.
4. 1-INCH S.S. CURB STOP
5. 2-INCH S.S. BALL VALVE
6. 2-INCH S.S. INLET PIPING. S.S. FITTINGS AS REQUIRED.
7. 2-INCH BRASS CORPORATION STOP
8. 2-INCH S.S. DOUBLE STRAP TAPPING SADDLE
9. ACTIVATED CARBON WRAPPED IN FILTER FABRIC. 9'± DEEP. ENTIRE BOTTOM OF VAULT
10. 3-INCH PVC PIPE
11. 3-INCH PVC PIPE, PERFORATED TOP HALF ONLY
12. 3-INCH PVC CAP

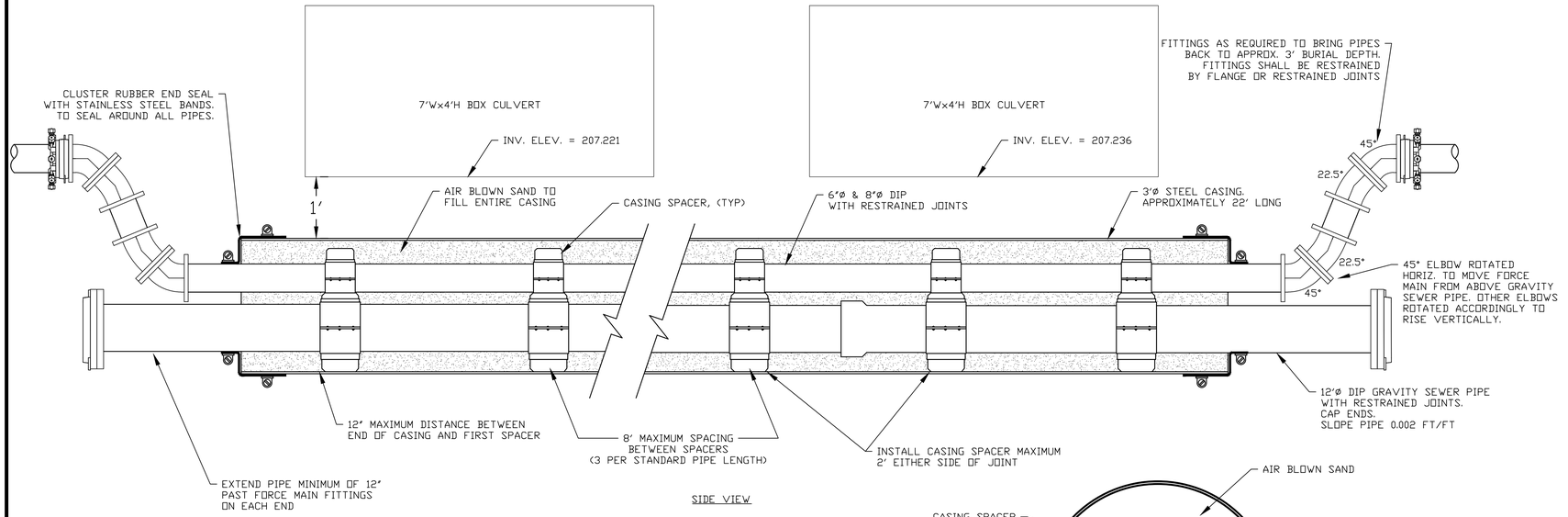
LENGTH TO BE RESTRAINED ON EACH SIDE OF BEND

PIPE SIZE	90° BEND	45° BEND	22.5° BEND	11.25° BEND
6"	38'	16'	8'	4'
8"	49'	21'	10'	5'

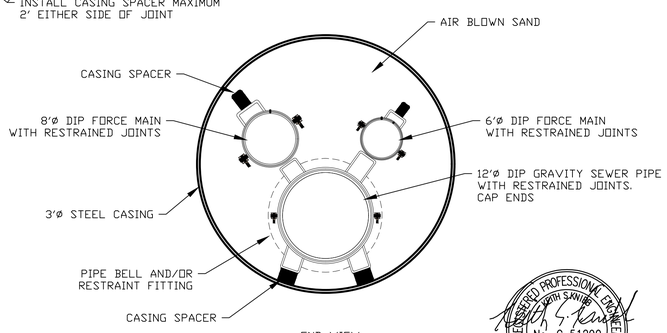
NOTES: (1) ALL JOINTS WITHIN THE CALCULATED LENGTH MUST BE RESTRAINED.
(2) IF DISTANCE BETWEEN FITTINGS IS LESS THAN OR EQUAL TO THE RESTRAINT LENGTH, RESTRAIN ALL JOINTS BETWEEN THOSE FITTINGS.

2 D4 THRUST RESTRAINT SCHEDULE

Scale: N.T.S.



SIDE VIEW



END VIEW

NOTE:

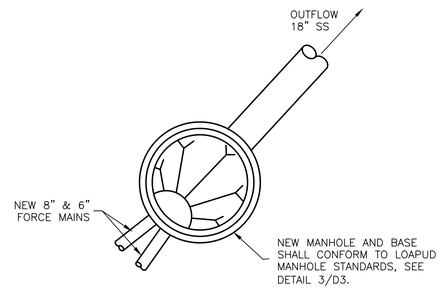
1. SEE ALSO SHEET P1 FOR FURTHER PROFILE LAYOUT OF PIPES UNDER BOX CULVERTS.
2. INSTALL TRACER WIRE OVER BOTH OF THE TWO FORCE MAIN PIPES AND THE GRAVITY PIPE.

3 D4 BOX CULVERT UNDERCROSSING. STA. 14+50 - 14+80

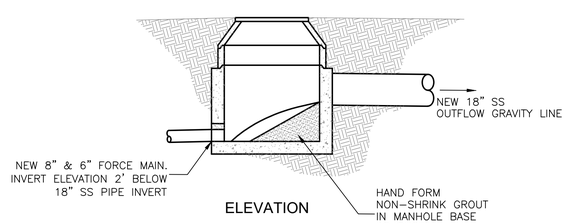
Scale: N.T.S.

REGISTERED PROFESSIONAL ENGINEER
KEITH S. KNUDSEN
No. C 51290
Exp. 3-31-22
CIVIL
STATE OF CALIFORNIA

04-15-21



PLAN VIEW



ELEVATION

4 D4 TERMINAL MANHOLE FM & GRAVITY PIPE LAYOUT. STA 100+50

Scale: N.T.S.

REVISIONS | INITIAL | REV | DATE

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PIPELINE DETAILS 2

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
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PROJECT NUMBER:	00-001-70
DESIGN BY:	KSK
DRAFTING BY:	KEM
CHECKED BY:	KSK
FILE PATH:	
DATE:	
SCALES: HORIZONTAL	D4
VERTICAL	SHEET: 19 of 26

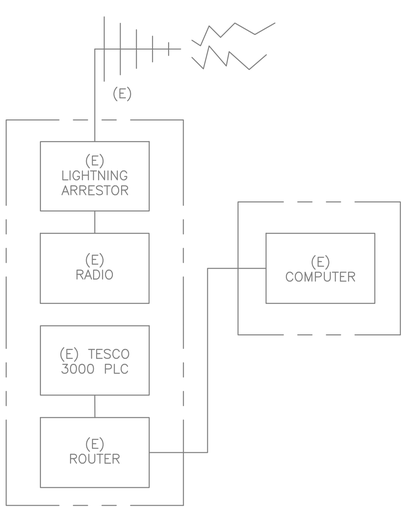
EXHIBIT H.1

SYMBOLS

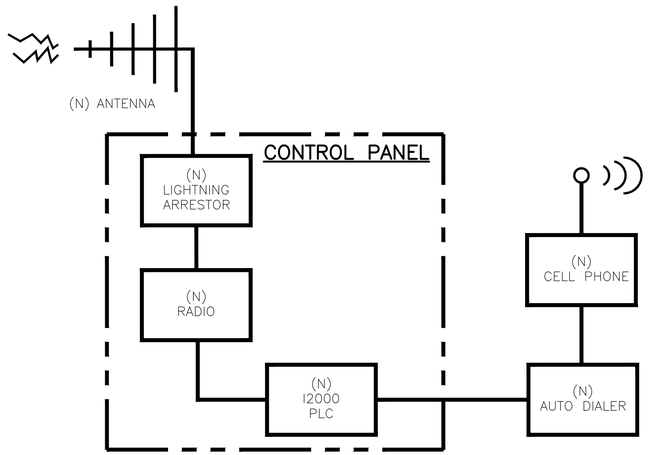
SYMBOL	DESCRIPTION
A	LIGHTING FIXTURE SYMBOL
	PANELBOARD
	CONTROL PANEL
	SWITCHBOARD
PFR	PHASE FAILURE RELAY
TM	ELAPSED TIME METER
	CONTROL STATION (SEE WIRING DIAGRAMS) COMBINATION STARTER
LOS	LOCK–OFF–STOP SELECTOR SWITCH
	TRANSFORMER
	CONTROL POWER TRANSFORMER
	CURRENT TRANSFORMER
M	METER & CURRENT TRANSFORMER
	SELECTOR SWITCH
TDD	TIME DELAY RELAY
TC	7 DAY, 24 HOUR TIME CLOCK
CR	CONTROL RELAY
R	INDUSTRIAL RELAY (MACHINE TOOL)
ISR	INTRINSICALLY SAFE RELAY
	TERMINAL BLOCK POINT
	WARNING LIGHT
	POLE MOUNTED LIGHT FIXTURE
$a	SINGLE POLE TOGGLE SWITCH, SWITCHING FIXTURES DENOTED
$3	THREE WAY TOGGLE SWITCH
$T	THERMAL MANUAL STARTER
	DUPLEX CONVENIENCE OUTLET
	20A, 220V RECEPTACLE OUTLET
	FOURPLEX CONVENIENCE RECEPTACLE OUTLET 20A, 125V
	DUPLEX CONVENIENCE OUTLET, HALF SWITCHED
	MOUNT OUTLET OR SWITCH ABOVE COUNTER OR BACKSPLASH
	EMERGENCY LIGHT

SYMBOL	DESCRIPTION
J	JUNCTION BOX
	GROUND
T	THERMOSTAT
	MOTOR, HORSEPOWER SIZE NOTED
M	MOTOR STARTER CONTRACTOR COIL
	DISCONNECT SWITCH – NON FUSED
F	DISCONNECT SWITCH – FUSED
	DISCONNECT SWITCH
	DISCONNECT SWITCH WITH START PB LOS & AUX CONTACT
5A	INDICATION FUSE HOLDER AMPERE SIZE SHOWN
5A	FUSE, AMPERE SIZE SHOWN
	CONDUIT RUN ON/IN WALL OR CEILING
	CONDUIT RUN UNDER FLOOR/GROUND
	DENOTES NUMBER OF #12 WIRES. NO MARKS = 3/4"C, 2 #12
	DENOTES WIRE FOR GROUND FAULT CIRCUIT INTERRUPTER OR GROUND
	CIRCUIT RUN DIRECT TO DESTINATION
	SEAL–OFF FITTING
	WIRES CONNECTED
	WIRES NOT CONNECTED
	CONDUIT CROSSING NOT CONNECTED
G	GROUND BUS
N	NEUTRAL BUS
	POLE MOUNTED FLOODLIGHTS
PB	PULL BOX
	LIGHT FIXTURE
	NIGHT LIGHT FIXTURE

SYMBOL	DESCRIPTION
	CONTACT NORMALLY OPEN
	CONTACT NORMALLY CLOSED
OL	OVERLOAD DEVICE CONTACT
OL	OVERLOAD DEVICE ELEMENT
	DISCONNECT SWITCH
W	WHITE PILOT LIGHT
	ANTENNA MAST
	GROUND ROD
	NAMEPLATE
P12A	CONDUIT
AE	ANALYZER ELEMENT
FE	FLOW ELEMENT
FIT	FLOW INDICATOR TRANSMITTER
FS	FLOW SWITCH
LE	LEVEL ELEMENT
LIT	LEVEL INDICATOR TRANSMITTER
LSH	LEVEL SWITCH HIGH
LSL	LEVEL SWITCH LOW
LT	LEVEL TRANSMITTER
PI	PRESSURE INDICATOR
PSH	PRESSURE SWITCH HIGH
PIT	PRESSURE INDICATOR TRANSMITTER
PEC	PHOTOELECTRIC SENSOR
ZS	LIMIT/INTRUSION SWITCH



(E) CORP YARD



(N) RTU

ABBREVIATIONS

A	AMPERES
ABF	ABOVE FINISHED FLOOR
ABG	ABOVE FINISHED GRADE
AI	ANALOG INPUT
AIC	AMPS INTERRUPTING CAPACITY
AO	ANALOG OUTPUT
ATS	AUTOMATIC TRANSFER SWITCH
BC	BARE COPPER
C	CONDUIT
CB	CIRCUIT BREAKER
CNTL	CONTROL
CONC	CONCRETE
CP	CONTROL PANEL
CPT	CONTROL POWER TRANSFORMER
CR	CONTROL RELAY
CU	COPPER
DI	DIGITAL INPUT
DIA	DIAMETER
DO	DIGITAL OUTPUT
(E)	EXISTING
EQ	EQUALIZATION
ETM	ELAPSED TIME METER
EYS	CATALOG NUMBER OF TYPICALGAS TIGHT CONDUIT SEAL
(F)	FUTURE
F	FUSE, FILTER
G	GROUND
GEN	GENERATOR
GFI	GROUND FAULT CIRCUIT INTERRUPTER
HPS	HIGH PRESSURE SODIUM
ID	INSIDE DIMENSION
INST	INSTANTANEOUS
ISR	INTRINSICALLY SAFE RELAY
JB	JUNCTION BOX
KVA	KILOVOLT AMPERES
KW	KILOWATT
LA	LIGHTNING ARRESTER
LCP	LOCAL CONTROL PANEL
LGT	LIGHT
LOS	LOCK OFF STOP PUSH BUTTON
LPU	LINE PROTECTION UNIT
mA	MILLIAMPERES
MC	MOTOR CONTROLS
MCC	MOTOR CONTROL CENTER
MCP	MOTOR CIRCUIT PROTECTOR
MFG	MANUFACTURER
MIN	MINIMUM
MOT	MOTOR OVER TEMPERATURE SENSOR
MT	EMPTY CONDUIT (W/ PULLROPE)
(N)	NEW
N	NEUTRAL
N.I.C.	NOT IN CONTRACT
N/A	NOT APPLICABLE
NA	NON AUTOMATIC
No.	NUMBER
NP	NAMEPLATE
NTS	NOT TO SCALE
OI	OPERATOR INTERFACE
OL	OVERLOAD DEVICE
PB	PULLBOX
PCRSC	RIGID STEEL PVC COATED
PFR	POWER FAILURE RELAY
PLC	PROGRAMMABLE CONTROLLER
PM	POWER MONITOR
PNL	PANEL
POC	POINT OF CONNECTION
PS	PUMP STATION
PTT	PUSH TO TEST
PWR	POWER
(R)	EXISTING TO BE REMOVED OR RELEASED
R	RED
REINF	REINFORCEMENT
RSC	RIGID STEEL CONDUIT
SB	SPLICE BOX
SP	SOLENOID PANEL
SPD	SURGE PROTECTION DEVICE
SV	SOLENOID VALVE
SW	SWITCH
SZ	SIZE
TB	TERMINAL BOX
TC	TIME CLOCK
TD	TIME DELAY RELAY
TM	THERMAL MAGNETIC
TSP	TWISTED SHIELDED PAIR
TYP	TYPICAL
UON	UNLESS OTHERWISE NOTED
UPS	UNINTERRUPTIBLE POWERSUPPLY
V	VOLTS, VOLTAGE
W/	WITH
WP	WEATHERPROOF
WW	WET WELL
XFMR	TRANSFORMER

UTILITY SERVICE NOTES

CONTRACTOR SHALL INCLUDE IN HIS BID ALL COSTS FOR UTILITY WORK SHOWN ON THE PLANS. FEES FOR NEW SERVICE WILL BE PAID BY THE OWNER. ALL WORK REQUIRED FOR UTILITY SERVICES SHALL BE IN ACCORDANCE WITH THE CONSTRUCTION DOCUMENTS, SPECIFICATIONS DRAWINGS AND AS REQUIRED BY THE UTILITY COMPANIES.

COORDINATE REQUIREMENTS WITH:

POWER COMPANY: PG&E

UTILITY ENGINEER: STEVE KRINSKY
NOR–COAST UTILITY DESIGN, INC.
771 JONI CT, WINDSOR, CA 95492
707–838–4492

	PROVIDED BY CONTRACTOR	OTHERS
PRIMARY CONDUIT	X	
PRIMARY CONDUCTOR & TERMINATIONS		X
TRANSFORMER PAD, BOLLARDS & GROUND ROD	X	
TRANSFORMER		X
SECONDARY CONDUIT	X	
SECONDARY CONDUCTORS		X
METER ENCLOSURE	X	
METER & CTS		X

NOTE:
FINAL COORDINATION W/ PG&E HAS NOT BEEN COMPLETED AND IS THE CONTRACTORS RESPONSIBILITY.

04/22/2021

ECS
ECS Engineering, Inc.
916-718-3686
samterry@earthlink.net

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN
LIFT STATION AND FORCE MAIN

ELECTRICAL SYMBOLS, ABBREVIATIONS AND NOTES

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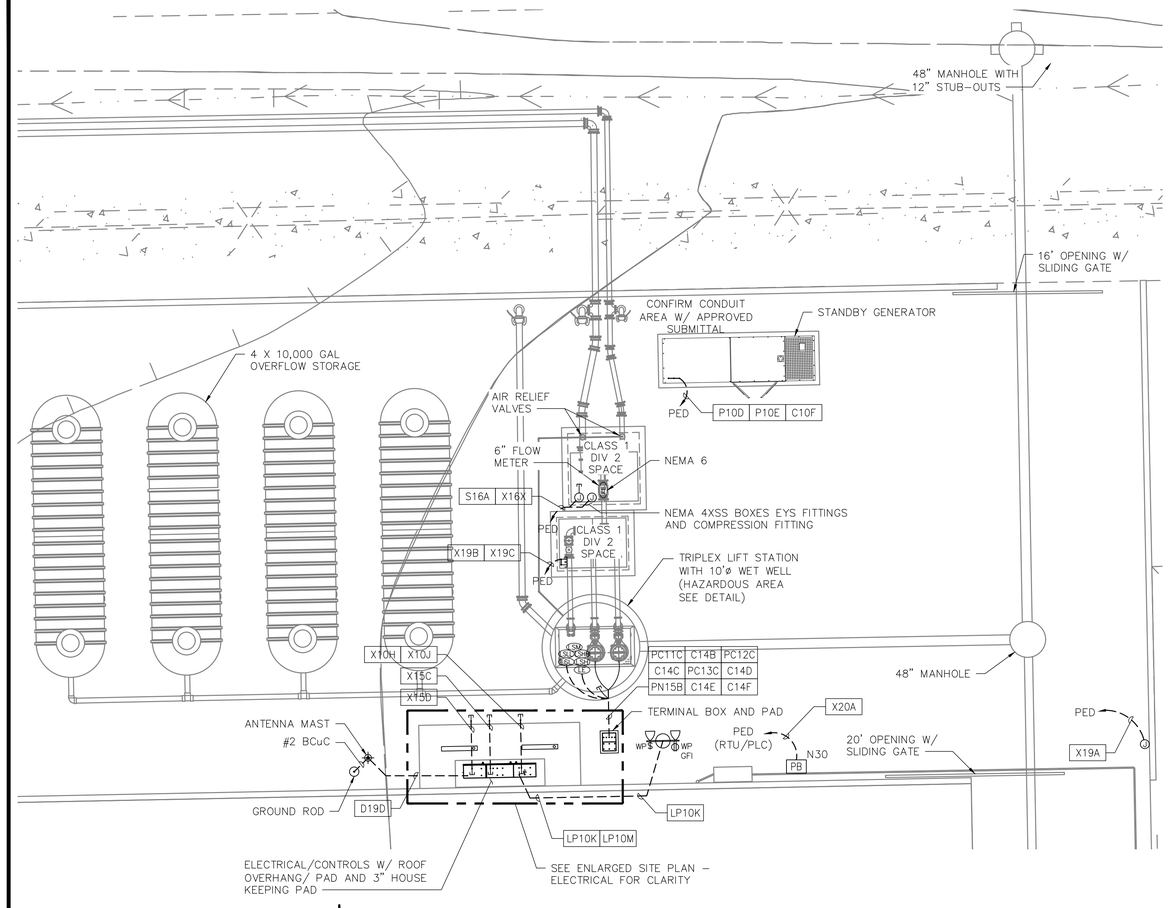
PROJECT NUMBER:	17-012-00
DESIGN BY:	SWT
DRAFTING BY:	CCE
CHECKED BY:	SWT
FILE PATH:	
DATE:	April 21, 2021
SCALES: HORIZONTAL	NA
VERTICAL	NA

E1

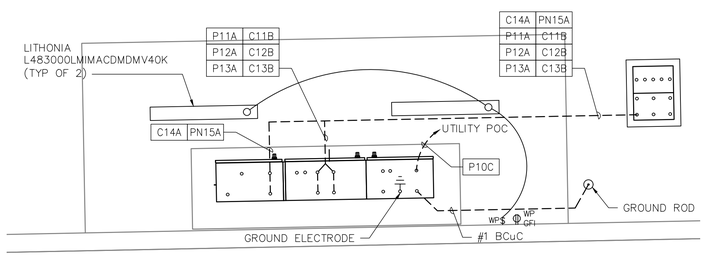
SHEET: 20 of 26

EXHIBIT H.1



SITE PLAN – ELECTRICAL

SCALE: 1/8" =1'–0"



ENLARGED SITE PLAN – ELECTRICAL

SCALE: 3/8" =1'–0"

CONDUIT SCHEDULE

CONDUIT NUMBER	CONDUIT SIZE	RUN FROM	RUN TO	EQUIP SERVED	CKT TYPE	CKT VOLTS	NO CKT WIRES	CKT TYPE WIRE	CKT WIRE SIZE	GND TYPE WIRE	GND WIRE SIZE	NOTES
P10A	4	PG&E POC	PG&E TRANSFORMER	PUMP STATION	P		1	Pullrope				PROVIDE PER UTILITY CO - PRIMARY
P10B	4	PG&E POC	PG&E TRANSFORMER	PUMP STATION	P		1	Pullrope				PROVIDE PER UTILITY CO - SPARE
P10C	3	PEDESTAL	PG&E TRANSFORMER	PUMP STATION	P	480	1	Pullrope				PROVIDE PER UTILITY CO - SECONDARY
P10D	2	PEDESTAL	GENERATOR	PUMP STATION	P	480	4	THWN	2/0	THWN	4	GENERATOR POWER
P10E	2	PEDESTAL	GENERATOR	PUMP STATION	P	240	4	THWN	10	THWN	2X12	GENERATOR AUX POWER
C10F	2	PEDESTAL	GENERATOR	PUMP STATION	P	24	2	THWN	12	THWN	12	GENERATOR CALL
X10H	2	PEDESTAL	STUB-OUT	SPARE	X		1	Pullrope				CAP FOR FUTURE USE
X10J	1	PEDESTAL	STUB-OUT	SPARE	X		1	Pullrope				CAP FOR FUTURE USE
LP10K	1	PEDESTAL	SITE LIGHT	LIGHT & RECPT	P	120	4	THWN	10	THWN	12	SITE LIGHT AND RECEPTACLE
LP10M	1	PEDESTAL	OVERHANG LIGHTS	LIGHT & RECPT	P	120	4	THWN	10	THWN	12	OVERHANG LIGHTS AND RECEPTACLE
P11A	1-1/2	PEDESTAL	TERMINAL BOX	PUMP NO. 1	P	480	3	THWN	6	THWN	8	PUMP POWER FEEDERS
C11B	3/4	PEDESTAL	TERMINAL BOX	PUMP NO. 1	C	120	5	THWN	14	THWN	14	MOISTURE AND TEMP SENSORS
PC11C	2	PUMP NO. 1	TERMINAL BOX	PUMP NO. 1	P	480	1	PUMP	CABLE			MFG PROVIDED CABLES, COIL EX CABLE
P12A	1-1/2	PEDESTAL	TERMINAL BOX	PUMP NO. 2	P	480	3	THWN	6	THWN	8	PUMP POWER FEEDERS
C12B	3/4	PEDESTAL	TERMINAL BOX	PUMP NO. 2	C	120	5	THWN	14	THWN	14	MOISTURE AND TEMP SENSORS
PC12C	2	PUMP NO. 2	TERMINAL BOX	PUMP NO. 2	P	480	1	PUMP	CABLE			MFG PROVIDED CABLES, COIL EX CABLE
P13A	1-1/2	PEDESTAL	TERMINAL BOX	(F) PUMP NO. 3	P	480	1	Pullrope				CAP FOR FUTURE USE
C13B	3/4	PEDESTAL	TERMINAL BOX	(F) PUMP NO. 3	C	120	1	Pullrope				CAP FOR FUTURE USE
PC13C	2	WET WELL	TERMINAL BOX	(F) PUMP NO. 3	P	480	1	Pullrope				CAP FOR FUTURE USE
C14A	1	PEDESTAL	TERMINAL BOX	LEVEL SWITCH	C	120	10	THWN	14	THWN	14	VIA JUNCTION/TERMINAL BOX
C14B	1-1/4	LEVEL SW	TERMINAL BOX	LEVEL SWITCH	C	24	1	CABLE				MFG PROVIDED CABLE
C14C	1-1/4	LEVEL SW	TERMINAL BOX	LEVEL SWITCH	C	24	1	CABLE				MFG PROVIDED CABLE
C14D	1-1/4	LEVEL SW	TERMINAL BOX	LEVEL SWITCH	C	24	1	CABLE				MFG PROVIDED CABLE
C14E	1-1/4	LEVEL SW	TERMINAL BOX	LEVEL SWITCH	C	24	1	CABLE				MFG PROVIDED CABLE
C14F	1-1/4	LEVEL SW	TERMINAL BOX	LEVEL SWITCH	C	24	1	CABLE				MFG PROVIDED CABLE
PN15A	1	PEDESTAL	UG PULLBOX	LEVEL ELEMENT	PN		1	TUBING				REACTIVE AIR TUBING
PN15B	1-1/4	LEVEL ELEMENT	UG PULLBOX	LEVEL ELEMENT	PN		1	TUBING				REACTIVE AIR TUBING
X15C	1	PEDESTAL	STUB-OUT	FUTURE	X		1	Pullrope				CAP FOR FUTURE USE
X15D	1	PEDESTAL	STUB-OUT	FUTURE	X		1	Pullrope				CAP FOR FUTURE USE
S16A	1	PEDESTAL	FLOWMETER	FLOWMETER	S	24	1	CABLE				FLOW ELEMENT SIGNAL
X16B	3/4	PEDESTAL	FLOWMETER VAULT	SPARE	X		1	Pullrope				CAP FOR FUTURE USE
X19A	1-1/4	PEDESTAL	GATE	FUTURE	X		1	Pullrope				CAP FOR FUTURE USE
X19B	1-1/4	PEDESTAL	VALVE VAULT	FUTURE	X		1	Pullrope				CAP FOR FUTURE USE
X19C	1	PEDESTAL	VALVE VAULT	FUTURE	X		1	Pullrope				CAP FOR FUTURE USE
D19D	2	PEDESTAL	ANTENNA MAST	PLC/RTU	D		1	COAX				RADIO ANTENNA CABLE
X20A	2	PEDESTAL	STUB-OUT	FUTURE	X		1	Pullrope				CAP FOR FUTURE USE

IDENTIFIES THE TYPE OF CIRCUIT BEING SERVICED

C=	CONTROL
S=	INSTRUMENT SIGNAL
P=	POWER
D=	DATA
X=	SPARE

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN
LIFT STATION AND FORCE MAIN

ELECTRICAL SITE PLAN AND CONDUIT SCHEDULE

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
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tel (530) 265-8021 www.sauerseng.com

REGISTERED PROFESSIONAL ENGINEER
No.14638
Exp.12-31-22
ELECTRICAL
STATE OF CALIFORNIA
04/22/2021

ECS
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916-718-3686
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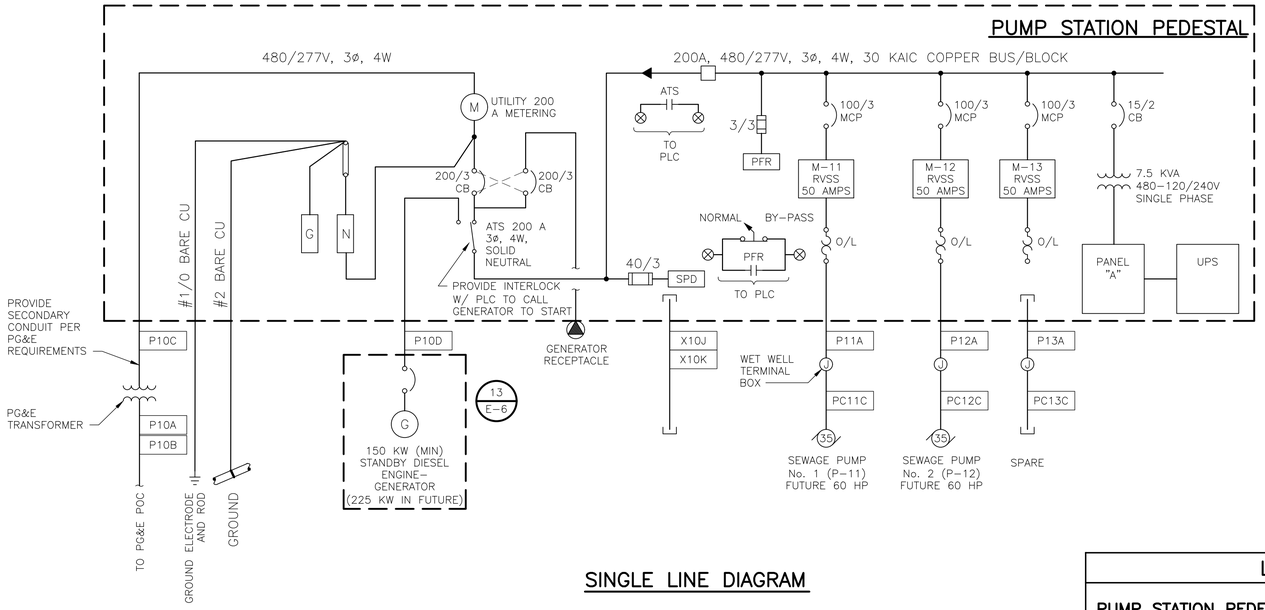
0 1
BAR IS ONE INCH ON ORIG. DRAWING
IF BAR DOES NOT MEASURE ONE INCH, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER:	17-012-00
DESIGN BY:	SWT
DRAFTING BY:	CCE
CHECKED BY:	SWT
FILE PATH:	
DATE:	April 21, 2021
SCALES:	
AS NOTED HORIZONTAL	E2
NA VERTICAL	SHEET: 21 of 26

EXHIBIT H.1



SINGLE LINE DIAGRAM

PANEL "A"

10 KAIC

VOLTAGE: 120/240 | MOUNTING: PEDESTAL | KVA: 4.5
BUS: 50 AMP | TYPE: 40/2 MCB | CURRENT: 20.0 AMPS

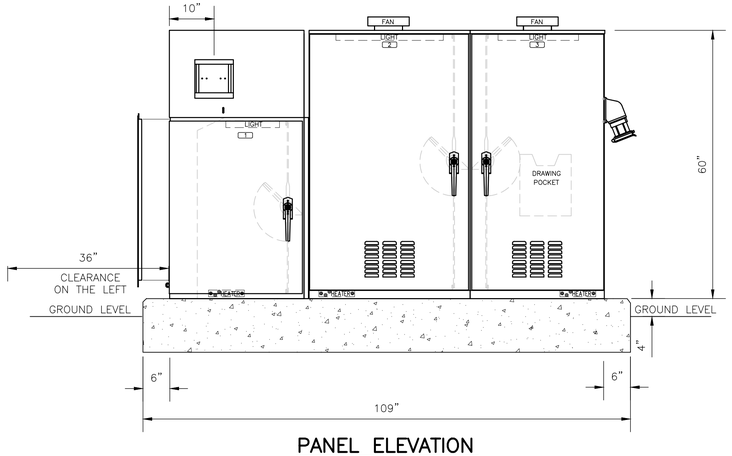
LOAD	KVA	CB	NO	NO	CB	KVA	LOAD
UPS RECEPTACLE-CONTROLS	1.00	20	1	2	20	0.50	PEDESTAL LIGHTS,HEATER & FAN
SPARE	0.00	20	3	4	20	0.20	PEDESTAL RECEPTACLES
GENERATOR BATTERY CHARGER	0.80	20	5	6	20	0.00	SITE RECEPTACLE
FLOW METER	0.05	20	7	8	20	0.30	SITE LIGHTS
GENERATOR HEATER	0.60	20	9	10	20	0.00	SPARE
GENERATOR HEATER	0.60	2	11	12	20	0.00	SPARE

LOAD CALCULATION

PUMP STATION PEDESTAL	UTILITY	GEN	STEP	FUTURE
PUMP NO. 1 (P-11)	46.0 AMPS	46.0 AMPS	3	125.0 AMPS
PUMP NO. 2 (P-12)	46.0 AMPS	46.0 AMPS	2	77.0 AMPS
PANEL	10.0 AMPS	10.0 AMPS	1	10.0 AMPS
25% OF LARGEST MOTOR	11.5 AMPS	0.0 AMPS		0.0 AMPS
TOTAL LOAD (102.6 KVA @ 480 V) FUTURE PUMP No. 3 IS STANDBY	113.5 AMPS	102.0 AMPS		212.0 AMPS

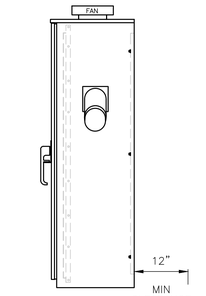
NAMEPLATE SCHEDULE

No.	LETTER SIZE	INSCRIPTION
1	1/4"	PUMP STATION PEDESTAL
2		SERVICE DISCONNECT
3		TRANSFER SWITCH
4		GENERATOR RECEPTACLE
5		SURGE PROTECTION DEVICE
6		POWER MONITOR
7		PUMP NO. 1
8		PUMP NO. 2
9		PUMP NO. 3
10		TRANSFORMER A
11		PANEL "A"
12	1/8"	HAND OFF AUTO
13		RUN
14		OVER TEMP
15		FAIL
16		SEAL FAIL
17		CONTROL POWER
18		CONTROL PANEL
19		OPERATOR INTERFACE
20		RADIO
21		BATTERY CHARGER
22		PFR NORMAL BY-PASS
23		ENGINE HEATER
24		ALARM LIGHT
25		HIGH LEVEL ALARM
26		LOW LEVEL ALARM
27		FLOW METER
28		AUTODIALIER

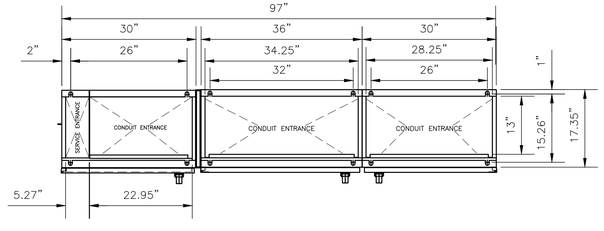


PANEL ELEVATION

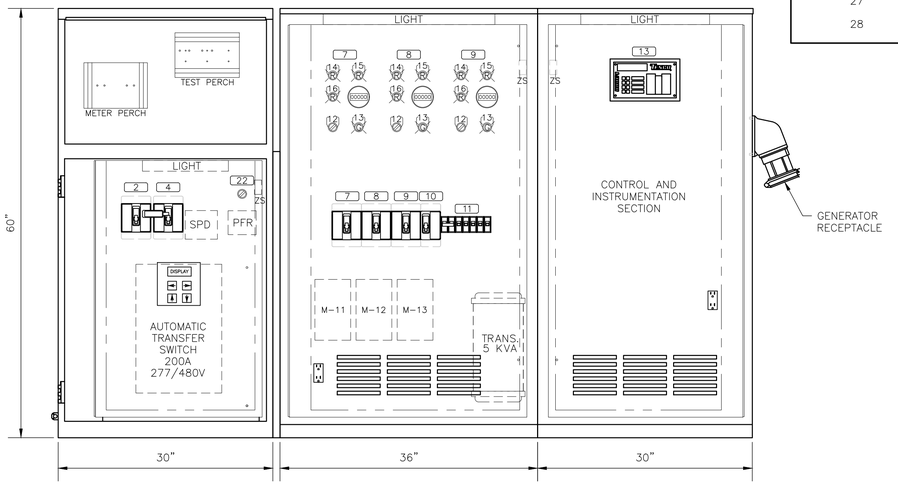
SCALE: NOT TO SCALE



RIGHT SIDE VIEW



PANEL BASE PLAN



INNER DEADFRONT DOOR

SCALE: NOT TO SCALE

⚠ WARNING

ARC FLASH & SHOCK HAZARD

APPROPRIATE PPE AND TOOLS REQUIRED WHEN WORKING ON THIS EQUIPMENT

PROFESSIONAL ENGINEER — No.14638 Exp.12-31-22 — ELECTRICAL — STATE OF CALIFORNIA

04/22/2021

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INITIAL | REVISIONS | REV | DATE

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LIFT STATION AND FORCE MAIN

SINGLE LINE DIAGRAM, ELEVATIONS AND LOAD CALCULATION

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NA HORIZONTAL	E3
NA VERTICAL	
SHEET:	22 of 26

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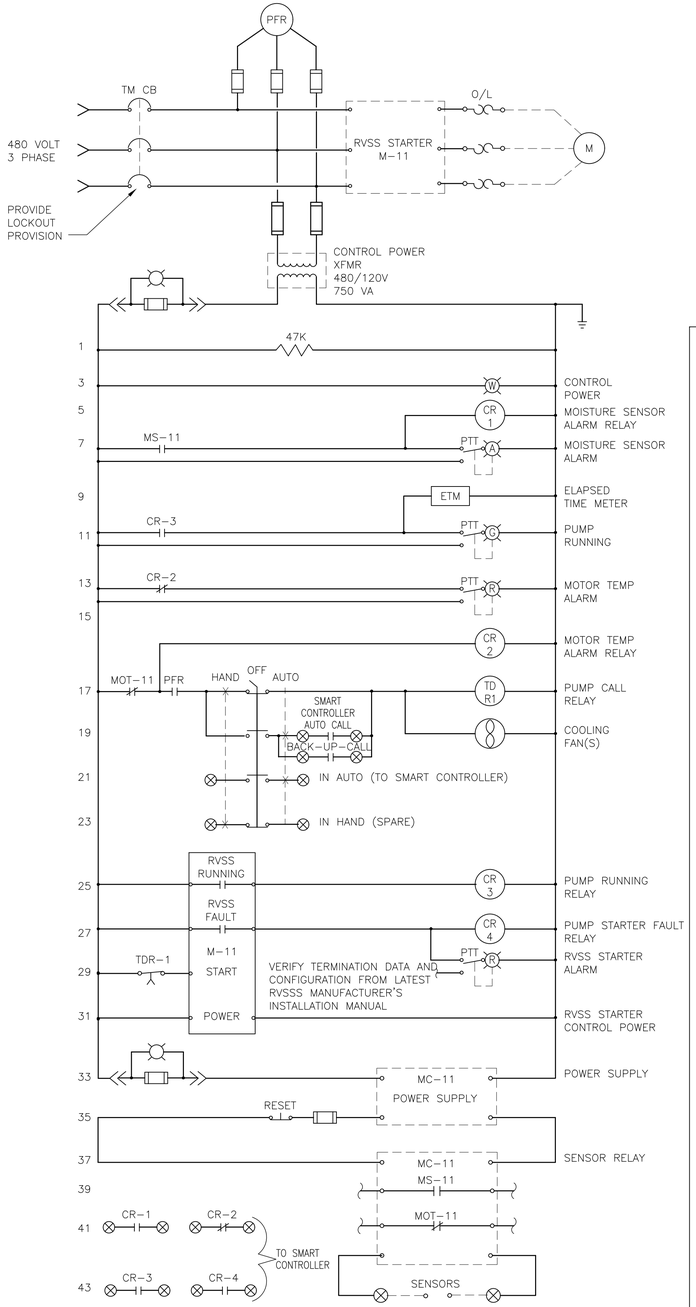
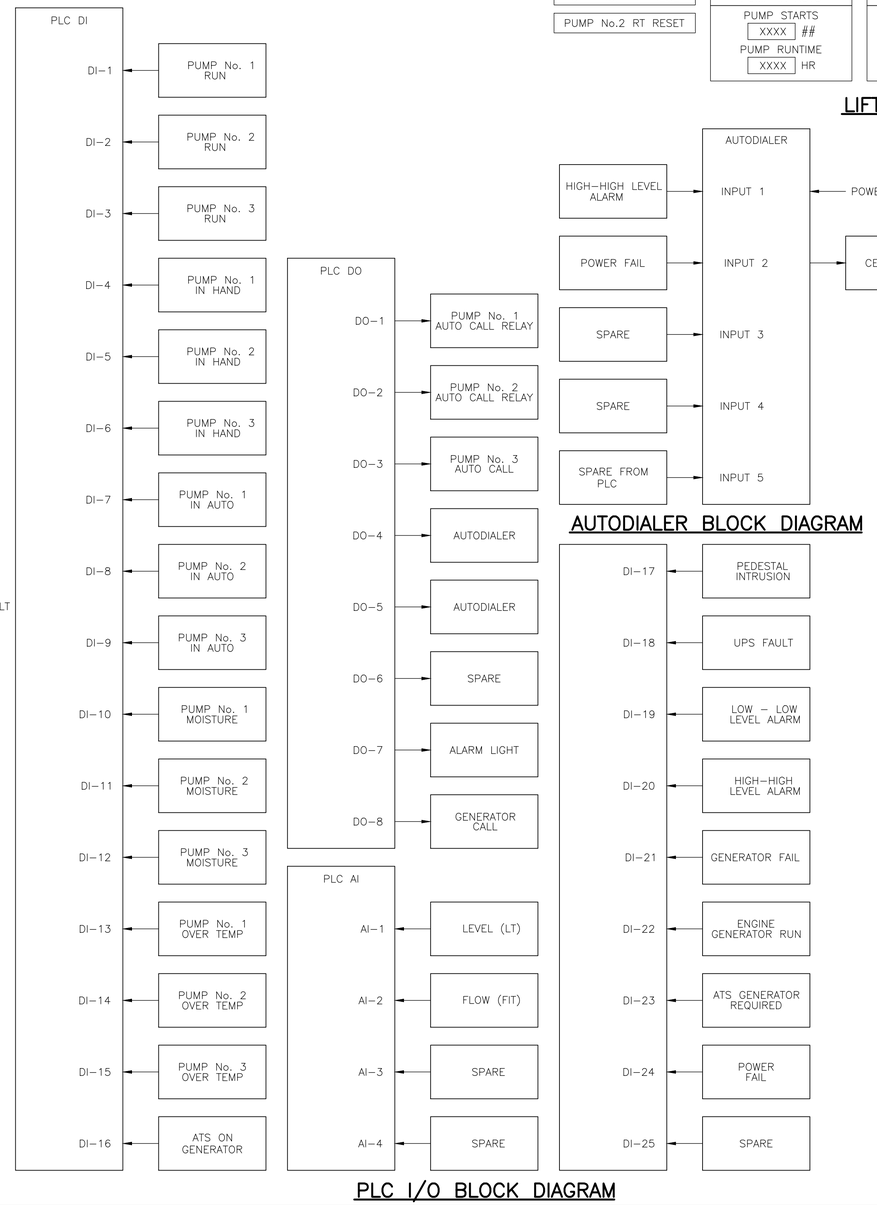


DEVICE IDENTIFICATION

DESCRIPTION	VFD	TDR	HS	MC
WET WELL PUMP No. 1	11	11(X)	11	11
WET WELL PUMP No. 2	12	12(X)	12	12
WET WELL PUMP No. 3	13	13(X)	13	13

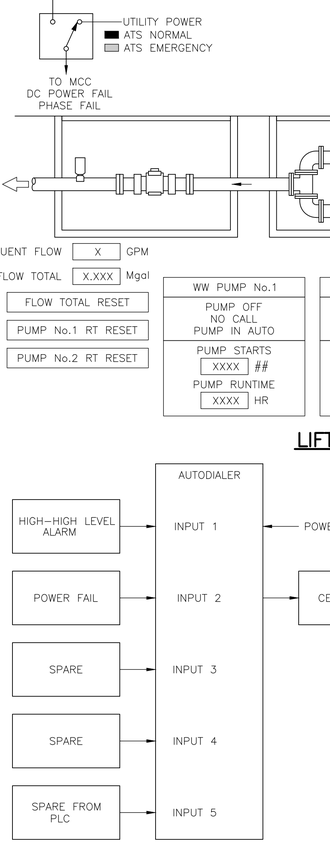
PUMP CONTROL WIRING DIAGRAM

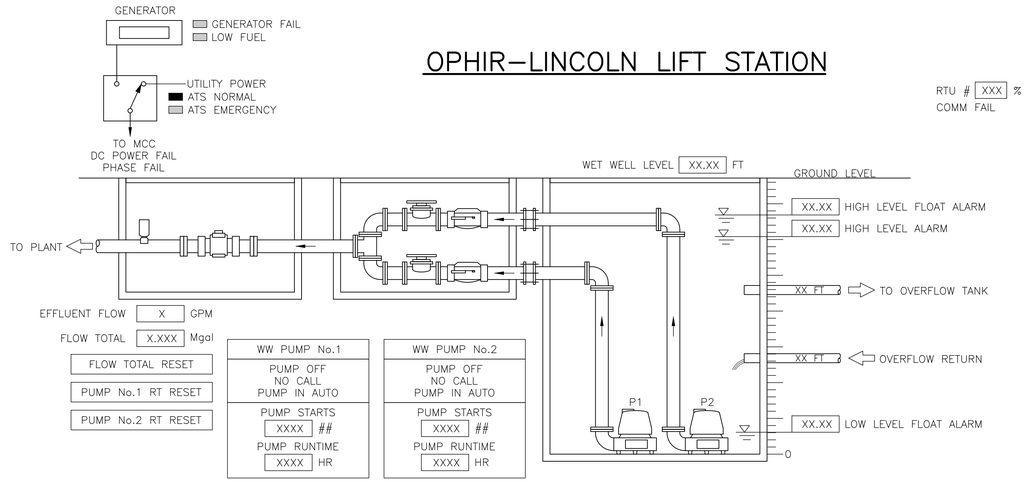
(TYPICAL OF 3)



PLC I/O BLOCK DIAGRAM

AUTODIALER BLOCK DIAGRAM





LIFT STATION SCADA SCREEN SHOT

SITE WET WELL LEVEL	X.XX	FT	DELAY (SEC)
WET WELL LEVEL XDCR HIGH	XX.00	FT	60
WET WELL LEVEL HI LEVEL	X.XX	FT	15
WET WELL LEVEL LO LEVEL	X.XX	FT	15
WET WELL LEVEL XDCR LOW	-X.XX	FT	
SITE EFFLUENT FLOW	**X.XX**	**GPM**	**DELAY (SEC)**
FLOW TRANSMITTER XDCR HIGH	XXX	GPM	60
FLOW TRANSMITTER HI FLOW	XXX	GPM	15
FLOW TRANSMITTER LO FLOW	XXX	GPM	15
FLOW TRANSMITTER XDCR LOW	XXX	GPM	
WET WELL PUMPS START-STOP LEVELS			**ALL IN FT**
LAG 1 PUMP START LEVEL			XXX
LAG PUMP START LEVEL			XXX
LEAD PUMPS START LEVEL			XXX
WET WELL CURRENT LEVEL			XXX
LEAD PUMP STOP LEVEL			XXX
LAG PUMP STOP LEVEL			XXX
LAG 1 PUMP STOP LEVEL			XXX
LOAD/LAG ALTERNATION NUMBER*			XXX

*0 = ALTERNATION 1 = PUMP No.1 LEAD
2 = PUMP No.2 LEAD

ADDITIONAL SITE RELATED DELAYS AT RTU	DELAY (SEC/MIN)	
A/C PHASE FAILURE DELAY	1	SEC
A/C POWER FAILURE DELAY	1	SEC
D/C POWER FAILURE DELAY	1	SEC
WET WELL FLOAT HI DELAY	5	SEC
WET WELL FLOAT LOW DELAY	5	SEC
PUMP SEQUENTIAL START DELAY	10	SEC
PUMP No.1 START FAIL DELAY	10	SEC
PUMP No.2 START FAIL DELAY	30	SEC
PUMP OVERTEMP DELAY	5	SEC
PUMP SEAL FAIL DELAY	5	SEC
BACKSPIN RE-START DELAY	10	SEC
BUBBLE PURGE INTERVAL	8	HR
SCADA COMM TEST INTERVAL	30	MIN
SCADA COMM TEST COUNTER VALUE	1	MIN

SETPOINT SCREEN

04/22/2021

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REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN
LIFT STATION AND FORCE MAIN

CONTROL WIRING DIAGRAMS

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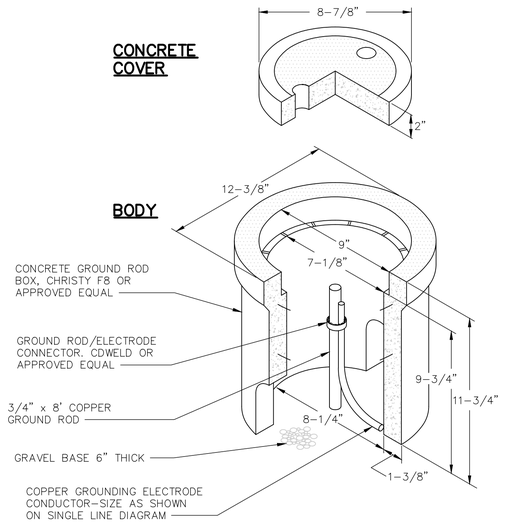
FILE PATH:	
DATE:	April 21, 2021
SCALES: HORIZONTAL	NA
VERTICAL	NA

E4

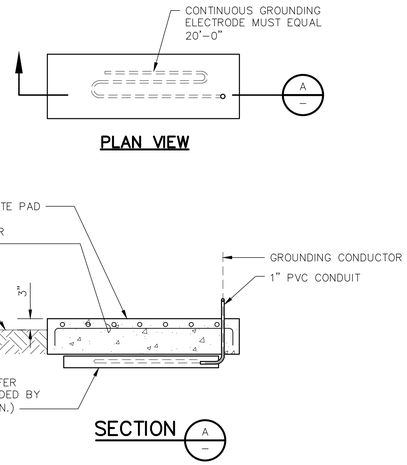
SHEET: 23 of 26

EXHIBIT H.1



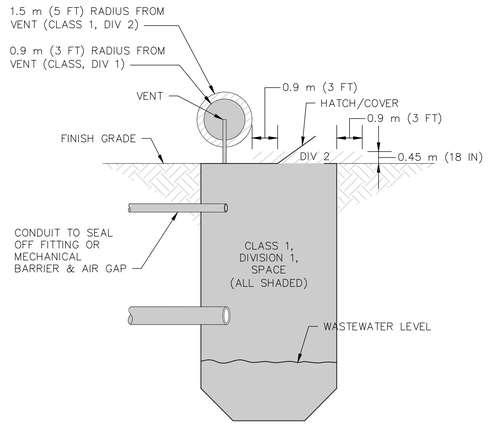
CONCRETE GROUND ROD BOX DETAIL 1 E-5

SCALE: NOT TO SCALE



PEDESTAL PAD AND GROUND DETAIL 2 E-5

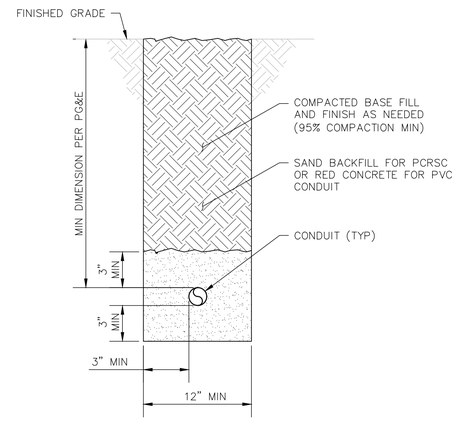
SCALE: NOT TO SCALE



NOTES:
ELECTRICAL INSTALLATION SHALL BE PER CEC/NEC 500 AND NFPA 820.

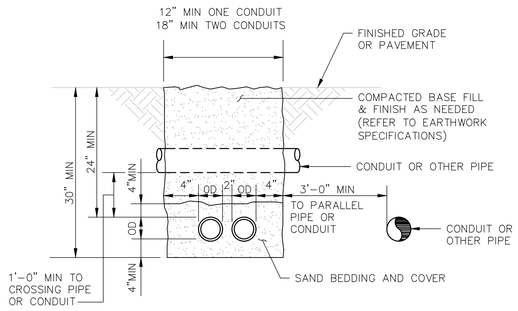
WET WELL HAZARDOUS AREA DETAIL 3 E-5

SCALE: NOT TO SCALE



TYPICAL SECONDARY SERVICE TRENCH DETAIL 4 E-5

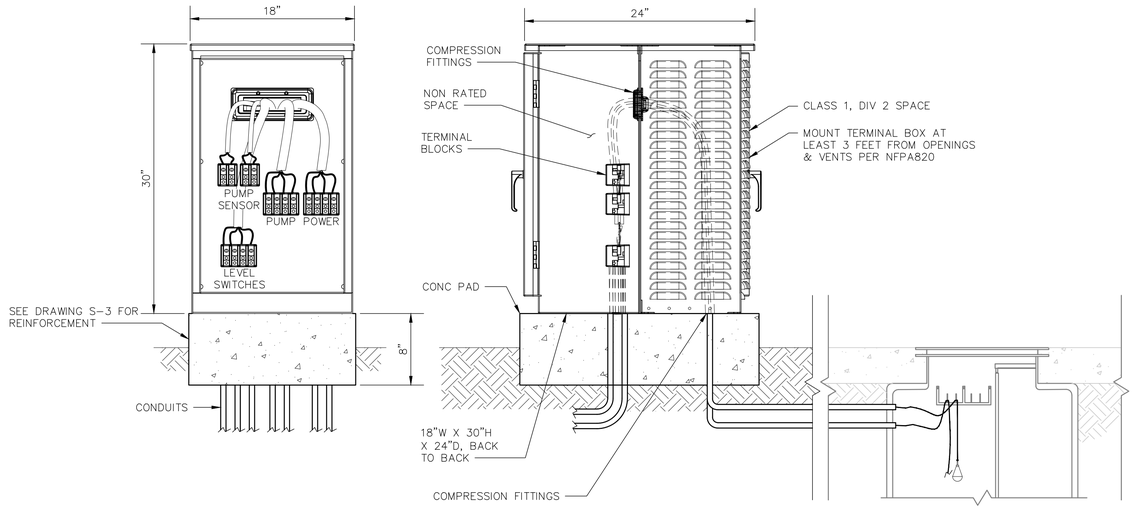
SCALE: NOT TO SCALE



NOTE:
TRENCHING LOCATED IN PAVED AREAS-ALL EARTHWORK AND REPAIR SHALL BE IN ACCORDANCE WITH AGENCY THAT HAS JURISDICTION.

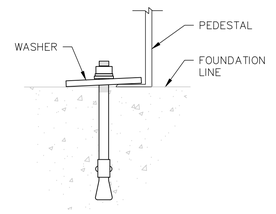
TYPICAL CONDUIT TRENCH DETAIL 5 E-5

SCALE: NOT TO SCALE



WET WELL PUMP TERMINAL BOX DETAIL 6 E-5

SCALE: NOT TO SCALE



ANCHOR DETAIL 7 E-5

SCALE: NOT TO SCALE

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ELECTRICAL DETAILS 1

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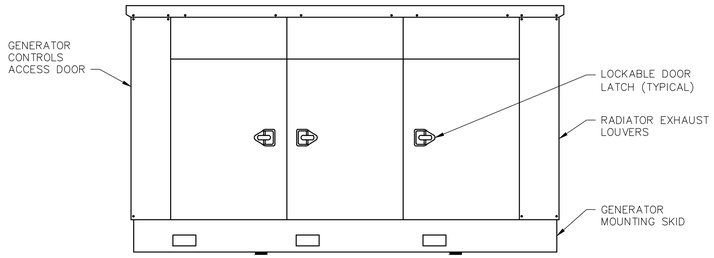
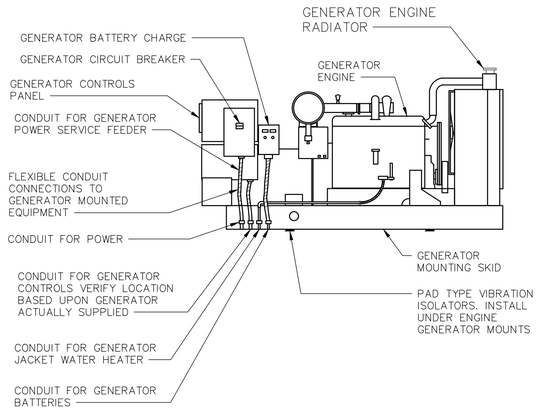
NA HORIZONTAL	E5
NA VERTICAL	
SHEET:	24 of 26



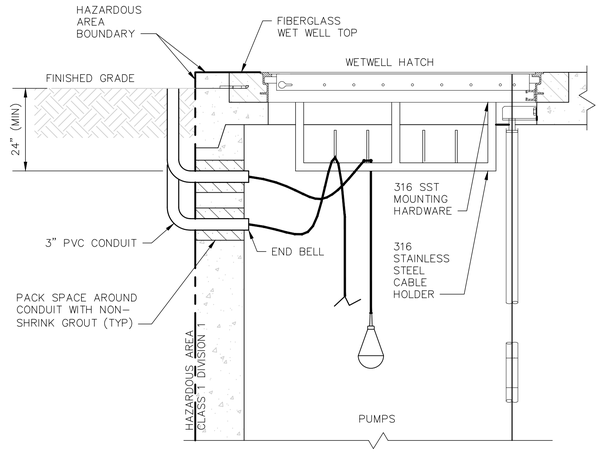
GENERATOR EXTERIOR ELEVATION VIEW (8/E-6)

SCALE: NOT TO SCALE



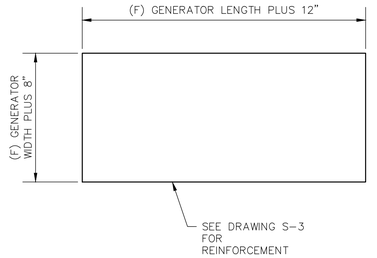
GENERATOR ELEVATION VIEW (9/E-6)

SCALE: NOT TO SCALE



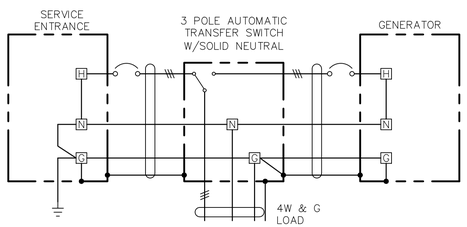
WET WELL SUBMERSIBLE PROBE DETAIL (10/E-6)

SCALE: NOT TO SCALE



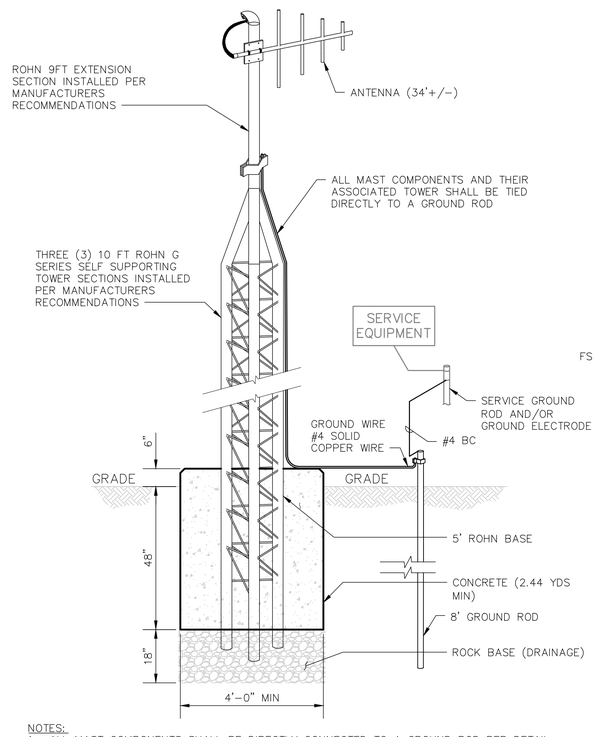
GENERATOR PAD DETAIL (11/E-6)

SCALE: NOT TO SCALE



NON-SEPERATELY DERIVED GROUND SYSTEM (12/E-6)

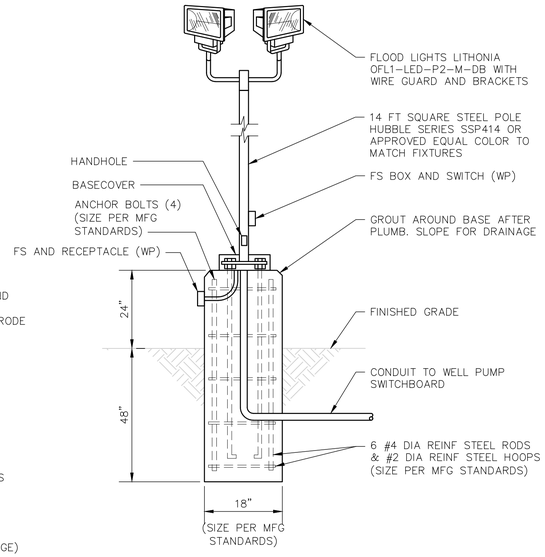
SCALE: NOT TO SCALE



NOTES:
1. ALL MAST COMPONENTS SHALL BE DIRECTLY CONNECTED TO A GROUND ROD PER DETAIL.
2. ROHN G SERIES INSTALLED FOR 90 MPH (3 SECOND GUST PER TIA-222-G OR 115 MPH 3 SECOND GUST) PER ASCE7-10.
3. PROVIDE STAMPED CALCULATIONS FROM MANUFACTURER.

ANTENNA MAST MOUNTING AND GROUNDING FOR TOWER DETAIL (13/E-6)

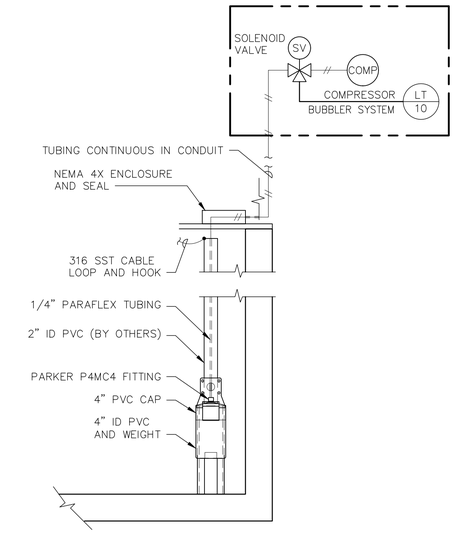
SCALE: NOT TO SCALE



NOTES:
FIXTURE WIRE THROUGH POLE TO LUMINAIRE TO BE RATED FOR 150° C.

LIGHT POLE DETAIL (14/E-6)

SCALE: NOT TO SCALE



BUBBLER MOUNTING DETAIL (15/E-6)

SCALE: NOT TO SCALE

REV	DATE	REVISIONS	INITIAL

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LIFT STATION AND FORCE MAIN

ELECTRICAL DETAILS 2

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REGISTERED PROFESSIONAL ENGINEER — Samuel Sauers — No.14638 Exp.12-31-22 — ELECTRICAL — STATE OF CALIFORNIA

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NA VERTICAL	SHEET: 25 of 26

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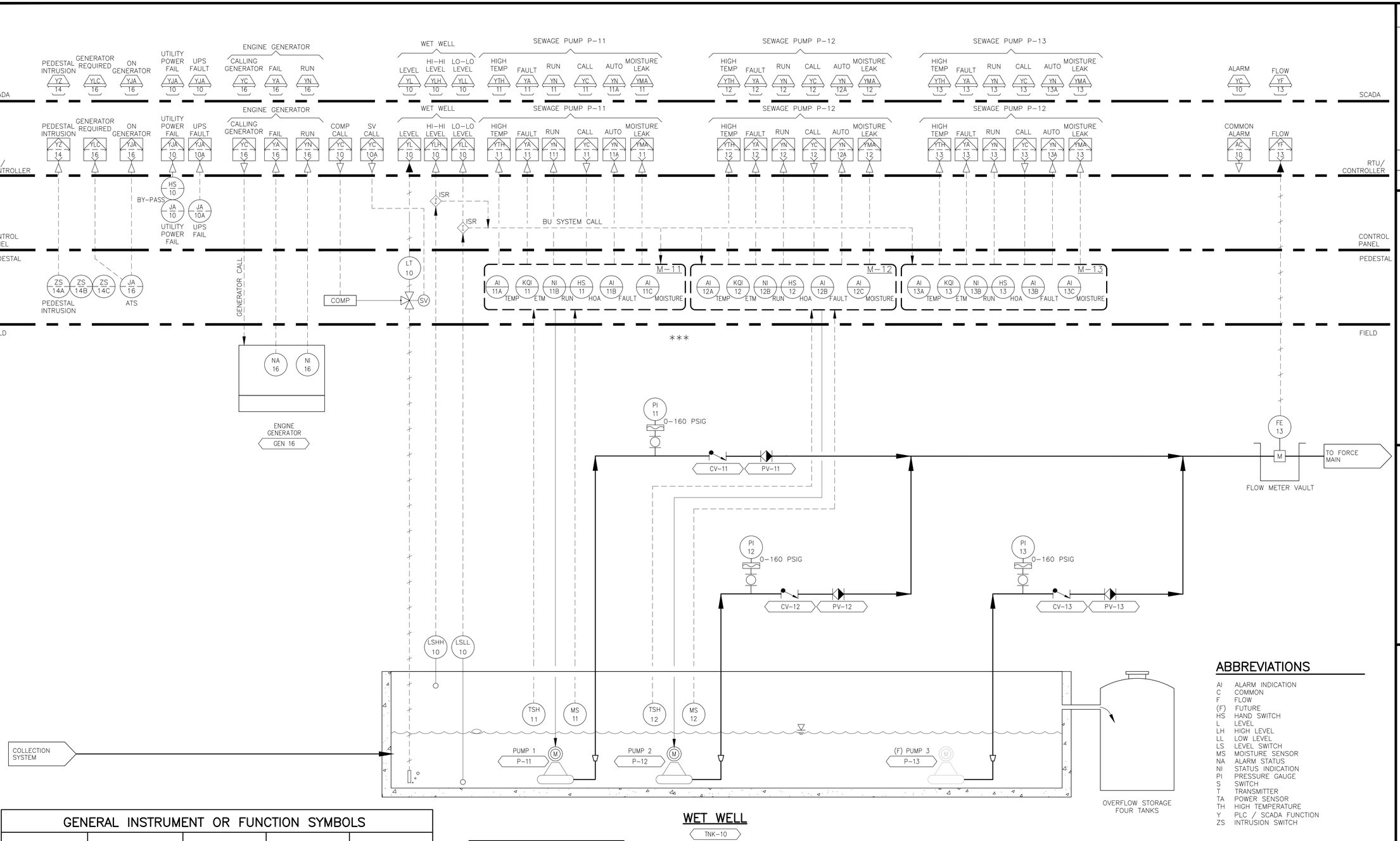

GENERAL INSTRUMENT OR FUNCTION SYMBOLS

	LOCATION NORMALLY ACCESSIBLE TO OPERATOR	FIELD MOUNTED	NORMALLY NOT ACCESSIBLE TO OPERATOR	NORMALLY ACCESSIBLE TO OPERATOR
DISCRETE INSTRUMENTS				
SHARED DISPLAY, SHARED CONTROL				
COMPUTER FUNCTION				
PROGRAMMABLE LOGIC CONTROL				

INPUT & OUTPUT SIGNALS TO PLC/RTU

- ANALOG INPUT
- ANALOG OUTPUT
- PULSE INPUT
- MODULATING OUTPUT
- DIGITAL INPUT
- DIGITAL OUTPUT

ABBREVIATIONS

AI	ALARM INDICATION
C	COMMON
F	FLOW
(F)	FUTURE
HS	HAND SWITCH
L	LEVEL
LH	HIGH LEVEL
LL	LOW LEVEL
LS	LEVEL SWITCH
MS	MOISTURE SENSOR
NA	ALARM STATUS
NI	STATUS INDICATION
PI	PRESSURE GAUGE
S	SWITCH
T	TRANSMITTER
TA	POWER SENSOR
TH	HIGH TEMPERATURE
Y	PLC / SCADA FUNCTION
ZS	INTRUSION SWITCH

REV	DATE	REVISIONS	INITIAL

OPHIR - LINCOLN LIFT STATION AND FORCE MAIN

PROCESS AND INSTRUMENTATION DIAGRAM, SEWAGE PUMPS

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
1960 ELGIN STREET
OROVILLE, CA 95966
TEL. (530) 533-2000

BUTTE COUNTY CALIFORNIA

Sauers Engineering, Inc.
Civil & Environmental Engineers
105 Providence Mine Rd. Suite 202, Nevada City, CA 95959
tel (530) 265-8021 www.sauerseng.com

REGISTERED PROFESSIONAL ENGINEER — Samuel W. Terry — No. 7125 — Exp. 06-30-2021 — CONTROL SYSTEMS — STATE OF CALIFORNIA

04/22/2021

ECS
ECS Engineering, Inc.
916-718-3686
samterry@earthlink.net

0 1
BAR IS ONE INCH ON ORIG. DRAWING
IF BAR DOES NOT MEASURE ONE INCH, ADJUST SCALES ACCORDINGLY

PROJECT NUMBER:	17-012-00
DESIGN BY:	SWT
DRAFTING BY:	CCE
CHECKED BY:	SWT
FILE PATH:	
DATE:	April 21, 2021
SCALES: NA HORIZONTAL / NA VERTICAL	E7
SHEET:	26 of 26

EXHIBIT H.2

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT

Ophir-Lincoln Lift Station and Force Main

TECHNICAL SPECIFICATIONS

February 22, 2021

Engineer:

Sauers Engineering, Inc.
Civil & Environmental Engineers
105 Providence Mine Road, Suite 202, Nevada City, CA
tel (530) 265-8021 www.sauerseng.com

EXHIBIT H.2

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
Ophir-Lincoln Lift Station and Force Main

TECHNICAL SPECIFICATIONS
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33 31 23	Sewer Force Main
33 32 00	Sanitary Sewerage Equipment
33 33 00	Valves and Appurtenances

SECTION 01-11-00
SUMMARY OF WORK

PART 1 GENERAL

1.1 SCOPE OF WORK - The work to be performed in this project includes the construction of a new wastewater lift station, overflow storage tanks, installation of new 6-inch and 8" force mains, 12" and 18" gravity sewer pipelines, manholes, all necessary valving, piping and appurtenances as well as all necessary electrical, and controls and other miscellaneous equipment as shown on the Contract Drawings for the Ophir-Lincoln Lift Station and Force Main in Oroville, CA. Work to be performed includes furnishing all labor, material, tools, equipment, and incidentals required to construct and to install all facilities, equipment, pipe, fittings, and appurtenances as shown on the Plans and as described in these Technical Specifications.

1.2 LOCATION OF WORK - The work is located in an unincoporated area of Butte County, CA, south of the City of Oroville. The lift station will be within the River Ranch Subdivision near the intersection of Ophir Road and Lincoln Boulevard. The force main is located along various county roads including Ophir Road, Lincoln Boulevard, Monte Vista Avenue, and Autry Lane. A location map is provided in the project drawings.

PART 2 PRODUCTS - (not used)

PART 3 EXECUTION - (not used)

* * END OF SECTION * *

SECTION 01-33-00
SUBMITTALS

PART 1 GENERAL

1 SPECIFIED PRODUCTS AND SUBSTITUTIONS

A. Products specified by referenced or performance standards: Contractor may select any product which meets the referenced or performance standards given.

B. Specified products: Wherever catalog numbers, model numbers and specific brand or trade names are used in conjunction with a designated material, product, thing or service mentioned in these specifications, they are used to establish the standards of quality, utility, performance, dimensions and appearance required. The specified product shall be understood to be the basis for the project design.

C. Matching products. If a specified product is identical or similar to other products already in use or possession of Owner, and if in the Owners opinion, keeping like-products reduces need for extra spare parts, tools or reduces maintenance costs, this is an acceptable reason for disallowing substitution.

D. For any Substitution, the Contractor must submit such Substitution through the Submittal process. If the Substitution will necessitate the modification of any design element of the project, whether to accommodate new dimensions or different utility or performance or any other characteristic, the Contractor shall clearly identify any and all such modifications or changes with the Submittal, and, if the Substitution is approved, Contractor shall solely bear the cost of any such modifications or adjustments.

E. Acceptable Equals: Where specifications include the designation “or equal”, “or approved equal”, “or accepted equal”, “or equivalent”, Contractor may request acceptance as “equal” any material, process or product through the Submittal process.

2 SUBMITTALS

A. Major Project Components: The Contractor shall submit to the Engineer complete sets of detailed Shop Drawings and Design Calculations for the items shown in the following table. The Contractor shall submit to the Engineer specifications, parts lists, maintenance and operations instructions as supplied by the manufacturers for all equipment items. The Contractor shall make submittals to the Engineer for specific items as further described in detail in these specifications and as listed in the table below: Note that this list may not be complete and the Engineer may request additional submittals.

B. All Submittals shall be submitted in an electronic Adobe pdf format and will be returned in the same form. After review of the Contractor's submittal, a pdf copy will be returned to the Contractor with the Engineer's comments noted on the submittal packages. The Contractor shall not commence fabrication of any items until the

submittal has been reviewed and returned Approved by the Owner's Engineer. Contractor shall allow 2 weeks for review of each submittal or resubmittal.

Item or Product for Submittal	Catalog Cuts and Specifications	Shop Drawings & Structural or Electrical Calculations[1]	Instructions for Operation and Maintenance and Parts lists[2,3]
Wet Well	X	X	X
FRP Overflow Tanks	X	X	X
Pump & Motor Units	X	X	X
Traffic Boxes and Lids	X		
Valve Boxes and Lids	X		
Pipe & Fittings	X		
Valves	X		X
Cast In Place Concrete	Mix Design		
Precast Concrete Products	X	X	
Access Hatches	X	X	X
Miscellaneous Equipment (pipe supports, wet well appurtenances, etc.)	X		X
Electrical Equipment & Controls	X	X	X
Bedding & Backfill Material	X	X	
A.C. Pavement and Base	X		
Tracer Wire	X		
Gates and Fencing	X		X
Masonry Block	X		
Structural Steel, Anchors	X	X	
Steel Casing Pipe, Spacers, End Seals	X	X	

1. Must be furnished prior to ordering equipment.
2. Must be furnished prior to equipment start-up.
3. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and parts lists.

PART 2 **PRODUCTS** (not used)

PART 3 **EXECUTION** (not used)

* * END OF SECTION * *

SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 CODES, STANDARDS AND REFERENCES

A. General - All construction shall comply with rules and regulations set forth in Title 24, California Code of Regulations, as most recently adopted by the local building official.

B. The following publications are adopted by reference and incorporated in the Butte County Code except as expressly amended or superseded by the provisions of this article. The 2010 Triennial Edition of Title 24, California Code of Regulations (CCR) consisting of the following parts:

1. Part 2 - California Building Code,
2. Part 2.5 - California Residential Building Code,
3. Part 3 - California Electrical Code,
4. Part 4 - California Mechanical Code,
5. Part 5 - California Plumbing Code,
6. Part 6 - California Energy Code,
7. Part 8 - California Historical Building Code,
8. Part 9 - California Fire Code,
9. Part 10 - California Existing Building Code,
10. Part 11 - California Green Building Standards Code (CALGreen Code),
11. Part 12 — Reference Standards Code. (Ord. 5629-B § 3, 2010).

C. Codes and Standards - Where applicable, the standards of the following organizations, trades and societies shall be adhered to:

1. AASHTO - American Association of State Highway and Transportation Officials
2. ACI - American Concrete Institute
3. ANSI - American National Standards Institute
4. ASME - American Society of Mechanical Engineers
5. ASTM - American Society for Testing and Materials
6. AWWA - American Water Work Association
7. CAL-OSHA California Division of Occupational Safety and Health Administration
8. CalTrans - California Department of Transportation
9. CCR - California Code of Regulations
10. LOAPUD – Lake Oroville Area Public Utility District
11. NSF - National Science Foundation; NSF Standard 61
12. UL - Underwriters Laboratories

These organizations, trades and societies may be referenced by acronym as defined herein.

D. References - the project plans and technical specifications may make reference to Standard Plans and Specifications which shall mean the standard plans and technical specifications as most recently adopted by California Department of Transportation (CalTrans).

1.2 SITE INVESTIGATION AND CONTROL

A. The Contractor shall check and verify all dimensions and conditions in the field continuously during construction. Any inaccuracies built into the work due to the Contractor's (including subcontractors's) failure to comply with this requirement shall be the Contractor's sole responsibility.

B. The Contractor shall inspect related and appurtenant work and report in writing to the Owner and Engineer any conditions which will prevent proper completion of the work. Failure to report such conditions shall constitute acceptance of all site conditions, and any required removal, repair, or replacement caused by unsuitable conditions shall be performed by the Contractor solely and entirely at Contractor's expense.

1.3 INSPECTION OF THE WORK

A. All work performed by the Contractor and Subcontractors shall be inspected by the Contractor. Nonconforming work and any safety hazards in the work area shall be noted and promptly corrected. The Contractor is responsible for the work to be performed safely and in conformance to the Contract Documents.

B. The work shall be conducted under the general observation of the Owner's Resident Project Representative to ensure strict compliance with the Contract Documents.

C. The presence of the Owner, or any designated representatives shall not relieve the Contractor of the responsibility for the proper execution of the work in accordance with all requirements of the Contract Documents. Compliance is the responsibility of the Contractor. No act or omission on the part of the Owner or any designated representatives shall be construed as relieving Contractor of this responsibility. Inspection of work later determined to be nonconforming shall not be cause or excuse for acceptance of the non-conforming work. The Owner may accept nonconforming work when adequate compensation is offered and it is in the Owner's best interest as determined by the Owner.

D. All materials and articles furnished by the Contractor or Subcontractors shall be subject of rigid documented inspection by qualified personnel, and no materials or articles shall be used in the work until they have been inspected and accepted by the Contractor's quality control representative. No work shall be backfilled, buried, cast in concrete, covered, or otherwise hidden until it has been inspected by the Owner. Any work covered in the absence of inspection shall be subject to uncovering. Where uninspected work cannot be easily uncovered, such as in concrete cast over reinforcing steel, all such work shall be subject to demolition, removal, and reconstruction under proper inspection.

E. Any materials and articles furnished to the Contractor by the Owner shall be subject to rigid inspection by the Contractor's quality control representative before being used or placed by the Contractor. The Contractor shall inform Owner, in writing, of the results of said inspections within one working day after completion of inspection. In the event that the Contractor believes any material or article provided by the Owner to be of insufficient quality for use in the work, the Contractor shall immediately notify the Owner.

1.4 TIME OF INSPECTION AND TESTS

A. Samples and test specimens required under these Specifications shall be furnished and prepared for testing in ample time for the completion of the necessary tests and analyses before said articles and materials are to be used. The Contractor shall furnish and prepare all required test specimens at the Contractor's own expense. As provided in the Contract Documents, performance of the certain tests will be by the Owner, and all costs therefor will be borne by the Owner at no cost to the Contractor except that the costs of any test which shows unsatisfactory results shall be back-charged to the Contractor.

B. Whenever the Contractor is ready to backfill, bury, cast in concrete, hide, or otherwise cover any work under this Contract, the Owner shall be notified not less than 24 hours in advance to request inspection before beginning any such work of covering. Failure of the Contractor to notify the Owner at least 24 hours in advance of any such inspections shall be reasonable cause for the Owner to order a sufficient delay in the Contractor's schedule to allow time for such inspection. The cost of any remedial, or corrective work required, and all costs of such delays, including its impact on other portions of the work, shall be borne by the Contractor.

1.5 SAMPLING AND TESTING

A. When not otherwise indicated, all sampling and testing shall be in accordance with the methods prescribed in the current standards of the ASTM, as applicable to the class and nature of the article or materials considered. However, the Owner reserves the right to use any generally-accepted system of inspection that, in the opinion of the Owner, will ensure that the quality of the workmanship is in full accord with the Contract Documents.

B. The Owner reserves the right to waive tests or quality assurance measures, but waiver of any inspection testing or other quality assurance measure, whether or not such waiver is accompanied by a guarantee of substantial performance as a relief from the indicated testing or other quality assurance requirements as originally specified, and whether or not such guarantee is accompanied by a performance bond to assure execution of any necessary corrective or remedial work, shall not be construed as a waiver of any technical or qualitative requirements of the Contract Documents.

C. Not withstanding the existence of such waiver, the Owner shall reserve the right to make independent investigations and tests as specified in the following paragraph and

failure of any portion of the work to meet any of the qualitative requirements of the Contract Documents, shall be reasonable cause for the Owner to require the removal or correction and reconstruction of any such work.

D. In addition to any other inspection or quality assurance provisions that may be indicated, the Owner shall have the right to independently select, test, and analyze, at the expense of the Owner, additional test specimens of any or all of the materials to be used. Results of such tests and analyses shall be considered along with the tests or analyses made by the Contractor to determine compliance with the applicable specifications for the materials so tested or analyzed, provided that wherever any portion of the work is discovered, as a result of any such independent testing or investigation by the Owner, which fails to meet the requirements of the Contract Documents, all costs of such independent inspection and investigation and all costs of removal, correction, reconstruction, or repair of any such work shall be borne by the Contractor.

1.6 RIGHT OF REJECTION

A. The Owner shall have the right at all times and places to reject any articles or materials to be furnished hereunder which, in any respect, fail to meet the requirements of the Contract Documents, regardless of whether the defects in such articles or materials are detected at the point of manufacture or after completion of the work at the site. If the Owner, through an oversight or otherwise, has accepted materials or work which are defective or in any way contrary to the Contract Documents, such materials, no matter in what stage or condition of manufacture, delivery, or installation, may be rejected.

B. The Contractor shall promptly remove rejected articles or materials from the site of the work after notification of rejection. Contractor shall replace any rejected materials with acceptable quality materials.

C. All costs of removal and replacement of rejected articles or materials shall be borne by the Contractor at no increased cost to the Owner.

D. Failure to promptly remove and replace rejected work or materials shall be considered a breach of this contract and the Owner may, after 7 days notice, terminate the Contractor's right to proceed with the affected work and remove and replace the work and issue a back-charge to cover the cost of the work.

1.7 CONTRACTOR'S QUALITY CONTROL REQUIREMENTS

A. The Contractor shall establish and execute a Quality Control program for the services which are being procured from the Contractor. The program shall provide the Contractor with adequate measures for verification and conformance to defined requirements by its personnel and lower-tier Subcontractors. This program shall be described in a Quality Control Plan responsive to this section.

1.8 TESTING SERVICES

A. All tests which require the services of a laboratory to determine compliance with the Contract Documents shall be performed by an independent commercial testing firm acceptable to the Owner. The testing firm's laboratory shall be staffed with experienced technicians, properly equipped and fully qualified to perform the tests in accordance with the specified standards.

B. The Contractor's independent testing laboratory shall be accredited by the American Association of State Highway and Transportation Officials (AASHTO) for the tests they will perform and as appropriate to the construction work being performed. The Contractor's laboratory shall be AASHTO accredited in the following:

1. ASTM C1077 - Practice for laboratories Testing Concrete and Concrete Aggregates for use in Construction and Criteria for Laboratory Evaluation.
2. ASTM D3740 - Practice for Evaluation of Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design/Construction.
3. ASTM D3666 - Specifications for Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials.

C. The Owner shall have the right to inspect work performed by the independent testing laboratory both at the project and at the laboratory. This shall include inspection of the independent testing laboratory's internal quality assurance records (quality assurance manual, equipment calibrations, proficiency sample performance, etc.).

D. The Contractor shall obtain the Owner's acceptance of the testing firm before having services performed, and Contractor shall pay all costs for these testing services.

E. Testing services provided by the Owner, if any, are for the sole benefit of the Owner. However, test results shall be available to the Contractor. Testing necessary to satisfy the Contractor's internal quality control procedures shall be the sole responsibility of the Contractor.

F. Testing Services Furnished by Contractor:

1. Unless otherwise indicated, the Contractor shall furnish all testing services in connection with the following materials as required for Owner's review:
   a. Concrete materials and mix design.
   b. Embankment, fill, and backfill materials.
   c. Quality Control testing of all precast concrete.
   d. Holiday testing of pipeline coatings.
   e. All tests and inspection of welding work, including welding procedure qualifications, welder operator qualifications, all work performed by the certified welding inspector, all appropriate non-destructive testing and all repair and retest of weld defects.
   f. Pressure testing and testing of water-tightness.
   g. All other tests and engineering data required for the Owner's review of materials and equipment proposed to be used in the work.

G. Testing Services Furnished by Owner:

1. Unless otherwise indicated, the Owner will provide Quality Control testing services in connection with the following materials and equipment incorporated in the work:

    a. Cast-in-place concrete strength tests.
    b. Testing of field welds for steel pipe and other nondestructive testing of pipe joints.
    c. Moisture-density and relative density tests on embankment, fill, and backfill materials.
    d. In-place field density test on embankments, fills, and backfill.
    e. Other materials testing and equipment as indicated herein.

2. Testing shall be performed by the Owner, the Engineer, or the Owner's testing firm's laboratory personnel, in general manner and frequency as deemed appropriate by Owner or Engineer.

    a. The testing firm's laboratory shall perform all laboratory tests within a reasonable time consistent with the specified standards and will furnish a written report on each test.
    b. The Contractor shall furnish all sample materials and cooperate in the testing activities, including sampling. The Contractor shall interrupt the work when necessary to allow testing, including sampling to be performed. The Contractor shall have no claim for an increase in Contract Price or Time due to such interruption. When testing activities, including sampling, are performed in the field by the testing firm's laboratory personnel, the Contractor shall furnish personnel and facilities to assist in the activities.

H. Transmittal of Test Reports

1. Written reports of tests and engineering data furnished by the Contractor for the Owner's review of materials and equipment proposed to be used in the work shall be submitted as indicated for Shop Drawings.
    a. The testing firm retained by the Contractor for material testing shall furnish five copies of written report of each test. Four copies of each test report shall be transmitted to the Owner within 3 days after each test is completed. Each report for each type of test shall be consecutively numbered.
    b. The Owner shall furnish one copy of each field and laboratory Quality Control test performed by the Owner to the Contractor.

1.9 ACCEPTANCE TESTING

A. The Contractor shall provide acceptance testing as specified for each item of work. This shall include but not be limited to disinfection and pressure testing of piping, tanks and appurtenances, testing the operation of the water treatment systems, the valves and controls, the pump systems and chemical feed systems, electrical instrumentation and control systems and coating systems. Further details on each system are included in the appropriate sections of these Technical Specifications.

B. The Owner has the right to reject any project element that fails to meet testing standards. Contractor must replace or repair or otherwise rectify any defective work element until it meets quality criteria as demonstrated by successful testing.

PART 2 **PRODUCTS** (not used)

PART 3 **EXECUTION** (not used)

* * END OF SECTION * *

SECTION 02-30-00

EARTHWORK

PART1 GENERAL

1.1 SCOPE OF WORK

A. This Section includes a description of requirements for materials and services necessary to complete earthwork including trenching, excavation, backfill, structural fill, and compaction as shown and/or specified for construction of all work related to the project.

B. Related Sections:

1. Section 014000 - Quality Requirements

1.2 QUALITY ASSURANCE

A. Safety Regulations: work shall comply with all Federal, State and County regulations regarding safety, including the requirements of the following:
1. County Requirements: Any work falling under the jurisdiction of Butte County, shall conform to the County's applicable requirements.
2. All trench work shall conform to Trench Construction Safety Orders of California State Industrial Accident Commission

B. Observations and Inspections: The Owner will observe, and respective utilities agencies' representatives will inspect utilities trenching, excavation, backfilling and compaction as appropriate. See Section 014000 for additional observation and inspection information.

C. Contractor shall appropriately schedule all inspections prior to commencing trenching and backfilling operations. All installations are subject to satisfactory inspection by appropriate agency.

D. Relative Compaction Tests
1. Where relative compaction densities are specified in these specifications and/or on the project plans, the laboratory and field tests shall be made in conformance with test methods as applicable: ASTM D 1557, ASTM D 1556, ASTM D 2922, AASHTO T 191 and AASHTO T 238.
2. In-Place density testing of trench backfill shall be conducted by an independent consultant at the expense of the Owner.

1.3 STOCKPILING OF MATERIAL

A. Stockpiling of excavated and backfill materials within the limits of any Butte County roadway or driveway will not be allowed. Contractor shall make arrangements for appropriate storage of materials as necessary.

B. All excavated material shall be removed from site or stockpiled in an approved manner that will not obstruct or cover any hydrants, water and gas valves, manhole covers, fire and police call boxes, or any other utility boxes. Gutters shall be kept open or other satisfactory provisions made for street drainage.

1.4 EXCAVATION AREA

A. Any street-excavation area shall be kept level with the adjacent street, shoulder or ground and maintained to prevent a traffic or pedestrian hazard until such time as the permanent surfacing is placed.

PART 2 PRODUCTS

2.1 BEDDING, BACKFILL AND STRUCTURAL OR ENGINEERED FILL

A. Pipe bedding and backfill shall conform to the technical specifications and project plans for the specific type of pipe being used and/or as described in other Sections of these specifications. Trench backfill in County right-of-way shall be as shown on the Butte County Encroachment Permit.

B. Engineering fill and structural fill shall conform to the material called for in the technical specifications and project plans for area in question (tank foundation,wet well foundation, etc.) Soil used in fill shall be uncontaminated, granular, non-expansive native or approved import soil. Rocks in fill must be broken to 8" or less in any dimension. Any proposed import soil must be sampled and submitted to Engineer a minimum of 72 hours prior to import. Cohesive, predominantly fine-grained or potentially expansive soil encountered during grading shall be stockpiled for removal, used in landscape areas, or mixed with better material as approved by the Engineer. It may, if specifically approved by Engineer, be used at depths greater than three feet below sub-grade.

2.2 MATERIALS

A. Class 1 Backfill shall be material consistent with California Department of Transportation Class 1 material. Well-graded gravels and sands, gravel-sand mixtures, crushed well-graded rock, little or no fines (GW, SW). Non-plastic.

B. Class 2 Backfill shall be material consistent with California Department of Transportation Class 2 material. Poorly graded gravels and sands, silty gravels and sands, little to moderate fines (GM, GP, SP, SM). Plasticity index of : non-plastic to 4.

C. Sand shall be free from clay or organic material, suitable for the purpose intended, and shall be of such size that 90 - 100% passes a No. 4 sieve and not more than 5% passes a No. 200 sieve.

D. Native Material - the site may contain native material that may be unsuitable for use as sub-grade or engineered fill material. Any relatively loose fill material encountered within 5 feet of a proposed structure footprint shall be over-excavated until competent native soil or rock is encountered. The grade shall be re-established with engineered fill as specified.

PART 3 EXECUTION

3.1 TRENCHING

A. Except by specific approval of the Engineer, no more than three hundred (300) feet of open trench, within the public street, shall be excavated in advance of laying pipe. Not more than two hundred (200) feet of trench shall be left open in the rear of the pipe laying operations. Not more than fifty (50) feet of trench excavation shall remain open at the end of each day's work, with proper plating. The remainder of the trench shall be backfilled, compacted and open to traffic where applicable.

B. The Contractor shall make a reasonable effort to maintain trench widths to a minimum as to minimize damage to existing structures and the existing pavement. When necessary the Contractor may be required to step the trench walls in order to install the proper shoring and bracing.

C. Any trenching within three feet of any County, public or private roadway edge of pavement shall be filled to the original ground line elevation before the end of each working day.

D. All Butte County trench backfill requirements apply to all trenches within the County right-of-way on this project.

E. Bore pits shall not be excavated at locations that are deemed detrimental to structures, drainage facilities, or trees. Backfill of bore pits shall meet the same requirements as backfill for trenches.

F. Ponding or jetting the top four feet of structure backfill will not be allowed.

G. Any damaged tree roots shall be clean cut and a root sealant applied.

3.2 SHORING

A. Pursuant to Labor Code 6705 and 6707, the Contractor shall include in his base bid all costs incidental to the provision of adequate sheeting, shoring, bracing or equivalent method for the protection of life or limb, which shall conform to all applicable Federal and State Safety Orders including California Occupational Safety and Health Administration (OSHA) requirements.

B. The Contractor's attention is directed to the provisions for "Shoring and Bracing Drawings" in Section 6705 of the California Labor Code. Before beginning any excavation 5' or more in depth, Contractor shall submit to Owner's representative a detailed plan showing the design of shoring, bracing, sloping, or other provisions to be made for worker protection from the hazard of caving ground during excavation. The proposed plan shall comply with the standards established by the State of California Construction Safety Orders and Title 24 of the California Code of Regulations (CCR). If the detailed plan varies from such shoring system standards, it shall be prepared by a registered civil or structural engineer whose name and registration number shall be indicated on the Drawing. If a dispute arises as to whether the plan must be prepared by a registered civil or structural engineer, Owner's representative's determination of the matter shall be final and conclusive on Contractor. The cost of required engineering services shall be borne by Contractor and shall be deemed to have been included in the amount bid for the work.

C. Neither the review nor approval of any plan showing the design of shoring, bracing, sloping, or other provisions for worker protection, shall relieve Contractor from its obligation to comply with Construction Safety Order Standards and Title 24 California Code of Regulations (CCR) for the design and construction of such protective work, and Contractor shall indemnify Owner and Owner's representative from any and all claims, liability, costs, actions, and causes of action arising out of or related to the failure of such protective systems. Contractor shall defend Owner, its officers, employees, and agents and Owner's representative in any litigation or proceeding brought with respect to the failure of such protective systems.

D. Contractors must still comply with the State of California Construction Safety Orders, Article 6 - Excavations, Trenches, Earthwork. The requirements of Article 6 apply whether the excavation, trench or earthwork is less than 5', or 5' or more.

E. Any damage to work or to adjacent structures resulting from failure of excavation walls will be the Contractor's responsibility.

F. Bracing, forms, and rubbish shall be removed from the excavation before the backfill is placed. Where sheeting, shoring, or bracing is to remain in place, it shall be cut off a minimum of 30" below finish grade. Sheeting, shoring, and bracing to be removed shall be removed at such time as will best prevent the loosening of un-excavated material and facilitate the placing and compacting of the backfill. Sloping sides of the excavated space that could cause wedging action of the backfill against the structure shall be stepped or serrated.

G. If steel piling is utilized, it may be withdrawn with compacting of backfill to proceed as it is removed.

3.3 TRENCH DEPTH

A. The depth of the trench shall be in accordance with the lines and grades shown on the plans with proper allowance for bedding and thickness of pipe and for the type of fittings

specified. Any portion of the trench excavated below the proper grade shall be backfilled with approved bedding material compacted to 95% relative compaction at the Contractor's expense and at the direction of the Owner or his agent. All areas of unsuitable material required by the Owner or his agent to be removed shall be replaced in the same manner.

3.4 DEWATERING

A. Removal and disposal shall be required of all water entering the excavation. Disposal of water shall be done in a manner to prevent damage and nuisance to adjacent properties or to the public. Sufficient pumping equipment shall be provided by the Contractor in a manner so as to maintain trenches in a dry condition during the bedding and initial backfilling of the pipe. Appropriate precautions shall be taken to prevent drainage water from entering the pipeline being constructed. If groundwater or saturated soil conditions are encountered during grading, the Engineer shall be notified and consulted.

B. Water in the trench as a result of ground conditions, the Contractor's use in balling and flushing, stormwaters, broken water pipes, or from any other condition shall not be allowed to enter the existing water system under any circumstances.

3.5 ALIGNMENT AND GRADE CONTROL

A. The grade and alignment of all new facilities shall be maintained by use of a method approved by the Engineer in advance of the construction. The proposed method shall be submitted for approval prior to commencing the work. The Engineer shall determine the adequacy of the proposed method and shall set the tolerances required for the work. The Engineer, at any time during the course of the work, may require alterations of the grade control method to conform to the required conditions of the work.

B. Horizontal and vertical alignment shall be true to lines shown on the project plans. Any deviation must meet the approval of the Engineer.

C. Owner shall provide a minimum of one benchmark at each of the construction sites. Said benchmark shall serve as the project datum, and Contractor shall construct all facilities according to the project plans relative to the project benchmarks, both horizontally and vertically. Contractor is solely responsible for all construction staking on the project and for ensuring accurate lines and grades as per the project plans. Contractor shall determine appropriate limits for construction staking, and shall take responsibility for the finished location for all project elements. The Engineer may at any time check the alignment and grade of project elements from staking and benchmarks, but Engineer is in no way responsible for any defects in construction staking nor for the horizontal and vertical placement of project elements. The Contractor shall be responsible for any inaccuracies and/or deviations from the lines and grades of all project elements, and shall correct any discrepancies of any magnitude as directed by the Engineer. The Contractor shall take appropriate means to preserve, as is practicable, all stakes, bench marks and control used in setting of alignment and grade.

3.6 TRENCH BACKFILL

A. Following completion of the initial backfill phase, approved backfill material shall be placed and compacted to the appropriate depth, as indicated on the plans, above the top of the pipe unless otherwise approved by the Engineer. Compaction shall be by approved means. In no case shall roots, vegetable matter or otherwise deleterious material be placed in the trench backfill.

B. Soil used to construct trench backfill should be uniformly moisture conditioned to within 3% of ASTM D1557 optimal moisture content.

C. Trench backfill and compaction shall be as specified on Butte County Plates Encroachment Permit. Soil shall be placed in maximum 12" loose lifts prior to compacting.

D. All backfill compaction testing shall be conducted by an independent consultant at the expense of the Owner, and as directed by the Engineer.

3.7 STRUCTURAL EXCAVATION AND ENGINEERED FILL

A. Structural Excavation

1. All excavation shall be done to the dimensions and levels shown on the drawings or specified herein. Excavation shall be made to such width outside the lines of the structure to be constructed therein as may be required for proper working methods, the erection of forms and the protection of the work. Where possible care shall be taken to preserve the foundation surfaces shown on the drawings in an undisturbed condition. If the Contractor excavates or disturbs the foundation surfaces shown on the drawings or specified herein without written authorization of the Engineer he shall replace at his expense such foundations with compacted gravel foundation fill or other material approved by the Engineer in a manner which will show by test an equal bearing strength with the undisturbed foundation material.
2. To suit field conditions, excavation below the depths shown may be ordered, but changes may only be made as directed. Soft, spongy, or unsuitable bearing material of any kind shall be entirely removed down to solid bearing and replaced with compacted gravel (95% maximum dry density). If relatively loose material is encountered within 5 feet of foundations, it shall be over-excavated until competent native material or rock is encountered.
3. Any water that may be encountered or that may accumulate in excavations shall be removed and kept out by pumping or other approved method. All construction shall be carried on in the dry. Water shall be removed until structures are complete to above water, safe from uplift and horizontal water pressure and the backfill has been placed. Any saturated material encountered shall be reported.
4. All excavated top soil of suitable quality for planting shall be saved and piled separately. The required amount of excavated earth shall be stored conveniently for use in back-filling and grading, but so as not to interfere with the work of others.

5. Where indicated on the plans, excavation shall be carried below footings and floor slabs of certain structures to the depth shown, and the excavated material replaced with an engineered fill as specified herein.
6. The Contractor shall notify the Engineer when excavation is complete. No forms, reinforcing steel, concrete, or pipe shall be placed until the excavation has been approved by the Engineer.
7. Excavated material determined by the Engineer to be unsuitable, or in excess of the amounts required for backfill, shall be disposed of off the site by the Contractor at his expense.

B. Foundation Preparation for Buildings, Structures and Tanks

1. The terms engineered fill, structural fill and foundation preparation all refer to the preparation of subsurface material to support buildings, structures and tanks. All references in the plans and technical specifications to shall apply.
2. The site shall be stripped of all organic material within the foundation areas. Any organic topsoil material shall be stockpiled. It shall not be incorporated into any of the embankment or structural fills.
3. Any loose, soft or saturated sub-grade soils shall be over-excavated to firm underlying materials and replaced with compacted backfill soil or aggregate base (95% maximum dry density).
4. The surface soil shall be scarified to a minimum depth of 6 inches below ground surface or to resistant rock.
5. The soil to construct fill shall be uniformly moisture conditioned to within about 2% of ASTM D157 optimum moisture content.
6. Fill shall be placed in maximum 8-inch loose horizontal lifts prior to compacting.
7. The soil shall be compacted to achieve a minimum relative compaction of 90% based on ASTM D 1557 maximum dry density. The upper 12 inches of fill in paved areas, beneath slabs and within proposed building and tank footprints shall be compacted to a minimum of 95% relative compaction.
8. All footings shall be trenched a minimum of 12 inches into competent native soil, weathered rock or compacted fill.

3.8 CLEAN UP

A. After completing all site development, the Contractor shall leave the site in a neat and clean condition, doing such finish grading as is required by the plans, or if not called for on the plans to restore the site to its finished shape and configuration. Any existing features, improvements, structures, and other facilities damaged or affected by the work shall be replaced, repaired, or restored to their original conditions or better.

* * END OF SECTION * *

SECTION 03-01-00
PRECAST CONCRETE

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:
Miscellaneous precast vaults and manholes per Drawings

B. Additional Requirements Specified Elsewhere:

1. Quality Control: Section 014000
2. Submittals: Section 013300

1.2 QUALITY ASSURANCE

A. Acceptable Manufacturers:

1. Precast vaults:
   a. Santa Rosa
   b. Utility Vault
   c. Christy/OldCastle Infrastructure
   d. Mid-State Concrete Products
   e. Jensen Precast
   f. Or equal

B. Reference Standards:

1. ACI 318: Building Code Requirements for Reinforced Concrete
2. PCI MNL-116: Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products
3. Uniform Plumbing Code: UPC-91
4. ASTM C150: Standard Specification for Portland Cement
5. ASTM C478: Standard Specification for Precast Reinforced Concrete Manhole Sections

1.3 SUBMITTALS

A. Shop Drawings and Product Data:
1. Design calculations with pertinent tables, charts, and definitions
2. Analysis of sections where concentrated loads are applied and where boxouts are provided
3. Complete layout, fabrication, and installation Drawings showing inserts and embedments
4. Limitations of field cutting and modification

5. If requested by Engineer, information on plant capability, productivity, certification, and details of manufacturing equipment and procedures

B. Test Reports:
1. Certified reports covering source and quality of materials
2. Certified reports of compressive strength of each design mix

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Delivery and Handling:
1. Transport and handle precast concrete units with equipment to protect from dirt and damage
2. Do not place units in positions that cause overstress, warp, or twist
3. Handle by means of lifting inserts
4. Do not move from manufacturer's yard until curing is complete

B. Storage:
1. Store units off ground
2. Place stored units so that identification marks are discernible
3. Separate stacked members by battens across full width of each bearing point
4. Stack so that lifting devices are accessible and undamaged
5. Do not use upper member of stacked tier as storage area for shorter members of heavy equipment

PART 2 PRODUCTS

2.1 MATERIALS

A. Reinforcement:
1. Prestressing strand: ASTM A416
2. Reinforcing steel: ASTM A615

B. Concrete:
1. Minimum compressive strength: 3,000 psi at 28 days
2. Cement: ASTM C150
   a. Vaults: Type I or Type III
3. Aggregate: ASTM C33 or C330

C. Water: Clean and free of deleterious substances

D. Accessories:
1. Bearing pads: Teflon
2. Expansion joint filler: ASTM D1752, Type I, preformed sponge rubber
3. Steel plates and shapes: ASTM A36

E. Valve Boxes
1. Dimensions and styles as shown on the drawings.
2. In-Line Gate Valve / Plug Valve Box: Christy, Model G5 or approved equal.

F. Wet Well and Vault Lid & Access Hatch

1. The precast concrete lid with the access cover shall be capable of supporting a live load of the H20 designation. The hatch shall be aluminum with non-slip heat-resistant coating.

   The pump access hatch shall have minimum clear openings as shown on the plans. Provide a single frame with 2 doors. Pump access hatch shall be furnished with a seal such that vapors cannot escape through access hatch when access hatch is closed.

   Door shall be equipped with heavy stainless steel hinges, stainless steel pins, compression spring operators for easy operation, and an automatic hold-open arm with release handle. A snap lock with removable handle shall be provided. Mill finish with bituminous coating applied to exterior of the frame prior to embedment. Manufacturer shall guarantee proper operation and against defects in material and workmanship for a period of 10 years. The door shall be equipped with a covered, recessed padlock mechanism.

   The access hatch shall include a protective grating panel for fall protection. The grating panel shall be constructed of 1-1/2" I bar aluminum with a safety orange powder coated finish. The grating shall be hinged and shall be supplied with a positive latch to maintain unit in an upright position.

2.2 FABRICATION AND MANUFACTURE

A. General:

1. Use rigid, adequately braced equipment free from dents, gouges, or other irregularities that would impair quality, appearance, or performance
2. Methods and equipment in conformance with generally accepted standards for the industry
3. Manufactured by experienced manufacturer's
4. Casting surfaces: Level and free form imperfections
5. Apply parting compound to form work
6. Concrete:
   a. Prevent segregation of materials
   b. Continuously vibrate during casting
7. Reinforcing steel:
   a. Maintain in proper location during casting
   b. Cover: 3/4 inch minimum
8. Embedded items:
   a. Locate accurately
   b. Maintain in proper location during casting
   c. Sufficient anchorage and embedment for design requirements

B. Curing:

1. Steam cured for 12 hours or fog spraying

2. Do not remove from molds for 12 hours minimum or attainment of 3,000 psi compressive strength
3. After removal of forms, continue curing until concrete attains specified strength
4. Curing: Consistent and uniform for all precast elements for this project

C. Release of Tension: Do not release pretensioning stress until the concrete has reached a compressive strength of 3,000 psi

D. Embedded Accessories:
1. Install plates, inserts, anchors, and other items required to be embedded at the time of manufacture
2. Accurately position embedments in forms and fix rigidly in place
3. Install bearing plates in exact and true position
4. Provide lifting loops or similar devices to facilitate handling

E. Holes and Openings:
1. Incorporate holes and openings for items indicated on Drawings
2. Carefully review Drawings for holes and inserts required by workers of all trades and include all that are beyond the limitations of field modification
3. Provide saddles, headers, or other suitable supports required for the size and location of the openings

F. Ends of Strands:
1. Cut flush with concrete
2. Coat or finish to prevent rusting

G. Surface Finish:
1. Float-finish top surfaces
2. Formed surfaces to be uniform in color and texture
3. Remove all fins and projections and repair all holes and other surface defects to Engineer's satisfaction
4. Power-grind repaired areas, or areas from which fins and projections have been removed, that will be exposed to view as required for a uniform finish

H. Shop Marking:
1. Paint or label each member in an area not to be finally exposed
2. Indicate location and position in structure in accordance with manufacturer's layout Drawings

PART 3 EXECUTION

3.1 INSTALLATION

A. General:
1. Precast concrete units shall be installed true to the lines and grades as shown on the plans. Connections to piping shall be made with an approved water tight grout or other method as indicated on the Plans. Contractor shall install compacted and level sand or gravel bedding under precast concrete products as per the manufacturer’s

recommendations for each unit. Methods indicated on the drawing or specified by the manufacturer shall govern over these specifications.

* * END OF SECTION * *

SECTION 03-30-00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SCOPE OF WORK

A. This section covers all plain and reinforced concrete for the project and comprises the requirements for all materials, labor, tools and equipment needed for mixing, placing and curing the concrete. This section describes the requirements for concrete including, but not limited to, materials to be used, forms and details of construction, workmanship, and measurement and payment. This section describes inserts into cast-in-place concrete work.

1.2 DESCRIPTION OF WORK

A. Work under this section shall include, but not be limited to, furnishing and placing all materials for mass concrete and reinforced concrete, reinforcing steel and supports, expansion joint fillers, water-stops, floor hardener, bonding agents, packing and non-shrink grout, epoxy anchors; constructing and removing form work, measuring, mixing and transporting concrete; placing, conveying, and vibrating concrete; installing construction and expansion joints, removing the forms, curing and protecting the concrete, finishing the concrete; placing concrete fillets, topping and equipment pads; and testing for quality and water-tightness.

1.3 SUBMITTALS

A. Submittals supplied by the Contractor include: samples and catalog data of materials used, a written description of the proposed forming methods, reinforcing steel shop drawings, and concrete mix design(s).

B. The Contractor shall submit and receive approval of the proposed concrete mix design prior to pouring concrete, a copy of all load slips, and catalog information on all additives shall be included.

1.4 STORAGE

A. Cement and aggregates to be used for concrete mixed on the job site shall be stored in such a manner as to prevent deterioration of their quality or intrusion of foreign matter. Reinforcing steel shall be stored on pallets, off the ground, and kept free of dirt and oils. All other materials, except forms, shall be stored in dry, clean containers. Any materials which have been deteriorated or damaged shall not be used and shall be removed from the job site.

1.5 LINES, GRADES AND TOLERANCES

A. Offset lines or coordinates, and grades shall be established for the Contractor, as necessary, for accurate location of concrete structures, all as described in the Special Conditions of this Contract. The Contractor shall, at his own expense and responsibility, transfer offset lines and coordinates, and grade and set batter boards and string lines, and make all necessary measurements and sightings, all from the construction staking provided, and all as necessary to accurately place the structures.

B. Tolerances in any dimension shall be not more than 1/4 inch in 10 feet.

1.6 INSPECTION

A. The Contractor shall make all material stock piles available for inspection by the Engineer. Plants used to produce ready mix concrete shall be subject to periodic inspection by the Engineer. The Contractor shall make available, for testing purposes, samples of all materials and samples of the concrete being placed.

Each phase of work shall pass inspection by the Engineer before commencing work on the next phase. The phases shall consist of, but not be limited to excavation, construction of forms, placing reinforcing steel and inserts, prior to placing concrete, placing concrete, grouting, installing anchors, finishing concrete, backfilling, and testing.

PART 2 PRODUCTS

2.1 GENERAL

A. Materials furnished for concrete and reinforced concrete shall include, but not be limited to, concrete and its constituents, reinforcing steel and supports, expansion joint filler, water-stops, floor hardeners, curing aids, bonding agents, patching grout, non-shrink grout, and epoxy anchors.

2.2 CONCRETE

A. The materials furnished for concrete shall include, but not be limited to, Portland cement, water, coarse and fine aggregates, fly ash, and admixtures.

1. Portland Cement - Portland Cement shall be Type II Modified conforming to Type II cement, as specified in ASTM C150.

2. Water - Water for washing aggregates and for mixing and curing concrete shall be clean, free from oil, acid, alkalies, vegetable matter, or other deleterious substances.

3. Coarse Aggregate - The coarse aggregate shall consist of clean, hard, dense, tough and durable natural gravel, crushed gravel, or crushed rock. It shall be free

from oil, organic matter or other deleterious substances and shall conform to ASTM C33.

4. Fine Aggregate - Fine aggregate shall consist of hard, durable, un-coated natural sand or other approved material. It shall be free from oil or other deleterious substances.

5. Fly Ash - Fly ash shall conform to ASTM A618, Class F or N, except that the loss on ignition shall be limited to 1%.

6. Admixtures - Water-reducing agents such as Pozzolith, WRDA, or equal shall be used in all concrete. The admixture shall conform to ASTM Specifications C494. Proportioning and mixing shall be as recommended by the manufacturer. Admixtures causing accelerated setting of cement in concrete shall not be used. Air-entraining admixtures compatible with the concrete mix shall be used, as required, as a moderate addition to the water-reducing agent, to obtain the specified percent air in the resultant concrete. The Contractor shall submit data verifying that the admixtures are compatible with the mix. Air-entraining admixture shall conform to ASTM Specification C260.

2.3 REINFORCEMENT

1. Steel Bars - All steel bars shall have a deformed surface and shall conform to ASTM A615, including Supplementary Requirement S1, Grade 60, free from dirt, rust, scale, oil, and frost. No. 3 bars may be Grade 40.

2. Epoxy-Coated Steel Bars - Where shown on the plans, bars shall be epoxy coated in conformance with ASTM A775, Section 2.02A.

3. Welded Wire Fabric - Welded wire fabric shall be of gauge and mesh size shown on the plans and shall meet the requirements of ASTM A185 or ASTM A497 for smooth wire fabric. Wire fabric shall be free from dirt, rust, scale, oil, and frost.

2.4 REINFORCING SUPPORTS

A. Reinforcement supported from form work shall rest on Class E (stainless steel protected) bar supports, as specified in "Manual of Standard Practice" by the Concrete Reinforcing Steel Institute (CRSI).

B. Reinforcement supported from the ground shall rest on 3-inch-high precast concrete blocks not less than 4 inches square.

C. Epoxy-coated reinforcing bars supported from form work shall rest on coated wire bar supports, or on bar supports made of dielectric materials or other acceptable materials. Wire bar supports shall be coated with dielectric material, compatible with concrete, for a minimum distance of 2 inches from the point of contact with the

epoxy-coated reinforcing bars. Reinforcing bars used as support bars shall be epoxy-coated.

2.5 EXPANSION JOINT FILLER

A. Filler for expansion joints shall be 1/2 inch thick pre-molded type conforming to ASTM D1751.

2.6 WATER-STOPS

A. Water-stops shall be neoprene or PVC conforming to Standard Specifications paragraph 51-1.14. Water-stops shall be of the size and type shown on the plans and shall have a hollow bulb in the center.

2.7 FLOOR HARDENER

A. Compounds used for floor hardener shall be Lapidolith, non-metallic consisting of quartz aggregate, dispersing agent and Portland cement. The hardener shall be manufactured, not field mixed, and compatible with the curing method used.

2.8 CURING AIDS

A. Aids for curing concrete shall be either a cover or applied spray. Covers shall be white or reflective 4-mil polyethylene, or moist burlap or rugs. Spray-applied curing compounds shall be white-pigment membrane type conforming to ASTM C309.

2.9 BONDING AGENT

A. Agents used for bonding concrete fillets, topping slabs, equipment pads, or similar applications, shall be Concressive 1001-LPL, or approved equal.

2.10 PATCHING GROUT

A. Grout used for patching small surface blemishes shall consist of neat Portland cement, water, and fine sand passing a No. 30 mesh sieve with an approved acrylic modifier.

2.11 NON-SHRINK GROUT

A. Non-shrink grout shall be Masterflow 713 by Master Builders Co., or approved equal.

2.12 EPOXY ANCHORS

A. Compounds used for poured epoxy-grouted anchors shall be Concressive Epoxy Adhesives, or approved equal. The type used for each application, as shown on the plans, shall be as recommended by the manufacturer.

B. Systems used for injected epoxy for anchors shall be HVA adhesive anchors by HILTI Fastening Systems, or approved equal.

PART 3 EXECUTION

3.1 FORMING SYSTEMS

A. The forming system used by the Contractor shall allow for proper sequencing of the work and removal of the forms without damage to the concrete. Form systems may be lumber, prefabricated wood panels, metal, or plastic-lined panels, all sound and free from any defects that will mar or detract from the surface of the finished concrete. The forms shall be treated with a nonstaining material to eliminate absorption of water and to act as a form release agent.

B. Walls and footings below existing and final grades may use earth trench walls as forms, provided the widths shown on the plans shall be increased two (2) inches, if approved after inspection of the trenches, provided the sides are clean, even, vertical, true, and further provided the bottoms are level, clean, and without fill.

3.2 REINFORCEMENT

A. The requirements for placing reinforcement shall include, but not be limited to, furnishing submittals, bending, storage and protection, placement, splicing and minimum concrete cover.

B. Prior to starting shop fabrication or field placement, the Contractor shall submit and receive approval of reinforcing steel shop drawings. The drawings shall comply with the requirements of ACI 318, detailed in accordance with ACI SP66, and adapted to the proposed placement schedule, showing size, dimension, bending, placing, and construction joint details and placement. The Contractor shall also submit the type, size, and location of all wire and bar supports.

C. Bending of the reinforcing steel shall be in accordance with the Concrete Reinforcing Steel Institute, Manual of Standard Practice, Chapter 7.

D. Reinforcing steel shall be stored off the ground and protected from oil, or other deleterious materials. Epoxy-coated reinforcing bars shall be stored on protective wood cribbing.

E. Placement
1. All reinforcing bars shall be accurately cut, bent and placed as shown on the drawings; they shall be securely tied at all intersections, and shall be firmly supported in the proper locations so that placing of concrete will not cause displacement of the reinforcing, all in conformance with Concrete Reinforcement Steel Institute, Manual of Standard Practice, Chapter 8.
2. Horizontal wall bars in double layer walls shall be staggered.

3. In walls reinforced with epoxy-coated bars, spreader bars where required, shall be epoxy-coated. Proprietary combination barclips and spreaders used in walls with epoxy-coated reinforcing bars shall be made of corrosion-resistant material or coated with dielectric material. Epoxy-coated reinforcing bars shall be tied with plastic-, epoxy- , or nylon-coated tie wire, or other acceptable materials.
4. Splices shall be placed as shown on the plans. For any splices not shown, the bars shall be overlapped a minimum of 30-bar diameters. Splices in adjacent bars shall be staggered a minimum of 5 foot center to center. All laps forming splices shall be securely wired.
5. All reinforcement shall have proper concrete cover thickness as per the Concrete Reinforcing Steel Institute Manual of Practice. In all cases, the thickness of concrete over the reinforcement shall be not less than one and one-half times the bar diameter.

3.3 CONCRETE MIX

A. Concrete shall consist of Portland cement, fine aggregate, coarse aggregate, a water reducing agent, an air-entraining agent, pre-approved additives, and water, all of which shall conform to CALTRANS Section 90 and these specifications.

B. Concrete shall meet the minimum compressive strength or concrete class as shown on the plans. Concrete that is not assigned a minimum compressive strength or class on the plans shall comply with the minimum compressive strength or class using the types of uses described in this subsection. The allowable slump, maximum water-cement ratio, and air entrainment shall also comply with the following table:

TYPE OF USE	CLASS	(1) MINIMUM COMPRESS. STRENGTH (psi)	SLUMP (inches)	(2) MAXIMUM WATER-CEMENT RATIO	(3) ENTRAINED AIR REQUIRED*
Liquid Containing Structures:					
Slabs & Footings	A	3500	2 to 3	0.45	5½% ±1%
Vertical Wall Sections & Columns	A	3500	3 to 4	0.45	5½% ±1%
Mass concrete &Unformed Slopes	A	3500	1 to 2	0.45	5½% ±1%
Other Structural Concrete					
Slabs & Footings	A	3000	2 to 3	0.45	--------
Vertical Wall Sections & columns	A	3000	3 to 4	0.45	--------
Curbs, Gutters, & Sidwalks	B	2500	3 to 4	0.55	--------
Thrust Blocks & Concrete Fill	C	2000	3 to 4	0.60	--------

(1) Minimum compressive strength to be attained at 28 days.
(2) Maximum water/cement ratio by weight.
(3) Based on 1½" maximum aggregate size. Where 1" maximum aggregate size is used, increase entrained air by ½%.

C. Concrete shall contain the following minimum amount of Portland cement per cubic yard:

Class A	564 pounds
Class B	470 pounds
Class C	376 pounds

D. The Contractor may, at his option, substitute up to 15 percent by weight of fly ash for the Portland Cement required herein.

E. Grading shall be as set forth in CALTRANS Section 90. In addition, the maximum size aggregate shall be no larger than one-fifth of the narrowest distance between forms, nor larger than three-quarters of the minimum clear spacing between reinforcing bars. The maximum size aggregate grading shall be 1½inch.

F. All concrete shall be machine mixed at the site, or delivered to the site by transit mixers. No concrete shall be placed in the work after it has begun to set. If transmit mix is used, the rate of delivery, haul time, mixing time and hopper capacity shall be such that all mixed concrete delivered shall be placed in the forms within one hour from the time of introduction of cement and water to the mixer. All concrete shall be kept continuously agitated until discharged in the hopper at the job site. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C94 and Chapter 7 of ACI 301. Plant equipment and facilities shall conform to the "Check List for Certification of Ready Mixed Concrete Production Facilities" of the National Ready Mixed Concrete Association.

3.4 CONCRETE PLACING

A. Before placing concrete, all form work and reinforcing shall be cleaned of dirt and construction debris, water, rust, scale, frost or other coatings deleterious to the bond, then securely and properly fastened in its correct position, forms at construction joints re-tightened, and all bucks, sleeves, hangers, pipes, conduits, bolts, wires, etc., installed. No concrete shall be placed before the forms, reinforcing steel and all work that is to be embedded have been set, observed and approved by the Engineer. Excavations shall be kept free from water while concrete is being placed, cured and finished therein. Footing, slab and sub-grade soils must be moisture conditioned to between 75 and 90% of saturation to a depth of 24 inches a minimum of 24 hours before concrete placement. Soil shall be wetted prior to concrete placement to reduce the risk of problems caused by wicking of moisture from curing concrete. Fresh concrete shall be protected at all times from running water.

B. Concrete shall be conveyed from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent the separation or loss of the materials. The concrete shall be deposited in the forms as nearly as practicable in its final position to avoid re-handling and the use of vibrators for extensive shifting of the mass of fresh concrete will not be permitted. Fresh concrete shall not be permitted to fall from a height greater than 4 feet without the use of adjustable length pipes, tubes or double

belting placed to prevent segregation of the concrete. Mixed concrete, after being deposited, shall be consolidated until all voids are filled and free mortar appears on the surface.

C. In vertical sections, concrete shall be deposited continuously in horizontal layers of 24 inches maximum depth so as to maintain a horizontal plastic surface until the completion of the unit. No concrete shall be deposited on concrete which has hardened sufficiently to cause the formation of seams and planes of weakness within the section.

D. Concrete for horizontal members or sections shall not be placed until the concrete in the supporting vertical members or sections is no longer plastic and has been in place at least two hours. In all slabs, concrete shall be deposited in a continuous or monolithic operation to the full thickness of the slab. Each batch shall be dumped against previously placed concrete and not away from it, and shall not be dumped in separate piles and then worked together.

E. The concrete in each integral part of the structure shall be placed continuously, and work will not be allowed to commence on any such part unless sufficiently inspected and approved material for the concrete is on hand, and forces and equipment are sufficient to complete the part without interruption in the placing of the concrete.

F. With the exception of concrete placed as slope paving and aprons, and concrete placed under water (where approved), all concrete shall be consolidated by means of high frequency internal vibrators within 15 minutes after it is deposited in the forms. The vibrators shall not be attached to or held against the forms or the reinforcing steel. Vibrating shall be done with care and in such manner so as not to displace forms, reinforcement, ducts, and embedded items.

3.5 COLD WEATHER CONCRETE WORK

A. Concrete shall not be mixed or placed while the atmospheric temperature surrounding the work is at or below 35 degrees F, or is expected to be at or below 35 degrees F, within 24 hours. Concrete work may be carried on during cold weather, but only with the express permission of the Engineer after approval of a plan of operation. Precautions shall be taken to see that the concrete is properly protected after pouring and during the cure period. In general, the requirements of the CALTRANS Section 90 in this regard will apply.

3.6 HOT WEATHER CONCRETE WORK

A. During hot weather, proper attention shall be given to ingredients, production methods, handling, placing, protection, and curing to prevent excessive concrete temperatures or water evaporation which will impair the required strength or serviceability of the member or structure.

3.7 CONSTRUCTION JOINTS

A. The Contractor shall obtain approval for joints not shown and locate them where they least impair the strength of the structure. Unless otherwise shown on the drawings, joints in walls and columns shall be at the underside of floors, slabs or grade beams, and at the top of footings or floor slabs. Place grade beams at the same time as slabs. At least two hours shall elapse after depositing concrete in columns or walls before depositing concrete in supported grade beams or slabs. As the new concrete is placed, re-vibration in tops of columns and walls is desirable.

B. Make construction joints perpendicular to the main reinforcement.

C. All horizontal construction joints in walls shall have a continuous wood screed strip at the outer face of the joint to form a true line. Screeds shall be removed and the joint thoroughly cleaned out before pouring the next portion of wall.

D. Reinforcing steel and mesh shall continue across construction joints. Exposed reinforcing steel shall be cleaned of all concrete and other unsuitable coatings.

E. Construction joints shall be made rough by chipping the entire surface, sandblasting with coarse silica sand, or hosing the surface 4 to 6 hours after the pour with a fine spray, exposing solidly embedded clean aggregate. Forms shall be scraped and cleaned of drippings, debris, etc., and dusted by means of compressed air. Surfaces of the hardened concrete shall be cleaned to the satisfaction of the Engineer and wetted as required before placing of new concrete. Just before starting the new pour, all free water shall be removed and the horizontal surfaces shall be covered with at least 4 inch thickness of concrete composed of cement and fine aggregate, omitting the coarse aggregate. Cement content of such mortar shall be increased to at least 7½ sacks per cubic yard, but not less than the approved concrete design mix.

3.8 EXPANSION JOINTS

A. Install expansion joint fillers to within ½ inch below top of slab levels.

B. Where shown, load transfer dowels shall consist of plain bars with one-half coated with an approved anti-bond coating. The coated half shall be sleeved. No other reinforcement or metal shall extend continuously through expansion joint.

3.9 WATERSTOPS

A. The design and location of waterstops shall be as shown on the plans. Each piece of premolded waterstop shall be of maximum practicable length to minimize the number of end joints. Embed center bulb in the center of the joint.

B. All joints in waterstops including but not limited to, intersections and end to end joints, shall be joined following the manufacturer's instructions. Joints shall develop effective watertightness fully equal to that of the continuous waterstop material and shall develop not less than 50 percent of the mechanical strength of the parent section.

Do not lap sections of waterstop. All joints shall be butt spliced using a heat-sealing method and in conformance with the manufacturer's instructions.

C. Support waterstops securely against displacement by wire tie between the last rib and the end of the waterstop, or use a method specifically recommended by the manufacturer.

D. If the joint is not watertight after construction, the joint shall be grouted by drilling grout holes to the center of the structure unit and force epoxy grout into the joint under pressure. This shall be repeated until the leak has stopped completely.

3.10 NON-SHRINK GROUT

A. Use non-shrink grout to fill voids around embedded items, at locations shown on the plans, and as directed by the Engineer. Grout shall be mixed and used in accordance with manufacturer's recommendations. Exposed surfaces and edges shall be smooth, straight, even, and finished with a steel trowel.

3.11 EPOXY ANCHORS

A. These anchors shall be installed in strict conformance to the manufacturer's printed instructions. Embedded reinforcing bars shall not be damaged when drilling holes for these anchors.

3.12 OTHER EMBEDDED ITEMS

A. Prior to placing concrete, all required sleeves, inserts, anchor bolts and embedded items shall be in place. Give all trades whose work is related to the concrete ample notice and opportunity to introduce embedded items before concrete is placed.

B. Position embedded items accurately and support them against displacement. Fill voids in sleeves, inserts, and anchor slots temporarily with readily removable material to prevent the entry of concrete.

C. Anchor bolts placed in slabs, equipment pads, top of walls and similar installations, shall be held firmly in place by a plywood or similar type template to ensure accurate placement.

3.13 FORM REMOVAL

A. When approved for removal, the forms shall be removed carefully to insure complete safety of the structure. For all portions of a structure supported by forms and shoring, the forms shall remain in place for a minimum of 10 days. Beam sides, columns, or other vertical forms may be removed after 24 hours, providing the concrete will not be injured and a curing method has been approved. Do not remove supporting forms or shoring until effected members have acquired sufficient strength to safely support

their weight and imposed loads. The Contractor shall assume full responsibility for safe removal of the forms.

3.14 CURING AND PROTECTING

A. The Contractor shall begin to protect the concrete immediately after placement from drying, excessively hot and cold temperatures, and mechanical injury. Measures shall be taken to keep moisture loss to a minimum until the cement has hydrated and the concrete is hard, but not less than seven days.

B. CURING - For formed surfaces, keep the forms wet. Cool metal forms exposed to sun with water. Forms shall remain in place for seven days for curing purposes unless an approved curing compound, water cure process, or waterproof membrane is used, as specified below.

1. For surfaces not formed or formed surfaces whose forms have been removed prior to the seven day requirement, immediately apply a curing compound, water cure, or waterproof membrane. The Contractor shall consult with the Engineer and receive approval of the curing method prior to placing the concrete.

2. If approved for use, curing compound shall be applied to the concrete following the surface finishing operation immediately after the moisture sheen disappears from the surface, but before any drying shrinkage or craze cracks begin to appear. Water curing shall keep the surfaces of the concrete wet for a period of seven (7) consecutive days by covering with water-saturated material kept wet by means of a system of perforated pipes, mechanical sprinklers, or porous hose, or by any approved methods which will keep all surfaces to be cured continuously (not periodically) wet.

3. Waterproof membrane curing shall be accomplished by first wetting the concrete surface with water using a nozzle that atomizes the flow into a mist, not a spray, until the concrete has set, then covering the concrete with a waterproof membrane. The waterproof membrane shall be a white or silver reflective material. All joints in the membrane shall be securely cemented together to provide a waterproof joint. The membrane shall remain in place for a minimum of 72 hours after being placed.

C. PROTECTING

1. During curing period, the Contractor shall protect concrete from mechanical damage, loading, shock and vibration.

2. In cold weather, while curing proceeds, the Contractor shall maintain the moisture conditions, and shall maintain the temperature of the concrete between 50 degrees F and 70 degrees F for entire curing period by either heating or covering, or both.

3. In hot weather, the Contractor shall take immediate steps to protect newly finished concrete from drying effects of wind and sun, and maintain temperature of the air surrounding the concrete uniform within 5 degrees F in any one hour or 50 degrees F in any 24 hour period

3.15 FINISHING

A. All concrete surfaces, including precast vaults, shall be finished as shown on the plan or as follows.

1. Backfilled, buried and covered surfaces shall be repaired as necessary. Repairing shall consist of cleaning, filling holes or depressions, repairing rock pockets and honeycombed areas, removing fins, bulges, offsets, and stains, and repairing any other defects. Patching mortar used in repair shall contain enough silica sand and white cement to result in a patch which, when cured, will match the surrounding concrete

2. All formed concrete surfaces, including vaults, that are to remain exposed in the final product shall be formed, repaired and dressed to a level 6" below final grade. Dressing shall be as follows: All formed concrete surfaces that require final dressing shall receive a coat of mortar. The area shall be cleaned thoroughly and dampened. The dressing mortar shall be a mixture of one part Portland cement and two parts clean silica sand with enough water to form a loose paste. The dressing mortar shall be applied with a float having a resilient rubber surface. The dressing process shall create a smooth, uniform surface, both in texture and color. After taking its initial cure, the dressing mortar shall be kept damp for 48 hours. Surfaces shall be dressed prior to installing any conduits, pipe, ducts, or equipment that would interfere with the dressing process.

3. Exterior slabs and walkways shall be screeded, floated and broomed. Brooming shall be perpendicular to the direction of traffic if applicable. Sidewalks and outside slabs shall be marked and scribed into rectangles of not less than 12 square feet nor more then 20 square feet with a scoring tool which will leave the edges rounded. All sidewalk and outside slab edges shall be tooled to a rounded edge.

4. All inside floors, such as areas inside treatment plants, pumping plants; and tank floors, topping slabs, and equipment pads shall be screeded, floated and troweled.

5. All exposed horizontal and vertical edges or other corners, both interior and exterior of structures, shall be chamfered 3/4 inch minimum, measured on the sides, not hypotenuse. If shown on the plans, larger chamfers shall be used for specific corners or structures.

3.16 CONCRETE EQUIPMENT PADS

A. Equipment pads shall be placed over a bonding agent as soon as possible after completion of the curing period of the concrete. Contact surfaces shall be thoroughly cleaned to the degree recommended by the bonding agent manufacturer.

B. The bonding agent shall be accurately and thoroughly mixed and applied at the manufacturer's recommended coverage rate. Mix only the amount which can be used prior to expiration of the pot life. Concrete shall be immediately placed over the fresh bonding agent before the surface takes an initial set, all as recommended by the manufacturer. Bonding agent which sets up prior to placing concrete shall be removed and a fresh coat of bonding agent applied prior to placing concrete.

C. Concrete fillets, topping slabs, and equipment pads shall be accurately screeded to the slopes and elevations shown on the plans. Cure the concrete as specified for slabs above. Set equipment anchor bolts in pad to accommodate equipment furnished. Finish fillets the same as adjacent surfaces. Finish topping slabs and equipment pads as shown on the plans, or as specified herein.

3.17 QUALITY TESTING

A. Quality testing shall be done at the Owner's expense, unless otherwise specified in the Special Conditions of this Contract. If the Contractor is required to arrange for testing, it shall be done by a certified testing laboratory and all test results shall be forwarded immediately to the Engineer. The Contractor shall cooperate with and provide any equipment or manpower necessary to assist the Engineer in testing the concrete.

B. The Contractor may, at any time, and at his own expense, perform additional testing for purposes of quality control and shall not depend on testing by other parties for such purposes. The Contractor shall, at his own expense, perform any tests necessary to acquire the strength of the concrete for the purpose of, and shall be solely responsible for, form removal and safety of the structure.

C. Prior to placing the concrete, each load or batch shall be tested for proper slump and air entrainment. The samples shall be taken in accordance with ASTM C 172. Slump test shall be as per ASTM C143 and air test as per ASTM C 231 or 173.

D. The acceptable strength of concrete shall be based on compressive test specimens taken and cured in accordance with ASTM C31. A minimum of three specimens shall be taken from every 20 cubic yards of concrete placed or for each major placement during the day. The Engineer shall determine the number of specimens to be taken as he deems necessary to ensure the concrete meets the specifications. The compressive tests shall be in accordance with ASTM C39. The standard compressive test shall be 28 days.

3.18 WATER-TIGHTNESS

A. Water-tightness testing shall be done at the expense of the Contractor.

B. All concrete structures and channels which will later be subjected to hydrostatic pressure shall be tested for water-tightness. The tests shall be made prior to application of waterproof coating, if required. Testing shall consist of filling the structure with clean water to a level of 6 inches below the top. Cells adjacent to the cell being tested shall be empty and dry. Water shall be allowed to stabilize for 12 hours, refilled, then the water level shall be measured at the beginning, middle, and end of a 24-hour test period. Allowable leakage shall not exceed 1/2 percent of the contents. The Contractor shall repair any visible leaks and shall correct the cause of any test failures. The repair procedure shall be submitted to the Engineer for approval. After repairs are made, the Engineer may require retesting of structures and/or channels which have been repaired.

3.19 BACKFILL

A. Backfill around structures shall not begin until the concrete has reached sufficient strength, as determined by the Contractor, but not earlier then 7 days after the pour. All forms shall be removed, all repairs made, and all concrete shall pass inspection prior to beginning the backfill operation. The type of backfill shall be as shown on the plans.

* * END OF SECTION * *

DIVISION 04 - MASONRY

SECTION 04 22 00
CONCRETE UNIT MASONRY

PART 1 GENERAL

1.1 SCOPE OF WORK

A. This section includes specifications for construction of the lift station walls.

1.2 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall submit materials testing reports and other pertinent information certifying that the masonry block, grout, mortar, concrete, and reinforcing steel conform to the requirements of the CONTRACT DOCUMENTS.

PART 2 PRODUCTS

2.1 CONCRETE BLOCK MASONRY MATERIALS

A. Concrete Block shall be made from lightweight expanded shale aggregate or other approved equivalent lightweight aggregate. All blocks shall comply with the requirements of the Uniform Building Code and A.S.T.M. Standard C-90, Type 1, and with the following minimum requirements:

1. Linear Shrinkage – saturated to cool oven dry – not to exceed 0.08%.

2. Concrete weight per cu. ft. 110 lb. Maximum.

B. Test methods shall conform to A.S.T.M. Standard C140, as applicable; volume change test as directed by Engineer.

C. Blocks shall be free from cracks and other defects that will impair the strength and appearance, with all edges square and true. Blocks shall be capable of being cut with a saw and shall take nails without cracking; blocks shall afford good holding power for nails. Submit samples for approval. Blocks shall be tan colored.

D. Type and size of blocks shall be as shown on the drawings; 8" x 8" x 16" and 8½" x 12" x 16" (nom.) split face exterior, smooth face interior unless otherwise indicated. Only whole blocks shall be used, except as otherwise indicated. They shall be Basalite, or equal.

E. The type of block units to be used shall be two-cell or four-cell Open End Units, laid in pattern or bond as indicated on plans.

F. Mortar shall be freshly prepared and uniformly mixed in ratio of one part Portland cement to not more than 3½ parts surface dry sand, by volume, to which may be added lime in the quantity of ¼ part by volume cement. Cement shall be as specified under "Portland Cement Concrete." Sand shall be clean, well graded and free from loan, vegetable matter, or deleterious matter of any kind and shall comply with the requirements of A.S.T.M. C144, except not less than 3% shall pass a #100 sieve. Mortar strength: 2000 psi at 28 days. Where block is colored, mortar shall be colored to match.

G. Concrete used in filling cells and bond beams shall be concrete gout, not mortar, and shall contain pea-gravel coarse aggregate. Aggregate shall conform to requirements of A.S.T.M. C404. Materials for such concrete shall be as specified under "Portland Concrete Cement," except that 28 day strength shall be 2000 psi, and the proportions shall be approximately 1 part cement, 2 parts sand, and 2 parts gravel, or as otherwise determined or approved by the Engineer.

H. Lime: Hydrated lime shall conform to "Standard Specifications for Hydrated Lime for Masonry Purposes" A.S.T.M. designation C207. Quicklime shall conform to "Standard Specification for Quicklime for Structural Purposes" A.S.T.M. designation C5. Quicklime shall be slaked and then screened through a 16-mesh sieve. After slaking, screening, and before using, it shall be stored and protected for not less than 10 days.

I. Reinforcing Steel, furnished and placed hereunder, shall be as specified under "Portland Cement Concrete" and shall be lapped in accordance with applicable requirements.

PART 3 EXECUTION

3.1 WORKMANSHIP

A. All concrete block masonry walls shall be true and plumb, and built to dimensions, bond or patterns, as indicated on the plans. The wall should be laid in straight uniform courses with vertical and horizontal joints aligning, giving perfect alignment of vertical and horizontal cells, affording maximum size openings for reinforcing of wall.

B. Provisions shall be made for all special units as may be required to form all bond beams, openings, and offsets, and maintain a proper bond through the length of the wall.

C. The work of the masonry contractor shall be coordinated with that of the other trades. All openings and chases for heating, plumbing, and electrical ducts, pipes, and conduits shall be built into the masonry walls as shown on the plans, and all cuts shall be neat and regular, Provisions shall be made for installation of bolts, toggles, flashing, beams, anchors, hangers, nailing strips, wall plugs, and frames, as required.

3.2 CONSTRUCTION

A. Masonry Units shall be cured and dried before being used and the surfaces shall be clean, and free from dirt when laid in the walls. Masonry units shall not be wet before being

used. Proper masonry units shall be used to provide for all doors, bond beams, lintels, pilasters, etc., with a minimum of unit cutting.

B. Joints – Mortar joints shall be straight, clean, and uniform in thickness and shall be tooled as shown on the plans or described herein to produce a dense surface well bonded to the block at the edges. Tooling shall be done when the mortar is partially set but still sufficiently plastic to bond. All tooling shall be done with a tool which compacts the mortar, pressing the excess mortar out of the joint rather than dragging it out. All visible joints exterior and interior, shall be "concave" type.

C. Unless otherwise specified or detailed on the plans, horizontal and vertical mortar joints shall be ⅜" thick with full mortar coverage on the face shells and on the webs surrounding cells to be filled. Vertical head joints shall be butted well for a thickness equal to the face shell of the block and these joints shall be shoved tightly so that the mortar bonds well to both blocks. Joints shall be solidly filled from the face of the block to the depth of the face shell. it is necessary to move a block so as to open a joint, the block shall be removed from the wall, cleaned, and set in fresh mortar.

D. Grouting – Reinforcing steel shall be in place and inspected before grouting starts. When a foundation dowel does not line up with the vertical core to be reinforced, it shall not be bent over, but shall be grouted into a core in direct vertical alignment, even though it is in an adjacent cell to the vertical wall reinforcing. All open end cells shall be grouted.

E. A cleanout hole shall be provided at the bottom of each cell to be poured when the height of grout pour exceeds four feet. All debris and projecting mortar shall be cleaned out before pouring grout. Vertical cells to be filled shall have vertical alignment to maintain a continuous unobstructed cell area not less than 2" x 3". Cells containing reinforcement shall be solidly filled with grout in lifts not to exceed 4' and pours shall be stopped 1½" below the top of a course to form a key at pour joints.

F. Grouting of beams over openings shall be done in a continuous operation. All bolts, metal frames, anchors, etc., inserted in the wall shall be solid grouted in place.

G. Wall Care – Extreme care shall be taken to prevent mortar splotches. No construction supports shall be attached to the wall except where specifically permitted by the Engineer. All forms shall be made tight (special attention is necessary for bottom form of block bond beams) and concrete and grout spilled on the wall shall be washed off before it can be set up. After the wall is constructed it shall not be saturated with water for curing or any other purpose.

H. Forms for concrete beams or lintels that are exposed shall be of plywood; elsewhere, other forms may be used; all form work and concrete shall be as called for under "Portland Cement Concrete".

3.3 WATERPROOFING

A. All interior and exterior block surfaces shall receive three coats of clear waterproof sealer equal to Thompson's Water Seal No. 201, in accordance with manufacturer's directions.

3.4 CLEAN-UP

A. At the conclusion of the masonry work, the contractor shall clean down all masonry walls, remove his scaffolding and equipment used in the work, clean up all debris, refuse, and surplus material, and remove them from the premises.

** END OF SECTION **

DIVISION 09 - FINISHES

PROTECTIVE COATINGS

SECTION 09 90 00

PART 1 GENERAL

This specification covers work, materials and equipment required for protecting and/or rehabilitating concrete and masonry manholes and other underground vaults by monolithic spray-application of a high-build, solvent-free epoxy coating or a polymorphic resin coating to eliminate infiltration, provide corrosion protection, repair voids and enhance structural integrity. Procedures for surface preparation, cleaning, application and testing are described herein.

1.01 SECTION INCLUDES

A. Requirements for surface preparation, repairs and solvent-free epoxy coating application to specified surfaces.

1.02 REFERENCES

ASTM - The published standards of the American Society for Testing and Materials, West Conshohocken, PA.

NACE - The published standards of National Association of Corrosion ENGINEERs (NACE International), Houston, TX.

SSPC - The published standards of the Society of Protective Coatings, Pittsburgh, PA.

1.03 SUBMITTALS

A. The following items shall be submitted:

1. Technical data sheet on each product used, including ASTM test results indcating the product conforms to and is suitable for its intended use per these specifications.

2. Material Safety Data Sheets (MSDS) for each product used.

3. Project specific guidelines and recommendations.

4. Applicator Qualifications:
   (a) Manufacturer certification that APPLICATOR has been trained and approved in the handling, mixing and application of the products to be used.

(b) Certification that the equipment to be used for applying the prod ucts has been manufactured or approved by the protective coating manufacturer and APPLICATOR personnel have been trained and certified for proper use of the equipment.

(c) Five (5) recent references of APPLICATOR (projects similar size and scope) indicating successful application of the product to be used.

(d) Proof of any necessary federal, state or local permits or licenses necessary for the project.

5. Design details for any additional ancillary systems and equipment to be used in site and surface preparation, application and testing.

1.04 QUALITY ASSURANCE

A. APPLICATOR shall initiate and enforce quality control procedures consistent with applicable ASTM, NACE and SSPC standards and the protective coating manufacturer's recommendations.

B. A NACE Certified Coating Inspector may be provided by the DISTRICT. The Inspector will observe surface preparation, application and material handling procedures to ensure adherence to the specifications.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Materials are to be kept dry, protected from weather and stored under cover. Protective coating materials are to be stored between 50 deg F and 90 deg F.

B. Protective coating materials are to be handled according to their material safety data sheets.

1.6 WARRANTY

A. APPLICATOR shall warrant all work against defects in materials and workman ship for a period of one (1) year, unless otherwise noted, from the date of final ac ceptance of the project. APPLICATOR shall, within a reasonable time after re ceipt of written notice thereof, repair defects in materials or workmanship which may develop during said one (1) year period, and any damage to other work caused by such defects or the repairing of same, at his own expense and without cost to the DISTRICT.

PART 2 PRODUCTS

2.01 EXISTING PRODUCTS

A. Remove existing coatings prior to application of the new protective coating. APPLICATOR is to maintain strict adherence to applicable NACE and SSPC recommendations with regard to proper surface preparation and compatibility with existing coatings.

2.02 MANUFACTURER

A. Con-Tech of California,Inc. Stockton, CA 209-941-8324

or

B. IET System 3 two-component polymorphic resin manufactured by Integrated Environmental Technologies, Santa Barbara, California.

2.03 REPAIR MATERIALS

A. Repair materials shall be used to fill voids, structurally reinforce and/or rebuild surfaces, etc. as determined necessary by the ENGINEER and protective coating APPLICATOR. Repair materials must be compatible with the specified epoxy or polymorphic coating and shall be applied in accordance with the manufacturer's recommendations.

2.04 PROTECTIVE COATING MATERIAL

A. Protective coating shall conform to these specifications:

Product type	Epoxy or resin
Color	white or light gray
Solids Content (vol %)	100
Compressive Strength	>10,500 psi
Tensile Strength	>4,500 psi
Tensile Elongation	min. 6%
Flexural Modulus, psi	450,000 - 500,000 psi
Bond Strength - Concrete	>Tensile Strength of Concrete

B. Products shall be Con-Tech of California's HYDRO-POX 212 GL or HYDRO-POX 204 UHB primed with HYDRO-POX 251 epoxy coating system or Approved equal product as manufactured by Integrated Environmental Technologies, Santa Barbara, California.

2.05 PROTECTIVE COATING APPLICATION EQUIPMENT

A. Appropriate spray equipment or the appropriate equipment for hand application shall be used per the manufacturer recommendations.

PART 3 EXECUTION

3.01 ACCEPTABLE APPLICATORS

A. Protective coating must be applied by a Certified APPLICATOR of the protective coating manufacturer and according to manufacturer specifications.

3.02 EXAMINATION

A. All structures to be coated shall be readily accessible to APPLICATOR.

B. Appropriate actions shall be taken to comply with local, state and federal regulatory and other applicable agencies with regard to environment, health and safety.

C. Any active flows shall be dammed, plugged or diverted as required to ensure that the liquid flow is maintained below the surfaces to be coated. Flows should be totally plugged and/or diverted when coating. All extraneous flows into the wet well at or above the area coated shall be plugged and/or diverted until the coating has set hard to the touch. As an option, hot air may be added to the wet well to accelerate cure time of the coating after the material has set.

D. Pipe joint seals shall be installed by others. No leaks may be present prior to commencing and during work.

E. Installation of the protective coating shall not commence until the concrete substrate has properly cured in accordance with these specifications.

F. Temperature of the surface to be coated should be maintained between 40 deg F and 120 deg F during application. Prior to and during application, care should be taken to avoid exposure of direct sunlight or other intense heat source to the structure being coated. Where varying surface temperatures do exist, care should be taken to apply the coating when the temperature is falling versus rising

3.03 SURFACE PREPARATION

A. APPLICATOR shall inspect all surfaces specified to receive a protective coating prior to surface preparation. APPLICATOR shall notify DISTRICT of any noticeable disparity in the surfaces which may interfere with the proper preparation or application of the protective coating.

B. All contaminants including: oils, grease, incompatible existing coatings, waxes, form release, curing compounds, efflorescence, sealers, salts, or other contaminants shall be removed.

C. All concrete or mortar that is not sound or has been damaged by chemical exposure shall be removed to a sound concrete surface or replaced.

D. Surface preparation method(s) should be based upon the conditions of the substrate, service environment and the requirements of the coating to be applied.

E. Surfaces to receive protective coating shall be cleaned and abraded to produce a sound surface with adequate profile and porosity to provide a strong bond between the protective coating and the substrate. Generally, this can be achieved with a low pressure water cleaning using equipment capable of 5,000 psi at 4 gpm. Other methods such as high pressure water jetting (refer to NACE Standard No. 5/SSPC- SP12), abrasive blasting, shotblasting, grinding, or scarifying may also be used. Detergent water cleaning and hot water blasting may be necessary to remove oils, grease or other hydrocarbon residues from the concrete. Whichever method(s) are used, they shall be performed in a manner that provides a uniform, sound clean neutralized surface.

F. Infiltration shall be stopped by using a material which is compatible with the specified repair mortar and is suitable for topcoating with the specified protective coating.

G. Test prepared surfaces after cleaning but prior to application of the coating to determine if a specific pH or moisture content of the concrete is required according to manufacturer's recommendations.

H. All surfaces should be inspected by the Inspector during and after preparation and before the material is applied.

3.04 APPLICATION OF REPAIR MATERIALS

A. Areas where structural steel has been exposed or removed shall be repaired in accordance with the Project ENGINEER'S recommendations.

B. Repair materials shall meet the specifications herein. The materials shall be trowel or spray applied utilizing proper equipment on to specified surfaces. The material thickness shall be specified by the Project ENGINEER according to DISTRICT'S requirements and manufacturer's recommendations.

C. If using approved cementitious repair materials, such shall be trowelled to provide a smooth surface with an average profile equivalent to coarse sandpaper to optimally receive the protective coating. No bugholes or honeycomb surfaces should remain after the final trowel procedure of the repair mortar.

D. The repair materials shall be permitted to cure according to manufacturer recommendations. Curing compounds should not be used.

E. Application of the repair materials, if not performed by the coating certified APPLICATOR, should be inspected by the protective coating certified

APPLICATOR to ensure proper finishing for suitability to receive the specified coating.

F. After abrasive blast and leak repair is performed, all surfaces shall be inspected for remaining laitance prior to protective coating application. Any evidence of remaining contamination or laitance shall be removed by additional abrasive blast, shotblast or other approved method. If repair materials are used, refer to these specifications for surface preparation. Areas to be coated must also be prepared in accordance with these specifications after receiving a cementitious repair mortar and prior to application of the epoxy coating.

G. All surfaces should be inspected during and after preparation and before the protective coating is applied.

3.05 APPLICATION OF PROTECTIVE COATING

A. The CONTRACTOR may spray or hand apply the protective coating.

G. For spray application:

1. Application procedures shall conform to the recommendations of the protective coating manufacturer, including material handling, mixing, environmental controls during application, safety, and spray equipment.

2. The spray equipment shall be specifically designed to accurately ratio and apply the specified protective coating materials and shall be regularly maintained and in proper working order. Or mix and applied in complete Factory proportioned units.

3. The protective coating material must be spray applied by a Certified APPLICATOR of the protective coating manufacturer.

4. Specified surfaces shall be coated by spray application of a moisture tolerant, solvent-free, 100% solids, epoxy or resin protective coating as further described herein. Spray application shall be to a minimum wet film thickness of 125 mils.

5. Spray application equipment or other approved by the coating manufacturer shall be used to apply each coat of the protective coating.

C. Hand applied protective coatings shall conform to manufacturer specifications for product application.

D. If necessary, subsequent topcoating or additional coats of the protective coating should occur while the base coat is still tacky, ideally within 8 hours but no later than the recoat window for the specified products. Additional surface preparation procedures will be required if this recoat window is exceeded.

3.06 TESTING AND INSPECTION

A. During application a wet film thickness gage, such as those available through Paul N. Gardner Company, Inc. meeting ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness of Organic Coatings by Notched Gages, shall be used to ensure a monolithic coating and uniform thickness during application.

B. After the protective coating has set hard to the touch it shall be inspected with high-voltage holiday detection equipment. Surface shall first be dried, an induced holiday shall then be made on to the coated concrete surface and shall serve to determine the minimum/maximum voltage to be used to test the coating for holidays at that particular area. The spark tester shall be initially set at 100 volts per 1 mil (25 microns) of film thickness applied but may be adjusted as necessary to detect the induced holiday (refer to NACE RPO188-99). All detected holidays shall be marked and repaired by abrading the coating surface with grit disk paper or other hand tooling method. After abrading and cleaning, additional protective coating material can be hand applied to the repair area. All touch-up/repair procedures shall follow the protective coating manufacturer's recommendations.

C. Measurement of bond strength of the protective coating to the substrate can be measured in accordance with ASTM D4541. Any areas detected to have inadequate bond strength shall be evaluated by the Project ENGINEER. Further bond tests may be performed in that area to determine the extent of potentially deficient bonded area and repairs shall be made by APPLICATOR in strict accordance with manufacturer's recommendations.

D. A final visual inspection shall be made by the Inspector. Any deficiencies in the finished coating shall be marked and repaired according to the procedures set forth herein by APPLICATOR.

** END OF SECTION **

SECTION 26 00 00
GENERAL ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. All general provisions of the Contract Documents apply to all work specified in this Division 26 Electrical.

B. Furnish all necessary labor, materials, equipment and incidentals required to install a complete and operational electrical system according to the intent of this specification and the accompanying drawings, whether itemized or not.

C. Examine the specification and drawings for mechanical equipment and provide all starters, circuit breakers, switches, pushbuttons and appurtenances, which are not specified to be with the mechanical equipment. Erect all electrical equipment not definitely stated to be erected by others, furnish and install conduit, wire and cable and make connections required to place all equipment in complete operation.

D. Where mechanical and process equipment is provided with specialty protective relays, the relays shall be incorporated into the controls at no additional cost to the Owner.

E. The general extent of the electrical work includes, among others, the furnishing and installing of the following items:

1. Service enclosure, panelboard, motor controllers and disconnects.
2. Control panel, autodialer and instrumentation.
3. Transfer switch and generator.
4. Complete circuiting and connections for all motors, including their remote control and indicating devices.
5. All supports, bases, anchors, sleeves, hangers, conduit seals, and the like, all electrical work shown and/or specified, not particularly mentioned above.
6. Complete grounding system.
7. Significant documentation, including submittal, instruction, operations and maintenance manuals.
8. Significant field services including pre-start-up check-out, testing, calibration, start-up, communications testing and training.
9. Conduit, Fittings and Conductors.
10. Power, control, alarm, and instrumentation wiring for all equipment specified in Divisions 22 and 26.

F. Throughout this Contract, provide protection for materials and equipment against loss or damage in accordance with provisions elsewhere in these Contract Documents. Throughout this Contract, follow manufacturer's recommendations for storage. Protect everything from the effects of weather. Prior to installation, store items in clean, dry, indoor locations. Store in clean, dry, indoor, heated locations items subject to corrosion under damp conditions, and items containing electrical insulation, such as transformers, conductors, motors, and controls. Energize all space heaters furnished with equipment. Provide temporary heating, sufficient to prevent condensation, in transformers, pedestals, switchgear, switchboards, motors, and motor controls, which do not bare space heaters.

G. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. When equipment intended for indoor installation is installed at the Contractor's convenience in areas where it is subject to dampness, moisture, dirt, or other adverse atmosphere until completion of construction; ensure that adequate protection from these atmospheres is provided that is acceptable to the Construction Manager. Cap conduit runs during construction. Energize all space heaters furnished with equipment.

H. All temporary wiring for the motors and equipment shall have disconnect means, overcurrent protection, and conduit or metal wireways as required by the National Electrical Code, except that jacketed flexible cables may be exposed on equipment.

I. Provide an experienced field supervisor to monitor work progress and to attend regular project meetings. Reference the General Conditions for specific requirements.

J. Removal of Salvaged Material: Use reasonable care in removing salvaged electrical material to avoid all unnecessary damage. Handle equipment to be removed and salvaged with special care to avoid damage of any nature. Repair any unnecessary damage to salvaged equipment at the Contractor's expense. Deliver all such material to the DISTRICT's storage area, and neatly stockpile as directed.

K. The work includes significant documentation, engineering, start-up services and training. Review the specific requirements throughout Division 26 with due diligence.

1.2 CODES AND STANDARDS

A. All Work shall conform to the following codes:

1. National Electrical Code - Latest Edition
2. NFPA 70E – Electrical Safety
3. NFPA 101 - Life Safety Code - Latest Edition
4. Uniform Building Code - Latest Edition
5. Local Electrical Code
6. NETA Standards for Testing

7. Any additional codes enforced at the job site

B. The Contractor shall furnish without extra charge any additional material and labor which may be required for compliance with these laws, rules, and regulations, even though the work is not mentioned in these particular specifications or shown on the drawings.

C. The Contractor shall apply and pay for all permits required by any of the legally constituted public authorities for the installation or construction of the work included under this Division. The Contractor shall arrange and pay for any inspections or examinations so required and deliver certificates of all such inspections to the Engineer. When these specifications call for materials or construction of a better quality or larger sizes than required by the above mentioned rules and regulations, the provisions of the specifications shall take precedence.

1.3 ARC FLASH ANALYSIS AND SIGNAGE

A. Any circuits or equipment, on the site, fed from a utility service shall have an arc flash analysis performed. The arc flash analysis shall be based on based on calculations performed per 1584a standards published by the IEEE 1584 working group. The worst case Incident Energy released shall be determined and boundaries shall be marked for Arc Flash Protection. Markings and hazard signage and labels shall conform to OSHA 29 CFR 1910 132(d) and other applicable requirements. Working distances, required PPE Level, shock hazard voltage and limited, restricted and prohibited approach distances shall be posted. The arc flash hazard analysis shall utilize results from a short circuit study and from a protective device co-ordination study. All study results shall be presented in a bound report with all assumptions, methodology, equipment lists with component ratings, electrical one-lines used, calculations and resulting requirements.

B. Submit a short circuit study adequate to support the arc flash analysis and the coordination study.

C. Submit protective device coordination study with recommended coordinated settings for adjustable breakers with a check list for confirming implementation.

D. Submit label for review by DISTRICT prior to affixing to the equipment.

1.4 QUALITY OF MATERIALS

A. All electrical materials used on this project shall be new and free from defects.

B. All electrical materials used on this project shall conform where applicable, to the following standards, unless otherwise noted:

1. NEMA - National Electrical Manufacturers Association

2. ANSI - American National Standards Institute

3. UL - Underwriters Laboratories, Inc.

C. Each type of material shall be of the same manufacturer and quality throughout

the work.

1.5 SUBSTITUTIONS

A. Specific brand names and catalog numbers are used to describe materials in order to establish standards of performance and quality or to match existing equipment. Refer to Section 01 33 00 regarding the procedure for submitting substitutions.

B. The decision of the Engineer shall govern as to what is equal to the item specified. Equality will be judged on the basis of the following:

1. Conformance with description or performance required.
2. Equal in quality.
3. Comparable in appearance and artistic effect where these are considerations.
4. Comparable operation, maintenance and performance.
5. Equal in longevity and service under conditions of climate and usage.
6. Conformance with space allocations and requirements for operations from mechanical or electrical services provided without necessitating changes in details and construction or related work.
7. Compatible with existing equipment and spare parts stock.

C. If the Engineer considers it necessary, tests to determine the quality of the proposed materials shall be made, at the expense of the Contractor, by an unbiased laboratory, satisfactory to the Engineer.

D. Any material, article, or method judged by the Engineer equal to that specified will be approved, provided the Contractor submits a single written request, in triplicate, to the Engineer, within 45 days after contract award, with the following information for each item:

1. Name of manufacturer or supplier.
2. Trade or brand name.
3. Type, model, style, and/or catalog number.
4. Size or capacity rating.

E. The Contractor assumes full responsibility for including complete, correct data in this one request and shall also attach completely referenced diagrams descriptive and technical data sheets for the Engineer's determination of equality or suitability of appearance of any substitution item. Only one such request may be submitted. The Engineer's rejection of any substitute shall automatically require the Contractor to furnish the specified item without further discussion or delay.

1.6 MATERIAL, EQUIPMENT AND SHOP DRAWING SUBMITTALS

A. Submittals shall be prepared in accordance with General Conditions, Section 01 33 00.

B. The following information shall be clearly marked on each shop drawing, catalog data sheet, specification sheet, etc. submitted:

1. Project Title.
2. Date.
3. Submitted By.
4. Identification of item represented.

C. Shop drawings shall be drawn to scale or completely dimensioned and shall give all information required to completely describe the item. Shop drawings of switchboards, panels, and motor control centers shall all be submitted on 11" x 17" or 24" x 36" size sheets at one time. 8-1/2" x 11" sheets will not be accepted. Drawings shall show front views, plan views, elementary wiring diagrams and numbered terminal blocks. Drawings shall be submitted for existing equipment requiring modifications as called for on drawings.

D. The Contractor shall carefully check all his shop drawings for compliance with this Specification and the Plans.

E. In the event that certain shop drawings are rejected by the Engineer, they will be so noted and returned to the Contractor for resubmittal. Resubmittals are to be made within 14 days.

F. If the shop drawings show variation from the contract requirements because of standard shop practice or other reasons, the Contractor shall make specific mention of such variations in order that if acceptable, suitable action may be taken for proper adjustment of the Contract. The Contractor will not be relieved of the responsibility for executing the work in accordance with the Contract, even though the shop drawings have been reviewed.

G. The Engineer's review of shop drawings will be for general design and arrangement only, and shall not relieve the Contractor from responsibility for errors of any sort in shop drawings or schedules. The Contractor shall verify all dimensions and job site conditions affecting the work, and shall be responsible for furnishing and installing the proper materials required by the Contract, whether or not indicated on the shop drawings.

H. Work requiring shop drawings shall not be started before receipt of the Engineer's written approval.

I. Provide complete interconnection wiring diagrams. Interconnections drawings shall show for each piece of equipment and all wiring between all devices, panels, cabinets, terminal boxes, control equipment, motor control centers and any other devices and equipment including equipment provided in other Divisions of the Specifications as well as equipment provided by the DISTRICT. Each inter-connection diagram shall show the following as a minimum: each conduit number, wire label, wire color code and terminal number, as actually installed; each motor, starter, cubicle, disconnect, switch, panel, cabinet, instrument, device, and all other equipment; and grounding points.

J. Commercial Warranties: Pursuant to the General Provision of the contract, prior to final payment, the Contractor shall furnish to the Engineer a listing of all manufacturers of their materials and equipment. The list of these warranties must include the time period of each warranty, i.e. 6 months, 1 year, and the like. One copy each of those warranties whose time period exceeds 1 year shall be submitted with the listing.

K. Submit seismic calculations for the anchor systems for each item specified herein which weighs in excess of 400 pounds (wet, or operating weight). Calculations shall include seismic horizontal and vertical forces as well as dead load or live load calculations, as applicable. Calculations shall include details, which show size and material of anchor bolts, spacing requirements, grout and filler specifications, strap material, spacing and fastening requirements, and any miscellaneous information required to properly secure the item of equipment. Calculations shall be stamped by a Structural Engineer registered in the State of California.

L. Submit a single complete package for all products on the following list:

1. Conduit, fittings, supports, conductors, vaults and boxes.
2. Service meter enclosure, panelboard, transformer, motor controllers and disconnects.
3. Generator and transfer switch.
4. Light fixtures, receptacles and switches.
5. Control panel including instruments.
6. Seismic Calculations and anchor recommendations.
7. Arc Flash Analysis and Signage with short circuit study, protective device coordination study and circuit breaker settings.

1.7 OPERATION AND MAINTENANCE MANUALS:

A. The CONTRACTOR shall provide an Operation and Maintenance manual in pdf file format on a disk prior to completion of the Work. Provide hard copies for training. The hard copy manuals shall be bound and covered and be 9 inch by 12 inch in size. Provide a table of contents and one section for each item of equipment specified herein. All pages shall be nearly assembled and fit within the manual cover.

B. For each section provide the following information, as applicable:

1. An itemized list of all data provided.
2. Name and location of the manufacturer, the manufacturer's local representative, the nearest suppliers, and spare parts warehouse.
3. Recommended installation, adjustment, start up, calibration, and troubleshooting procedures.
4. Recommended lubrication, lubrication intervals, and an estimate of yearly

quantity needed.

5. Recommended step-by-step procedures for all modes of operation.
6. Complete internal and connection wiring diagrams.
7. Recommended preventive maintenance procedures and schedule.
8. Complete parts lists, by generic title and identification number, with exploded views of each assembly.
9. Recommended spare parts and special tools.
10. Disassembly, overhaul, and reassembly instructions.
11. All approved shop drawing information pertinent to facility operation and maintenance.
12. Equipment calibration data, calibration sheets including equipment/instrument description.
13. Approved submittal information.

C. Record (as-built) submittal information covering all Contractor supplied equipment.

D. As-built drawings, containing complete wiring diagrams, shall be submitted with the Operation and Maintenance manuals described above.

E. As built Contract Documents Drawings shall be marked with red pencil to show electrical work revisions and actual routes of embedded or buried conduit, which may differ from the Drawings. Refer to the General Conditions for additional requirements.

F. Test results/reports shall be contained within the Operation & Maintenance manual and shall be placed under each respective equipment item tested.

1.8 AS BUILT RECORD DRAWINGS

A. The Contractor shall keep an accurate legible record of all changes and conduit relocations made during construction and shall make up a separate legible record copy of Contract Drawings at completion of the project. A working copy of as-built drawings shall be maintained on site at all times during construction.

1.9 INTERPRETATION OF DRAWINGS

A. Any error or omissions of detail in either the drawings or the specifications shall not relieve the Contractor from correctly installing all materials necessary for complete and operating electrical system.

B. The Contractor shall inspect the site and verify all measurements and conditions and shall be responsible for the correctness of same. No extra compensation will be allowed because of differences between work shown on the drawings and measurements at the site.

C. The electrical drawings are diagrammatic, but shall be followed as closely as existing conditions and work of other contractors will permit. All deviations from

the drawings required to make the work conform to structures as constructed, and to the work of others, shall be made at the Contractor's expense.

D. The Contractor shall examine the civil, structural, mechanical, architectural and manufacturer's drawings for the various equipment in order to determine exact routing and final terminations for all conduits and cables. Conduits shall be stubbed up as near as possible to equipment enclosure.

1.10 LOCATIONS AND ENCLOSURES

A. Provide equipment, materials, and wiring methods suitable for the type of locations in which they are located.

B. Definitions of types of locations and types of enclosures to be provided:

1. Dry locations: All indoor areas that do not fall within the definitions below for wet, damp, hazardous, nor corrosive locations and which are not otherwise designated on the drawings. Provide NEMA 1A or NEMA 12 enclosures.

2. Wet locations: All locations exposed to the weather, whether under a roof or not, unless otherwise designated on the drawings. Provide NEMA 3R enclosures.

3. Damp locations: All indoor [or outdoor] spaces wholly or partially underground, or having a wall or ceiling forming part of a channel or tank, over or near water areas, or any area subject to water spray, unless otherwise designated on the drawings. Provide NEMA 4X (SS) enclosures.

4. Corrosive location: Provide NEMA 4X (non-metal) enclosures.

5. Hazardous locations: NEMA 7 rated enclosures.

6. Below grade locations: All electronic or otherwise equipment sensitive to moisture or flooding shall be mounted in a NEMA 6P rated enclosure.

1.11 MATERIAL AND EQUIPMENT INSTALLATION

A. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The OWNER reserves the right to require minor changes in location of outlets or equipment, prior to roughing in, without incurring any additional costs or charges.

B. All electrical equipment and appurtenance facilities, which are separately mounted or anchored, shall be so installed as to be in conformance to all requirements of the Uniform Building Code, latest edition, both for vertical and seismic loading. Provide housekeeping pads for floor or pad mounted equipment.

C. Follow the manufacturer's installation recommendations unless otherwise indicated. Keep copy of the manufacturer's installation instructions available on the job site for review at all times.

1.12 SEISMIC REQUIREMENTS

A. All electrical, mechanical, and instrumentation equipment and appurtenant

facilities which are separately mounted or anchored shall be so installed as to be in conformance to all requirements of the California Building Code, both for vertical and seismic loading. This requirement applies, but is not limited to, such items as light fixtures, electrical and instrumentation panels, tanks, pumps, piping, pipe supports and hangers, generator, motors, fans, ventilating ducts and equipment, and other similar equipment or facilities in excess of 400 pounds.

B. All components of this facility shall be considered essential for the purpose of determining seismic force values. The seismic zone shall be considered Zone 4 for this project.

1.13 UTILITY COORDINATION

A. Coordinate the new electrical service.

B. The Contractor shall pay all costs for utility work shown on the Plans and described in the Specifications. The Contractor shall coordinate the completion of forms, even where the DISTRICT is filling out the majority of the form. The Contractor is responsible for providing trenching, conduit, concrete encasement, risers, primary and secondary conductors, medium voltage terminations, transformers, transformer pads, pullropes, poles, pull sections and meters per base requirements. The Contractor is responsible for coordinating inspections, site visits and all paperwork to completion.

C. Provide temporary power during construction. Remove temporary power equipment at end of the project.

1.14 CUTTING AND PATCHING

A. Do not cut or notch any structural member or building surface without specific approval of the Engineer. Carefully carry out any cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of materials and equipment. Following such work, restore surfaces neatly to new condition using skilled craftsmen of the trades involved, at no additional cost to the DISTRICT.

1.15 INSPECTION

A. The Contractor shall cooperate with the Engineer and shall provide assistance at all times for the inspection of the electrical work. Remove covers, operate machinery, or perform any reasonable work, which in the opinion of the Engineer, will be necessary to determine the quality or adequacy of the work.

B. If any material does not conform with these specifications the Contractor shall, within three days after being notified by the Engineer, remove the materials from the premises.

C. Work shall not be closed in or covered before inspection and approval by the Engineer. Cost of uncovering and making repairs where uninspected work has been closed in shall be borne by the Contractor.

1.16 SUPERVISION AND WORKMANSHIP

A. The Contractor shall employ a competent electrical foreman on the job throughout

the entire period of construction to see that his work is carried on without delay and completed as rapidly as possible.

B. Before the start of construction and in conjunction with the schedule of other Contractors, the Electrical Sub-Contractor shall furnish to the Engineer a tentative construction schedule showing the order of the work, the pedestal and control panel shop drawings submittal dates, scheduled manufacturing dates, and the anticipated delivery dates.

1.17 COOPERATIVE WORK WITH OTHERS

A. The Contractor shall cooperate with others, with due regard to their work, towards promotion of rapid completion of project. If any cooperative work must be altered due to lack of proper supervision of such, or failure to make proper provision in time by Contractor, then he shall bear expense of such changes as necessary to be made in work of others.

B. Labor and materials, including templates, sleeves, anchors, concrete inserts and the like shall be furnished in ample quantities at such times as necessary to ensure uninterrupted progress of work.

C. Contractor shall cease work at any particular point temporarily and transfer his operations to such points or execute such portions of work as directed, when in the judgment of the Engineer it is necessary to do so.

PART 2 PRODUCTS

2.1 ANCHORS AND FASTNENERS

A. Fasteners and anchors for securing equipment to walls, floors and the like shall be stainless steel. When fastening to walls, floors, and the like, provide capsule anchors, not expansion shields. Size capsule anchors to meet load requirements.

B. Where seismic calculations have been submitted and approved, provide recommended fasteners and anchors.

C. Where manufacturer provide specialty braces to meet seismic requirements for their equipment, install the braces per the manufacturers' recommendations.

2.2 EQUIPMENT IDENTIFICATION

A. All panelboards, motor contollers, control panels, internal control panel components, all disconnect switches and circuit breakers, transformers, push buttons, controls, instruments, boxes, etc. shall be properly identified with a descriptive nameplate. Nameplates shall be made of 1/6 inch laminated plastic with black background and white letters. Size of letters shall be 1/4 inch high, minimum. Letters shall be machine engraved. All nameplates shall be screw mounted with oval head machine screws tapped into metal. Adhesive material shall not be used. Every cubicle in the motor control center shall be provided with a nameplate with 1/2" high lettering.

2.3 SPARE PARTS, CONSUMABLE ITEMS, AND TOOLS

A. The contractor shall supply all spare parts prior to functional acceptance test. All

parts shall be sealed in plastic bags and delivered to the site in a heavy-duty plastic storage box.

B. In addition to spare parts described elsewhere in these Specifications, provide:

1. Fuses. Provide 20 percent of each size and type used rounded to the next whole number, but no less than three of each size and type.

2. Indicating Lamps. Provide 20 percent of each size and type used rounded to the next whole number, but no less than 10 of each type.

PART 3 EXECUTION

3.1 CLEANING

A. After all other work has been accomplished pedestals, starters, panelboards, control panels and all other electrical equipment shall be cleaned of all dust, dirt, grease, plaster, paint or other marks, by the Contractor. All meter enclosures, panelboards, motor controls, control panels, switchboards and motor control centers shall be "touch-up" painted to match original colors.

3.2 TESTING, GENERAL

A. Testing, test plans, and test reports shall be provided by the Contractor as specified herein. The Contractor shall perform tests as required to demonstrate that the equipment and systems covered in this Specification operate safely and meet the requirements of these Specifications: reference the Specification Section 01 77 00. The Contractor shall provide labor, instruments, and other material to complete the tests.

1. Perform the Operational Readiness Test and Functional Acceptance Test.

2. Perform independent testing services for the electrical system prior to Functional Acceptance Test.

3. Perform other specific test required by Specification Sections in Division 26.

4. Perform support activities for the final facilities, described throughout the Specifications (i.e. additional factory and field testing).

B. Operational Readiness Test (ORT)

1. Point-to-Point Wire Check. After installation, termination, and identification of conductors, perform a point-to-point wire check to verify that all wiring has been properly installed and identified, and that there are no shorts between wires, shields, and ground. Lift wires from terminals as required to perform this test.

2. Insulation Test. Perform a megger test on all control and power wiring. The Engineer shall be notified at least 1 week prior to the insulation test so that the testing maybe witnessed.

3. Motor Test. Submit test data showing (for every motor): Perform a winding resistance check of each phase. Amperes in each phase with motor loaded;

motor nameplate amperes; Thermal overload element rating and catalog number. At time of test record voltage at switchboard for all three phases. Check for correct rotation of mechanical equipment.

C. Functional Acceptance Test (FAT)

1. The Contractor shall perform the FAT after he has delivered written notice to the Engineer that the ORT has been completed.

2. The Contractor shall inform the Engineer at least 2 weeks prior to the FAT so that the Engineer may witness the test.

3. The FAT shall operate all equipment and systems over the full operating range, shall demonstrate proper operation of alarms and indicators, and, in general, shall demonstrate that the equipment and systems meet the requirements of the Drawings and Specifications.

4. If any equipment or system fails the FAT, the Contractor shall correct the problem and shall repeat the test until it is successful.

5. The FAT shall be performed in the presence of the Engineer.

D. Final System Testing

1. Provide resources and personnel, on site, as necessary, to support the effort required to complete testing of the facility in a timely manner.

2. Personnel include an electrician and a control system start-up technician.

3.3 TRAINING

A. The Contractor shall provide four man-hours for general training of the operation of the electrical and control systems to DISTRICT personnel.

B. Instructions shall consist of the functional description of each piece of equipment, including calibration and setting of set points. Demonstration of the operation of each system shall be included.

C. The Contractor shall provide all manuals and study materials required for the training of DISTRICT's personnel.

3.4 WARRANTY

A. The Contractor shall leave the entire electrical system in proper working order and shall, at his own expense, replace any work, material, or equipment furnished by the firm which develops defects within one year from the date of acceptance.

B. The control system supplier shall have a staff of experienced personnel available to provide service on 2 working days notice during the warranty period. Such personnel shall be capable of fully testing and diagnosing the hardware and software delivered; and of implementing corrective measures.

C. If the control system supplier fails to respond in 2 working days, the DISTRICT at its option will proceed to have the warranty work completed by other resources; the total cost for these other resources shall be reimbursed in full by the Contractor. The use of other resources, as stated above, shall not change or relieve

the Contractor or supplier from fulfilling the remainder of the warranty requirements.

D. Prior to "final acceptance", the Contractor shall furnish to the Engineer a listing of warranty information for all manufacturers of materials and equipment used on the project. The listing shall include the following:

1. Manufacturer's name, service contact person, phone number, and address.
2. Material and equipment description, equipment number, part number, serial number, and model number.
3. Manufacturers warranty expiration date.
4. Completed test forms.

* * END OF SECTION * *

SECTION 26 79 00
STANDBY ENGINE GENERATOR AND TRANSFER SWITCH

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Applicable provisions of Section 26 00 00 are incorporated herein as though fully set forth at length.

B. This Section covers the work required to furnish, install, start up, test, and document a standby engine-generator, including fuel system, starting system, cooling system, exhaust system, control system, sound attenuating enclosure and other items required for a complete operating system as shown on the Drawings and as specified herein.

C. The Contractor is responsible for securing all the required permits with the local air board.

1.2 UNIT RESPONSIBILITY

A. The CONTRACTOR shall cause the supplier of the standby generator to take unit responsibility for the entire standby generator systems, including all of the items specified in this Section, and to provide a complete and operable system which meets all requirements of these Contract Documents. The standby generator supplier shall be responsible for the selection, design, manufacture, and testing of the equipment specified herein, and to ensure complete compatibility of the elements of the standby generator system with one another and with other equipment in the facility.

B. The generator set shall be certified by the engine manufacturer to be suitable for use at the installed location and rating, and shall meet all applicable exhaust emission requirements at the time of commissioning at the location installed for standby duty. Provide certification that the engine-generator complies with requirements of the EPA and Local Air Quality Management District.

C. The generator will be installed on a site near 2500 feet above sea level. The units shall meet the requirements of the specifications at the elevation they are installed.

D. The unit shall be mounted on a pad. The pad will be sized for a future 250 KW unit.

1.3 GENERAL

A. The standby generator shall be an engine-driven generator set rated to serve continuously during interruption of prime power. Speed shall not be greater than 1,800 rpm. The set shall operate on diesel fuel and shall be liquid cooled.

B. Each unit shall consist of an engine directly connected to a generator and mounted on a steel base, and shall include all necessary engine and generator

auxiliaries, accessories, and controls required to provide electrical output as specified herein. Minimum required accessories and controls include a controls and alarm panel, external water jacket heater, silencer, batteries, and battery charger. The unit shall be the product of a supplier regularly engaged in the assembly of generator sets. The component parts of the unit shall be the products of firms regularly engaged in the manufacture of these parts. All materials shall be new and of current manufacture.

C. The supplier of the generator set and the manufacturers of the component parts shall have service and spare parts facilities located within 150 miles of the installation that can provide regular service, inspection, spare parts, and emergency service.

D. Departures from Drawings. Submit to the DISTRICT, in writing for review, details of any necessary proposed departures from these Contract Documents, and the reasons therefore, as soon as practicable and within 30 days after the award of the Contract. Make no such departures without the prior written approval of the DISTRICT.

1.4 SUBMITTALS

A. Submit material or equipment data in accordance with the Specification Section 26 00 00, General Requirements, Electrical.

B. In addition to the general requirements, the submittal for each generator shall include the following:

1. Bill of Materials. A listing shall include all of the panels, racks, instruments, components, and devices provided under this Section.

2. Equipment list tabulating all components furnished, followed by the manufacturer's name, manufacturer's model number, and a cross reference to its location on the Shop Drawings.

3. Drawings and descriptive (catalog) data and brochures of each item of equipment.

4. Dimensional drawings and weights of each item of equipment.

5. Certified foundation and anchor bolt plans for all floor-mounted equipment.

6. Diesel engine data.

a. Manufacturer

b. Model

c. Revolutions per minute (rpm)

d. Rated capacity brake horsepower (bhp)

e. Make and model of governor

f. Piston displacement (cubic inches)

g. Guaranteed fuel consumption rate in gallons per hour at full load, 3/4 load, ½ load.

7. Generator data:
   a. Manufacturer
   b. Model
   c. Rated kVA
   d. Rated kW
   e. Voltage
   f. Temperature rise above 40 degrees C ambient
   g. Detailed generator sizing calculation
   h. Generator efficiency, including excitation losses at 80-percent power factor at full load, 3/4 load and 1/2 load
   i. Satisfactory voltage dip/motor starting [sizing] calculations
8. Engine-generator unit and accessories:
   a. Weight of skid-mounted unit
   b. Overall length
   c. Overall width
   d. Overall height
   e. Exhaust pipe size
   f. Cubic feet per minute (cfm) of air required for combustion and ventilation
   g. Heat rejected to room by engine and generator in Btu/hr
   h. Cooling air volume required
   i. Total efficiency of the unit.
9. Generator circuit breaker:
   a. Catalog data
   b. Recommended trip settings for all adjustable settings
   c. Short-circuit interrupting ratings
10. Electrical Drawings
   a. Complete elementary and connection diagrams of all electrical circuits and devices, including generator winding data and connection diagrams. Include battery charger and water jacket power requirements.

b. Complete drawings and descriptive data, both mechanical and electrical or control panels.

11. Manufacturer's certificate of satisfactory installation is required for work under this Section.

12. Catalog and installation information on fuel fill and monitoring system, fuel tank, exhaust mounting brackets, battery, battery cabinet, battery charger, water jacket heater, voltage regulator and governor.

13. Satisfactory voltage dip [starting] calculations and confirmation that after derating for elevation the submitted generators are adequate to start and run the loads as described.

14. Testing procedures, syllabus of training and a schedule.

1.5 OPERATING AND MAINTENANCE MANUALS

A. The CONTRACTOR shall provide an electronic copy of an Operation and Maintenance manual in pdf format for each generator prior to completion of the Work.

B. For each section provide the following information, as applicable:

1. An itemized list of all data provided.

2. Name and location of the manufacturer, the manufacture's local representative, the nearest suppliers, and spare parts warehouse.

3. Recommended installation, adjustment, start up, calibration, and troubleshooting procedures.

4. Recommended lubrication, lubrication intervals, and an estimate of yearly quantity needed.

5. Recommended step-by-step procedures for all modes of operation.

6. Complete internal and connection wiring diagrams.

7. Recommended preventive maintenance procedures and schedule.

8. Complete parts lists, by generic title and identification number.

9. Recommended spare parts and special tools.

10. Disassembly, overhaul, and reassembly instructions.

11. All approved shop drawing information pertinent to facility operation and maintenance.

1.6 WARRANTY

A. The work and equipment covered in this Section shall be guaranteed for a period of 2 years minimum from the date of acceptance thereof against defective materials, design, and workmanship.

1.7 PERFORMANCE REQUIREMENTS

A. As a minimum, the standby generator at the site shall have the following continuous ratings (as used herein, the term "continuous" shall mean for the duration of a utility company power outage at the facility):

1. 150 KW (minimum) at 0.8 pf.
2. 480/277 Volts, three phase, four wire plus ground.
3. 60 Hz.
4. Not to exceed safe operating temperatures when operating at full load in an ambient temperature of 50 degrees C.
5. The generator shall be capable of starting the loads shown on the drawings (assume single 35 HP induction motor with a NEMA code letter F and RVSS motor controllers) with less than a 15 percent voltage dip with a second similar pump 35 HP pump and 5 KW of single phase miscellaneous load energized. Provide an engine and generator combination capable of meeting the voltage dip requirements: 150 KW minimum. Confirm the engine-generator combination has the capacity to start and run the load, as described, at 2500 feet elevation without derating
6. The standby generator system maximum time for recovery to rated frequency shall be 10 seconds after full-rated load is applied in one step.
7. Under steady-state conditions, after a maximum of 3 minutes of operation the standby generator system long-time frequency drift shall not exceed 0.5 Hz.
8. Under steady-state conditions, after a maximum of 3 minutes of operation the standby generator system voltage regulation shall be better than 2 percent for any load between no load and full load.

1.8 TECHNICAL REQUIREMENTS FOR SMART CONTROLLER INTERFACE

A. Each standby generator system shall include generator run status and fail alarm dry contact outputs rated 0.5 Amps at 120 Volts, 60 Hz, non-inductive.

B. All alarm and status contacts shall be brought out to terminal strips and numbered and identified on a wiring diagram.

PART 2 PRODUCTS

2.1 GENERAL

A. Unless otherwise indicated, provide all first-quality new materials, free from any defects, and suitable for the intended use and the space provided. Provide equipment approved by NFPA and UL wherever standards have been established. As a minimum provide equipment that meets the requirements of UL 508 (Electric Industrial Control Equipment), UL 142 (Sub Base Fuel Tanks), UL 1 36 Battery Chargers, UL 2200 Generator Sets and UL 499 (Heaters).

B. Furnish and install all incidental items not specifically shown or specified which

are required by good practice to provide the complete systems specified herein.

C. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.

2.2 STANDARD PRODUCTS

A. Unless otherwise indicated, provide materials and equipment which are products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturer's latest design that conforms to these Specifications.

2.3 MECHANICAL ASSEMBLY

A. The standby generator set shall consist of an industrial engine and single-bearing generator mounted on a structural steel skid-type base assembly with lifting holes and accessory mounting provisions. The engine and generator shall be coupled together through a flexible metallic coupling which permits alignment of the two units. The couplings shall be properly guarded to prevent injury to personnel.

B. The standby generator skid shall incorporate a mounting configuration to accommodate nominal uneven floor surfaces without imposing misalignment forces on the engine or generator.

C. The unit shall include a secure sound attenuating weatherproof enclosure.

1. The weatherproof enclosure shall be completely lined with sound deadening material. This material must be of a self extinguishing design with a reflective surface for enhanced serviceability.

2. The enclosure shall be made of steel with a minimum thickness of 16 gauge. The enclosure is to have hinged, removable doors to allow access to the engine, alternator and control panel. The hinges shall allow for door fit adjustment. Hinges and all exposed fasteners will be stainless steel. The use of pop-rivets weakens the paint system and not allowed on external painted surfaces. Each door will have lockable hardware with identical keys. The enclosure shall be coated with electrostatic applied powder paint, baked and finished to manufacturer's specifications. The color will be manufacturer’s standard.

3. The genset silencer shall be mounted on or in the enclosure.

4. Provide sound attenuating enclosure. Submit supporting technical data: 78 dBA (nominal, or less) at 23 feet.

2.4 ENGINE

A. The engine shall be diesel, four-cycle, fuel injection, compression ignition, liquid cooled with an integrally mounted heat exchanger, and shall operate satisfactorily on a commercial grade of diesel fuel (CARB).

B. The engine manufacturer shall certify the engine to be suitable for use at the

installed location, at the installed rating, and shall meet all applicable exhaust emission requirements at the time of commissioning at the location installed for standby duty. Provide certification that the engine-generator complies with requirements of the EPA and Local Air Quality Management District: Tier 4 requirements.

C. The engine shall be rated for continuous operation under a constant load equal to the generator-set rating plus the load of all connected accessories.

D. The engine speed shall be controlled by an isochronous governor.

E. The engine shall be provided with crankshafts, which shall be statically and dynamically balanced and fully counterbalanced. Crankshafts shall be drilled for full-pressure lubrication to all bearings. All crankshaft bearing surfaces shall be hardened. There shall be one more main bearing than there are crankshaft throws. Intake and exhaust valves shall be heat-resistant alloy steel with Stellite-faced exhaust valve inserts.

F. The engine shall receive a prime coat and two coats of industrial paint suitable for the intended use.

G. The engine shall be equipped with a pressurized lube oil system and a full-flow filter system consisting of an oil pickup strainer located upstream of a replaceable filter.

H. Engine air intake shall be provided with a dry air cleaner of adequate capacity to effectively remove dirt and abrasives from the combustion air. The dry-type filter shall be arranged for easy removal and replacement of the filter element.

I. All exposed rotating parts of the engine shall be provided with guards for protection of personnel.

J. Governor

1. An electronic governor system shall provide automatic isochronous frequency regulation.

2. The governor and control system shall actively control the fuel rate as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed.

3. The governor system shall include a programmable warm up at idle and cooldown at idle function. While operating in idle state, the control system shall disable the alternator excitation system.

2.5 ENGINE COOLING SYSTEM

A. The engine shall be cooled by means of an engine-mounted heat exchanger. The heat exchanger shall include a solenoid valve to control potable water. The potable water will be at a temperature between 2 degrees C and 20 degrees C. The heat exchanger shall be sized to maintain safe operation at 50-degree C maximum ambient temperature, with the engine at full load. The engine cooling

system shall be filled with a solution of antifreeze with corrosion inhibitor as recommended by the engine manufacturer. An external water jacket heater (120 VAC) shall be provided to maintain the engine water at 35 degrees C at all times the engine is not running. Jacket water heater shall be provided with isolation valves. If a different configuration is required to meet the manufacturer's standards and/or this Specification, power distribution changes shall be made at no cost to the DISTRICT.

2.6 ENGINE FUEL SYSTEM

A. The fuel system shall include an engine-driven fuel pump and primary and secondary filters which shall be easily accessible for servicing. Filters shall have replaceable elements. Primary fuel filter shall be capable of filtering 15- to 25-micron particles and secondary unit filtering particles of 5 microns or smaller.

B. Flexible connectors of braided steel construction shall be furnished for connection of fuel lines to engine. The connectors shall be no less than 18 inches long.

C. Provide a skid mounted, sub-base, double wall, fuel tank for the engine-generator which meets the requirements of UL 142. The fuel tank shall be a standard product of the manufacturer of the engine generator set. Each tank shall be sized for 48 hours of operation at 50% loading (35 HP and 35 HP + 5 KW assuming 150 KW unit), minimum capacity. The tank shall include a mechanical gage, high and low level sensors with output contacts, overfill/spill containment device at fill point and light and horn annunciation when full.

D. The fuel tank shall be vented and shall include insect screens and flame arresters.

2.7 ENGINE STARTING SYSTEM

A. The engine shall be started automatically by a 12 or 24 Volt dc electric starting system with positive engagement drive.

B. Provide a heavy-duty lead-acid storage battery set. The battery set shall be of sufficient capacity to provide for continuous 1-1/2 minutes total cranking time at 20 degrees F without recharging. The batteries shall be provided with a battery tray and batteries shall be secured.

C. A current-limiting automatic 2-rate, temperature compensated, UL listed battery charger shall be furnished to automatically recharge batteries. It shall include overload protection, silicon-diode full-wave rectifiers, voltage surge suppressors, dc ammeter and voltmeter with plus or minus 2 percent accuracy, and fused ac input. The ac input voltage shall be 120 volts, 60 Hz. Rated output of the battery charger shall be no less than 10 amperes dc. The charger shall include an autoboost circuit to equalize the batteries after an AC power failure or low battery voltage condition. The battery charger shall be manufactured by Sens or equal.

2.8 ENGINE EXHAUST SYSTEM

A. The engine exhaust system shall include an exhaust silencer, gas-proof and

seamless stainless steel flexible exhaust connection, exhaust outlet piping, and a raincap. An exhaust condensation trap with manual drain valve shall be provided. Insulation shall be provided on all portions of the engine exhaust piping and muffler system inside of enclosure.

B. The exhaust silencer shall be a residential grade silencer. All exterior components of the exhaust silencer shall be fabricated of aluminized steel and coated with high heat resistant silicone aluminum paint. Guards shall be provided in accordance with State safety requirements to protect personnel from accidental contact from the exhaust manifolds, turbochargers, exhaust pipe, etc. A rain cap shall be provided for the exhaust piping tip.

2.9 ENGINE INSTRUMENTS

A. The engine instruments shall include an oil pressure gauge, coolant water level and a water temperature gauge plus manufacturer's recommended alar indicators.

2.10 GENERATOR

A. The generator shall be heavy-duty industrial type suitable for standby duty under the conditions specified. The generator shall meet all applicable NEMA and UL standards for standby generator, including temperature rise and short-circuit ratings.

B. The generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc.

C. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system and shall be UL1446 listed. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees Centigrade.

D. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage up to 5 percent above or below rated voltage.

E. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.

F. The subtransient reactance of the generator shall not exceed 13.0 percent, based on the standby rating of each of the generator sets.

G. The generator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic, and no 3rd order harmonics or their multiples. Telephone influence factor shall be less than 40.

H. The generator shall be suitable for use in a solidly grounded system. The neutral

shall not be grounded at the generator.

I. Provide an output circuit breaker, rated as shown on the Drawings, in a separate enclosure for each generator.

J. The generator sets shall include a full wave rectified automatic solid state digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from mis-operation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter.

1. The voltage regulation systems shall be equipped with three-phase line to neutral RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The systems shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate, and be capable of being curve-matched to the engine torque curve with adjustments in the field.

2. The voltage regulators shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.

2.11 CIRCUIT BREAKERS

A. The generator circuit breaker shall be integral with the standby generator and shall be provided in NEMA 1 deadfront enclosures. The circuit breakers shall be of the indicating type providing ON, TRIPPED, and OFF positions of the operating handle. Breakers shall be labeled. Include provisions for padlocking the circuit breakers in the OFF position. Interlock enclosure to prevent opening the cover with the circuit breakers in the ON position, and provide defeater mechanisms. The circuit breakers shall be quick-make, quick-break, with thermal-magnetic action. The circuit breakers shall meet the requirements of Specification Section 26 06 00, Miscellaneous Electrical Equipment.

2.12 CONTROL PANELS

A. Provide an engine-generator control panel for each generator. The panels shall be shock-mounted to the generator set that is factory built, wired, and tested by the generator manufacturer. The control panels shall be capable of operating the generator sets in compliance with these Specifications. Provide an emergency “STOP” pushbutton.

B. With the mode selector switch in AUTO, the system shall perform as specified under FUNCTIONAL REQUIREMENTS.

C. With the mode selector switch in HAND, the generator set shall be started and stopped by the manual start-stop pushbutton control in the control panel.

D. When the mode selector switch is moved to OFF, it shall not be possible to start the generator set, and, if the generator set is running, it shall stop.

E. The control panels shall operate on dc battery voltage; shall include NEMA 1, vibration isolated, dead front, 14-gauge steel enclosures; and shall be constructed so that all components can be adjusted and replaced from the front. Control wiring shall be stranded copper and shall be brought to master terminal blocks for termination of external wiring. Identify control wiring with wire labels and terminal points with appropriate markers. Arrange wiring neatly cut to proper length, bundle wires, and tie them down securely. Wiring shall not be spliced or tapped except at device terminals or on terminal blocks. The control panel shall include the following equipment:

1. Manual start-stop control.
2. Three-position mode selector switch, with positions labeled AUTO, OFF, and HAND.
3. GENERATOR RUNNING indicating light and normally open contact.
4. READY indicating light and normally open contact.
5. The generator set control shall indicate the existence of the following alarm and shutdown conditions on an alphanumeric digital display panel:
    a. low oil pressure (alarm)
    b. low oil pressure (shutdown)
    c. oil pressure sender failure (alarm)
    d. low coolant temperature (alarm)
    e. high coolant temperature (alarm)
    f. high coolant temperature (shutdown)
    g. high oil temperature (warning)
    h. engine temperature sender failure (alarm)
    i. low coolant level (alarm or shutdown--selectable)
    j. fail to crank (shutdown)
    k. fail to start/overcrank (shutdown)
    l. overspeed (shutdown)
    m. low DC voltage (alarm)
    n. high DC voltage (alarm)
    o. weak battery (alarm)
    p. low fuel-daytank (alarm)
    q. high AC voltage (shutdown)

r. low AC voltage (shutdown)

s. under frequency (shutdown)

t. over current (warning)

u. over current (shutdown)

v. short circuit (shutdown)

w. over load (alarm)

x. emergency stop (shutdown)

6. Separate alarm (normally open) contacts for high coolant temperature, low coolant level, low oil pressure, high oil temperature, overspeed, generator fail, fail to start, generator not in "AUTO", battery voltage low, and battery voltage high.

7. Separate gauges for indicating oil pressure, oil temperature, and water temperature.

8. Separate meters for Voltage, Amps and frequency (all 2 percent accuracy class).

9. Running time meter.

2.13 LIFTING LUGS

A. Equipment over 100 pounds in weight shall be provided with lifting lugs.

2.14 ANCHOR BOLTS AND TIEDOWN LUGS

A. Furnish and install anchor bolts and tiedown lugs. As a minimum requirement, furnish and install anchor bolts and tiedown lugs as recommended by the manufacturer and approved by the DISTRICT.

B. Submit seismic calculations based upon the requirements of 26 00 10, General Electrical Requirements.

2.15 SPARE PARTS, CONSUMABLE ITEMS, AND TOOLS

A. Provide the following spare parts for each generator, as a minimum:

1.	2 sets	Lube oil filter element
2.	2 sets	Fuel filter element
3.	1 set	Air cleaner element
4.	1 set	V-belts (complete set)

2.16 GENERATOR MANUFACTURERS

A. The standby engine generator and skid-mounted assemblies shall be as manufactured by Caterpillar D150-10 -C7.1 (industrial 150 KW engine with upsized alternator) with weatherproof enclosure, integral fuel tank and residential Grade exhaust system.

PART 3 EXECUTION

3.1 INSTALLATION

A. The generator set, including all auxiliaries and accessories, shall be installed in accordance with the manufacturer's instructions and recommendations. Antifreeze and oil of the type and amount recommended by the manufacturer shall be furnished and added to the engine.

B. Keep a copy of the manufacturer's installation instructions available on the job site for review at all times.

C. Provide a housekeeping pad for the engine-generator set.

D. Mount all devices which an operator may need to read or operator between 42 and 72 inches above the finished floor.

E. Installation shall be checked and approved by the engine-generator set supplier.

F. Mount the transfer switch were shown on the drawings. The Contractor shall coordinate efforts between vendors to arrange for the transfer switch to be mounting in the factory.

3.2 START-UP SERVICES

A. A manufacturer/supplier's representative shall be present at the job site for a minimum of one day. Include for each generator the following start-up services:

1. One site visit of 1 day for assistance during installation, assistance during system startup, testing and training of DISTRICT Personnel.

3.3 TESTING

A. After each installation has been completed, Contractor shall conduct tests required by Section 26 00 00, General Requirements, Electrical.

B. In addition, testing, test plans, and test reports shall be provided by the CONTRACTOR as specified herein. The CONTRACTOR shall perform tests as required to demonstrate that the equipment and systems covered in this Section operate safely and meet the requirements of these Specifications. The CONTRACTOR shall provide labor, instruments, fuel, and other material to complete the factory, operational readiness, and functional acceptance tests.

1. Test plans and test reports shall be treated as formal submittals and shall meet all applicable requirements of the submittals.

2. Tests and test plans shall be in the cause and effect format. The person conducting the test shall initiate an action (cause) and, upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied.\

C. Factory Test (FT)

1. The generator sets, together with all controls and safety devices, shall be tested at the manufacturer's plant per standard manufacturer’s testing.

D. Operational Readiness Test (ORT)

1. Prior to startup, the complete standby generator systems, including standby generator, and fuel systems, shall be inspected, tested, and documented to show that it is ready for operation.

2. The CONTRACTOR shall prepare a test plan for the ORT and shall submit it for review at least 30 days before the ORT is performed.

3. The ORT shall demonstrate on a paragraph-by-paragraph basis that the complete interconnected standby generator system can start up and run through its normal operating and shutdown sequence as described in the rawings and Specifications.

4. If any component or subsystem fails the ORT, the CONTRACTOR shall correct the problem and shall repeat the test until it is successful.

5. After completion of the ORT, the CONTRACTOR shall prepare a test report and shall submit it for review. The ORT shall be successfully completed and the test report submitted to and reviewed by the DISTRICT before the FAT (functional acceptance test) is performed.

E. Functional Acceptance Test (FAT)

1. Once the facility has been started up and is operating, a witnessed FAT shall be performed on the complete standby generator systems to demonstrate that it is operating as specified and meets the requirements of the Specifications.

2. The CONTRACTOR shall prepare a test plan for the FAT and shall submit it for review at least 30 days before the FAT is performed. The test plan shall include a copy of the proposed test log sheet to record load data, temperatures, pressures, fuel consumption, and all other test data.

3. Each specified function shall be demonstrated on a paragraph-by-paragraph basis.

4. The FAT shall operate all equipment and systems over the full operating range, shall demonstrate proper operation of alarms and indicators, and, in general, shall demonstrate that the equipment and systems meet the requirements of the Drawings and Specifications.

5. The FAT shall demonstrate under actual operating conditions that operation is satisfactory without overheating of any part and that the equipment is free from excessive vibration throughout the entire range of speed and load.

6. The generator set shall be operated at rated standby service load for a period of not less than 2 hours, and all necessary adjustments shall be made by the generator-set supplier. This test shall demonstrate the ability of the set to satisfactorily carry its rated load and to meet requirements for motor starting.

7. Testing shall include checking of all automatic controls for proper functioning. The CONTRACTOR shall supply the fuel required for the tests and shall supply a load bank to supplement available loads in order to test the set under the specified loadings. Load banks with unity power factor are suitable for the FAT.

8. With the station load at normal operating level, a power failure shall be initiated by opening the main circuit or breaker supplying the normal power to the pump station. The following records shall be maintained throughout the tests: time of day, coolant temperatures, cranking time until prime mover starts and runs, time required to come up to operating speed, voltage and frequency overshoot, time required to achieve steady-state condition with the transfer switch transferred to the emergency position, voltage, frequency, current, oil pressure, ambient air temperature, kilowatts, power factor, and battery charger rate at 5-minute intervals for the first 15 minutes and at 15-minute intervals thereafter. Continue this load test for 2 hours, observing and recording load changes and the resultant effect on voltage and frequency. Return normal power, and record the time delay on retransfer and the time delay on prime mover cool-down period and shutdown.

9. Upon completion of the above portion of the test, allow the prime mover to cool for 5 minutes. Then apply full-rated load (nameplate kW) consisting of pump station load. This full-load pickup shall be in one step immediately upon reaching rated speed.

10. If any equipment or system fails the FAT, the CONTRACTOR shall correct the problem and shall repeat the test until it is successful.

11. A manufacturer's service representative for the standby generator manufacturer shall be present during the FAT.

12. The FAT shall be performed in the presence of the Engineer.

13. After completion of the FAT, the CONTRACTOR shall prepare a test report and shall submit it for review. The standby generator system will not be accepted before the FAT is successfully completed and the test report submitted to and reviewed by the DISTRICT.

F. TRAINING

1. Upon completion of the FAT, final adjustments shall be made to the equipment as necessary. Fuel and oil filters shall be replaced, oil shall be changed, fuel tanks shall be refilled, and the proper operation of all equipment shall be demonstrated to the DISTRICT. DISTRICT personnel shall be instructed in the maintenance and operation of the equipment. These final adjustments and instructions shall be carried out by the generator-set supplier.

** END OF SECTION **

SECTION 26 04 00
RACEWAY AND FITTINGS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The work under this section includes all equipment, labor and material necessary to furnish and install a complete raceway system including fittings, boxes and supports.

B. Raceway shown in the schedule with multiple conduits shall be used for installing different types of conductors; for example power (120, 208, 240 and 480 VAC) conductors in the first conduit, control (discrete 24 and 120 VAC) conductors in the second and signal (analog 4-20 mA, 24 VDC and other instrumentation) conductors in the third.

1.2 QUALITY ASSURANCE

A. All raceway shall comply with applicable standards of the Underwriter's Laboratories, Inc.

B. Conduits, entering the bottom of pad mounted equipment under enclosure structural members design to be flush with the pad, shall be removed, reworked and reinstalled properly, so the conduit enters the manufacturer’s recommended conduit area, unobstructed. These modifications to conduit and pad shall be at the Contractor’s expense.

C. Do not cut, bend or deform, pedestal, switchboard, motor control center, control panel or equipment enclosure steel to accommodate conduits.

1.3 SUBMITTALS

A. The Contractor shall submit, in accordance with the requirements of Section 26 00 00 the following materials and information:

B. A list of materials to be furnished, the name of the suppliers and the date of delivery of materials to the site.

C. Catalog data sheets and manufacturer’s information all equipment described in this Specification Section.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and equipment to project site in manufacturer's original packaging with labeling showing product name, brand, model, project name, address, and Contractor's name. Store in a location as agreeable with Site Engineer, secure from weather or accidental damage.

PART 2 PRODUCTS

2.1 CONDUIT

A. Rigid Steel Conduit (RSC)

1. Rigid steel conduit shall be hot dip galvanized on the exterior and may be zinc or enamel on the interior meeting the requirements of UL-6 and ANSI C80.1.

2. Couplings, locknuts, and all other fittings shall be hot dip galvanized. All couplings and locknuts shall be of the threaded type only.

3. Bushings for standard weight rigid steel conduit shall be non-metallic for 1 inch and smaller. For conduits larger than 1 inch, insulated metallic bushings shall be used.

B. Plastic Coated Rigid Steel Conduit (PCRSC)

1. Plastic coated rigid steel conduit and fittings shall be hot dip galvanized prior to the plastic coating. The galvanized surfaces shall be coated with an epoxy-acrylic primer before plastic coating. The plastic coating shall be applied by the dip method. Minimum thickness of the exterior coating shall be 40 mils. The interior of conduit and fittings and all male threads shall be coated with 2 mils of urethane. PCRSC shall be manufactured by Rob Roy, Ocal or equal.

2. Couplings, locknuts, and all other fittings shall be hot dip galvanized and plastic coated. All couplings and locknuts shall be of the threaded type only. All couplings shall have longitudinal ribs 40 mils in thickness. Condulets shall be supplied with stainless steel screws. All screws shall be encapsulated in plastic.

3. Enclosure sealing hubs shall be similarly coated and be manufactured by Meyers type or equal.

4. Bushings for standard weight rigid steel conduit shall be non-metallic for 1 inch and smaller. For conduits larger than 1 inch, insulated plastic coated metallic bushings with grounding connection, where required, shall be used.

5. All damaged coatings shall be repaired according to the manufacturer's instructions.

C. Flexible Metallic Conduit (Flex)

1. Flexible metallic conduit shall be hot dipped galvanized steel.

2. Neoprene jacketed flexible metallic conduit shall be used in all damp or weatherproof locations where flexible conduit is required.
Fittings for flexible metallic conduit shall be hot dipped galvanized or sheradized, squeeze type. Fittings which use a screw to bind against tubing will not be accepted. Fittings for neoprene jacketed flexible conduit shall be of the screw in type.

D. Flexible Non-Metallic Conduit (NMFlex)

1. Flexible non-metallic conduit and fittings shall be heavy duty PVC.

Conduit shall consist of PVC spiral surrounded by flexible PVC.

2. Flexible non-metallic conduit shall be liquid tight and fittings shall be corrosion resistant with stainless steel retaining rings. Provide sealing gaskets at all threaded connections. NMFlex shall be manufactured by Thomas and Betts or equal.

E. Polyvinylchloride Conduit (PVC)

1. PVC Conduit shall be rigid heavy weight type, Schedule 40 when encased in concrete or schedule 80 when exposed or not encased in concrete. PVC conduit shall be supplied complete with PVC fittings. PVC conduit shall be manufactured by Carlon or equal.

2. Utility company conduits may require oversized Schedule 80 in part or in whole.

F. Electrical Metallic Tubing (EMT) is not allowed on this project.

2.2 CONDUIT SUPPORTS

A. Pipe hangers for individual conduits shall be factory made, consisting of a pipe ring and threaded suspension rod. The pipe ring shall be malleable iron, split and hinged, or shall be spring-able steel. Rings shall be bolted to or interlocked with the suspension rod socket.

B. Pipe racks for groups of parallel conduits shall be constructed of galvanized structural steel preformed channels of length as required. Racks or channel shall be suspended on threaded rods and secured with nuts above and below the cross bar or bolted to concrete walls with stainless steel anchors.

C. Pipe straps shall be the two piece bolted type. Pipe straps shall be coated to be compatible with the conduit (and coating) installed.

D. Conduit support components shall be manufactured by Unistrut, B-line or equal. Channel and associated hardware shall be stainless steel.

2.3 CAST BOXES

A. Cast boxes shall be galvanized, threaded, cast malleable iron. Cast boxes shall be manufactured by Appleton, Feraloy, Crouse-Hinds, type FS or FD, or equal. Hub arrangements on threaded fittings shall be the most appropriate for the conduit arrangement required in each case to avoid unnecessary conduit bends and fittings.

B. Use plastic coated cast boxes with plastic coated conduit.

2.4 UNDERGROUND VAULTS, PULLBOXES AND HANDHOLES

A. Provide underground vaults, pullboxes and handholes, where shown on drawings or required by length of conduit runs. Underground vaults and pullboxes shall be pre-fabricated concrete type shall be manufactured by Christy Concrete Products, Brooks or equal. All pullboxes shall have standard brass holddown bolts and hardware. Vaults and boxes located in paved areas or other areas over which vehicles normally may travel shall have traffic covers. All covers shall be labeled

appropriately, i.e. ELECTRICAL, SIGNAL, TELEPHONE, etc...\ Provide cable supports in vaults and large boxes. Cable supports, saddles, arms, and racks mounted in pullboxes shall be manufactured by Underground Devices or equal.

2.5 WIRE TROUGH

A. Wire trough shall be NEMA 4 with neoprene gaskets on the hinged doors or removable covers. Box and gutter sizes, metal thickness, and installation details shall comply with the National Electrical Code. Wire gutter shall be manufactured by Hoffman or equal.

2.6 DUCT SEAL

A. Duct seal shall be non-hardening compound designed for sealing between conduit and electrical cable. Duct seal shall be manufactured by O.Z., Gedney DUX or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. General. Unless otherwise specified or indicated, wiring shall consist of insulated conductors installed in raceways of the types indicated. Provide pullboxes or conduit bodies in addition to those shown on the Drawings to limit the number of bends as required by the NEC.

1. Minimum size conduit installed on this project shall be 3/4 inch.
2. Use the following types of conduit for the locations listed, unless indicated otherwise:
    a. Use galvanized rigid steel conduit (GRS) for all exposed, dry locations.
    b. Use plastic-coated steel conduit (PCRSC) outdoors in wet and damp locations, and below grade for direct-buried conduit where sand encased.
    c. Use rigid polyvinyl chloride (PVC) conduit for concealed locations, for embedded conduit and conduit installed below grade in concrete encased duct banks, except use plastic coated steel conduit (PCRSC) at least 5 feet on both sides of penetrations through building footings and outside walls, under equipment mounting pads, where embedded in exterior light pole foundations, and where conduit changes from underground to exposed or from embedded to exposed. Use PVC conduit in corrosive spaces and where required by a utility company.
    d. Use liquidtight flexible metal conduit (flex) with steel fittings for the last 18 to 36 inches of conduit run to a piece of equipment where required to isolate vibration or to facilitate maintenance or adjustment.

e. Electrical metallic tubing (EMT) shall not be used on this project.

B. Conduit Installation

1. Conduit system installation shall meet or exceed the requirements of the 2014 NEC. Raceways shall be concealed or exposed, as indicated, and shall be at least 6 inches away from parallel runs of flues and steam or hot water pipes. Group raceways in same area together. Raceways shall be supported at intervals required by the NEC and shall have exposed runs installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Avoid field-made bends and offsets where possible, but where necessary make with an approved hickey or conduit bending machine. Heating of conduit to facilitate bending shall not be acceptable, except as noted hereinafter. Changes in direction of runs shall be made with symmetrical bends or cast metal fittings. Do not install crushed or deformed raceways. Avoid traps in raceways where possible. Take care to prevent the lodging of plaster, dirt, or trash in raceways, boxes, fittings, and equipment during the course of construction. Raceways shall be entirely free of obstructions or shall be replaced. All conduit shall be reamed, deburred, and cleaned for proper introduction of wires and cables. Immediately after installation, plug or cap all conduit ends with watertight and dust tight conduit seals until the time for pulling wires. In block walls, do not run conduit in the same horizontal course with reinforcing steel.

2. Install bushings on the ends of all conduits, except where conduits terminate in threaded hubs on cast boxes or cabinets. Provide plastic inserts where conduits terminate in threaded holes in cast boxes. Provide suitable expansion fittings for raceways crossing expansion joints in structures or concrete slabs, or provide other suitable means to compensate for expansion and contraction.

3. All conduit supports, fasteners, and accessories for metal conduit shall be galvanized steel.

4. Conduit shall be of the greatest practicable single length between joints. Joints shall be made up with approved jointing compound. Do not use red lead as a joint compound. Do not use nails to fasten conduit. Do not use wire in lieu of straps or hangers, and do not notch structural members for the passage of raceways except with prior approval of the Engineer.

5. Install and equip conduit, boxes, and fittings installed outdoors or in other wet or damp locations so as to prevent water from entering the conduit. Provide sealing hubs. Do not run conduit in equipment foundation pads.

6. Provide a suitable seal inside each conduit or raceway entering buildings and structures, raceways entering boxes and enclosures in wet or hazardous locations.

7. Empty ducts and conduits shall be identified at both ends and shall be capped and provided with a 1/8-inch-minimum nylon cord, unless noted otherwise.

8. The Contractor shall run a mandrel through all unexposed conduits immediately prior to wire or pullstring installation to ensure conduits are clear of debris and foreign objects.

9. For PVC conduit, use factory made ells where applicable. Use approved heating methods for forming all other bends (less than 12 degrees). Provide expansion joints as required or as recommended by the manufacturer. When joining PVC conduit to metallic fittings, use approved PVC terminal adapters. When joining PVC conduit to rigid steel conduit, use an approved PVC female adapter. PVC conduit joints shall be solvent-welded with solvent recommended by the conduit manufacturer. Where PVC conduit is used, a separate grounding conductor shall be run with the conductors.

10. Concealed, embedded, and buried conduits shall emerge at right angles and shall have none of the curved portion of a bend exposed, unless otherwise approved by the Engineer. Where slabs are on grade, install conduit beneath the slab and not in the slab. Where ells are required to penetrate floor slabs, the ells shall be galvanized rigid steel conduit.

11. Where conduit size is 4 inches or less, final connection to motors, motor heaters, wall- or ceiling-mounted fans and unit heaters, dry transformers, and to other equipment where flexible connection is desired or required to minimize vibration or to facilitate maintenance or removal of equipment, shall be made with flexible conduit. Length shall be 18 to 36 inches, unless otherwise approved by the Engineer.

12. Flexible conduit shall never be used as a ground. Flexible conduit shall be secured with conduit clamps or equivalent means except where the flexible conduit is fished and where sections less than 4 feet in length are used in concealed areas for lighting fixtures.

13. Exposed conduit shall be neatly installed parallel to or at right angles to the structural members.

14. Exposed conduit stubbing up through the floor into the bottom of exposed panels, cabinets or equipment shall be lined up, properly spaced and shall be straight and plumb. Conduits shall be installed at sufficient depth below the floor to eliminate any part of the bend above.

15. Maintain at least 12 inches of separation between conduits carrying power and instrumentation cables.

16. Provide large radius elbows and LBs when entering existing buildings and enclosures.

17. Provide a suitable seal inside each conduit or raceway entering buildings and structures, raceways entering boxes and enclosures from chemical storage rooms. Seal inside the conduit with oakum or suitable plastic expansible compound to prevent passage of insects, rodents, gasses, and liquids.

18. Where flexible equipment cords are utilized for final connection to

equipment use a compression type seal fitting: Crouse-Hinds CGB or equal.

C. Underground and Embedded Conduit

1. In general, trenches with two or more underground conduits shall be red concrete-encased PVC conduits (duct bank). In general, a single underground conduit in trench shall be sand encased PVC coated rigid steel conduit (PCRSC). Conduit under concrete slabs and foundations may be PVC conduit with PVC coated rigid steel conduit transitions and risers. Underground conduits provided for utility company cabling shall meet the requirements of the serving utility

2. Except as otherwise indicated, underground and embedded conduit shall be 24 inches deep, except conduit under building slabs may be just below the slab. Do not embed conduit in slabs. Conduit installation shall meet the requirements of the NEC.

3. Separate parallel runs of four or more conduits in a single trench or embedded duct bank with preformed, nonmetallic spacers designed for the purpose. Install spacers at 6 feet or at intervals not greater than that specified in the NEC for support of the type of conduit used. Support conduits installed in fill areas suitably to prevent accidental bending until backfilling is complete.

4. Groups of conduit shall be arranged substantially as shown on the Drawings, but minor changes in location or cross sectional arrangement shall be made as necessary to avoid obstructions, etc. Where conduit runs cannot be installed substantially as shown because of conditions not discoverable prior to digging of trenches, the condition shall be referred to the Engineer for instructions before further work is done. Underground conduit work shall be coordinated with other construction work.

5. All underground conduit shall be mandrelled prior to pulling wires/cables.

D. Trenching and Backfill

1. Unless otherwise noted, conduit shall have a minimum cover of 24 inches. Trench bottoms shall be free of rocks and other hard objects. For direct buried cable and when rocks that cannot be removed are encountered at the trench bottoms, sand bedding material shall be used for a depth of 3 inches below the conduit. In any case, bedding material shall be used for the zone 6 inches above the direct burial conduit.

2. Bedding material shall contain no rocks larger than 3/4 inch in diameter and shall be free from roots and debris.

3. Where conduit trenches are located in roads or in structural backfill, the compaction requirements shall be as required by the agency that has jurisdiction for those areas. Where conduit trenches are located in an area where backfill material specifications are more rigid than those of this Section, the trench backfill shall meet the more rigid specification. In any

event, trench backfill compaction shall be as required by the Specifications.

4. Conduits shall be placed parallel in the bottom of the trench. Where conduits are required to cross, they shall be separated by a minimum of 3 inches of bedding material. Where more than one level of conduit are placed in the same trench, they shall be separated by a minimum of 3 inches of bedding material.

5. Conduit trenches in paved or improved areas shall be installed and backfilled before the area is paved or improved.

6. For trenches through existing paving, the paving shall be saw cut in order to obtain a neat vertical edge for repaving. Saw cuts shall be parallel and shall be a minimum of 6 inches outside of the trench area. Unless covered by other sections of the Specifications, paving shall be replaced in accordance with the original paving Specifications.

7. All existing improvements damaged as a result of the Contractor's operation shall be reconstructed by the Contractor at no cost to the Owner.

E. Penetrations

1. Penetrations may be cast in place or run through blockouts or holes, except where waterproof penetrations are required. Dry pack with non-shrink grout around conduits run through blockouts or holes.

2. Where a waterproof penetration through a concrete structure is shown on the Drawings or called out elsewhere in the Specifications, an approved malleable-iron watertight entrance sealing device shall be provided. Each end of the device shall have a gland type sealing assembly with pressure bushings which may be tightened at any time, except where a concrete envelope is specified or shown on the Drawings. Where there is a concrete envelope specified or shown on the Drawings, a sealing gland assembly may be on the more accessible side only. The device shall be securely anchored into the concrete with one or more integral flanges. The sealing device shall be OZ/Gedney Type WSK, or equal.

F. Boxes

1. Provide each outlet in the wiring or raceway systems with an outlet box to suit the conditions encountered. Each box shall have sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of the NEC. Provide flush or recessed fixtures with separate junction boxes when required by the fixture terminal temperature requirements. Boxes used with concealed conduits shall be flush mounted, unless otherwise indicated. Boxes must be accurately placed for finish, independently and securely supported by manufactured box hangers. Fixture outlets shall be located symmetrically.

   a. Install cast boxes outdoors, in wet or damp locations, with exposed conduit and with embedded and buried conduit. Cast boxes installed with threaded conduit shall have threaded hubs. Cast boxes installed

with PVC or plastic coated conduit shall be similarly coated.

b. Boxes in concealed conduit systems, other than in cast-in-place concrete and exterior faces of walls or where weatherproof devices are required, shall be galvanized or cadmium plated steel.

2. Underground pullboxes shall be sized by contractor in accordance with NEC. Underground pullboxes shall be precast concrete type as shown on the Drawings complete with steel traffic covers, extension rings and concrete bases. Entire box shall be sealed to prevent entrance of mud and rainwater. Conduits shall enter box horizontally, not vertically. Conduit entry shall be grouted in place with approved insulated bushings. Seals shall be installed in conduits around conductors to prevent water from entering the conduit system.

3. Unless otherwise shown on the Drawings, install boxes in a rigid and satisfactory manner, and support boxes independently of the conduit. For frame construction, use bar hangers; on concrete or brick, fasten directly to the surface using bolts or expansion shields; on hollow masonry units, use toggle bolts or expansion shields; and on steelwork, use machine screws. Threaded studs driven in by a powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields. Where boxes are flush mounted in walls, if not embedded in concrete, the hole shall be no larger than required to receive the box. Set flush mounted sheet steel boxes flush with the finished surface, providing them with suitable extension rings or plaster covers as required. Mounting hardware in industrial areas shall be galvanized.

3.2 ELECTRICAL CONTINUITY

A. The entire electrical raceway system shall form a continuous metallic electrical conductor from service point to every outlet and shall be grounded by connection to the main service ground.

B. Rigid steel conduit shall have threads filled with conductive sealant before screwing into fittings.

C. A ground wire shall be installed in all conduits.

3.3 TRENCH SETTLING

A. If at any time during a period of one year dating from the date of final acceptance of the project, there shall be any settlement of conduit trenches, the Engineer may notify the Contractor to immediately provide additional fill and to make such repairs or replacements in paving, planting, or structures, as may be deemed necessary at the Contractor's expense.

3.4 TRENCHING

A. Verify the location of all existing cables, conduits, piping, and other equipment in or near the areas to be trenched, prior to starting trenching. Repair any equipment damaged during trenching. Trenches shall not be left unattended unless the area is fenced or barricaded to restrict entry to the area. Call an Underground Service

firm before trenching.

3.5 TESTING

A. After installation has been completed, Contractor shall conduct tests required by Section 26 00 00, General Requirements, Electrical.

* * END OF SECTION * *

SECTION 26 05 00
WIRE AND CABLE

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to install wire and cable for a complete operable electrical system as shown on Drawings.

1.2 QUALITY ASSURANCE

A. All wire and cable shall comply with applicable standards of the Underwriter's Laboratories, Inc.

B. Conductors, including insulation, cabling, jacket, filler, shielding, covering, and testing, shall meet applicable requirements of IPCEA and NEC.

1.3 SUBMITTAL

A. Submit complete description of all power, signal, communication and instrumentation cables including name of the manufacturer, type of insulation, type of conductor, and size and catalog number of control, instrument signal cables.

B. The Contractor shall submit, in accordance with the requirements of Section 26 01 01 the following materials and information:

C. A list of materials to be furnished, the name of the suppliers and the date of delivery of materials to the site.

D. Catalog data sheets and manufacturer’s information all equipment described in this Specification Section.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and equipment to project site in manufacturer's original packaging with labeling showing product name, brand, model, project name, address, and Contractor's name. Store in a location as agreeable with Owner, secure from weather or accidental damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS LABELING

A. Electrical conductors shall be delivered to the job site plainly marked or tagged on 24 inch centers as follows:

1. Underwriters Laboratories Label
2. Gauge
3. Voltage
4. Kind of Insulation

5. Name of Manufacturer

6. Trade Name

B. Conductor labels shall be white PVC tubing with machine printed black marking. Tubing shall be sized to fit conductor insulation. Adhesive strips are not acceptable.

1. Labels shall be manufactured by Panduit, Thomas & Betts, or equal.

2.2 POWER AND CONTROL CONDUCTORS

A. Insulation for all conductors shall be rated at 600 Volts.

B. All low voltage wiring shall be type THWN/THHN unless shown otherwise.

C. All conductors shall be sized for operation at 75 degrees C maximum operating temperature.

D. Unless specifically noted otherwise herein, all conductors for general wiring shall be a minimum of 98% conductivity, stranded, soft drawn copper. Aluminum or aluminum alloys are not acceptable.

E. 120 Volt control conductors may be #14 AWG, and shall be stranded.

F. Battery cables shall be fine stranded, high capacity, flexible conductors.

2.3 SPECIALTY CABLES

A. Instrumentation signal cables shall be of the type used for process control with twisted shielded pairs (TSP) of triads with PVC jacket an overall shield over the multiple pairs or triads. Two conductor (pair) cable shall have black-clear insulation, three conductor cable shall have black-red-clear insulation. The instrumentation cable shall be rated 600 Volts at 60 degrees C or better. The size of the instrumentation cable shall be AWG No. 18 with seven strands minimum. All instrumentation cables shall be UL listed. Shield shall be an aluminum-backed synthetic material providing 100-percent shielding, with a copper drain wire. The cable shall be rated 90 degrees C minimum. Twisted shielded pair (TSP) cable shall be manufactured by Belden, Alpha or equal.

B. Telephone Cable (TIC) shall consist of 2 to12 pairs with 24 AWG conductors of soft bare copper. Conductors shall have thermoplastic compound insulation and shall be color coded per the telephone industry standards. The entire cable assembly shall have an outer jacket of black polyethylene that is resistant to abrasion, moisture, weather and environmental cracking. Cable shall be suitable for installation in conduit or direct burial and shall be manufactured by Alpha, Belden or equal.

C. Data cable (Cat 5) shall consist of 4 bonded pairs, each pair shielded, with 23 AWG conductors of soft bare copper and drain wire. Conductors shall have thermoplastic compound insulation and shall be color-coded per the telephone industry standards. The entire cable assembly shall contain a foil shield and have an outer jacket of black polyethylene that is resistant to abrasion, moisture, weather and environmental cracking. Cable shall meet the requirements for

Category 5 data transmission cable, be suitable for installation in conduit or direct burial and shall be manufactured by Alpha, Belden or equal. Data outlets shall be rated Category 5 shielded. Termination methods shall be similarly rated.

D. Coaxial Cable (Coax) Cable shall be sized for length of run and application. Cable shall be suitable for installation in conduit and outside in free air, exposed to the elements: it shall be watertight. The cable shall be manufactured by Times Microwave, Series LMR or equal.

E. Other specialty cables shall be provided by the manufacturer of the equipment or instrument they connect to.

2.4 PULLING LUBRICANT AND ROPES

A. Wire pulling lubricant shall be "Flax-soap", "minerallac" or equal.

B. Pullropes shall be 3/16" stranded nylon rated for 800 lbs.

2.5 CONNECTION

A. Motor connection and splice kits shall be 3M series DB or equal.

B. Wire nuts for joints, splices and taps for conductors #8 and smaller shall consist of a cone shaped expandable coil spring insert, insulated with a teflon or plastic shell. Threaded or crimp types will not be accepted. All wire nuts shall be taped. Use "Skotchlock", "Hydent", or equal.

C. Lugs and connectors for conductors #6 and larger shall be compression types of one piece tubular construction with flat rectangular tongues. Two hole lugs shall be used for sizes 4/0 and larger. Fittings for copper conductors shall be tin-plated copper.

D. Electrical tape shall be UL approved plastic.

E. Splices shall not be installed in raceway. Splice wires in approved boxes or condulets only.

2.6 GROUNDING WIRE

A. Ground wires, number 1/0 AWG or larger shall be tinned stranded bare copper cable. All smaller ground wires shall be insulated with green color insulation.

PART 3 EXECUTION

3.1 CLEANING

A. All debris and moisture shall be removed from both new and existing raceways, boxes, and cabinets before installing wire or cable.

3.2 PULLING

A. No oil, grease or similar substances shall be used to facilitate the pulling in of conductors. Use a specifically approved wire pulling compound.

B. No wire or cable shall be pulled in until all construction, which might damage insulation or fill conduit with foreign material is completed.

C. Wire shall be pulled into conduits with care to prevent damage to insulation, using basket pulling grips to avoid slipping of insulation on conductors. Nylon rope or other "soft" surfaced cable must be used for pulling in conduits other than steel.

3.3 CONNECTIONS

A. Use a kit for motors with #8 and larger feeder conductors.

B. Joints, splices and taps in dry locations for feeder conductors #10 and smaller shall be made with twist-on connectors suitably sized for the number and gauge of the conductors.

C. Furnish and install proper lugs in all panelboards, pedestals and gutters as required to properly terminate every cable. Where paralleled conductors, or conductors of large size are to terminate on a breaker, a short length of copper cable (of capacity of the breaker) shall be connected to the breaker, and the proper compression type lug installed to connect this cable to the feeder cable. The cutting of cable strands to fit the breaker will not be permitted.

D. Only crimping tools approved by the manufacturer of the terminals or lugs shall be used.

E. Uninsulated lugs and wire ends shall be insulated with layers of plastic tape equal to insulation of wire. Wire in pedestals, panels, cabinets, pullboxes and wiring gutters shall be neatly grouped together with cable ties or other methods acceptable to the Engineer.

F. In underground location, joints, splices and taps shall be insulated by the "Skotchcast" epoxy-resin method. In-line splices may be insulated by approved waterproof "shrink tube" method. Splices shall be made if specifically approved by the City (on a case by case basis).

G. In panels, pullboxes, gutter, etc. conductor shall be neatly fanned out and tagged with wire markers. Conductors installed as part of this project but for connection to equipment to be installed in the future shall be 50% longer than the estimated final connection length, neatly coiled and sealed for storage in the equipments respective pullbox.

H. At outlets, junction boxes, pullboxes, fittings, etc., conductors shall be looped or pigtailed to extend at least six inches without splice beyond such wiring enclosures, and where used, pigtails added to loops for connection to fixtures or devices shall be at least six inches long.

I. Conduit shall be capped during construction by means of manufactured conduit seals or caps to prevent entrance of water or debris, and shall remain closed until ready for use

J. Splices shall not be installed in raceway. Splice wires in approved boxes or condulets only.

3.4 COLOR CODING AND LABELING

A. Color Coding of Low-Voltage Building Wire: Provide color coding throughout the entire network of feeders and circuits (600 volts and below) as follows:

Phase	120/208(or 240) Volts	277/480 Volts
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green

AC control wire shall be red or pink.

DC control wire shall be light blue or violet.

DC power supply wires shall be red. DC analog signal wires shall be black if positive and white (or clear) if negative. DC system signal commons shall be white.

Equipment grounds shall be green.

B. In addition to color coding, all power, control, and alarm wiring shall be numbered and identified by means of wire markers at all pedestals, switchboards, MCCs, panelboards, gutters, junction boxes, pull boxes, receptacle outlets, light outlets, manholes, disconnect switches, and circuit breakers. These markers shall correspond to numbers on shop drawings and wiring diagrams. Wire markers shall consist of machine engraved numbers applied by an approved marking device. Provide Brady heat shrink labels or equal.

1. All individual conductors shall be labeled origin, destination and sequence number. The information shall be separated by slashes (/). The origin and designation shall be designated with the names shown on the Contract Documents. The sequence number shall be a unique sequential number for that particular cable run. At the PLC wire labels shall include the rack, slot and terminal number.

2. Multi-conductor cables shall be labeled origin, destination and sequence number. The information shall be separated by slashes (/). The origin and designation shall be designated with the names shown on the Contract Documents. The sequence number shall be a unique sequential number for that particular cable run. Twisted shielded cables shall be considered multiconductor cables.

3.5 SEALING CONDUCTORS IN CONDUITS

A. All conduits containing conductors shall be sealed as the conduit enters motor control centers, pull boxes and vaults. Power conductor, control conductors, and instrumentation conductors shall be bundled and supported separately and independently in pullboxes.

3.6 TESTING

A. After installation has been completed, Contractor shall conduct tests required by Section 26 00 00, General Requirements, Electrical. Contractor shall furnish necessary instruments and personnel required for testing.

* * END OF SECTION * *

SECTION 26 06 00
MISCELLANEOUS ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required, and install, complete ready for operation, and field test the miscellaneous electrical equipment as shown on the Drawings and/or specified herein.

1.2 QUALITY ASSURANCE

A. All equipment and components shall comply with applicable standards of the Underwriter's Laboratories, Inc.

B. Provide enclosures suitable for the type of location in which they are located per Specification Section 26 00 00, General Requirements, Electrical

1.3 SUBMITTAL

A. The Contractor shall submit, in accordance with the requirements of Section 26 00 00 the following materials and information:

B. A list of materials to be furnished, the name of the suppliers and the date of delivery of materials to the site.

C. Catalog data sheets and manufacturer’s information for all equipment covered by this Specification Section.

D. Submit metering equipment and devices to the utility company in compliance with their requirements.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and equipment to project site in manufacturer's original packaging with labeling showing product name, brand, model, project name, address, and Contractor's name. Store in a location as agreeable with Site Engineer, secure from weather or accidental damage

PART 2 PRODUCTS

2.1 TERMINAL BLOCKS

A. Terminal blocks shall be side entry, snap-in type for mounting on DIN rail. End clamps and end cover plates shall be provided to hold terminal blocks in place. All components shall be rated for 600 Volts.

B. At each starter or control panel terminate all alarm, control, and any other wiring at identified numbered terminal blocks. AC and DC terminals shall be separated. Power terminal blocks shall be separated from controls and instrumentation terminal blocks. Provide a ground terminal point for each cable shield. Stacked terminal blocks will not be accepted.

C. Fuses shall be incorporated into the terminal blocks when not shown on a door or panel face. Fuse blocks shall include blown fuse indicator and be disconnecting type.

D. Provide 20% spare terminal, but not less than ten points with each terminal block.

2.2 RELAYS

A. Control relays shall be plug-in type with hold-down clamps and led indicators, unless noted otherwise. Plug-in relays shall be UL listed, enclosed, with contacts rated 10 amps at 120-volts-60 Hz, and 28 volts DC. Enclosures shall be clear plastic. Relays shall operate reliably at 80 percent of rated coil voltage. Coil burdens shall be not greater than 1.5 watts for DC coils or 2.6 VA for 60-Hz coils. The relays shall be IDEC RR Series, or equal.

B. Machine tool type relays shall be rated B300. Machine tool relays shall be manufactured by Allen-Bradley, Cutler-Hammer, Square D or equal.

C. Time delay relays with required ranges up to 180 seconds shall be enclosed and shall operate properly at any voltage within plus or minus 15 percent of the nominal voltage rating, and shall have a time delay on energization or deenergization, as required, which is knob-adjustable over the range 2 to 180 seconds. They shall have double-pole double-throw contacts rated 10 amps at 120 volts, 60 Hz. Time delay relays shall be manufactured by Idec RTE series, or equal.

D. Intrinsically safe relays (ISRs). Intrinsically safe relays shall be UL approved for Class 1, Division 1 hazardous area applications. Relays shall be manufactured by Gem, or approved equal.

E. Phase/Power Failure Relays (PFR) shall detect phase over voltage and under voltage conditions. Provide an adjustable drop out settings and an adjustable time delay on drop out. Phase failure relays shall be manufactured by Diversified SLD-440-ALE or equal. Provide a by-pass switch for the PFR output contact to the PLC.

2.3 PILOT DEVICES

A. Indicating pilotlights shall be low voltage transformer operated, with integral push to test button. Lamps shall be LED. Pilotlights shall be rated NEMA 4/4X and be 30.5 mm in diameter. Pilotlights shall be manufactured by Eaton Allen-Bradley or equal.

B. Selector switches and pushbutton switches shall be heavy duty type and match pilotlights. Switches and pushbuttons shall be rated NEMA 4/4X and be 30.5 mm in diameter. Switches and pushbuttons shall be manufactured by Eaton, Allen-Bradley Series or equal.

C. Running time meters shall be non-reset, 0-99,999.9 hour range, 120 VAC manufactured by Redington/Engler.

D. Control Stations shall be manufactured by the same manufacturer as the pilot devices and rated NEMA 4 unless shown otherwise..

2.4 WIRING DEVICES

A. Light switches shall be specification grade and shall be manufactured in accordance with UL 20. Switches shall be single pole, rated for 20 amps at 277 VAC. Switches shall be Hubbell 1221, Leviton 1201-2, or equal.

B. Receptacles shall be duplex and rated 20 amps at 120 VAC, 2 pole, 3 wire, NEMA type 5-20R and specification grade. Receptacles shall be Hubbell, Leviton or equal, GFI type where shown on the Plans.

C. Where surface mounted, provide a [FS style] cast box and cover plate.

D. Device cover plates shall be suitable for the environment in which they are installed. Stainless steel cover plates inside and weatherproof covers outside. Where weather protection is required with a plug in the receptacle, clear plastic bubble covers shall be provided.

2.5 DISCONNECTS

A. Heavy duty, motor rated switches fused or non-fusible as indicated on the Drawings, shall be provided as required. General duty switches will not be allowed. Switches shall have "Quick-break" actuating mechanisms and shall be enclosed as required by the conditions of installation. The cover shall be interlocked with the switch such that the enclosure cannot be opened with the switch in the "on" position. The "on" and "off" positions shall be clearly marked by the manufacturer. The switch shall be capable of being locked in the open position. Provide enclosures suitable for the specific type of location in which they are installed. Disconnect switches shall be manufactured by Cutler-Hammer, Square D or equal. Disconnect switch enclosures shall meet the requirements of Specification Section 26 00 00.

2.6 OVERCURRENT PROTECTIVE DEVICES

A. Circuit breakers shall be of the proper type and rating for each application. They shall be molded case, thermal-magnetic, with inverse time characteristic response - temperature compensated. Motor circuit protectors shall be similar to circuit breakers except with adjustable magnetic trip and no thermal trip. The fault current intertupting rating shall not be less than that shown on the Drawings (65,000 ASYM minimum). Provide auxiliary contacts were shown on the Drawings. Circuit breakers having a frame size of 225 Amps or less shall be molded case type with thermal magnetic non-interchangeable, trip free units. Thermal magnetic molded case circuit breakers shall be Cutler-Hammer Series C K-Frame Type HFD, or equal. The interrupting capacity of all main, feeder and branch circuit breakers shall be rated for a minimum of 65,000 RMS symmetrical Amps at operating voltage.

B. Circuit breakers feeding motors starters shall be molded case instantaneous only motor circuit protector unless shown otherwise on the Drawing. Motor circuit protectors shall be rated for 600 VAC. Motor circuit protectors shall be Cutler-Hammer Series C Type HMCP, or equal. The interrupting capacity of all motor circuit protectors shall be rated for a minimum of 65,000 RMS symmetrical Amps at operating voltage. The CONTRACTOR is responsible to provide correct motor

circuit protector size, trip rating and setting for all installed equipment.

C. Circuit Breakers shall be manufactured by Eaton, Allen-Bradley, Square D or equal. Enclosures shall meet the requirements of Specification Section 26 00 00.

D. Panelboard circuit breakers shall be bolt on type unless noted otherwise. Multiple pole breakers shall be manufactured as a single unit. Use of "tandem" circuit breakers or "two in the space normally occupied by one" will not be acceptable. The fault current intertupting rating shall not be less than that shown on the Drawings (10,000 ASYM minimum).

E. Enclosed circuit breakers shall be as indicated on the Drawings and as required by Section 26 00 00. The enclosures shall have been manufactured specifically for the type of circuit breaker provided and shall be UL listed.

F. Fuses shall be provided for all fuse holders as shown on the Drawings and specified herein. They shall be current-limiting, non-renewable as indicated on the Drawings - Fusetron or Limitron type manufactured by Bussman or equal. Provide spare fuses for each size and class of fuse used.

2.7 PANELBOARDS

A. All panelboards shall comply with applicable standards of the Underwriter's Laboratories, Inc. (UL) and shall be UL listed. They shall be manufactured and tested in accordance with the applicable sections of the latest editions of NEMA PB-1, UL-67, and the NEC.

B. Panelboards shall be of a type and rating as shown on the Drawings. They shall be dead front with hardware for accepting molded case bolt-on circuit breakers of the maximum size allowable in each space. The entire assembly including circuit breakers shall be rated for not less than the available short circuit current shown on the Drawings (10,000 Amps symmetrical when not otherwise indicated).

C. Branch circuit connections to the main buses shall be of the distributed phase type as indicated on the panel schedules. Circuit numbering shall be labeled as indicated. Main buses and branch circuit straps shall be copper or electrical grade aluminum with tin or copper plating. Non-platted aluminum current carrying parts will not be accepted. Solid neutral and ground buses shall be provided as required in each panelboard. A separate isolated ground bus shall be provided where shown on the Drawings.

D. For copper feeder conductors, mechanical or compression lugs, listed for use with copper conductors, may be used. All lugs (main and branch) shall be UL listed for use with 75 degree C wire.

E. Enclosures shall be suitable for the conditions encountered. Enclosures shall be surface or flush mounted as indicated. Panelboards shall be suitable for the location in which they are installed. Enclosures shall meet the requirements of Specification Section 26 00 00. Panelboards installed in motor control centers shall utilizes the MCC manufacturer’s standard enclosure design.

F. A removable panelboard circuit directory with plastic cover shall be provided on the door.

G. Panelboards shall be manufactured by Cutler-Hammer, Square D or equal.

2.8 FUSES

A. Fuses shall be provided for all fuse holders as shown on the Drawings and specified herein. They shall be current-limiting, non-renewable as indicated on the Drawings. They shall be Fusetron or Limitron type manufactured by Bussman or approved equal.

2.9 TRANSFORMERS

A. Transformer shall be convection cooled NEMA 1 or NEMA 3R enclosed units designed specifically for energy efficient operation and not greater that 80 deg. C temperature rise over 40 deg. C ambient. Enclosure temperature rise may not exceed 35 deg. C. over 40 deg. C ambient.

B. Manufacturer shall guarantee that sound level will not exceed NEMA standard for the KVA rating of the transformer. Applicable NEMA standards are as follows: 40 db. The core shall be mechanically isolated from the enclosure with rubber vibration absorbers.

C. The windings, for three phase transformers, shall be separate primary and secondary coils factory connected in Delta primary and grounded WYE secondary configuration. A secondary system grounding lug shall be provided prewired to WYE "neutral" and transformer enclosure. Single phase transformers shall have 120/240 Volt secondary with a grounded neutral.

D. Primary taps shall be full capacity, with a minimum of two 2-1/2% above and below rated voltage.

E. Transformers shall be manufactured by Jefferson, Square D, Cutler-Hammer, or approved equal.

2.10 UTILITY METER ENCLOSURE

A. The metering equipment, main service disconnect section and pull section shall be provided as shown on the Drawings and shall be rated for voltage as shown on the singleline diagram with current rating as shown on the Drawings and 22,000 Amps RMS symmetrical, unless shown otherwise. The metering equipment shall be UL listed and shall be equipped with a metering socket and shall meet the requirements of the serving utility company. Metering equipment shall be manufactured by Circle AW, Cutler-Hammer, Square D or equal.

2.11 AUTOMATIC TRANSFER SWITCH

A. The electrically operated, mechanically held, transfer switch shall be mounted and wired as shown on the Drawings.

B. The transfer switch shall be 480/277 Volt, three phase, 60 hertz, three pole, with solid neutral operation in ambient temperatures of 40 to 100 degrees F. The transfer switch shall be double throw, actuated by an electrical operator connected to the transfer mechanism. The transfer switch shall be rated for all classes of load, both inductive and non-inductive, at 600 Volts, and tungsten lamp load not to exceed 30 percent of the continuous rating at 600 Volts. The transfer switch

shall be designed, built, and tested to close on an inrush current up to and including 20 times the continuous rating of the switch without welding or excessive burning of the contacts. The transfer switch shall be capable of 50 operations at 6 times the continuous rating and capable of enduring 6000 operations at two times rated current, at a rate of six per minute, without failure. The electrically operated transfer switch shall have a withstand current rating that is equal to or exceeds 30,000 Amperes RMS symmetrical at 480 Volts.

C. The controls shall direct the operation of the transfer switch. The ATS panel's sensing and logic shall be controlled by a built-in microprocessor for maximum reliability, minimum maintenance, and inherent digital communications capability. The control panels shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the control panel to be disconnected from the transfer switch for routine maintenance. The control panels shall be completely enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance Sensing and control logic shall be provided on plug-in printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers.

D. The voltage of each phase of the normal source shall be monitored, with pickup adjustable from 85% to 100% and dropout adjustable from 75% to 98% of pickup setting. Repetitive accuracy of all settings shall be +/- 2% or better over an operating temperature range of -20^{o}C to 70^{o}C. Voltage and frequency settings shall be field adjustable in 1% increments without the use of tools, meters or power supplies.

E. A time delay shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Adjustable from 0 to 3 seconds. A time delay shall be provided on transfer to emergency, adjustable from 0 to 5 minutes for controlled timing of transfer of loads to emergency. A time delay shall be provided on retransfer to normal, adjustable from 0 to 30 minutes. Time delay shall be automatically bypassed if emergency source fails and normal source is acceptable. Also, provide bypass switch. A time delay shall be provided on shutdown of engine generator for cool down, adjustable from 0 to 60 minutes.

F. Other Features include a set of DPDT gold contacts rated 10 Amps, 32 VDC and shall be provided for a low voltage engine start signal with the ATS. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred. Also provide a "commit/no commit to transfer" selector switch to select whether the load should be transferred to the standby generator if the normal source restores before the generator is ready to accept the load.

G. A momentary type test switch shall be provided to simulate a normal source failure.

H. Terminals shall be provided for a remote contact, which opens to signal the ATS to transfer to emergency and for remote contacts, which open to inhibit transfer to

emergency and/or retransfer to normal.

I. Auxiliary contacts, rated 10 amps, 480VAC shall be provided consisting of one contact, closed when the switch is connected to normal source and one contact closed, when the switch is connected to emergency source. Provide auxiliary contacts with the ATS. These contacts will be wired to the control panel. Indicating lights shall be provided, one to indicate when the switch is connected to normal source and one to indicate when the switch is connected to emergency source.

J. Terminals shall be provided to signal the actual availability of the normal and emergency sources, as determined by the voltage sensing pickup and dropout settings for each source.

K. Automatic transfer switches shall be manufactured ASCO or equal.

2.12 MOTOR CONTROLLERS

A. Size per applicable Electrical Codes. Accept the minimum NEMA size shall be size 1. Where a combination starter is required, use a type with circuit breaker disconnecting device unless shown otherwise.

B. Running Overload Protection: An overload relay shall be installed in each ungrounded motor circuit leg. They shall be sensitive to motor current only, have inverse time characteristics, and be of the manual reset type with a reset button operable from the outside of the starter enclosure. They shall be temperature compensated type. Select the overload relay heaters as required by the applicable Electrical Code only after the actual nameplate data for the motor has been determined.

C. Provide and install all control devices not otherwise provided for. This includes specifically: control transformers, pilot devices, push buttons and selector switches, auxiliary contacts, etc., which are required to be mounted on or within the starter enclosure. Each starter contactor shall be provided with at least one extra N.O. auxiliary contact.

D. All motor starters shall be installed in enclosures suitable to the conditions and provided with a nameplate identifying the equipment controlled.

E. Provide phase failure relays for motor loads over 25 horsepower.

F. Provide and install any specialty relays required by the various pump manufacturers at no extra cost to the Owner.

G. NEMA rated starters shall be manufactured by Cutler-Hammer, Square D, Allen-Bradley or equal.

H. Where mechanical or process equipment is provided with a specialty protective relay, the relay shall be incorporated into the motor controls at no additional cost to the Owner.

2.13 REDUCED VOLTAGE SOLID STATER MOTOR CONTROLLERS

A. Reduced voltage solid state (RVSS) motor controllers shall be solid state devices.

The starters shall utilize SCRs to control output voltage level. The controller shall start at zero Volts and ramp-up to full Voltage to produce a soft start effect.

1. Ambient Conditions: Environment – enclosure mounted, rated to run at its rated load in an ambient temperature as high as of 50^{o}C, at an altitude 6,000 feet maximum, without derating and relative humidity 95% maximum.

2. The control module shall consist of all the circuitry required to control the power components. The control logic shall provide for the following functions: soft start with kick-start, soft start with current limit and full voltage start. The logic circuitry shall be designed to operate at 85-260 Volts, 60 Hz. The voltage shall be supplied from a control power transformer. The primary side of the transformer shall be connected to line Voltage. The primary and secondary shall be fused. The acceleration ramp time shall be DIP switch selectable from 2-30 seconds. The kick-start shall be adjustable via a rotary digital switch with 10 settings from 5%-90% of locked rotor torque. The kick-start shall be provided with an adjustable time pulse of current limit prior to the normal start mode. The current shall be held at 500% of full load for a time adjustable with 9 settings between 0.4 and 2 seconds via a rotary digital switch. This feature shall be field defeatable.

3. The energy saver function shall automatically reduce the output voltage of the power module during periods when the motor is lightly loaded. The energy saver feature shall be field defeatable. The energy saver function shall automatically reduce the output voltage of the power module during periods when the motor is lightly loaded.

4. The following protection shall be provided during starting and running modes: start fault, line fault, temperature fault and stalled motor. When these conditions are detected, starting of the controller shall be inhibited or the controller shall shut down if running.

5. Dual function LED indicators shall be provided for advisory status and fault annunciation. The LEDs shall be color coded and include: control voltage present, starting, running, energy saver, stopping, start fault, stalled motor fault, temperature fault and line fault. The controller shall include an up to speed output contact.

6. The power module shall consist of three clamped semiconductor stacks - silicon controlled rectifiers (SCR). The SCRs shall have a peak inverse Voltage rating of 1400 Volts. The power module shall be mounted on a single heatsink. The heatsink shall be isolated form the power module and include provisions for grounding. The power module shall have a service factor of 1.15.

B. Reduced voltage solid-state motor controllers shall be manufactured by Allen-Bradley, SMC plus or equal.

2.14 SURGE PROTECTION DEVICE.

A. The surge protection devices (SPD) shall be designed to protect all AC electrical circuits and connected equipment from destructive, damaging or disruptive effects of lightning induced transients, normal utility load switching activities and internal generated transients. The surge suppression device shall be parallel configured, solid state, voltage clamping components demonstrating threshold suppression characteristics. Clamping components shall be metal oxide varistors. All suppression devices shall be encapsulated and mounted in a NEMA RATED enclosure. The unit shall be rated for 120 KA per phase and 60 KA per mode minimum. The device shall have all normal mode (L-L and L-N) and common mode (L-G and N-G) circuit paths protected with suppression components. The device shall be rated for 240/120 V systems, shall include a remote alarm form C contact. The device for the facility service entrance shall be installed in accordance with the manufacturer's recommendations. The manufacturer shall provide a ten year warranty. The SPD unit shall be manufactured by Square D, Eaton, Leviton or equal.

2.15 ENCLOSURES

A. Provide NEMA rated enclosures where shown on the drawings, required by these Specifications or required by the NEC. Enclosures shall be Tesco, Hoffman or equal.

2.16 PEDESTAL ENCLOSURES

A. Furnish and install all equipment as shown on drawings in a low profile 60 inch high, U.L. listed weatherproof, vandal resistant, NEMA 3R, pedestal style switchboard and instrument enclosures. Enclosure shall consist of sections with dead front interior and hinged gasketed exterior doors. Outer enclosure shall be constructed of 12 gauge hot dipped galvanized steel. Doors shall be equipped with 316 stainless steel handles with 3-point roller bearing latches and hasps for OWNER padlocks. Concrete base with anchor bolts to meet applicable seismic requirements shall be provided.

B. Provide LED lights, door switch, GFCI receptacle, PFR power fail relay, strip heater, thermostat and heat shield (if required). All openings shall be sealed to prevent entrance of insects and rodents. Finish shall be polyester dry powder, electrostatically applied and baked on at 380 deg. F. Color shall be white interior doors and light brown (camel) exterior. The painting process shall include five stages of metal preparation using dip tanks as follows: 1) Alkaline cleaner, 2) Clear water rinse, 3) Iron phosphate application, 4) Clear water rinse, and 5) Inhibitive rinse to seal phosphated surfaces. All bussing and wire shall be copper. All wire shall be stranded with locking spade pressure connectors and labeled with clip-on permanent plastic wire markers. All circuit breakers and dead front mounted devices (lights and switch) shall be equipped with engraved nameplates.

C. The enclosure shall be compartmentalized such that the programmable pump controller and power sections are isolated from each other. The compartments containing the programmable controller and power sections shall be separated by barriers behind the inner dead front door. Doors shall be hinged on the same side and shall open to greater than 90 degrees. All dead front latches are 1/4 turn adjustable with 1/8" thick latching dog and knurled knob.

D. Thermostatically controlled heating and cooling systems shall be provided, if required, and as approved by the OWNER'S REPRESENTATIVE to maintain suitable climate conditions within the control panel as required to provide proper operation of the panel and to comply with the Drawings and Specifications.

E. Provide ventilation fan cover and/or sunshield, finished to match the enclosure, where shown on the drawings.

F. Arrange outer doors that allow operators to stand in front of both the control/ instrumentation section and power/motor control section at the same time.

G. Provide generator receptacle and interlock for generator breaker where shown on the Drawings.

H. Provide intrusion switch where shown on the Drawings.

I. A ground bus shall be provided in the service equipment. It shall be connected to the grounding electrode system by exothermic welded stranded copper grounding conductors. Screw type lugs shall be provided for connection of equipment grounding conductors.

J. Provide interior lighting and switches for each pedestal section. The luminaries shall be the size and type normally supplied with the specified spaces. As a minimum, the luminaries shall be a rapid start LED strip type fixture with lamps. A lens or guard shall be furnished and installed over each lamp. The fixture ballasts shall be capable of providing reliable starts with ambient temperatures down to 30 degrees. Ballast noise shall not exceed 50 dBA.

K. Provide a receptacle in each pedestal section. Receptacles shall be of specification grade and of NEMA configuration and rated 2 pole, 3 wire grounding, 20 amperes, 125 volts. All external and dead front receptacles shall be installed on ground fault interrupter circuits "GFCI".

L. The electric service meter compartment shall be arranged as shown to meet the electric utility company requirements.

M. Provide neutral bar for grounding.

N. Provide guard over power company watt-hour meter with hinged access cover that has a hasp for utility company padlock.

O. Provide wire and lugs for service entrance as required by utility company.

P. The pull section and utility compartments shall be accessible only by the utility company.

Q. Provide a meter base, test perch with test by-pass and other materials, as required by the electric utility, which will provide service to the facility, for installation of metering equipment and attachment of service conductors.

R. Power wiring, power distribution blocks and all other power components shall be rated for 30 KAIC unless otherwise noted.

S. Pedestals shall be manufactured by TESCO Class 24-000, Pacific Utility Products or Equal.

2.17 WET WELL TERMINATION BOX ENCLOSURE

A. Provide NEMA rated pump termination boxes where shown on the drawings. Termination box shall include two sections. Each section shall include a vandal resistant, padlockable door. The enclosure shall be constructed of 316 stainless steel and rated NEMA 3R. All hardware shall be stainless steel. The first section will include a ventilated space suitable for a Class 1, Division 2 hazardous area. Conduits entering this space shall include a Rotex compression fitting suitable for creating a mechanical barrier between for equipment cables to pass through from a Class 1, Division 1 area to a Class 1, Division 2 hazardous area. This section shall also contain instructions for installation and maintaining the integrity of the barriers. The second section shall include pump cable termination blocks (power and controls): this section shall be an unrated area. Blocks shall be rated for a minimum of 150% of pump FLA and rated for the type of conductors used. The barrier between the rated and non-rated hazardous area shall comprise of a second mechanical barrier for equipment cables to pass from a Class 1, Division 2 area to an unrated area. The second barrier shall be a Rotex compression style sealing plate capable of creating a barrier with multiple cables of varying size. All compression points shall include blank plugs for installation when cables are removed. Provide Tesco 24-SP-SS or similar custom manufactured unit with all accessories and hardware shown or described.

2.18 FASTENERS

A. When fastening to pads, concrete walls, floors, and the like, provide capsule anchors, not expansion shields. Size capsule anchors to meet load requirements. Minimum size capsule anchor bolt shall be 3/8 inch diameter. Use 316 stainless steel hardware in the wet well and 304 stainless steel hardware elsewhere, unless noted otherwise.

2.19 PORTABLE GENERATOR RECEPTACLE

A. The portable generator receptacle shall match [connect to] the District's existing 100 A portable generator plugs, be reverse service with angle adapter and back box.

2.20 AUTODIALER

A. Furnish and install an autodialer and program on site as directed by the OWNER'S REPRESENTATIVE.

1. The Autodialer shall monitor four input alarm channels and also internally monitor AC power source. The four input channels shall be configured as digital (dry contract) or analog inputs. The autodialer shall include digitally recorded programming support messages, station identification message, power failure alarm message, and four default alarm messages. Application specific, user recorded messages may be digitally recorded to replace the default station identification message and four default alarm messages.
2. The automatic dialer shall be a self-contained, solid state device and UL listed. The autodialer shall continuously monitor the presence of main power and the status of four independent alarm input channels, which may be programmed for N.O. or N.C. dry-contact (or logic levels) inputs or for

4−20 mA analog inputs. Each of the four input channels shall be programmable to alarm on any of the following: OPEN circuit, CLOSED circuit, or analog HIGH and / or LOW alarm set points. Alarms shall be capable of independently being programmatically turned OFF. On AC power failure and/or on violation of alarm criteria for any of the four alarm inputs, the dialer shall go into alarm status and begin alarm dialing and alarm notification. Dialing shall continue until the alarm(s) is (are) acknowledged.

3. Unless alarm notification is by pager, notification shall be by playback of high resolution digitally recorded alarm voice messages. Each alarm shall cause the playback of its specific custom message. Analog alarm messages shall include the percent-of-full-scale of the analog inputs. Alarm acknowledgement shall be accomplished by pressing the 9-button on the telephone touch pad or by using the switch on the dialer front panel. Call-back alarm acknowledgement capability shall be available in the event that alarm notification is by numeric pager. The dialer shall re-alarm and resume alarm dialing after a programmable period of time has elapsed after an alarm(s) has been acknowledged but the fault(s) causing the alarm(s) not remedied.
4. The dialer shall respond to inquiry calls from any telephone and shall provide a status report of alarm input point status (OPEN, CLOSED, or analog PERCENT) and main power status. The report shall include alarm status for each point (normal, alarm, and alarm acknowledged but fault not remedied). A warning message shall be provided if no phone numbers have been programmed for alarm notification or if the switch on the dialer front panel is set to DISARMED rather than READY.
5. The dialer shall be FCC approved. It shall operate on a standard cell phone and shall be capable of calling from one to eight phone numbers, each up to 60 digits in length. Dialer shall be programmed using a standard touch tone telephone handset that shall be connected to the dialers through the RJ11 programming port. After programming, the programming telephone shall be disconnected and removed from the dialer. Pre-programmed speech shall provide entry guidance and confirmation of programmable features. Coded programming using function codes shall provide direct access to specific programmable items.
6. The autodialer enclosure shall be NEMA-12 and shall be capable of surface or flush mount. Enclosure shall have LED lights indicating main power failure, DISARMED status, phone line fault, phone off hook, alarm input line status (Normal, Fault with alarm trip delay not timed out, Unacknowledged Alarm, and Acknowledged Alarm).
7. Main power for the dialer shall be 105−135 VAC (GAC option). Backup power to allow dialer operation should main power be lost shall be by an internal 6 V, 4 AH gel cell rechargeable battery and precision voltage controlled charger, option GBB. A trickle charger shall be provided. Battery backup shall be 20 hours. User program storage shall be by an internal lithium battery rated for 10 years from date of shipment. Dialer operating system and default voice messages shall be stored in non-volatile memory.

B. The unit shall be covered by a Two (2) Year Warranty covering parts and labor performed at the Factory.

C. The autodialer shall be RACO Guard-It with cellular wireless telephone communications or equal.

D. Provide cellphone and antenna to match autodialer and complete the operational system.

2.21 LIGHT FIXTURES

A. Lighting fixtures should be provided as scheduled, however; fixtures of similar design, having equivalent mechanical characteristics and virtually identical luminous intensity distributions and luminances over the angles of interest (in at least the perpendicular and parallel planes), may be submitted for approval. Sufficient photometric and mechanical data must be provided with the submittal for a substitute fixture to allow for meaningful comparison with the specified item. A sample of any or all substitute lighting fixtures may be required to be furnished to the Engineer for physical evaluation to determine the acceptability of the substitute item. When making substitute fixture submittals, allow sufficient time for this process.

PART 3 EXECUTION

3.1 INSTALLATION

A. Equipment installation, including supports, anchors, and restrainers, shall meet the requirements specified in Section 26 00 00, General Requirements, Electrical.

B. Install freestanding equipment in accordance with the manufacturer's recommendations. Secure freestanding equipment rigidly to floors or mounting pads with anchor bolts, expansion shields, or other approved means. Install wall mounted equipment in a similar manner, plumb, with appropriately sized anchors.

C. Lighting fixtures shall be installed as indicated on the Drawings. Provide all brackets, hangers, poles, masts, bases and other hardware as may be required for each particular condition of installation.

3.2 TRAINING

A. A factory trained service technician shall instruct operating personnel in the operation, maintenance and adjustment of the all systems. The training shall be four hours in length.

3.3 TESTING

A. After installation has been completed, Contractor shall conduct tests required by Section 26 00 00, General Requirements, Electrical.

* * END OF SECTION * *

SECTION 26 07 00
UTILITY SERVICE

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The CONTRACTOR shall provide utility services as described in the Specifications and shown on the Drawings. Provide and install all service entrance equipment, vaults, pads, pullboxes, raceways, risers, ground rods, receptacles, cabinets, supporting structures, pullropes, bollards and other facilities as required by the serving utilities.

B. The CONTRACTOR shall make the "application for service" for new service and coordinate all service requirements with the various utility companies in accordance with their rules and requirements. Obtain Drawings of actual service equipment installation requirements from the utilities prior to construction. Submit equipment and devices to the utility company in compliance with their requirements.

C. The CONTRACTOR shall provide temporary power during construction. Pay for equipment rental, fuel, power, etc. Remove temporary facilities after completion of construction.

D. The CONTRACTOR’s effort shall include significant coordination with the various utility companies and the OWNER.

E. RELATED WORK SPECIFIED ELSEWHERE

1. Division 3, Concrete
2. Division 2, Earthwork, Trenching
3. Section 26 00 00, General Electrical Requirements
4. Section 26 04 00, Raceway Systems
5. Section 26 09 00, Electrical Grounding

1.2 QUALITY ASSURANCE

A. Like materials provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance and manufacturer’s service.

B. All work and material provided shall be in strict accordance with each utility company's rules, requirements, and standards, but in no case less than the requirements of this Specification. Coordinate all work, outages, etc., with the various utilities, the OWNER and others to prevent unnecessary delays in the progress of construction.

1.3 SUBMITTAL

A. Submit all utility equipment to the appropriate utility for review and approval

prior to formal submission.

B. The CONTRACTOR shall furnish catalog data and shop drawings in accordance with the requirements of Section 26 00 00.

PART 2 PRODUCTS

2.1 GENERAL

A. All materials shall be as specified by the utilities, but in no case less than the requirements of this Specification.

B. Revenue Metering and visual isolation of metering must comply with PG&E Standards.

C. The electric service meter compartment shall be arranged as shown to meet the electric utility company requirements. Provide neutral bar for grounding volt three phase, four wire service. Provide guard over power company watt-hour meter with hinged access cover that has a hasp for utility company padlock. Provide wire and lugs for service entrance as required by utility company.

D. The metering equipment shall be UL listed and shall be equipped with a metering socket and shall meet the requirements of the serving utility company. Enclosure shall be rated NEMA 3R. Metering equipment shall be manufactured by Tesco, Pacific Utility Products, Meyer, IEM, Circle AW, Cutler-Hammer, Square D or equal

E. Where specifically required by the utility companies, provide a sand bed in utility trenches per their standards.

F. Provide, conduit, pullboxes, backboards, ground rods, risers, meters, service disconnects and transformer pads per the utility companies' requirements.

PART 3 MATERIALS

3.1 INSTALLATION

A. Installation of all structures and equipment shall be in strict accordance with utility company standards.

B. Warning tape shall be laid in Utility trenches at a depth of 12 inches below finished grade and at least 6 inches above installed equipment. It shall be laid on the compacted backfill for the full length of the trench. Do not stretch the tape. Use wide yellow Brady "Identoline" stating: CAUTION BURIED ELECTRICAL LINE. Installation of identification tape under building slabs is not required.

* * END OF SECTION * *

SECTION 26 09 00
GROUNDING SYSTEM

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Applicable provisions of Section 26 00 00 are incorporated herein as though fully set forth at length.

B. Ground Power system, electrical equipment and raceway grounding and bonding, and specialized systems including testing.

C. Work Included: Furnish all labor, material, equipment, tools and services necessary for the installation, connection and testing of all grounding as specified herein and as shown on the Drawings.

1.2 STANDARDS

A. American Society for Testing and Materials (ASTM) Publication:

1. B228 Copper Clad Steel Conductors Specification
2. D178 Specifications for Rubber Insulating Matting

B. National Electric Code (NEC)

C. International Electrical Testing Association (NETA) Publication:

D. ATS - Acceptance Testing Specifications for Electrical Equipment Power Systems

1.3 SUBMITTALS

A. Submit material or equipment data in accordance with the Product Information category of the General Conditions and the submittal requirements of Section 26 00 00.

B. Manufacturer’s product data for the following:

1. Connection methods and details.
2. Ground Rods.
3. Ground rod wells.

1.4 QUALITY ASSURANCE

A. Comply with the following codes and standards, and section 26 00 00:

1. IEEE 81- Recommended guide for measuring ground resistance and potential gradients in the earth.
2. NEMA.
3. UL Listings.
4. MIL Handbook 419.

PART 2 MATERIALS

2.1 GENERAL SYSTEM DESCRIPTION

A. The grounding systems shall consist of the ground rods, grounding conductors, ground bus, ground fittings and clamps, and bonding conductors to water piping and structural steel as shown on the Drawings. One system shown provides service and separately derived system grounds. A second system is an electronic ground system to provide for the discharge of static electricity. All are bonded together.

B. Ground all electrical equipment, conduits, supports, cabinets, and switchgear in accordance with National Electrical Code and as shown on the drawings, the intent being a complete system ground and equipment ground.

2.2 SYSTEM COMPONENTS

A. Ground Rods: Ground rods shall be cone pointed copper clad Grade 40 HS steel rods conforming to ASTM B228. The welded copper encased steel rod shall have a conductivity of not less than 27% of pure copper. Rods shall be not less than 3/4-inch in diameter and 10 feet long, unless otherwise indicated. The manufacturer's trademark shall be stamped near the top.

B. Ground Conductors: Buried conductors shall be medium-hard drawn bare copper; other conductors shall be soft drawn copper. Sizes over No.6 AWG shall be stranded. Coat all ground connections except the exothermic welds with electrical joint compound, non-petroleum type, UL listed for copper and aluminum applications.

C. Ground Connections: Connection to ground rods and buried connections shall be by exothermic weld. Lugs for attachment of cables to steel enclosures shall be of the binding post type with a 1/2-13NC stud. Each post shall accommodate cables from #4 AWG to #3/0 AWG.

D. Ground Rod Boxes: Boxes shall be a 9-inch-diameter precast concrete unit with hot-dip galvanized traffic covers. Units shall be 12-inches deep. Covers shall be embossed with the wording "Ground Rod."

E. Ground rod wells shall be 8” inch diameter constructed of reinforced concrete with a reinforced concrete removable cover stamped “GROUND” as manufactured by Christy or equal.

F. Ground Bus: Ground bus shall be a high conductivity copper alloy strap measuring 3/16-inch by 3/4-inch and of lengths as shown on the Drawings. Bus shall be predrilled and tapped to accept 8-32” brass machine screws on 12-inch centers or with greater density if required.

PART 3 EXECUTION

3.1 INSTALLATION

A. Ground all equipment for which a ground connection is required per NEC

whether or not the ground connection is specifically shown on the Drawings.

B. Where mechanical lugs are not welded or fastened with threaded bolt, surfaces shall be thoroughly cleaned and paint scraped to bare metal before connections are made to insure good metal-to-metal contact.

C. Grounding conductors shall be so installed as to permit shortest and most direct path from equipment to ground. Ground connections shall be accessible for inspection and made with approved solderless connections braced (or bolted) to the equipment or structure to be grounded.

D. An equipment grounding conductor must be installed in each conduit with power conductors or, in the case of multi-conductor cable, run inside the sheath.

E. Where generators and transformers are indicated on the drawings to be grounded solidly to a separate grounding electrode located at the equipment in addition to the ground connection, this grounding electrode shall be bonded to the system ground through the equipment grounding conductor(s) and/or a separate grounding conductor as indicated on the drawings.

F. A main system ground, bare copper conductors, size as indicated, shall be run in PVC conduit from the pedestal to a ground point outside the pad and an electrode ground under the pad as indicated on the drawings. This ground shall be extended to metallic water piping.

G. Connections to ground rods shall be as noted on Drawings or be exothermically welded. Ground rod connections shall be in a ground rod well for inspection purposes.

H. All bonds between the grounding electrode conductors and the grounding electrodes must be accessible for inspection and routine maintenance. No buried ground connections (except rebar bonds) shall be accepted.

I. All enclosure doors with 120 VAC mounted devices shall be bonded to the enclosure ground bus.

J. Where ground rods must be driven to depths over 8 feet, increase rod diameter used, sufficiently to prevent the rod from bending or being damaged.

K. All direct buried conductors shall be minimum of 30” below grade.

L. Bond metallic water piping at its entrance into each building. Ground separately derived electrical system neutrals to the metallic water piping in addition to the system driven ground, per NEC requirements.

M. Provide a ground wire in every conduit carrying a circuit of over 50 volts to ground.

N. Make embedded or buried ground connections, taps and splices with exothermic welds. Coat ground connections.

O. Effectively bond structural steel for buildings to the grounding system using exothermic welds.

3.2 TESTING

A. Conduct ground resistance tests using a ground megohmmeter with a scale reading of 25 ohms maximum. Resistance between ground and absolute earth shall not exceed 25 ohms and shall be measured using the fall of potential method with a three or four terminal ground resistance tester. A minimum of ten (10) ground resistance tests shall be measured at 30-foot intervals from the service-grounding electrode.

B. The test results shall be plotted on a curve and submitted in the report. The ground resistance test shall be conducted in the presence of the Engineer before the equipment is placed in operation. Use of salts, water or compounds to attain the specified ground resistance is not acceptable.

C. Test methods shall conform to NETA Standard ATS using the three electrode method. Conduct tests only after a period of not less than 48 hours of dry weather.

D. Furnish to the Owner a test report with recorded data of each ground rod location included on a drawing with date of test, weather conductions and the measured resistance.

* * END OF SECTION * *

SECTION 26 61 00
CONTROL PANEL

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, equipment and incidentals, including a SCADA remote unit, communication components, associated equipment, hardware and software necessary to provide a complete and operational control system.

B. The CONTRACTOR is responsible for the testing, startup and training.

C. The CONTRACTOR shall provide, connect and test instruments.

D. The CONTRACTOR shall provide field services associated with all components covered by this Specification Section.

1.2 SUBMITTALS

A. Submittals shall include those set forth in Specification Section 26 00 00, General Requirements, Electrical.

B. Provide operating and maintenance instructions as specified in Section 26 00 00, Electrical Requirements, General. This shall include complete technical manual, programming, wiring diagrams. Provide drawings and diagrams showing final as-built conditions.

1.3 MANUFACTURER'S DIRECTIONS

A. Manufacturer's directions shall be followed in all cases where manufacturers of articles used furnish directions covering points not shown on the drawings or herein specified.

1.4 WARRANTY

A. Guarantee all work for one year from date of acceptance against all defect in material, equipment, and workmanship.

1.5 SITE CONDITIONS

A. General Environment. The programmable logic controller shall withstand anticipated environmental conditions of -20 degrees to 65 degrees C operating temperature and 5 percent to 95 percent humidity non-condensing. Electro-magnetic interference (EMI) and radio frequency interference (RFI), as may be anticipated in a typical industrial environment, shall not impede proper functioning of the control systems. EMI and RFI is expected from two-way radios, variable frequency drives, lightning strikes, motors, transformers, contactors, relays, etc.

B. Normal fluctuations of the 120 VAC 60 Hz power supply shall not cause improper operation of the CONTROLLER system. Normal fluctuations are voltage

excursions between 100 and 130V, or surges caused by switching of electrical loads.

1.6 QUALITY ASSURANCE

A. The custom control panel shall be built in accordance with the overall sizing and component layouts as detailed on the Drawings, and no deviations will be allowed without prior approval of the Engineer.

B. The Controller and control panels shall be UL labeled as industrial control panel.

C. All devices and components of a similar type or function (i.e., circuit breakers, control relays, timers, etc.) shall be the product of one manufacturer unless otherwise noted.

D. The Control panel shall be manufactured by Aqua Sierra Controls, Tesco or approved equal.

PART 2 PRODUCTS

2.1 CONTROL PANEL ENCLOSURE

A. Furnish and install all control equipment, as shown on drawings, in U.L. listed NEMA enclosures: Tesco, Hoffman or equal.

2.2 CONTROL PANEL CONSTRUCTION

A. Control Panels shall be so constructed for the application of a UL Listing Label by an approved UL Control Panel Assembly Facility. All electrical connections shall be properly inspected and torqued in compliance with ISO specifications. External connections to the control panel shall be by way of numbered terminal blocks. Control Panels shall be properly checked and load tested with power applied. A control panel test log shall be supplied with the control panel. Control Panels shall be supplied from a UL approved control panel assembly facility with all of the required labels properly attached.

B. Control Panel Enclosure Specific Construction Requirements

1. Enclosure shall be sized according to physical and functional device requirements.
2. Enclosure seams shall be continuously welded and ground smooth.
3. Enclosure door opening flange trough shall exclude liquids and contaminants.
4. Enclosure shall include an integral body grounding stud and sub-panel mounting studs.
5. Enclosure door shall have hidden hinges for a clean, aesthetic appearance.
6. Enclosure door opening angle shall be standard, full access, 135 degree opening radius.
7. Enclosure door shall be interchangeable and removable by pulling a captive hinge pin.
8. Enclosure door shall have a high-impact thermoplastic data pocket mounted on the inner side of the enclosure door.
9. Enclosure door shall have a seamless, foam-in-place, one-piece gasket to provide an oil-tight, dust-tight seal against contaminants.
10. Enclosure shall have a three-point latching system with a zinc die-cast

handle that is painted with black textured polyester powder paint.

11. Enclosure handles shall be capable of being padlocked.
12. Steel sub-panel shall be white.
13. When enclosure cut-outs for instruments and other devices are required, holes shall be cut, punched, or drilled and finished with rounded edges.
14. A door stiffener shall be used where applicable to prevent door deflection under instrument loading or operation.

C. Wiring for AC and DC control circuits shall be Type THWN stranded copper and shall be sized for the applied voltage and current. Unless otherwise noted, control circuit wiring shall not be smaller than No. 14 AWG. Cable wiring for analog signal circuits shall be twisted, shielded pairs of stranded copper conductors that shall not be smaller than No. 18 AWG. Wiring for special signalling equipment such as communications, digital data, and multiplexed signals shall be provided by the equipment supplier. Wiring shall be numbered and marked at each termination point. Terminal blocks for internal or external wiring shall be DIN rail mounted, individual screw compression type terminals with machine printed labels. Provide wire barriers: IBOCO or equal.

D. Nameplates are defined as inscribed, plastic plates mounted above or near a panel face mounted component. Unless otherwise noted, nameplates shall be engraved, rigid, laminated plastic with an adhesive back. Nameplate color shall be white with black letters. Component Labels are defined as printed, vinyl labels mounted above, below or near a sub-panel (back) mounted component for identification. Printed vinyl labels shall be white in color with black letters and an adhesive back.

E. Provide LED light fixture and switch.

F. There shall be a 120VAC, 15 Amp GFCI rated convenience receptacle mounted on the dead front swing door of the control panel. Receptacle circuit shall be protected by a thermal magnetic circuit breaker.

G. There shall be a 120VAC, 50 watt enclosure heater inside the control panel.

H. Provide Remote Telemetry Unit per Specification Section 26 63 00.

I. Other components shall be provided as described in Specification Division 26.

J. Space shall be provided for instruments indicated as furnished by others to be mounted and wired by the control panel manufacturer. These units shall be shipped to the control panel manufacturer in sufficient time for wiring. Coordination of instrument delivery shall be the responsibility of the CONTRACTOR.The instruments and controls to be located on each panel are shown on the instrumentation drawings, electrical schematics, and/or in the individual Specification.

PART 3 EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the manufacturer's instructions and located as shown on the Drawings. The CONTRACTOR shall be responsible for

coordinating the equipment, performing the installation and start-up in a timely manner, and assuring a fully operable and function-tested system.

3.2 GROUNDING

A. Ground transfer switch directly to the service entrance ground source in accordance with NEC.

3.3 PROGRAMMING SERVICES AND DOCUMENTATION

A. The programmer shall provide programming documentation that fully describes the program function and application.

3.4 FIELD SERVICES

A. Provide field services to support the start-up of the system including the control panel and instruments. Provide two days of start-up services minimum.

B. Provide start-up services for all instrumentation components.

3.5 TRAINING

A. Provide training on site for minimum of 4 hours.

3.6 TESTS

A. Testing shall be provided as described in Specification Section 26 00 00, General Requirements, Electrical.

* * END OF SECTION * *

SECTION 26 63 00
REMOTE TELEMETRY UNIT

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, equipment and incidentals, including RTU/PLC, communication components and associated equipment required, to install complete and ready for operation, and field test the RTU/PLC, radio and SCADA modifications as shown on the Drawings and/or specified herein.

B. The SCADA system modifications and Remote Telemetry Unit/Programable Logic Controller shall meet all the requirements of Section 26 61 00, Control Panels.

C. The CONTRACTOR is responsible for the factory and field testing and startup.

D. The CONTRACTOR shall program the existing SCADA system for the new site to match other similar existing lift stations in the DISTRICT's collection system. The CONTRACTOR shall match the existing SCADA displays and functionalities as much as possible to provide a smooth transition for OWNER personnel in integrating the new facility into the existing system.

E. Provide a point to point radio study providing final height for the antenna mast and antenna mounting height.

F. Provide a system for disabling the generator when pumps are not required and the UPS battery power is available.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 00 00, General Electrical Requirements

B. Section 26 09 00, Electrical Grounding

C. Section 26 06 00, Miscellaneous Electrical Equipment

D. Section 26 61 00, Control Panel

E. Section 26 89 00, Instrumentation

1.3 CONTRACTOR SUBMITTALS

A. The following information shall be provided in accordance with Section 26 00 00, General Electrical Requirements.

B. A copy of this specification section, with any addendum updates included, and all referenced and applicable sections, with any addendum updates included, shall be submitted with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

Checkmarks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

C. Submittals shall be provided to confirm that materials to be used comply with information specified herein.

D. Upon receipt of approved hardware submittals and commencement of SCADA System configuration and programming, the CONTRACTOR shall submit a digital copy of the static SCADA screen displays and pop-ups for a development review. Upon favorable review of progress, development shall continue towards factory testing and delivery milestones.

E. Submit radio study and recommendations.

F. Provide operating and maintenance instructions as specified in Section 26 00 00. This shall include a complete technical manual, programming, all wiring and interconnection wiring diagrams, including but not limited to RTU/PLC hardware, communications, power, and network. Provide drawings and diagrams showing final as-built conditions.

G. Provide the services of a qualified factory trained field DISTRICT'S REPRESENTATIVE to test and put the system into operation, and instruct DISTRICT's personnel.

1.4 QUALITY ASSURANCE

A. The CONTRACTOR shall furnish all of the hardware and software including custom programming, for RTU/PLC and SCADA system.

B. The RTU/PLC shall be completely inspected and subjected to a factory test prior to shipment.

C. The SCADA system modifications, remote telemetry unit and communication equipment shall be guaranteed against defects of design, material, and workmanship for a period of one (1) year from the date of acceptance by the DISTRICT. The SCADA system integrator shall be Tesco or preapproved equal.

D. The SCADA RTU/PLC shall be the product of a manufacturer regularly engaged in the design, production, and support of complex RTU/PLC and SCADA systems. The supplier shall demonstrate experience of at least 100 similar installations. The RTU/PLC supplier shall have been in business for twenty-five years. All equipment shall include a 1 year warranty. The system shall be manufactured by Tesco L2000 series or preapproved equal.

E. The RTU/PLC and SCADA system supplier shall have a service organization

available upon 24 hour notice and stock applicable spare parts within 100 mile radius of the project site.

F. The CONTRACTOR shall be responsible for the compatibility, installation, and start-up of the RTU/PLC, SCADA and associated equipment.

G. The CONTRACTOR and the system supplier shall meet with the DISTRICT for four hours to discuss coordination issues related to programming, communication, factory test and start-up/testing of the SCADA system prior to factory testing of the equipment.

H. The CONTRACTOR and system supplier shall provide all field services including installation oversight, testing, start-up and training.

1.5 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. The following references are part of this Section. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail. The latest edition of the following references at the time of bid shall be used.

1.6 SCADA TESTING

A. General

1. The CONTRACTOR shall perform a factory test of SCADA system equipment and all necessary site testing and adjustment of the complete, assembled SCADA system as specified herein. The CONTRACTOR is responsible for providing all personnel, equipment, instrumentation, and supplies necessary to perform all required testing. Written notification of any planned testing shall be given to the DISTRICT'S REPRESENTATIVE at least 14 days prior to any test, and in no case shall notice be given until after the CONTRACTOR has received written approval of the specific test procedures.

B. Factory Test

1. Procedures

a. The test procedures shall define all the tests required to ensure that the system meets technical, operational, and performance specifications. The test procedures shall identify all capabilities and functions to be tested. The test procedures shall be developed by the CONTRACTOR based on the design documentation. Test Procedures shall include the testing of all SCADA, RTU/PLC hardware/software interfaces of CONTRACTOR furnished SCADA system equipment. Each software module, application program, graphic element, and communication protocol shall be tested including as to how these interfaces are coordinated with field devices, CONTRACTOR developed interface software and CONTRACTOR-furnished hardware and software. The final procedures shall be provided to the observers prior to the commencement of testing.

2. Factory System Testing

a. CONTRACTOR shall test the operation and display of all application software based on a simulation of 100% percent of total input/output count, both analog and discrete. Discrete input simulation shall consist of jumpering inputs and observing the specified action at the RTU. Discrete outputs shall consist of forcing control outputs at the RTU/PLC from the [temporary test] SCADA application and observing the associated output action using a multimeter. Analog points and ranges shall be checked at 0, 10, 50, 90 and 100% of full scale using a multimeter or calibration tester. Testing shall show that the monitoring and control application software associated with the input/output points, and internal programmed controls and data, perform the process control functions and SCADA display indication, control, trending, alarm dial out and reporting of the System.

3. Field System Testing

a. The CONTRACTOR shall perform start-up, field, performance verifications, and endurance tests of SCADA system equipment and all necessary site testing and adjustment of the complete SCADA system as specified herein. The CONTRACTOR is responsible for providing all personnel, equipment, instrumentation, and supplies necessary to perform all required testing. Written notification of any planned testing shall be given to the DISTRICT'S REPRESENTATIVE at least 14 days prior to any test. All testing shall be coordinated with the DISTRICT and discussed during progress meetings.

b. Overall system testing shall be similar to that of factory testing. Control verification shall be live field conditions. Discrete/analog and control testing with RTU/PLC and field equipment shall be verified with DISTRICT personnel present to assist in manipulation of process equipment. All final field SCADA, I/O and control testing verification shall be witnessed by the DISTRICT'S REPRESENTATIVE.

1.7 GENERAL SYSTEM DESCRIPTION

A. Lift Station Site

1. Tesco L2000 or approved equal with communication components, UPS and controls.

B. Programming

1. Provide programming which shall include configurations, screen building, report generation, trend setup and auto-dialer programming, radio study, radio license application filing, antenna alignment and radio communications testing, as-built drawings, start-up services, four hours of operator training, setup workstation computers to connect to server, setup

workstation backup and startup for all stations.

PART 2 PRODUCTS

2.1 SITE CONDITIONS

A. General Environment. The remote terminal unit shall withstand anticipated environmental conditions of 0 degrees to 55 degrees C temperature and 10 percent to 95 percent humidity. Electro-magnetic interference (EMI) and radio frequency interference (RFI), as may be anticipated in a typical industrial environment, shall not impede proper functioning of the RTU and SCADA systems. EMI and RFI is expected from two-way radios, variable frequency drives, lightning strikes, motors, transformers, contactors, relays, etc.

B. Power Source (unless shown otherwise):

1. Normal fluctuations of the 120 VAC 60 Hz power supply shall not cause improper operation of the RTU and SCADA systems. Normal fluctuations are voltage excursions between 100 and 130V, or surges caused by switching of electrical loads.

2. On loss of station AC power, the RTU shall initiate an orderly shutdown of its control functions while powered by a UPS. On restoration of power, the RTU shall restart the system in an orderly and controlled sequence.

3. No erratic operation of any RTU output device is allowed during start-up, shutdown, operation, or on loss of or restoration of power.

4. The RTU shall include uninterruptible power source functionality. Power supplies shall keep batteries at a float charge. The batteries shall not be damaged by deep discharges.

C. Surge Protection. All control and RTU components, power supplies, CPU and all I/O devices shall have built-in surge withstand capacity to prevent damage from electrical surges on any connected line.

D. Supply interfacing relays whenever loads exceed 0.5 Amp continuous or 1.0 Amp spikes [or surges]. Supply DC interfacing relays when using DC output module to control AC loads. Supply analog isolation modules whenever a loop contains more than 3 devices or more than one grounded [common] device.

2.2 SCADA RTU/PLC

A. The RTU/PLC shall have all the characteristics and features listed herein. All these features shall be readily available as an integral part of the RTU/PLC and shall be standard catalog items for the product. The use of any third party hardware or software add-on products to meet this specification is not acceptable. The L2000 RTU/PLC from Tesco Controls, Incorporated or preapproved equal.

1. The RTU/PLC itself and support for the controller shall be available directly from the manufacturer. Programming services shall be available direct from the manufacturer as a normal practice. The manufacturer shall also produce a Supervisory Control and Data Acquisition (SCADA) system

that integrates directly with the RTU/PLC, supporting the controller's native communications protocol, to take full advantage of its capabilities.

2. The RTU/PLC manufacturer shall provide a 1 year warranty with the unit. A 5 year warranty and a 10 year warranty shall be available at additional cost. These warranties shall be available in writing directly from the manufacturer before bid acceptance. A warranty or service contract from a source other than the RTU/PLC manufacturer is not an acceptable substitute. The warranty shall provide for direct on-site replacement of the entire plug-in RTU/PLC, complete with the original program and configuration. The manufacturer shall provide personnel to perform the warranty service, at no additional cost to the purchaser. The replacement controller shall be available within 24 hours, installed and running at the station, without requiring that the original unit first be removed and returned to the factory.

3. The RTU/PLC manufacturer shall provide telephone support for questions related to any aspect of the controller, including general use, application-specific issues, programming, and use of the programming software. This support shall be available directly from the manufacturer at no extra charge with the purchase of a controller.

4. The RTU/PLC should be constructed using a card cage architecture incorporating a 96 pin 3U DIN VME standard backplane interconnection. The printed circuit cards shall be designed to slide into the card rack and interconnect with the VME backplane. A high density I/O card with a mix of I/O types as well as an I/O card for each individual I/O type shall be available. The system shall operate with a minimum of 2 cards and shall be easily expandable to 20 cards. The RTU/PLC shall be solidly mountable, but shall be capable of being removed easily in the field. Card cages with a capacity of 2 to 20 slots shall be readily available. All field wiring to the I/O cards shall be done at externally mounted terminal blocks with ribbon cable interconnects to the relative I/O card.

5. The RTU/PLC shall operate correctly under an ambient temperature range of -40 to +200 degrees F without requiring forced air or other special cooling measures. Coatings on connectors, component leads, and other materials used in the construction of the RTU/PLC shall be substantially resistant to atmospheres containing significant amounts of Hydrogen Sulfide gas and Chlorine gas. Each component shall have passed testing and be certified in writing by the manufacturer to be acceptable for use in water treatment and waste water treatment environments.

6. The RTU/PLC shall have a low-power shut-down mode suitable for use with standby diesel engine generator or other sites where power consumption is critical.

B. Card Architecture

1. Processor Card -
   a. The RTU/PLC shall be microcontroller-based, using a

microcontroller that, at minimum, supports the following: 25/33 MHz clock rate Flat (non-segmented) memory addressing RISC Communication Co-Processor Serial DMA channel Dual-ported RAM Watchdog timer 4 configurable timers with interrupt capability 3 serial ports with separate baudrate generators 2 ethernet RJ45 ports Write-protect enable/disable

b. The RTU/PLC shall use a real-time, preemptive, multitasking operating system, contained in Read Only Memory (ROM). The ROM shall also contain all firmware that is not specific to a particular job or application, such as operator interface and communications firmware.

c. Application-specific programming and data shall be contained in battery-backed RAM. The RAM shall be low standby power, CMOS static RAM. The backup battery shall maintain RAM contents when the RTU/PLC is not connected to an external power source. The backup battery shall be a Lithium cell capable of continuously powering the RAM in a standby state for a minimum of 10 years with no loss of data. The RTU/PLC shall be available with a total of at least 1 megabytes of RAM.

d. The RAM shall be divided into two sections - write-protected, and non write-protected. The boundary between these two sections shall be user definable.

e. Critical information, including the application program, control constants (setpoints), and configuration information shall be stored in write-protected RAM. The controlling of write-protected RAM shall be an integral feature of the micro-controller allowing writes to the write-protected memory only after a proper registration sequence. The RTU/PLC shall contain a watchdog timer circuit that will reset the micro-controller within 1 second of detecting a firmware failure. To provide a means of checking data integrity, the RTU/PLC shall compute a CRC-16 value on the contents of write-protected RAM whenever the data is changed and store the CRC value in a reserved location of write-protected RAM. An ongoing self test process shall periodically recompute the CRC and check it against the stored CRC during normal operation.

f. Non write-protected RAM shall be used as a scratch area to hold temporary information and data values that are subject to constant change.

g. A dedicated TELCO style communications port shall be readily available for maintenance port operations using a laptop computer. Up to five additional communication ports shall be available for telemetry operations. A fault relay connector shall be readily available to provide closed contacts in the event of an internal failure or power loss.

2. High Density Input/Output Card

a. The RTU/PLC shall support the following high density card with the listed characteristics:

b. Analog input: senses voltage or current (selectable for 0-5V or 4-20

mA) minimum 12-bit resolution differential, isolated available with at least 6

c. Analog output: sources voltage or regulates current (selectable for 0-5V or 4-20 mA) minimum 12-bit resolution differential, isolated in current mode available with at least 2

d. Digital input: senses a contact open/closed condition 7500 V optically isolated LED annunciators for each input on card faceplate available with at least 16

e. Digital output: 10A relay contact LED annunciators for each output on card faceplate available with at least 8

3. Sequence of Events Card

a. The RTU/PLC shall support the following SOE card with the listed characteristics: Digital input: senses a contact open/closed condition event timestamp accuracy to 1mS, user defined event window sequence of events reporting 7500 V optically isolated LED annunciators for each input on card faceplate available with at least 16 and Digital output: 10A relay contact LED annunciators for each output on card faceplate available with at least 16

4. Analog Input Card

a. The RTU/PLC shall support the following analog input card with the listed characteristics: Analog input: senses voltage or current (selectable for 0-5V or 4-20 mA) minimum 12-bit resolution differential, isolated available with at least 16

5. Analog Output Card

a. The RTU/PLC shall support the following analog output card with the listed characteristics: Analog output: sources voltage or regulates current (selectable for 0-5V or 4-20 mA) minimum 12-bit resolution differential, isolated in current mode available with at least 8

6. Digital Input Card

a. The RTU/PLC shall support the following digital input card with the listed characteristics: Digital input: senses a contact open/closed condition 7500 V optically isolated LED annunciators for each input on card faceplate available with at least 32

7. Digital Output Card

a. The RTU/PLC shall support the following digital output card with the listed characteristics: Digital output: 10A relay contact LED annunciators for each output on card faceplate available with at least 32

C. Input/Output Characteristics

1. The RTU/PLC shall provide built-in digital filtering of analog inputs. The filter constants shall be adjustable from the keyboard and through the communications ports. Each analog input shall have an independent filter constant. The RTU/PLC shall provide a virtually infinitely variable wide range of adjustment from no filtering to extreme filtering. Each analog output shall have the ability to maintain output or zero output when

entering standby mode. Each digital output shall be turned off when entering standby mode.

D. Field Wiring Terminal Blocks

1. The terminal blocks shall support the following listed characteristics:
   a. pull-apart two piece wiring blocks for fast and easy wiring/re-wiring
   b. separate wiring blocks for each I/O type and each wire point fully labeled
   c. versatile internal or external analog power source
   d. digital outputs shall have socketed 10A relays with LED "ON" indicators entire terminal block shall snap on/off standard track mount
   e. onboard passive circuit protection to protect RTU/PLC
   f. shall be available with a built-in isolated current loop power supply, powered from the 12V DC main power. The current loop power supply shall be capable of producing at least 24V DC and 161 mA.
   g. 3 distinct classes of lightning protection shall be available: Standard Class A lightning protection shall consist of dual MOVs at each AI/AO individually fused AI/AO power source fused DI source and common with clamping diodes onboard spare fuses for all fuse types Class AA lightning protection shall, in addition to Class A, include dual gas discharge tube at each AI/AO Class AAA lightning protection shall offer the most comprehensive protection full 500 joule 12 stage lightning protection at each AI/AO

E. Power Supply

1. The RTU/PLC shall be powered by a 12V/5V DC power supply, with an allowed operating range of at least +/- 10%. A 12V battery backup of the 12V DC shall be available such that the 5V DC is also maintained by the 12V battery.

F. Operator Interfaces

1. The RTU/PLC shall be available with the choice of at least two operator interface units that easily flush-mount in the enclosure door.
2. The compact model shall have at least the following attributes:
   a. 60 *Brite Lite* LED annunciators with adjacent site-specific label descriptions
   b. 8 *Brite Lite* LED mode annunciators and communication activity annunciators
   c. 8 character *Brite Lite* alphanumeric display of at least 0.5 inches high
   d. 4 keys to easily traverse a user-friendly menu tree that allows full control of operation
   e. 4 user-programmed macro keys with adjacent site specific label descriptions
3. The full display model shall have at least the following attributes:
   a. 360 *Brite Lite* LED annunciators with adjacent site-specific label descriptions
   b. 8 character *Brite Lite* alphanumeric display of at least 0.5 inches

high

c. 4 key to easily traverse a user-friendly menu tree that allows full control of operation

d. 32 keys for full front panel programming

e. 4 user-programmed macro keys with adjacent site specific label descriptions

4. The operator interfaces and site specific nomenclature and labels shall be completely covered with a mylar overlay that is impervious to corrosive atmospheres and wash-down environments.

G. Keyboard

1. The keyboard construction shall be sealed membrane type, using a stainless steel backing plate, and shall be impervious to atmospheres containing Hydrogen Sulfide and Chlorine gases. The keys shall provide tactile feedback. Both keyboard options shall provide a menu-based operator interface, allowing the operator to perform at least these functions, without process interruption:

a. Examine and change setpoints

b. Examine analog input and output registers

c. Examine and change timers and counters

d. Examine and change analog input filter constants

e. Calibrate analog inputs and outputs

f. Force digital outputs on and off

g. Override analog inputs and outputs

h. Examine control program

2. The full keyboard shall, in addition, allow the operator the ability to change the control program, and provide direct access to major functions without the use of menus. Either keyboard shall be available with at least 4 macro function keys. These macro keys shall be programmable to perform actions that would normally require multiple keystrokes on the normal keyboards. The programming shall be supported both by downloading through a communication port, and directly through the full keyboard.

H. LED Character Display

1. The RTU/PLC shall be available with an alphanumeric *Brite Lite* LED display capable of displaying at least 8 characters at a time using at least 15 segments per character. This display shall be at least 0.5 inches in height and shall be readable from a distance of at least 25 feet. The LED character display shall be used for showing the values of registers, inputs, outputs and other data. It shall also be used to display English language menu options to implement the menu system described above.

I. LED Annunciators

1. The RTU/PLC shall be available with individual *Brite Lite* LED's arranged in columns, which shall be usable to display the on/off state of digital inputs and outputs (physical or internal). The LED's shall also be usable for bar graph displays. The mapping of LED's to digital inputs and outputs shall be completely configurable, allowing any random arrangement, including the ability to map any number of LED's to a single input or output to achieve maximum visibility.

J. Mode LED's

1. The RTU/PLC shall be equipped with at least the following mode display *Brite Lite* LED's:
   a. SBY lighted when in standby mode
   b. CMD lighted when in command mode
   c. RUN lighted when in run mode
   d. MEM lighted when write-protected memory is open
   e. CAL lighted when in calibration mode
   f. XMT lighted when a message is being transmitted via a communications port RCV lighted when a message is received via a communications port
   g. ERR lighted when an error condition is detected by the controller
2. The XMT/RCV LED's shall be configurable to selectively show activity on any combination of the communications ports.

K. Bar Graph Displays
1. The RTU/PLC shall have the ability to display at least 4 bar graphs on the *Brite Lite* LED annunciators. The bar graphs shall be individually configurable with respect to the following characteristics:
   a. Display position (anywhere on the 380 LED's)
   b. Height (allowing a range of at least 10-80 LED's)
   c. Value to be displayed (allowing any analog input or output register scale)
   d. Values representing the low point and high point of the bar graph scale engineering units
2. Each bar graph shall allow up to 4 markers to be displayed to show a related value. Each marker shall be assignable to any setpoint, analog input, or analog output register, such that when the value of the register changes, the position of the marker shown on the bar graph changes appropriately. The markers shall flash in order to be discernible from the rest of the bar graph display. If the value being monitored by the bar graph should go beyond the defined endpoints (under range or over range), the LED at that end of the bar graph shall flash to indicate the condition.

L. Operating Modes
1. The RTU/PLC shall have two basic modes of operation as described below:
   a. RUN: Actively controlling, running application-specific control program Sensing input signals Generating outputs under program control Peer-to-peer message initiation is enabled Polling is enabled
   b. STANDBY: Not actively controlling, application-specific control program is stopped Continues to sense input signals Analog outputs held at current level or set to zero Digital outputs go to off state Initiation of peer-to-peer messages is disabled Polling is disabled

M. Programming
1. Language
   a. The RTU/PLCshall be programmable using the IEC 1131-3 “Standard for Automation Programming Languages” which includes a full implementation of the following five languages: Sequential Function Chart Structured Text Instruction List

Function Block Diagram Ladder Diagram

b. The IEC 1131-3 program development environment shall at a minimum include the following features: Native Microsoft Windows Application Operate on a PC platform running Microsoft Windows 3.11/95/NT Allow Upload/Download of all program code Full Graphic Editor Tools optimized for creating and editing source programs Animated Graphic Tools Off-Line Simulation Tools On-Line Debugger Tools Documentation Tools Archive Tools Library Management Tools Project Management Tools Password Protection Tools for Projects and Libraries

2. In addition to the above IEC 1131-3 languages the controller shall have the ability to execute a higher-level BASIC-like programming language which is native to the controller.
3. The native programming language shall at the least support the following attributes:
4. The programming language shall be line number oriented, with an allowed range of line numbers of at least 65,000. The language shall support the ability to:
   a. Event subroutines that execute automatically upon change of input signal
   b. Create multiple execution loops within the program
   c. Create multiple subroutines
   d. Nest subroutines to at least 10 levels
   e. Make a direct jump to a specified line number
   f. Use built-in math functions, including log, inverse log, sine, cosine, tangent, min, max
   g. Use parenthesis to specify precedence in expression evaluation, nested to at least 10 levels
   h. Use indirection in register reference, where the specific register number referred to in an expression is stored in another register
   i. Execute code segments based on specified events that are monitored by the operating system to ensure immediate response to critical events. The RTU/PLC shall support the definition of at least 25 individual events. These events shall be definable as: Change of state on a digital input or output Logical truth condition of an arbitrary expression involving any register type (such as "ANALOG INPUT 7 > SETPOINT 17 + SETPOINT 18")

N. Registers

1. The RTU/PLC shall have at least the following preformatted register types arranged in a global system database, with the quantity of each register type selectable to at least the numbers given:
   a. Setpoint (for storing constants, at least 1000)
   b. Analog input (physical or internal, at least 1000 total)
   c. Analog output (physical or internal, at least 1000 total)
   d. Digital input (physical or internal, at least 1000 total)
   e. Digital output (physical, at least 64)
   f. Index (for indirection and general purpose use, at least 1000)
   g. Timer/counter (at least 1000 total)

2. The RTU/PLC shall store setpoint, analog input and analog output registers in 32-bit precision IEEE 754 standard format, providing the ability to represent numbers in the range +/- 3.37 x 1038. Index registers shall be stored as 32-bit precision unsigned integer values, providing the ability to represent numbers in the range 0 to 4,294,967,295. Timer/counter registers shall be stored as 32-bit precision unsigned values, supporting at least the following sub-types:
   a. Seconds timer (times in seconds with 10 mS or better resolution, up to 497 days)
   b. Hours timer (times in hours with 2 second or better resolution, up to 272 years)
   c. HMS timer (hours, minutes, seconds format, with 0.5 second or better resolution, up to 68 years)
   d. Event counter (integer value register supporting increment/decrement, range 0 – 4,294,967,295)
3. The RTU/PLC shall provide a counter type that may be associated with one of the 16 interrupt-driven digital inputs, in order to count pulse trains. The RTU/PLC shall support a pulse counting frequency of at least 1 kHz on a single input.
4. The RTU/PLC shall provide a timer type that may be associated with digital outputs, in order to produce variable duration output pulses. The range of pulse durations shall be at least 20 mS to 994 days, with 20 mS resolution.

O. Communications

1. The RTU/PLC shall have the ability to simultaneously support at least 3 serial communication ports 2 Ethernet/IEEE 802.3 RJ45 ports. Any of these serial ports shall be usable for both communications of telemetry data and control program/configuration upload/download and support baud rates of 230,400 bps or higher. The ports shall be configurable to support the following media:
   a. Full handshake RS-232 (at least 2 ports must be configurable this way)
   b. Direct Modem available with radio interface, supporting Bell 202 standard
2. In addition to the three (3) RS232 serial ports the RTU/PLC shall have two (2) Ethernet ports for a total of five (5) communications channels. All five (5) communications channels shall have the capabilities of independent operation. Each channel shall have the following capabilities:
   a. Poll/Response
   b. Quiescent (Unsolicited) Master Polling
   c. Message Store and Forward
   d. Automatic Port Escalation with Recovery
   e. Message Retries
   f. Communication Statistics and Diagnostics
3. The RTU/PLC design shall incorporate Dual Ethernet Design using 10BASE-T interface and TCP/IP industry standard Network Protocol with the following features:
   a. Redundant Hot standby Ethernet (Primary Network and Secondary

Fail Over Communications)

b. Standard 10BaseT Interface (10Mbps data transmission, over twisted-pair cable with RJ45 connectors)
c. Complies to IEEE 802.3 Specifications (Local Area Networks or Wide Area Networks)
d. Separate LED Line Status Indicators (Each port to confirm Frame Transmit, Receive, Link, Collision, and Interferance)
e. Individual IP Configuration (Multi Network Configurations)
f. Built-in PING Response (Test connectivity and verification of IP Address)
g. Multi Protocol Support (Modbus, Data Express, Data Express Plus)
h. Telemetry Message Routing (Communicate across all channels, i.e. RS232 to Ethernet and Ethernet to RS232)

P. Protocols

1. The RTU/PLC shall implement the Ethernet/IEEE 802.3 protocol. When the RTU/PLC wishes to transmit, it will check for activity on the LAN. When the LAN becomes silent for a specified period, the RTU/PLC will begin transmission. During transmission, the RTU/PLC will continually check for a collision on the LAN. If a collision is detected, the RTU/PLC will cease transmission. The RTU/PLC will then wait a random period of time before attempting to transmit again.
2. The RTU/PLC shall support serial communications using at least 3 different protocols. The de facto standard MODBUS RTU protocol with both integer and floating point messages shall be supported. The RTU/PLC shall also support a protocol capable of taking advantage of the advanced features available in the RTU/PLC (that ModBus would not be able to support). These protocols shall be able to coexist simultaneously on the same port.
3. The RTU/PLC shall support poll/response, polling master, quiescent, report-by-exception and message routing communications, as described in the following sections. Any of these communications modes shall be usable alone or simultaneously in any combination.

Q. Quiescent Communications

1. Using quiescent (peer-to-peer) communications, the RTU/PLC shall provide the ability to initiate messages transmitting register values under operator definable conditions. Quiescent communications operation shall be configured via a table such that listed registers may be sent to a peer RTU/PLC or other system based on an elapsed time interval, a change of state, or change by a threshold amount. The threshold values shall be storable in any analog input, output or setpoint registers. This table shall be downloadable via a communication port.

R. Report by Exception Communications

1. The RTU/PLC shall support a means of report-by-exception communications, where only those registers of interest that have changed since the last reporting are transmitted. All register types shall be supported. The RTU/PLC shall use a table to identify the registers that are to be transmitted via report-by-exception and individual thresholds that are used to determine significant change. This table shall be downloadable via

a communication port.

S. Message Routing

1. The RTU/PLC shall provide the ability to route received messages that are destined for another unit. The routed message can be received and sent in any combination of communication ports and physical media. Using this method the controller shall provide the ability to transfer messages between two or more units that are not directly connected, but that are both connected to the routing controller.

T. Failure Recovery

1. The RTU/PLC shall have the ability to switch to alternate communications paths in the event of failure of the primary path. There shall be no practical limit on the number of different paths that the RTU/PLC may try in order to deliver the information. These alternate paths shall be definable to be a different destination unit on the same port, or the same or different unit on a different port. In the event that the original communications path becomes available again, the RTU/PLC shall switch back to that path.

U. Redundant Message Elimination

1. The RTU/PLC shall automatically provide redundant message elimination when peer-to-peer and polled communications are used in combination. When a value is polled for and that same value is due to be reported via peer-to-peer communications, the conditions in the RTU/PLC shall be reset such that the peer-to-peer message doesn't immediately report the same information, but instead waits for the value to cross the threshold again, or pass the time interval.

V. Engineering Unit Representation

1. The RTU/PLC shall have the capability to represent all analog input and analog output values directly in engineering units. Engineering units are defined to be "real world" IEEE 754 standard floating point numbers corresponding to physical measurements, such as pressure, depth and flow. The RTU/PLC shall not require the operator to manipulate analog inputs and analog outputs in terms of the "raw" 12-bit (0-4095) data corresponding directly to the analog-to-digital and digital-to-analog converters. To provide engineering unit representation, the RTU/PLC shall not require the use of any additional registers or require that a program statement, formula or any expression be written to convert raw data to engineering units. Telemetry communications shall use engineering unit representation in all messages.

W. Calibration and Multipoint Calibration

1. A simple menu-driven procedure shall be provided that allows the operator to calibrate an analog input or output to an engineering unit measurement scale. This procedure shall be usable from both the full and minimal keyboards. The calibration information shall be uploadable/downloadable via a communication port.
2. In calibrating an analog input/output, the RTU/PLC shall allow the operator to select points along the response curve of the input/output device and assign them a corresponding engineering unit value. The RTU/PLC shall allow the operator to use up to 16 calibration points in order to account for non-linearities in the response of the attached input/output device. During

the calibration process, the RTU/PLC shall display the value of the actual signal on the input/output in terms of milliamps or volts, depending on how the input/output is configured. For an analog input, the RTU/PLC shall also allow the operator to perform a rough calibration without actual signal values on the input, by manually selecting simulated voltage or current values.

X. Power Fail/Brownout Detector

1. The RTU/PLC shall have an integral hardware device that detects a brownout or imminent power fail condition. Upon detection of the 12V DC power supply voltage dropping below an adjustable threshold, this device shall generate an immediate interrupt signal to the micro-controller. The micro-controller shall respond to this interrupt by finishing any memory write operations in progress, then going into a safe execution loop where no memory write operations are occurring.

Y. Security

1. The RTU/PLC shall be capable of being configured to require password entry before access to functions that would change the control characteristics or basic operating mode (run/standby) of the RTU/PLC. Multiple passwords shall be supported, with at least 100 allowed. Each password shall allow an independent set of privileges. A default list of privileges shall be definable that apply when no operator has unlocked the RTU/PLC with his password. If the operator does not operate the keyboard within a selectable time period, the RTU/PLC shall log him out automatically. Passwords shall be maintainable from both the full and minimal keyboards, if the operator has the Administer Passwords privilege. The RTU/PLC shall also support uploading and downloading of password configuration information via the communications ports.

Z. Data Archiving

1. The RTU/PLC shall provide a means of archiving register values into storage arrays. The register types that may be archived shall include:
2. For analog inputs and outputs, the RTU/PLC shall implement archiving using a data compression scheme such that each point stored represents the minimum, maximum, and average over the previous sample period. The sample period shall be configurable, allowing a range of at least 1 minute to 15 minutes. The RTU/PLC shall collect multiple samples, evenly spaced in time, within the sample period. The sample rate shall be configurable, allowing a range of at least 1 to 10 seconds. A second method of sampling shall be supported for analog inputs and outputs, where the data value is stored whenever it crosses a threshold from the previously stored value. The threshold shall be stored in a selectable analog input, output, or setpoint register. Digital inputs and outputs shall be stored upon change of state. The RTU/PLC shall allow the operator to define at least 25 separate registers to be archived, with individual timing and threshold parameters for each. The RTU/PLC shall provide direct read access through any communications port to the contents of each data archive. Each sample shall consist of a date and time stamp and the register value. The RTU/PLC shall also provide functions available through the communications port that allow an external SCADA or other system to reset specific archives and

obtain other necessary information about the data archives in use.

2.3 RADIO

A. Radio equipment shall be manufactured by Microwave Data Systems, SD9 “smart radio” or approved equal. The radios shall meet all of FCC part 94 out-of-band emission requirements and shall be capable of transmitting data at 9600 baud, operating half duplex. The R.F. transmitters shall be directly frequency modulated by a built-in digital modem from the digital data stream furnished by the PLC.

B. The radio assembly for each site shall consist of a non-protected transmitter, receiver, power supply and digital modem capable of operating in the 928 to 952 MHz band. Each assembly shall be capable of transmitting and receiving digital data at a rate of 9600 Baud over a 12.5 KHz FCC assigned channel. The radio shall include both Ethernet (10/100 BaseT) and serial (RS-232) connections and shall support encryption for radio traffic.

C. The antennas for all sites shall be heavy duty yagi type and shall have a frequency range of 928 to 960 MHz. A high gain Yagi or Omni-type antenna shall be used to transmit and receive data at the Remote Terminal Unit.

D. Transmission lines shall be Andrew Corporation Heliax Type LDF4-50A 1/2” diameter foam dielectric coaxial cable or approved equal.

E. The antenna mast/pole shall be hot dipped galvanized for corrosion protection. All mounting hardware shall be made of stainless steel.

F. Each radio shall be protected from electrical surge or transients entering through the coaxial cable by use of a coaxial cable surge protector. The coaxial cable surge protector shall meet or exceed the quality, reliability and performance of the IS-B50LN-C2 manufactured by Polyphaser.

2.4 GENERATOR CONTROL AND BACK-UP POWER SYSTEM

A. Provide Tesco generator control system to shut down the standby diesel engine generator when pumps aren’t required and restart when pumps are required or UPS batteries require charging: provide software module, float level switches and interfacing relays, as required to complete the system.

2.5 UNITERRUPTABLE POWER SUPPLIES

A. The uninterruptable power supplies (UPS) shall consist of desk top units securely mounted on channel. The units shall provide 120 volt uninterruptable power to the instrumentation and control equipment. Each UPS unit shall be modular in design with true electrical isolation and power conditioning. When utility power is available, rectifier/charger shall supply the load through the inverter and maintain the battery in a fully-charged "float" condition. When utility power drops below preset limits or fails the load shall be supplied from the battery through the static inverter. There shall be no output disturbance transmitted to the load. Upon return of the utility power, the rectifier/charger shall supply power to the load through the inverter while it recharges the battery. There shall be no output disturbance transmitted to the load.

B. The uninterruptable power supplies shall be manufactured by APC, Best or equal.

The UPS warranty shall be in effect no less than two (2) years after initial start-up. The battery manufacturer's standard warranty shall be passed to the end user.

C. Continuous Minimum Rating: Total 700 VA min (120 Vac). Maintain output voltage within specified limits at any load from full load to no-load. Supply full load power, at rated voltage, off of battery for 120 minutes.

D. UPS shall include dry contact outputs for failures and alarms as well as being incorporated into the generator control circuit. Contacts shall be relay type.

PART 3 EXECUTION

3.1 INSTALLATION

A. Follow the manufacturer's installation recommendations unless otherwise indicated. Keep copy of the manufacturer's installation instructions available on the job site for review at all times.

3.2 PROGRAMMING

A. All programming of the SCADA equipment and RTU/PLC shall be provided complete and operational.

B. General Requirements

1. All RTU/PLC control systems shall be configured to operate independent of SCADA workstation and master RTU/PLC status. The RTU/PLC shall be configured to operate failsafe in the event of a RTU/PLC failure.
2. The RTU/PLC shall accept pump sequencing/alternating and start/stop setpoints from the SCADA computer workstations.
3. Setpoints shall include deadbands to prevent excessive starting and stopping.
4. The RTU/PLC shall include logic to make a smooth transition from one pump sequence to another to prevent hydraulic transients.
5. The RTU/PLC shall monitor and transmit to the SCADA workstation all parameters, status and alarms.
6. Analog parameters shall be scaled in engineering units.
7. Orderly shutdown and restart on power failure/return. Sequenced/staggered start (independent time delays) of loads (in Auto) on restart on utility power and generator.
8. The RTU/PLC that require remote status information in order to execute control shall have backup control programs as defined herein. These emergency programs shall be resident in the RTU/PLC and shall activate on a communication failure or loss of a controlling signal (invalid).
9. All finished programs shall be fully documented and hardcopy printouts submitted as part of the O&M manual and include each program on disk.
10. The RTU/PLC with control programs with pumping unit(s) shall contain

adjustable delays (seconds) for start, start after stop (backspin), minimum runtime, and stop. RTU/PLC with control programs with multiple pumping units shall also provide for separate adjustable sequential start and stop delays (seconds) that parallel normal start and stop delays, and sequence/alternation selection.

11. Provide an "available" equipment status when the associated H-O-A hardware switch is in auto position and there are no control lockout alarms, for all controlled equipment interfaced with the RTU. Monitor "HAND" positions and provide indication of alarms, similar to "AUTO", when alarm conditions occur.

12. Provide a command-to-feedback fail alarm, when the associated H-O-A hardware switch is in auto position, for all controlled equipment interfaced with the RTU/PLC. The controller-based fail alarm shall be initiated if an equipment item is commanded to start/stop or open/close by the RTU and the appropriate pump run or, valve position status feedback (where available) or zero flow signal is not received within an adjustable time delay (seconds).

13. Installations with multiple pumps in which a pump becomes unavailable (not in fully automatic mode or has failed), the pump shall be tagged unavailable and control shall fail-over to the next sequence assigned pump. Upon availability being re-established to the unavailable pump, it shall be tagged available with lag pump setpoints and remain off until called to run or the replaced pump has stopped. It shall then be placed back into the original selected sequence.

14. The RTU/PLC with control programs with pumping unit(s) shall disable all control and control program affiliated alarms during a utility power fail. Upon power fail recovery, controls shall be re-enabled concluding an adjustable time delay (seconds).

15. The RTU/PLC with control programs with pumping unit(s), which requires remotely communicated analog data for control, shall disable all control and control program affiliated alarms during a communication failure concluding an adjustable time delay (minutes), unless otherwise noted. Upon communication restoration, controls shall be re-enabled.

16. Provide controller-based adjustable elapsed time meters (ETM) and number of starts with an adjustable reset for all motorized equipment interfaced with the RTU/PLC. The RTU/PLC shall transmit an alert to the SCADA when a motorized device exceeds a setpoint number of starts within a running 60 minute period of time (based on 6 minute intervals). Equipment run time and number of starts data shall be transmitted to the SCADA for graphic indication and reports.

17. Provide high, low and invalid (out-of-range) alarms for all analog points in the RTU/PLC whenever setpoint limits are exceeded for an adjustable time delay (seconds), and alarms for all hardwired alarm inputs after an adjustable time delay (seconds). Each associated alarm shall be generated

and transmitted to the SCADA for indication.

18. All analog signals shall be constantly processed, by each RTU/PLC, to provide minimum, maximum with time stamps and average values. Flows shall be totalized. Hourly pump runtimes and number of starts, flow totalization, minimum and maximum with time stamp, and average of each analog local and polled shall be placed in hourly holding registers for "today's" 24 hour period (adjustable end of 24 hour period setpoint, e.g. 2:00 am or 0200 hours). Upon reaching the end of the 24 hour period, the data shall be transferred to the "previous" 24 hour holding registers. Today's 24 hour period registers shall be reset to zero. The RTU/PLC shall hold the previous 24 hours of daily data, time and date stamped, total flow for the day and the previous 7 days of total daily flow, date stamped, to be retrieved by the SCADA for reports in the event of an extended communication failure.

19. All digital and analog alarms shall contain adjustable time delay (seconds) timeouts before alarming, unless otherwise noted.

20. Analog parameters shall be scaled in engineering units.

C. Pump Control Unit Programming (Mode)

1. The RTU/PLC pump control program shall include the following features:

   a. Triplex/Duplex/Simplex configurable. The RTU/PLC shall have the capability of being configured for one, two or three pumps.

   b. Local automatic control from transducer input, pump down. Back-up high level float call shall be independent of the RTU/PLC.

   c. Local manual control provided by HOA switch. HOA switches Alarms shall be reported back to central site computer. Alarms shall indicate that an HOA switch has been left in the HAND or OFF position.

   d. Remote control from the central site computer shall provide individual pump overrides and disables, station and alarm disables.

   e. Pump alternation function shall be provided. Alternation around non-operational pumps shall be provided.

   f. Alarm light outputs capable of driving 120 VAC loads to 3 amp.

   g. Float alarm reporting back to central site computer when floats are operating out of sequence. In the float mode each float position shall be capable of being transmitted to the central SCADA computer.

2. Control Strategy

   a. The two (2) current pumps shall be controlled based on wetwell level. Provide independent start and stop setpoints as well as high and low level alarms. Set up programming and I/O to easily add the

third pump in the future with operation similar to the first two pumps.

b. Sequencing.

1. Lead and Lag (plus future lag-lag) sequence selection shall be of sequential order (1-2, 2-1) or alternation sequentially of “available” pumps. Control logic shall not allow or assign selections where the lead pump is not “available”. Cycling of pumps due to a changed sequence selection shall not be allowed.

2. Alternation shall automatically alternate the sequence while “available” pump(s) are off and after achieving or exceeding a number-of-days adjustable setpoint. Once automatic alternation has been performed, alternation shall be reset until the next number-of-days setpoint is attained. Set pump to alternate once a day.

c. The RTU/PLC shall monitor the status of the hand-off-automatic (HOA) hardware switch, manual-off-auto software switch for each of the pumps and shall monitor the status of all permissive and alarm conditions to determine “availability”. If the level is above the adjustable start and stop setpoints, the lead pump is called on, after the start delay period, and the pump shall be started.

d. Pump Controls and Safety’s

1. Upon a utility power failure and recovery, pumping shall not resume for an adjustable time period. If multiple pumps were running at the time of the power failure and the wetwell level is at or above high alarm, normal start delays shall not inhibit automatic sequencing of the lag pump.

2. Upon failure of the level transmitter pump(s) shall remain at their current speed for an adjustable setpoint delay (seconds) before sequencing off. Upon receipt of a valid level signal or low level return to normal for an adjustable delay, automatic controls shall resume.

3. Upon receiving a Pump Alarm, a high motor [over] temperature alarm or determining a Command-to-Feedback Fail alarm, the pump shall shut down and lockout, the remaining running pump shall move up in the sequence, the sequence selection shall update to indicate the new lead pump, and the next pump in sequence shall start. The logic shall maintain the pump lockout of the failed pump until an alarm reset is received. Upon a reset being received, the pump shall be placed at the end of the “available” pump sequence queue and resume normal operation. Provide provisions for locking out a pump on moisture sensing.

3. Standby Generator and Transfer Switch Status Monitoring. Monitor and indicate transfer switch positions, standby generator run status and standby generator failure. Accumulate and indicate generator run hours.

   a. Monitor ATS generator required signal and disable when the pumps are not required and the UPS battery is capable of maintaining operation of the controls and instrumentation.

4. Monitor fuel level and alarm on high or low level.

D. Provide monitoring of all parameters, status points, alarm indication and logging, and provide setpoint modification capability at the SCADA workstation similar to other facilities in the DISTRICT: UPS, power failure, intrusion, etc ....

3.3 PROGRAMMING SERVICES

A. The RTU/PLC and SCADA workstation shall be programmed and tested. The programmer shall provide programming documentation that fully describes the application program function and application. The programming documentation shall clearly identify all programming functions, configurations, set-up and as-programmed ladder-logic rungs, function blocks, modules and structured text blocks. Documentation shall be prepared to present the information to both an experienced and inexperienced programming audience.

B. A comprehensive control description shall be provided for operations personnel inexperienced in programming. The control description shall be prepared in a narrative format that explains the operation of the program based on a process-by-process basis. The programming documentation shall be provided in three ring binders with a table of contents and tabbed accordingly. At a minimum the following sections shall be provided for each program:

1. System Overview: The system overview shall briefly describe the primary operation of the RTU/PLC and its functions. It shall identify the primary equipment and systems monitored and controlled by the RTU/PLC and delineate any communications requirements with additional RTU/PLC's or computing systems.

2. Control Descriptions: The control description shall be written as an operator's narrative of the control program broken into process blocks.

C. In addition to the required application programming and warranty service the CONTRACTOR shall provide an additional 2 hours of on site programming services.

D. Allotted programming hours are in addition to the requirements of the specification to provide for a complete and operational system. Programming allotment hours are to be utilized to provide for interfacing with equipment not specified or implied in the contract documents, enhancement of operation and interfacing with new equipment added during the course contract implementation.

E. Onsite programming service shall be defined and directed by the DISTRICT'S REPRESENTATIVE on a task basis during the course of construction. Programming hours shall be applied in the field and logged accordingly by the

DISTRICT'S REPRESENTATIVE.

F. Unused programming hours and shall be provided as a service contract during the warranty period.

3.4 TESTING

A. Test all systems upon completion of the work to demonstrate that equipment furnished and installed has connected functions electrically in the manner required.

B. General Requirements

1. Testing shall be provided as described in Section 26 00 00.

2. Do not energize RTU/PLC equipment before the manufacturer has check the installation.

3. Verify the level sensing elevation (to set offset) prior to programming level setpoints.

4. The CONTRACTOR shall contract with the manufacturer of the RTU/PLC equipment to provide a qualified manufacturer's service person to perform the following tasks:

a. Supervision Oversee the project regarding the installation of equipment.

b. Check the installation of all equipment prior to field testing and start-up.

c. Review the RTU/PLC logic at start-up. Additionally, read and record, then transfer all existing SCADA adjustable setpoints to the new SCADA System application.

5. Assist the CONTRACTOR in testing per Division 26. The CONTRACTOR shall perform thorough testing in close coordination with the DISTRICT'S REPRESENTATIVE. All status and control testing shall include verification with the SCADA displays. Field testing shall include:

6. Point-to-point wire checking of all RTU/PLC I/O circuits.

7. Verification of proper functioning of all analog I/O loops.

8. With all outputs disabled, manually activate each input device and check for status change at the appropriate input point.

9. With all outputs disconnected that would cause mechanical motion, use forcing to verify that each output is properly addressed.

10. Check program for proper logic, I/O and internal register address assignments, and timer, counter, and setpoint values.

11. Thorough function testing of the communication functions, including confirmation data is received by the SCADA system.

12. Closely monitor the systems when first placed in "AUTO" under RTU/PLC

control.

13. All hardware set-up modifications and program modifications shall be documented thoroughly and immediately.

14. Field test all control and indication functions as well as the communications system.

15. Confirm all information is properly transmitted to remote sites.

16. Operational readiness test (ORT) and the functional acceptance test (FAT).

17. SCADA modification testing.

18. Verification of correct SCADA trends and reports.

C. The CONTRACTOR shall coordinate with the RTU/PLC and Radio supplier to provide a qualified service person to perform the following tasks:

1. Verify communication links between sites, test the system and record the results.

2. Configure and troubleshoot system.

3. Demonstrate system under actual operational conditions.

4. Assist in operational readiness test (ORT) and the functional acceptance test (FAT).

3.5 TRAINING

A. Train DISTRICT personnel; provide eight hours of SCADA, RTU/PLC and Instrumentation on site training. The training shall be split into two duplicate four hour lessons on two different days, to allow for DISTRICT personnel scheduling conflicts. Training shall address application program operation, programming fundamentals, tuning, diagnostics setpoint manipulation and modes of operation. Applicable provisions of Section 26 00 00 are incorporated herein as though fully set forth at length.

* * END OF SECTION * *

SECTION 26 89 00
INSTRUMENTATION

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Provide and install all instruments, devices, wiring, terminal blocks, accessories, and enclosures as specified herein and as shown on Contract Drawings for the instrumentation system. The Contract Documents are intended as an outline for the work and are descriptive of the type of hardware and software configuration to be provided. Any error or omission of detail shall not relieve the Contractor from the obligations there under to provide and install in correct detail any and all materials necessary for a complete operational instrumentation system, at no additional cost to the DISTRICT.

B. Work includes that specified in Division 26, Electrical. Related Sections:

1. Section 26 00 00 – Electrical Requirements
2. Section 26 04 00 – Raceway Systems
3. Section 26 05 00 – Wire and Cable
4. Section 26 06 00 – Miscellaneous Electrical Equipment
5. Section 26 09 00 – Grounding.
6. Section 26 63 00 – Remote Telemetry Unit
7. Section 26 61 00 – Control Panels

C. The major components for in the instrumentation scope of work, which includes both the furnishing and installation of:

1. Level Transmitter and Reactive Air System
2. Level Switches
3. Pressure Gauges
4. Mag Meter Type Flowmeters
5. Accessories

D. The contract documents are not intended to cover every detail of materials, configuration, or construction. The Contractor shall furnish all tools, temporary utilities, materials, setup, parts, labor, and other incidentals necessary to fully complete the entire work, whether or not said details are particularly shown or specified, all at no additional cost to the DISTRICT.

E. Coordinate the installation of instruments and accessories in the control panel as shown on the Drawings.

1.2 REFERENCES

A. American National Standards Institute (ANSI).

B. National Electrical Manufacturers Association (NEMA).

C. Institute of Electrical and Electronic Engineers (IEEE).

D. Underwriter's Laboratory (UL).

E. California Electrical Code (CEC).

F. American Society for Testing Materials (ASTM).

1.3 QUALITY ASSURANCE

A. All equipment shall comply with applicable standards of the Underwriter's Laboratories, Inc.

B. Provide enclosures suitable for the type of location in which they are located per Specification Section 26 05 00, General Electrical Requirements.

1.4 SUBMITTALS

A. Provide submittals and drawings as specified in Sections 26 00 00 General Electrical Requirements..

1.5 OPERATION AND MAINTENANCE MANUALS

A. Provide operating instructions as specified in Section 16010, General Requirements, Electrical.

PART 2 PRODUCTS

2.1 GENERAL

A. It is the intent of the Contract Specifications and Drawings to secure the highest quality in all materials and equipment in order to facilitate operation and maintenance of the plant. All equipment and materials shall be new and the products of reputable suppliers having adequate experience in the manufacture of these particular items. For uniformity, only one manufacturer will be accepted for each type of product.

B. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection, and continuous or intermittent operation. All equipment shall be adequately stayed, braced and anchored; and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, and shall be of sturdy and durable construction suitable for long, trouble-free service. Light-duty, fragile and competitive grade devices of doubtful durability shall not be used.

C. Products that are specified by manufacturer, trade name or catalog number establish a standard of quality and do not prohibit the use of equal products of

other manufacturers provided they are approved by the Engineer prior to installation.

D. The equipment specifications have been prepared on the basis of the equipment first named in the Specifications. The Contractor shall note that the second named equipment, if given, is considered acceptable and equal equipment, but in some cases additional design, options, or modifications may be required, at no additional cost to the DISTRICT, to meet Specifications.

E. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting or operator interaction when power is restored.

F. Signal transmission from remote or field electric and electronic devices shall be 4-20 mA, powered by a 24 VDC loop supply from the panel that is to receive the signal. Nonstandard transmission methods such as impulse duration, pulse rate, and voltage regulated will not be permitted except where specifically noted.

G. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission.

2.2 PRESSURE GAUGES

A. The pressure gauges shall be 4-1/2 inch diameter bourdon tube type. The scale and range shall be as shown on the Process and Instrumentation diagrams. Gauge scales shall have a minimum of 5 major and 50 minor divisions. Major divisions shall be equally spaced and shall be in whole integers. Scale units (psi) shall be engraved on the scale face. Gauges shall have clear acrylic or shatterproof glass windows and shock resistant cases. Gauge accuracy shall be ± 1 percent of span. All wetted parts shall be Type 316 stainless steel. Pressure Indicator (gauge) 4.5"dial, Ashcroft 45-1279-SS-04L-XLL

2.3 REACTIVE AIR SYSTEM AND LEVEL TRANSMITTER

A. The Reactive Air System shall be configured and installed as shown on the Plans.

1. Air Compressor: The air compressor shall have a 1/6 HP motor driving a single stage, oil-less piston type compressor, air intake filter, and a cord with plug attached. Each compressor shall be mounted using rubber vibration isolators as directed by the Engineer. The air compressors shall be Bell and Gossett BLCT or ITT Pneumotive Model LGH 210-H02, or approved equal.

2. Air tubing inside the control panel shall be ¼” 316 stainless steel, model number Parker A-LOK or approved equal.

3. Pressure transmitters shall be Rosemount 2088G1-S22A1-M7.

4. Solenoid valve shall be ASCO model number 8320G202 or equal.

5. All components shall be mounted inside the control panel and nameplates shall be provided for each component.

B. Miscellaneous materials and devices shall be installed in the Reactive Air Bell

System as specified below and as shown on the drawings. The bell shall be Tesco CB 409 with 316 stainless steel mounting hardware. Provide extension pipe, 316 stainless steel bracket and hardware. Provide stabilizing weight/ballast.

C. Air tubing from the control panel to the sump shall be ¼" polyethylene black tubing, model number Parker EB-43-0100 with 4TIZ and 4NU4 fittings, or equal.

2.4 MAGNETIC FLOWMETER

A. The magnetic flowmeter shall be microprocessor-based and flanged. Each flowmeter shall include an element (tube), grounding rings, separately mounted transmitter and cables.

B. The element enclosure shall be a cast epoxy coated. The enclosure shall be NEMA 4 rated and suitable for exposure in outdoor conditions except where mounted below grade provide NEMA 6P enclosure. Provide ANSI class 150 carbon steel flanges. Provide grounding rings as recommended by the manufacturer. The electrode and liner shall be of materials recommended by the manufacturer.

C. The transmitter shall be mounted remotely and shall be microprocessor based: the transmitter shall be capable of being mounted 500 feet from the sensor element. The transmitter shall provide bi-directional 4-20 mA outputs proportional to flow rates and pulse outputs proportional to flows. The enclosure shall be NEMA 12 or 4.

D. The accuracy shall be at least 0.5% of flow rate over a 33:1 turn-down at all flow rates above 1 fps. Accuracy shall be verified by calibration in a flow laboratory traceable to the U.S. National Institute of Standards and Technology.

E. The flowmeter shall be capable of transmitting an isolated analog 4-20mAdc into 800 ohms.

F. A 2-line, backlit alphanumeric display shall include user-defined flow units and total flow. All menu advice and commands shall be visible on this display. The display shall be modular and rotatable 360 degrees, in 90 degree increments. Characters shall be at least 0.125" high for ease of readability. Display shall indicate flow units in gallons per minute (GPM).

G. The flowmeter shall have a switching power supply having an operating range from 77-265 Vac, 50/60 Hz. Power consumption shall not exceed 20 Watts.

H. The flowmeter shall be warranted against defective workmanship or materials for a period of two years from date of shipment.

I. Manufacturer: McCrometer UltraMag UM or approved equal.

2.5 LEVEL SWITCHES

A. The float level switches shall use the movement of a float, the weight of whose moving parts is less than that of the displaced process liquid, to actuate switches as the level rises and falls. The switches shall be integrally mounted within the float and connected to a terminal box by a waterproof electric cable. The unit

shall be mercury free.

B. The switch covering shall be made of indestructible polypropylene material. The cable shall be PVC coated. The switches shall be reversible such that the switching action operates on rising or falling level (three wire form C contact). The switch contacts shall be rated for 200 volts ac or dc and 16 amperes minimum, and shall be terminated with 14 AWG wires in a NEMA 4X terminal box with appropriate compression fittings. Provide intrinsically safe relays (ISR) for switches used in hazardous locations where shown on the Drawings.

C. Provide a 316 stainless steel cable management bracket and 316 stainless steel mounting hardware for adjusting the operating points of the float switches.

D. Float level switches and bracket shall be as manufactured by MJK 7030-202811 with cable lengths and 316 stainless steel installation and cable management hardware, as required, to complete the installation, or equal.

2.6 ACCESSORIES

A. Isolators. The current/current (I/I) and voltage/current (V/I) isolators shall have all solid state circuitry mounted in plug-in modules. Each isolator shall provide complete isolation and amplification of the 4-20 mA output signal from the 4-20 mA or 1-5 VDC input signal and the isolator power supply. The output signal shall be capable of driving a 600 ohm load. Accuracy shall be +/- 0.25% of span. The isolators shall be powered from a 120 VAC source. Isolators shall be intrinsically safe where shown on drawings. Each isolator shall have a seven year warranty. The isolators shall be as manufactured by AGM Electronics, Action Instruments, or equal.

B. Instrument valves shall be 1/4-inch, 3/8-inch or 1/2-inch from Whitey, Hoke or equal to match tubing material and size.

PART 3 EXECUTION

3.1 WORKMANSHIP

A. All instrumentation work in this contract shall conform to the codes and standards outlined herein.

B. The Contractor shall employ personnel who are skilled and experienced in the installation and connection of all elements, equipment, devices, instruments, accessories, and assemblies. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. Ensure that all equipment and materials fit properly in their installations.

D. Perform any required work to correct improper installations at no additional expense to the DISTRICT.

E. The DISTRICT reserves the right to halt any work that is found to be substandard or being installed by unqualified personnel.

F. Rejected equipment or equipment without approved submittals shall be immediately removed from the delivery or job site by the Contractor.

3.2 INSTALLATION

A. Install and supply all products necessary, at no additional cost to the DISTRICT, to provide an operational system. This shall include the following:

B. Contract Drawings are intended to show the basic functional requirements of the instrumentation system and do not relieve the Contractor from the responsibility to provide a complete and functioning system.

C. Provide relays, signal converters, isolators, boosters, power conditioners, circuit cards, and other miscellaneous devices as required for the proper interface.

D. Provide analog loop isolators where required to eliminate "ground loops."

E. All wires shall be identified with machine printed labels. Plastic wire gutters shall be used for routing of wire bundles. Wiring shall be neat and laced with plastic tie wraps.

F. The instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions and located as shown on the Drawings. When manufacturer's installation literature specifies a particular location or orientation in a process line due to measurement accuracy considerations, the installation shall be in conformance with the manufacturer's instructions.

G. Engineering scales and charts for all instruments shall be provided that match the range of instruments that monitor the process.

H. Instrument installation methods.

1. Install instruments at the location shown on the Plans or approved by the DISTRICT. Instruments shall be NEMA rated for the installed location.

2. Install level and plumb.

3. Instruments shall be provided with floor stands or wall brackets as shown or required.

4. Mounting hardware, stands, channels, and spacers shall be either galvanized steel, stainless steel, or non metallic to match the NEMA rated location.

5. All screws and bolts shall be stainless steel.

6. Tubing shall be install without splices. Tubing systems shall be pressure tested at 15 psig for 1 hour.

I. Wiring and raceway installation methods.

1. Instrumentation wiring shall be carried in conduits provided in compliance with the Division 16, electrical. All analog circuits shall be run as twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever three wire circuits are required. Triads are not to be formed by using two pairs. Terminal

blocks shall be provided at all instrument cable junctions and all wires shall be identified at such junctions. Instrumentation wiring shall be run without splices between instruments, terminal boxes, or panels.

2. The number of signal wires listed on the Drawings is approximate only, and the Contractor shall determine the required number of signal pairs or triads to properly connect the system furnished, especially when substituting equipment.

J. Wiring, grounding, and shielding methods.

K. It is important to observe good grounding and shielding practices in the generally noisy environment in this application. The following practices shall be observed unless modified by manufacturer's standards:

L. Each electronic equipment chassis shall be grounded to power ground.

1. All analog signals shall be transferred over shielded twisted pair cables.

2. All communication signals shall be transferred over shielded cables.

3. All shields of analog inputs and outputs of the PLC shall be connected at the PLC unit only. They shall not contact ground at any other point including the transmitters or receiving devices.

4. Status and alarm signals routed through noisy environment shall be transferred over shielded twisted pair cables.

5. Each shield which is not connected to ground shall be covered with a heat shrink insulating boot. Shields shall be connected together at each transition from one cable to another for a continuous effective shield circuit. All shields shall be connected on terminal blocks.

M. Mechanical Installation

1. Install new instruments and transmitters at locations as shown on Drawings.

2. Install and calibrate indicators/transmitter and connect to elements per manufacturer's recommendations.

3. Ground transmitters/elements per manufacturer's recommendations.

3.3 TESTING

A. The Contractor shall use the services of qualified testing personnel for the purpose of performing inspections and tests as herein specified and indicated on the Drawings. The procedures stated herein are guidelines for the intended tests, the Contractor shall be responsible to modify these tests to fit the particular application and insure personnel safety. It is the intent of these tests to assure that the instrumentation system is operational and is installed in accordance with design Documents.

B. Test plans and test reports shall be treated as formal submittal. Tests and test plans shall be in the cause and effect format. The person conducting the test shall

initiate an action (cause) and, upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied.

C. The Contractor shall be responsible for each supplier of equipment to provide the following minimum services for each type of instrument supplied. The supplier shall use a qualified instrumentation field technician (sales representatives are not acceptable) to perform services listed herein.

1. Advise and instruct Contractor on installation requirements.
2. Check, calibrate, and place equipment in operation.
3. All programmable devices shall be programmed and tested prior to startup. Programming shall be adjusted or changed as directed by the DISTRICT or Engineer, at no additional cost.
4. Coordinate with the DISTRICT and setup all alarm, process, and operation setpoints.
5. Perform the acceptance tests.
6. Visit the job as often as required and spend as much time as necessary to ensure an operational instrumentation system.
7. Be readily available by telephone to answer all questions on supplied equipment.
8. Provide training as specified in subsection labeled Training.
9. The Contractor shall insure each supplier of instrumentation assumes the responsibility for providing primary elements in a timely manner, for insertion into the process line, coordinating size and material type when applicable, overseeing the actual installation, calibration, and acceptance testing.

D. Operational Readiness Test (ORT)

1. Prior to startup, the complete instrumentation system shall be inspected, tested, and documented to show that it is ready for operation.
2. The Contractor shall prepare a test plan for the ORT and shall submit it for review at least 30 days before the ORT is performed.
3. The ORT shall demonstrate that the instrumentation system meets the requirements of the Specification which are nonloop-specific. Following are examples of nonloop specific functions.
    a. Capacity. Demonstrate that all components and subsystems have the specified capacity, including spare capacity.
    b. Timing. Include tests to demonstrate all specified timing requirements.
    c. Diagnostics. Include tests to demonstrate specified diagnostic capabilities and procedures.

4. If any component or subsystem fails the ORT, the Contractor shall correct the problem and repeat the test until it is successful.

5. After completion of the ORT, the Contractor shall prepare a test report and shall submit it for review. The ORT shall be successfully completed and the test report submitted to and reviewed by the Engineer before the FAT (functional acceptance test) is performed.

E. Functional Acceptance Test (FAT)

1. Once the facility has been started up and is operating, a witnessed FAT shall be performed on the complete instrumentation system to demonstrate that it is operating as specified and meets the requirements of the Specifications.

2. The Contractor shall prepare a test plan for the FAT and shall submit it for review at least 30 days before the FAT is performed.

3. The FAT shall operate all equipment and systems over the full operating range, shall demonstrate proper operation of alarms and indicators, and, in general, shall demonstrate that the equipment and systems meet the requirements of the Drawings and Specifications.

4. If any equipment or system fails the FAT, the Contractor shall correct the problem and shall repeat the test until it is successful.

5. The FAT shall be performed in the presence of the Engineer.

6. After completion of the FAT, the Contractor shall prepare a test report and shall submit it for review. The instrumentation system will not be accepted before the FAT is successfully completed and the test report submitted to and reviewed by the Engineer.

3.4 TRAINING

A. The Contractor shall provide an eight man-hour (total for both sites) for training of the operation of the instrumentation system to DISTRICT personnel.

B. Instructions shall consist of the functional description of each piece of equipment, including calibration and setting of set points. Demonstration of the operation of each system shall be included.

C. The Contractor shall provide all manuals and study materials required for the training of DISTRICT personnel.

3.5 WARRANTY

A. The instrumentation supplier shall have a staff of experienced personnel available to provide service on 2 working days notice during the warranty period. Such personnel shall be capable of fully testing and diagnosing the hardware and software delivered; and of implementing corrective measures.

B. If the instrumentation supplier fails to respond in 2 working days, the DISTRICT at its option will proceed to have the warranty work completed by other resources; the total cost for these other resources shall be reimbursed in full by the

Contractor. The use of other resources, as stated above, shall not change or relieve the Contractor or supplier from fulfilling the remainder of the warranty requirements.

C. Prior to "final acceptance", the Contractor shall furnish to the Engineer a listing of warranty information for all manufacturers of materials and equipment used on the project. The listing shall include the following:

1. Manufacturer's name, service contact person, phone number, and address.
2. Material and equipment description, equipment number, part number, serial number, and model number.
3. Manufacturers warranty expiration date.
4. Completed test forms.

* * END OF SECTION * *

DIVISION 31 - EARTHWORK

SECTION 31 11 00
CLEARING AND GRUBBING

PART 1 GENERAL

1.1 DESCRIPTION

A. This section specifies clearing, grubbing, removing, and disposing of all vegetation and debris within the clearing limits except objects designated to remain. Work includes preserving objects designated to remain.

B. Clearing limits are described as the extents of the proposed trench width plus a distance necessary for the CONTRACTOR to access the work site and conduct construction activities, not to exceed the extents of the sanitary sewer easement.

1.2 DEFINITIONS

A. Merchantable Timber will be defined as all logs and poles, at least 1/3 sound, having a minimum diameter of 6 inches under the bark, a minimum length of 8 feet, and a minimum of 10 board feet of sound wood.

1.3 LEGAL REQUIREMENTS

A. The Contractor shall promptly, and before the following conditions are disturbed, notify the District in writing of any:

1. Material that the Contractor believes may be material that is hazardous waste as defined in Section 25117 of the Health and Safety Code, that is required to be removed to a Class I, Class II, or Class III disposal site in accordance with provisions of existing law.

2. Subsurface or latent physical conditions at the site differing from those indicated.

3. Unknown physical conditions at the site of any unusual nature, different materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the contract.

B. The District shall promptly investigate the conditions, and if it finds that the conditions do materially so differ, or do involve hazardous waste, and cause a decrease or increase in the Contractor's cost of, or the time required for, performance of any part of the work shall issue a change order under the procedure described in the contract.

C. In the event that a dispute arises between the District and the Contractor whether the conditions materially differ, or involve hazardous waste, or cause a decrease or increase

in the Contractor's cost of, or time required for, performance of any part of the work, the Contractor shall not be excused from any scheduled completion date provided for by the contract, but shall proceed with all work to be performed under the contract. The Contractor shall retain any and all rights provided either by contract or by law which pertain to the resolution of disputes and protests between contracting parties.

D. Any and all materials wrongfully removed by the Contractor shall be paid for by the Contractor. The cost of any such items removed shall be agreed upon by the item owner and the Contractor; however, agreement that becomes impossible shall be decided by the Engineer and his decision shall be final and said arbitrated amount shall be withheld from the next progress payment due.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 SURFACE PREPARATION

A. Clearing and Grubbing

1. Clear all trees, brush, and other objects not designated to remain.

2. Clear all trees designated for removal. Clear trees, brush, and shrubs within clearing limits subject to irreparable damage by construction operations. Cut stumps to within 12 inches of the ground surface.

3. The Contractor shall review with the Engineer the location and limits of clearing and grubbing prior to commencing the work. In general, clearing and grubbing shall be done within permanent easements or rights of way. Only trees, plants and shrubs that are approved by the Engineer for removal shall be removed. Materials removed shall be disposed of at locations outside the work area and at locations selected by the Contractor, and approved by the Engineer.

4. Grub all stumps, brush, and roots (to a minimum 3" diameter) within the clearing limits.

B. Sod Removal and Preservation

1. Remove sod using equipment specifically designed for such work. Do not use hand methods (cutting, trimming, and undercutting). Remove sod in straight sections, cut square on ends.

2. Maintain sod in a moist condition suitable for use in resodding.

3. Replace sod damaged or allowed to die with commercially grown sod of a type

similar to that removed.

C. Tree Removal and Preservation

1. Fall trees toward the center of the area to be cleared.

2. Use controlled falling to prevent injury or defacement to structures, other trees, or property.

3. Trim branches flush with the tree.

4. Within 3 days of the damage, treat all cut or scarred surfaces of trees or shrubs designated to remain with a product prepared especially for tree surgery.

3.2 DISPOSAL OF MERCHANTABLE TIMBER

A. Merchantable timber shall become the property of the CONTRACTOR.

3.3 DEBRIS DISPOSAL

A. Unmerchantable timber greater than 6 inches in diameter may be hauled to a debris disposal site or cut into 18 inch lengths and stacked at the edge of the clearing limits or stacked at a location to be requested by the DISTRICT. Other vegetative debris may be hauled to a debris disposal site or chipped and spread evenly in areas adjacent to the clearing limits in depths no greater than 3 inches.

B. Burning, if done, shall conform to applicable local regulations. A copy of the Contractor's burning permit, as issued by the local fire control agency, shall be provided to the Engineer prior to any intended burning.

** END OF SECTION **

DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 32 12 16
AC PAVEMENT AND BASE

PART 1 GENERAL

1.1 SCOPE OF WORK

A. This section covers all roadway and area surfacing and comprises the requirements for all materials, labor, tools, and equipment needed for preparing and compacting the paving.

1.2 GENERAL

A. Asphalt concrete pavement shall be plant-mixed asphalt concrete and shall conform to the requirements of this Section.

1.3 CONTRACTOR SUBMITTALS

A. The CONTRACTOR shall submit materials testing reports and other pertinent information certifying that the AC pavement conforms to the requirements of the CONTRACT DOCUMENTS.

B. Suitability Tests of Proposed Materials: Tests for conformance with the Specifications shall be performed prior to start of the WORK. Results of all tests shall be submitted to the District for approval. Materials to be tested shall include aggregate base, coarse and fine aggregate for paving mixtures, mineral filter, and asphalt cement.

PART 2 PRODUCTS

2.1 AGGREGATE BASE

A. Aggregate base shall be Class 2, 3/4" maximum aggregate size crushed rock material of such nature that it can be compacted readily by watering and rolling to form a firm, stable base for pavements. The sand equivalent value shall not be less than 30, and the material shall meet the following gradation requirements:

Sieve Size	Percentage Passing Sieve
3/4-inch	100
3/8-inch	50-90
No. 4	35-55
No. 30	10-35
No. 200	2-10

B. Aggregate base shall conform to the following requirements:

Test	Testing Method	Requirements
Degradation Resistance	ASTM C131	B
R-Value	California Test 301	80, Minimum.[1]
Sand Equivalent	California Test 217	30, Minimum
Percentage Water	ASTM C131	
100 revolutions		15, Minimum
200 revolutions		52, Minimum
Specific Gravity	ASTM C127	2.58 Minimum[2]

1. The R-value requirement may be waived provided that the base material has a sand equivalent of 55 or more.
2. Not more that 15% by weight of the material shall be particles with a bulk specific gravity not less than 2.5.

C. The DISTRICT may, at its option, waive the percentage wear and specific gravity requirements provided that the aggregate base material has a minimum durability of 40, as Determined by California Test 229.

2.2 ASPHALT CONCRETE

A. Asphalt concrete shall be Type B, ½" maximum, medium grading material.

2.3 PRIME COAT

A. Prime coat shall be Grade SC-250 liquid asphalt complying with the requirements of AASHTO M 82 (ASTM D 2027).

2.4 SOIL STERILANT

A. Soil sterilant or chemical weed control agent shall be a commercial product manufactured specifically to sterilize the subgrade soil to prevent the growth of weeds, plants or any type of vegetation.

PART 3 EXECUTION

3.1 TRAFFIC STRIPE REMOVAL

A. Painted pavement markings and traffic stripes shall be removed by sandblasting. Grinding shall be utilized for thermoplastic markings and stripes. When such sandblasting is being performed within 10 feet of a lane occupied by vehicular traffic, the sandblast equipment shall be equipped with a vacuum attachment operating concurrently with the pressure equipment to immediately remove the sand from the surface after contact with the pavement. Shields shall also be used to protect the public. The CONTRACTOR shall remove all sand from the roadway immediately.

3.2 CUTTING EXISTING PAVEMENT

A. Cut lines made on the existing pavement, both longitudinally and transversely, for the placing of new structural section, shall be straight and smooth. Edges shall be clean and free of dirt and dust prior to placing tack coat. Asphaltic emulsion shall be used as a tack coat or paint binder on existing pavement that is to receive an asphalt concrete overlay and also along the exposed edges of abutting pavement and concrete curbs and gutters. Its use may also be required between subsequent layers of asphalt concrete placed by the CONTRACTOR when ordered by the ENGINEER.

3.3 AGGREGATE BASE

A. Any trench within five (5) feet of the existing edge of pavement and through driveways shall be capped with a minimum of eight (8) inches of aggregate base.

3.4 PRIME COAT

A. Prior to placing of pavement a prime coat of cutback asphalt shall be applied to the compacted base at a rate between 0.10 and 0.25 gallons per square yard.

3.5 ASPHALT CONCRETE

A. Asphalt concrete shall not be placed when the atmospheric temperature is below 10 degrees C or during unsuitable weather.

B. Prior written approval of the Engineer is required before the CONTRACTOR may place asphalt concrete without the use of a paving machine.

C. The asphalt concrete shall be evenly spread upon the base to such a depth that, after rolling, it will be of the required cross section and grade of the course being constructed.

D. Spreading, once commenced, shall be continued without interruption.

E. Prior to placing new AC pavement, the edges of all adjacent pavements shall be treated

with asphalt emulsion paint binder. The asphaltic emulsion shall be of the high viscosity grade and the method and rate of spreading shall conform to Sections 37, 39, and 94 of the State Specifications.

F. Trenches shall be capped with new asphalt concrete to a depth equal to the depth in the existing roadway.

G. Bore pits shall not be excavated at locations that are deemed detrimental to structures, drainage facilities and/or trees. Backfill of the bore pits shall meet the same requirements shown for trenches.

H. All surfacing materials of roadways and driveway approaches cut or damaged by or as a result of construction operations shall be replaced within ONE WEEK following the backfilling of excavation, weather permitting, with compacted layers of surfacing materials at least as thick as the existing, and no less than two (3") of asphalt concrete over eight inches (8") of aggregate base.

3.6 PAVEMENT MARKING AND STRIPING

A. Pavement marking paint shall only be applied where indicated only when the pavement surface is dry and clean, and when the air temperature is above 10 degrees C. All equipment used in the application of pavement marking shall produce stripes and markings of uniform width and quality with clean and well-defined edges that conform to the details and dimensions indicated. Drips, overspray, improper markings, and paint material tracked by traffic shall be immediately removed from the pavement surface by methods previously reviewed by the District.

B. Striping shall conform to CalTrans Standard Specifications.

3.7 FINISHING

A. The CONTRACTOR shall adhere to the finished surface requirements under Section 39-6.03 of the State Specifications.

** END OF SECTION **

DIVISION 33 - UTILITIES

SECTION 33 01 12.11
ACCEPTANCE TESTING

PART 1 GENERAL

1.1 DESCRIPTION

A. Section Includes: Description of requirements for materials, equipment, and services necessary to complete testing of sewer pipeline and manholes, for leakage, obstructions and deflection/out-of-roundness. The cost of performing any or all testing is incidental to sewer pipe construction.

1.2 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK in this Section:

1. AWWA C600-87 Hydrostatic Testing

PART 2 MATERIALS

2.1 SEWER SYSTEM PLUGS

A. Temporary plugs shall be mechanical type plugs and shall be installed on all sewer projects at the points of connection to existing facilities. These plugs shall remain in place until completion of the balling and flushing operations. The plugs, intended to prevent water from the balling and flushing operations, drainage, or any other condition from entering the existing system, shall not be removed until the system has been pumped clear of accumulated water.

PART 3 EXECUTION

3.1 CLEANING OF GRAVITY SEWERS

A. Prior to air testing the CONTRACTOR shall satisfy the Manager/ENGINEER that the thus far completed gravity sewer lines are free of obstructions to the point that the air test is deemed valid by the Manager/ENGINEER. Balling and flushing may be done at this time, however, balling and flushing is required after completion of all surface work and final paving, if any, and installation of manhole castings, final leveling thereof and any and all remaining manhole work. Where service lines extend through or into easements final air testing shall be performed after the completion of all work in easements.

B. Temporary plugs shall be installed and maintained during cleaning operations at points of connection to existing facilities to prevent water, dirt, and debris from entering the

existing facility.

3.2 TESTING FOR OBSTRUCTIONS IN GRAVITY SEWERS

A. All gravity sewer pipe lines shall be tested for obstructions and cleaned by balling and flushing. This shall be done with commercial sewer cleaning ball such as the Wayne Sewer Cleaning Ball manufactured by the Sidu Company, Long Beach, California, the Flexible Sewer Ball manufactured by Flexible, Inc., Los Angeles, California or approved equal. The ball shall be controlled by a tag line or rope or sewer rods and permitted to move slowly through the sewer. The ball shall be passed freely through the test section and all debris flushed ahead of it shall be caught and removed at the first manhole. If the ball is stopped or prevented from moving freely by debris, damaged pipe, alignment, irregularity or any other cause, the CONTRACTOR shall locate and remedy or repair the obstruction and shall retest the conduit by balling and flushing as well as air testing to the satisfaction of the Manager/ENGINEER.

3.3 TESTING FOR PIPELINE LEAKAGE IN GRAVITY SEWERS

A. The completed pipeline may be tested for leakage at the option of the CONTRACTOR prior to completion of backfill and surfacing. Retesting may be required by the Manager/ENGINEER following backfill operations. Testing of pipe lines for leakage shall be done prior to acceptance of completed Facility by the Board of Directors.

B. All pipe lines shall be air tested under the terms of the Ramseier Method as interpreted and reduced below:

1. The pipe line to be tested shall be plugged and pumped full of air to a pressure of not more than four (4.0) psi above the average back pressure created by any ground water that may submerge the pipe. A stabilization period of not less than five (5) minutes shall follow filling prior to beginning the test unless waived by the Manager/ENGINEER. The pressure at the beginning of the test shall not be less than three (3.0) psi. The allowable time for the pressure to drop a maximum of one-half (0.5) psi per size of pipe is shown on the following page.

Pipe Size	Allowable Time for 0.5 psi Drop
4"	125 seconds
6"	185 seconds
8"	245 seconds
10"	310 seconds
12"	370 seconds
15"	460 seconds
18"	550 seconds
24"	735 seconds
27"	865 seconds

2. If the pressure drop exceeds one-half (0.5) psi over time allowed, that section of pipe

shall have failed the test and the CONTRACTOR shall locate and repair the faulty portion or portions and successfully retest.

C. Hydrostatic testing of lines may be substituted for air testing if and as approved by the Manager/ENGINEER.

3.4 TESTING FOR DEFLECTION/OUT-OF-ROUNDNESS

A. Following the placement and compaction of backfill and prior to the placing of permanent surfacing, all plastic pipe mains shall be cleaned and then mandrelled in the presence of the Manager/ENGINEER or his/her representative to determine the existence of obstructions (deflections, joint offsets and lateral pipe intrusions).

B. A rigid mandrel that is approved by the Manager/ENGINEER, with a circular cross section having a diameter of at least 95% of the specified average inside diameter of the pipe, shall be pulled through the pipe by hand. The minimum length of the circular portion of the mandrel shall be equal to the nominal diameter of the pipe. Any obstructions encountered by the mandrel shall be properly repaired or replaced and rechecked as directed by the Manager/ENGINEER at no expense to the District.

C. Approximately eleven (11) months after acceptance of the WORK (at least twenty (20) days but not more than fifty (50) days prior to expiration of the one year maintenance period) all plastic pipe mains shall again be mandrelled in the presence of the Manager/ENGINEER or his/her representative. A rigid mandrel that is approved by the Manager/ENGINEER, with a circular cross section having a diameter of at least 90% of the specified average inside diameter, shall be pulled through the pipe by hand. The minimum length of the circular portion of the mandrel shall be equal to the nominal diameter of the pipe. All obstructions encountered by the mandrel shall be repaired or replaced and rechecked as directed by the Manger/ENGINEER at no expense to the District.

D. Only re-excavation and the reinstallation of pipe will be permitted to replace pipe rejected due to out-of-roundness. The removed pipe may be reinstalled only when the CONTRACTOR has received prior approval from the ENGINEER.

E. Any pipe subjected to any method or process (such as the use of a “re-rounder”) other than removal, which attempts, even successfully, to reduce or cure any over deflection, shall be uncovered, removed from the job site and replaced with new pipe. Any pipe found to be re-rounded will be replaced from structure to structure with new pipe at the expense of the CONTRACTOR.

3.5 MANHOLE TESTING

A. All manholes shall be tested by the placing of suitable plugs in the inlet and outlet lines and filling with water to the top of the casting. A one (1) hour maximum absorption may be required following which the testing of any leakage shall be observed. Maximum

allowable leakage in gallons per minute (gpm) shall be determined by the following formula:

(.001)*(M.H. Depth)*(head above invert or prevailing ground water[1])*0.5

[1]*whichever is least*

B. If the manhole leakage exceeds the allowable amount, the manhole shall have failed the test and the CONTRACTOR shall repair and retest the manhole to the Manager/ENGINEER's satisfaction.

3.6 VISUAL TESTING

A. Prior to final acceptance the DISTRICT shall conduct an independent closed circuit video inspection of selected sections of sewer pipeline. All video inspections shall be completed no later than 14 days following the CONTRACTOR's final acceptance testing.

B. During the course of video inspection, shall misalignments, cracks, offset joints, faulty gaskets, obstructions, breaks, exposed filler material, and water infiltration be detected, the ENGINEER shall submit in writing a report including corresponding photographs and the locations of the defects to the CONTRACTOR.

C. The CONTRACTOR shall repair all of the identified defects and the DISTRICT shall reconduct a video inspection of the specific areas prior to final acceptance.

3.7 FORCE MAIN TESTING

A. Force mains shall be tested as a whole or in sections between valves. The total length of pipe for any single test shall not exceed 2,000 feet. The force mains shall be tested in accordance with AWWA C600-87 under an average hydrostatic pressure of not less than 150 psi, using a 300 psi gauge, for a minimum of 2 hours.

B. All pumps, gauges, and measuring devices shall be furnished, installed, and operated by the CONTRACTOR. All water for testing and flushing shall be potable or reclaimed water provided by the CONTRACTOR and approved by the ENGINEER.

C. The quantity of water used for testing, which shall be compared to the allowable quantity, shall be measured by pumping from a calibrated container to be approved by the ENGINEER. All restrained sections of the buried force main shall be completely backfilled before such sections are tested.

D. When leakage occurs in excess of the specified amount, defective pipe, pipe joints, or other appurtenances shall be located and repaired at the expense of the CONTRACTOR. If defective portions cannot be located, the CONTRACTOR, at his own expense, shall remove and reconstruct as much of the original work as necessary to obtain a force main within the allowable leakage limits upon retesting.

** END OF SECTION **

DIVISION 33 - UTILITIES

SECTION 33 05 01
PIPING & ACCESSORIES - GENERAL PROVISIONS

PART 1 GENERAL

1.1 DRAWINGS

A. Dimensions shown on Drawings are approximate only. Verify all piping geometry in the field and to ensure proper alignment and fit of all piping consistent with the intent of the Drawings. Submit field layout drawings as required for approval.

PART 2 PRODUCTS

2.1 CONTRACTOR'S RESPONSIBILITY FOR MATERIAL

A. Examine all material carefully for defects. Do not install material which is known, or thought to be, defective.

B. The Engineer reserves the right to inspect all material and to reject all defective material shipped to the job site or stored on the site. Failure of the Engineer to detect damaged material shall not relieve the Contractor from his total responsibility for the completed work if it leaks or breaks after installation.

C. Lay all defective material aside for final inspection by the Engineer. The Engineer will determine if corrective repairs may be made, or if the material is rejected. The Engineer shall determine the extent of the repairs.

D. Classify defective pipe prior to the Engineer's inspection as follows:

1. Damage to interior and/or exterior paint seal coatings.
2. Damage to interior cement-mortar or epoxy lining.
3. Insufficient interior cement-mortar lining or epoxy thickness.
4. Excessive pitting of pipe.
5. Poor quality exterior paint seal coat.
6. Pipe out of round.
7. Pipe barrel area damaged to a point where pipe class thickness is reduced (all pipe).
8. Denting or gouges in plain end of pipe (all pipe).
9. Excessive slag on pipe affecting gasket seal (DIP).
10. Any visible cracks, holes.
11. Embedded foreign materials.
12. Non-uniform color, density and other physical properties along the length of the pipe.

E. The Contractor shall be responsible for all material, equipment, fixtures, and devices furnished. These materials, equipment, fixtures and devices shall comply with the requirements and standards of all Federal, State, and local laws, ordinances, codes, rules, and regulations governing safety and health.

F. The Contractor shall take full responsibility for the storage and handling of all material furnished until the material is incorporated in the completed project and accepted by the Engineer. Contractor shall be solely responsible for the safe storage of all material furnished to or by him until incorporated in the completed project and accepted by the Engineer.

G. Load and unload pipe, fittings, valves, hydrants and accessories by lifting with hoists or skidding to avoid shock or damage. Do not drop these materials. Pipe handled on skidways shall not be skidded or rolled against other pipe. Handle this material in accordance with AWWA C600, C605 or C906 whichever is applicable.

H. Drain and store fittings and valves prior to installation in such a manner as to protect them from damage due to freezing of trapped water.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL REQUIREMENTS

A. Lay and maintain all pipe to the required lines and depths. Install fittings, valves and hydrants in strict accordance with the Specifications at the required locations with joints centered, spigots home, and all valve and hydrant stems plumb. Do not deviate from the required alignment, depth or grade without the written consent of the Engineer.

B. Buried steel lugs, rods, brackets, and flanged joint nuts and bolts are not permitted unless specifically shown on the Drawings or approved in writing by the Engineer. Cover any and all buried steel lugs, rods, brackets, and flanged joint nuts and bolts with approved coating in accordance with AWWA Standard C217 prior to backfilling. Encase the same in polyethylene encased if the Specifications require polyethylene encasement of the pipe, valves or fittings.

C. Lay all pipe to the depth specified. Measure the depth from the final surface grade to the top of the pipe barrel. The minimum pipe cover shall be as shown on the Drawings or as specified in the Specifications.

D. Do not lay pipe in a wet trench, on subgrade containing frost, or when trench conditions are unsuitable for such work. If all efforts fail to obtain a stable dry trench bottom and the Engineer determines that the trench bottom is unsuitable for such work, the Engineer will order the kind of stabilization to be constructed, in writing. In all cases, water levels must be at least 6” below the bottom of the pipe.

E. Thoroughly clean the pipes and fittings before they are installed. Keep these materials clean until the acceptance of the completed Work. Lay pipe with the bell ends facing in the direction of laying, unless otherwise shown on the Drawings, or directed by the Engineer. Exercise care to ensure that each length abuts the next in such a manner that no shoulder or unevenness of any kind occurs in the pipe line.

F. Do not wedge or block the pipe during laying unless by written order of the Engineer.

G. Before joints are made, bed each section of pipe the full length of the barrel, at the required grade, and at the invert matching the previously laid pipe. Dig bell holes sufficiently large to permit proper joint making. Do not bring succeeding pipe into position until the preceding length is embedded and secure in place.

H. Take up and relay pipe that is out of alignment or grade, or pipe having disturbed joints after laying. Take up such in-place pipe sections found to be defective and replace them with new pipe. Take up, relaying, and replacement will be at the Contractor's expense.

I. Place enough backfill over the center sections of the pipe to prevent floating. Take all other necessary precautions to prevent the floating of the pipeline by the accumulation of water in the trench, or the collapse of the pipeline from any cause. Should floating or collapse occur, restoration will be at the Contractor's expense.

J. Contractor shall install tracer wire along all pipelines. Tracer wire shall be placed and centered on the bottom of the trench to prevent disturbance or damage to the tracer wire during repairs.

K. Bedding materials and concrete work for the pipe bedding and thrust restraint shall be as specified.

L. Prevent foreign material from entering the pipe while it is being placed. Do not place debris, tools, clothing, or other materials in the pipe during laying operations. Close all openings in the pipeline with watertight plugs when pipe laying is stopped at the close of the day's work, or for other reasons such as rest breaks or meal periods.

M. Only cut pipe with equipment specifically designed for cutting pipe such as an abrasive wheel, a rotary wheel cutter, a guillotine pipe saw, or a milling wheel saw. Do not use chisels or hand saws. Grind cut ends and rough edges smooth. Bevel the cut end slightly for push-on connections as per manufacturer recommendations.

N. In distributing material at the site of the Work, unload each piece opposite or near the place where it is to be laid in the trench. If the pipe is to be strung out, do so in a straight line or in a line conforming to the curvature of the street. Block each length of pipe adequately to prevent movement. Block stockpiled pipe adequately to prevent movement. Do not place pipe, material, or any other object on private property, obstructing walkways or driveways, or in any manner that interferes with the normal flow of traffic.

O. Exercise special care to avoid damage to the bells, spigots or flanged ends of pipe during handling, temporary storage, and construction. Replace damaged pipe that cannot be repaired to the Engineer's satisfaction, at the Contractor's expense.

P. Remove all existing pipe, fittings, valves, pipe supports, blocking, and all other items necessary to provide space for making connections to existing pipe and installing all piping required under this Contract.

Q. Maintain the minimum required distance between water and sewer lines and other utility lines in strict accordance with all Federal, State, and local requirements and all right-of-way limitations.

R. Provide and install polyethylene encasement for ductile iron pipe, fittings and valves as required.

S. The maximum allowable deflection at the joints for push-on joint pipe shall be the lesser of manufacturer's recommendations or as described in the DIPRA Guideline, *Ductile Iron Pipe Joints and Their Uses,* as follows:

TABLE 1
Maximum Allowable Deflection for DIP

Size of Pipe	Deflection Angle	Maximum Deflection	
		(18-ft Length)	(20-ft Length)
3"-12"	5 degrees	19"	21"
14"-42"	3 degrees	11"	12"
48"-64"	3 degrees	N/A	12"

T. The maximum allowable deflection at the joints for PVC pressure pipe shall be as follows:

TABLE 2
Maximum Allowable Deflection for PVC

Size of Pipe	Deflection Angle	Maximum Deflection
		(20-ft Length)
4"-12"	2 degrees	8"
14" +	1.5 degrees	6"

U. Use short lengths of pipe (minimum length 3 feet, no more than three short sections), when approved by the Engineer, to make curves that cannot be made with full length sections of pipe without exceeding the allowable deflection. Making these curves will be at no additional cost to the Owner.

V. Furnish air relief valve assemblies in accordance with Drawings provided or as specified in Specification Special Conditions section. The Engineer will provide standard detail for additional air release valve assemblies. Any deviation from the standard detail, proposed by Contractor must be approved in advance.

W. Exercise particular care so that no high points are established where air can accumulate. Install an air release valve and manhole, as extra Work to the Contract, when the Engineer determines that unforeseen field conditions necessitate a change in the pipe profile that requires the installation of an air release valve and manhole. If the Contractor requests a change in the pipe profile solely for ease of construction, and the requested change requires the installation of an air release valve and manhole as determined by the Engineer, the cost of furnishing and installing the air release valve and manhole will be at the expense of the Contractor.

X. All water mains 20” and greater in diameter shall be constructed using DIP only. Other construction materials, such as PVC and HDPE, are limited to water or sewer mains 16” and under in diameter. Alternate materials for larger water mains may be approved by the Engineer on a case-by-case basis.

Y. A minimum 3” wide marking tape is to be provided along all mains and service lines installed. Marking tape to be installed 12” below grade. Foil backing is not required on marking tape. Tape shall be colored green for sewer. Marking tape along pressurized force mains shall be labeled “Pressurized Wastewater”.

3.2 CONSTRUCTION METHODS TO AVOID CONTAMINATION

A. Heavy particulates generally contain bacteria and prevent even very high chlorine concentrations from contacting and killing such organisms. It is essential that the procedures of this Section be observed to assure that a water main and its appurtenances are thoroughly clean for the final disinfection by chlorination.

B. Take precautions to protect the interior of pipes, fittings, and valves against contamination. String pipe delivered for construction so as to keep foreign material out of the pipe. Close all openings in the pipeline with watertight plugs when pipe laying is stopped at the close of the day's work or for other reasons, such as rest breaks or meal periods. Use rodent-proof plugs approved by the Engineer, where it is determined that watertight plugs are not practical and where thorough cleaning will be performed.

C. Delay in placement of delivered pipe invites contamination. The more closely the rate of delivery is correlated to the rate of pipe laying, the lower the likelihood of contamination. Complete the joints of all pipe in the trench before stopping work. If water accumulates

in the trench, keep the plugs in place until the trench is dry.

D. When encountering conditions on pre-existing pipe that requires packing, employ yarning or packing material made of molded or tubular rubber rings, or rope of treated paper or other approved materials. Do not use materials such as jute, asbestos, or hemp. Handle packing material in a manner that avoids contamination.

E. Do not use contaminated material or any material capable of supporting prolific growth of microorganisms for sealing joints. Handle sealing material or gaskets in a manner that avoids contamination. The lubricant used in the installation of sealing gaskets shall be suitable for use in potable water. Deliver the lubricant to the job in closed containers and keep it clean.

F. If dirt enters the pipe, and in the opinion of the Engineer the dirt will not be removed by the flushing operation, clean the interior of the pipe by mechanical means. Clean using a pig, swab, or "go-devil" only when the Engineer has specified such and has determined that such operation will not force mud or debris into pipe joint spaces.

G. If the main is flooded during construction, the flooded section must be isolated from the remainder of the installation as soon as practical. Submit a plan to the Engineer on correcting the condition and do not proceed until authorized by the Engineer. Replace or fully clean the affected pipe at no additional cost to the Engineer.

3.3 VALVE INSTALLATION

A. Prior to installation, inspect valves for direction of opening, freedom of operation, tightness of pressure containing bolting, cleanliness of valve ports and especially of seating surfaces, handling damage, and cracks. Correct defective valves or hold for inspection by the Engineer.

B. Set and join to the pipe in the manner specified in Paragraph 3.01. Provide valves with adequate support, such as crushed stone and concrete pads, so that the pipe will not be required to support the weight of the valve. Set truly vertical. If polyethylene is applied to the pipe, the entire valve shall be encased in polyethylene encasement prior to backfill. The polyethylene encasement shall be installed up to the operating nut leaving the operating nut, exposed and free to be operated.

C. Provide a valve box for each valve. Set the top of the valve box neatly to existing grade, unless directed otherwise by the Engineer. Do not install in a way that allows the transfer of shock or stress to the valve. Center and plumb the box over the wrench nut of the valve. Do not use valves to bring misaligned pipe into alignment during installation. Support pipe in such manner as to prevent stress on the valve.

D. Provide extension stem for each valve, with a standard 2-inch AWWA nut. Pin the extension stem to the operating nut on the valves. Extension stem shall extend to with 12-inches of finished grade.

E. Provide valve marking posts, when authorized by the Engineer, at locations designated by the Engineer and in accordance with detail drawings.

3.4 THRUST RESTRAINT

A. Provide all plugs, caps, tees, and bends (both horizontal and vertical) with concrete thrust blocking and/or restrained joint pipe as represented on the Drawings, or specified in the Specification Special Conditions.

B. Place concrete thrust blocking between undisturbed solid ground and the fitting to be anchored. Install the concrete thrust blocking in accordance with Section Cast-In-Place Concrete and Standard Details provided. Locate the thrust blocking to contain the resultant thrust force while keeping the pipe and fitting joints accessible for repair, unless otherwise shown or directed.

C. Use restrained joints for fittings and valves for a minimum distance on either side as calculated using DIPRA guidance - “Thrust Restrained Design for Ductile Iron Pipe”.

D. Provide temporary thrust restraint at temporary caps and plugs. Submit details of temporary restraint to the Engineer for approval.

E. At connections with existing mains where there is a limit on the time the water main may be removed from service, use metal harnesses of anchor clamps, tie rods and straps; mechanical joints utilizing set-screw retainer glands; or restrained pushon joints as permitted by the Engineer. No restraining system can be installed without the approval of the Engineer. Submit details of the proposed installation to the Engineer for approval. For pipe up to 12-inches in size, use a minimum of two 3/4-inch tie rods. If approved for use, install retainer glands in accordance with the manufacturer’s instructions. Material for metal harnessing and tie-rods shall be ASTM A36 or A307, as a minimum requirement.

F. Protection of Metal Harnessing: Protect ties rods, clamps and other metal components against corrosion and by encasement of the entire assembly with 8-mil thick (12 mil thick in corrosive soils) loose polyethylene film in accordance with AWWA C105. Apply tape on all exposed tie rods prior to installing polyethylene.

** END OF SECTION **

DIVISION 33 - UTILITIES

SECTION 33 05 10
PIPES AND FITTINGS

PART 1 GENERAL

1.1 SCOPE OF WORK

This specification includes all materials and methods for the construction of buried sewer mains and fittings and certain above-ground piping and fittings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A.	Section 034820	Precast Concrete Valve Box
B.	Section 330112	Pressure & Leakage Tests
C.	Section 330501	Piping & Accessories – General Provisions
D.	Section 331405	Tracer Wire
E.	Section 400561	Gate Valves
F.	Section 400578	Air release & Vacuum Relief Valves

1.3 SUBMITTALS

A. Submittals for all equipment and products under this Section are required. Submit manufacturer's product data, installation instructions and certification for all materials to be furnished in accordance with Specification Section 013300. Submit classification and gradation test results for embedment and pipe backfill material.

B. Furnish manufacturer's installation and operation manuals for all products.

1.4 QUALITY ASSURANCE

A. All materials included in this section shall be new, quality materials and shall conform to all applicable specifications of ASTM and AWWA Standards. All materials in contact with potable water shall be certified as compliant with NSF Standard 61.

B. All installation, methods and workmanship shall conform in all respects to the above referenced standards as applicable and to the product manufacturer's recommendations.

PART 2 MATERIALS

2.1 GENERAL

A. Pipe materials and joining methods and materials shall be as designated on the project plans.

B. PVC Schedule 40 or 80 is not permitted for conveying wastewater within collection systems. However, it may be used in other applications, such as conveying chemicals or for drainage.

2.2 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

A. Small diameter PVC pipe used for water service shall be PVC 1120 pressure pipe made from class 12454 material as defined by ASTM D1784 with outside diameter dimensions of steel or cast iron pipe. The PVC compounds shall be treated or certified suitable for potable water products by the National Sanitation Foundation Testing Laboratory (NSF Standard No. 61).

B. PVC pipe 4-inch through 12-inch shall be AWWA Standard C900 pipe. Pipe and fittings shall conform in all ways to AWWA Standards C900 (Polyvinyl Chloride pipe in sizes 4-inch through 12-inch with integral bell and spigot joints) and AWWA C 905 (Polyvinyl Chloride water distribution pipe in sizes 14-inch through 24-inch with integral bell and spigot joints). C900 pipe shall be pressure class DR14 and where permitted DR18. DR25 pipe will not be allowed. DR14 shall not be subjected to pressures exceeding 250 psi. DR18 shall not be subjected to pressures exceeding 200 psi.

C. Pipe, fittings and elastomeric seals shall meet the requirements of ANSI/NSF 61.

D. PVC 900 and 905 pipe shall be manufactured to cast iron outside diameters (CIOD) in accordance with AWWA C900 and C905.

E. Elastomeric Seals shall meet the requirements of ASTM F477 “Standard for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

2.3 DUCTILE IRON PIPE AND FITTINGS

A. General

Ductile iron pipe shall be centrifugally cast, meeting the requirements of AWWA C151 as most recently adopted, with cement mortar lining and sealed in accordance with the latest revision of ANSI/AWWA C104/A21.4. The pipe or fitting exterior shall be coated with a bituminous coating in accordance with AWWA Standard C151.

B. Quality

Pipe and fittings shall meet the following minimum quality requirements by conforming to the following:

1. AWWA C104 / ANSI A21.4 Cement-Mortar Lining for Ductile-Iron Pipe and Fittings

2. AWWA C105 / ANSI A21.5 Water Polyethylene Encasement for Ductile-Iron Pipe Systems.

3. AWWA C110 / ANSI A21.10 Ductile Iron and Gray Iron Fittings, 3 NPS through 48 NPS for Water

4. AWWA C111 / ANSI A21.11 Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

5. AWWA C115 / ANSI A21.15 Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges

6. AWWA C116 / ANSI A21.16 Protective Fusion-Bonded Epoxy Coating for the Interior of Ductile-Iron and Gray-Iron Fittings for Water Supply Service

7. AWWA C150 / ANSI A21.50 Thickness Design of Ductile-Iron Pipe

8. AWWA C151 / ANSI A21.51 Ductile-Iron Pipe, Centrifugally Cast, for Water

9. AWWA C153 / ANSI A21.53 Ductile-Iron Compact Fittings, 3 NPS through 24 NPS and 54 NPS through 64 NPS, for Water Service

Ductile iron water pipe and fittings will be accepted on the basis of the Manufacturer's certification that the material conforms to this specification. The certification for iron fittings shall list a fitting description, quantity, bare fitting weight and source, (AWWA Standard C110, C153 or Manufacturer, if fitting is not listed in either standard). The certi fication shall accompany the material delivered to the project site.

C. The pressure class of DIP to be furnished shall be in accordance with Table 1 and the notes listed below.

Table 1
Minimum Rated Working Pressure for Ductile Iron Pipe
Manufactured in Accordance with AWWA Standard C151

Pipe Size (inch)	Pressure Class
6	350
8	350
12	350
16	300
20	300
24	250

NOTES:

1. The noted pressure class is adequate to support 3/4 and 1-inch corporation stops. Use a full saddle for larger taps (e.g., air relief valves or larger corporations) due to limited wall thickness.

D. Testing

Perform a hydrostatic test of all pipe and appurtenances as required by AWWA Standard C151 and Section - Pressure and Leakage Tests

E. Joints

1. Mechanical and Push-On

Mechanical and push-on joints including accessories shall conform to AWWA Standard C111.

2. Flanged

Flanged joints shall conform to AWWA Standard C110 or ANSI B16.1 for fittings and AWWA Standard C115 for pipe. Do not use flanged joints in underground installations except within structures

Furnish all flanged joints with 1/8-inch thick, red rubber or styrene butadiene rubber gaskets. The bolts shall have American Standard heavy unfinished hexagon head and nut dimensions all as specified in American Standard for Wrench Head Bolts and Nuts and Wrench Openings (ANSI B18.2). For bolts of 1-3/4-inches in diameter and larger, bolt studs with a nut on each end are recommended. The high-strength, low-alloy steel for bolts and nuts shall have the characteristics listed in Table 6 of AWWA Standard C111.

Stainless Steel nuts and bolts are required on piping within wastewater treatment plants and pump stations.

3. Restrained Joint Pipelines

Restrained joints for pipes shall be of the boltless push-on type which provides joint restraint independent of the joint seal. Restrained push-on joints allowed for pipe only shall have accessories conforming to AWWA Standard C111. Restrained system shall be suitable for the following minimum working pressures:

Size (inch)	Pressure

Less than 20	300
20	300
24	250
30-64	250

F. Fittings

1. Ductile Iron Fittings

Standard fittings shall be ductile iron conforming to AWWA Standard C110. Compact ductile iron fittings shall meet the requirements of AWWA Standard C153.

a. Working Pressures

Fittings Shall Be Suitable for the Following Working Pressures Unless Otherwise Noted in AWWA Standard C110 or C153:

Working Pressure		
Size (inch)	Compact Fittings	Standard Fittings
	Ductile Iron (psi)	
3-24	300	250, 300 (w/ special gaskets)
30-48	250	250
54-64	150	N/A

b. Coating and Lining

The fittings shall be coated on the outside with a petroleum asphaltic coating in accordance with AWWA Standard C110 or fusion-bonded epoxy in accordance with AWWA Standard C116. All Ductile Iron Pipe and fittings shall be lined with Protecto 401 coating.

G. Joints

1. Mechanical and Push-On

Mechanical and push-on joints including accessories shall conform to AWWA Standard C111. Anti-Rotation T-Bolts shall be used on mechanical joints shall be of domestic origin, high strength, low alloy steel bolts only, meeting the current provisions of ANSI/AWWA C111/A21.1 for rubber gasket joints for cast iron or ductile iron pipe and fittings. Bolt manufacturer's certification of compliance must

accompany each shipment. T-bolts shall be corrosion resistant to handle corrosive conditions on any buried bolts.

2. Flanged

Flanged joints shall meet the requirements of AWWA Standard C115 or ANSI B16.1. Do not use flanged joints in underground installations except within structures. Furnish all flanged joints with minimum 1/8-inch, thick red rubber or styrene butadiene rubber full-face gaskets. The bolts shall have heavy unfinished hexagonal head and nut dimensions all as specified in ANSI B18.2. Corrosion resistant hex bolts to handle corrosive conditions shall be used on any buried flanged bolts.

Bolts and nuts shall be threaded in accordance with ASME/ANSI B1.1, Unified Inch Screw Threads (UN and UNR Thread Form) class 2A external and class 2B internal. For bolts of 1-3/4 -inches in diameter and larger, stud bolts with a nut on each end are recommended. Material for bolts and nuts shall conform to ASTM A307, 60,000 PSI Tensile Strength, Grade B, unless otherwise specified. Bolt manufacturer's certification of compliance must accompany each shipment.

3. Restrained

Restrained joints for valves and fittings shall be of the boltless push-on type which provides joint restraint independent of the joint seal. Field Lok gaskets are not permitted on valves or fittings. Restrained push-on joints allowed for pipe only shall have accessories conforming to AWWA Standard C111. Restrained system shall be suitable for the following minimum working pressures:

Size (inch)	Pressure (psi)
Less than 20	300
20	300
24	250
30-64	250

Where adjacent fittings are to be placed (as in a mechanical joint hydrant tee and a mechanical joint hydrant valve), the use of a suitably sized Foster adaptor is permitted to facilitate restraint between the fittings.

H. Polyethylene Wrap

Polyethylene wrap shall only be used on projects where explicitly required in the Scope of Work. The determination for use of polyethylene wrap shall be determined by the OWNER.

2.4 GALVANIZED STEEL PIPE AND FITTINGS

A. All galvanized steel pipe and fittings shall be in conformance with ASTM A53 Standard Specifications for Pipe, Steel, Black and Hot Dipped Zinc Coated, Welded and Seamless, as appropriate for galvanized seamless and/or welded steel pipe. Pipe and fittings shall conform to these standards in materials, fabrication, dimensions, wall thicknesses, coatings, and thread patterns.

B. All pipe, fittings, and pipe joint compounds and all materials in contact with potable water shall be in compliance with NSF Standard 61 for use with potable water.

C. All pipe and fittings shall be installed in the configuration shown on the plans, and shall be supported and restrained with pipe clamps and braces as necessary to prevent movement of any kind.

2.5 WARNING TAPE

A. Warning tape shall be detectable type with a 5 mil minimum, overall thickness. The tape shall have a 50 gauge solid aluminum foil core laminated between two layers of inert plastic film. The tape shall be 3-inches wide with a minimum tensile strength of 100 pounds per 3-inch wide strip. The tape shall be APWA color coded (Green) and bear a continuous printed message in permanent black letters on one side" “CAUTION SEWER LINE BURIED BELOW” or words of a similar nature.

2.6 LOCATING CABLE

A. Locating cable/wire shall be installed as shown on the contract drawings in Detail MSG-W-05.

2.7 RECEIVING, HANDLING AND STORAGE

A. Inspect pipe and appurtenances for defects prior to installation in the trench. Set aside and clearly mark defective, damaged or unsound material and hold material for inspection by AW.

B. Load and unload all materials in accordance with the manufacturer’s recommendations and in such a manner as to prevent damage. Do not drop pipe and accessories or handle them in a rough manner.

C. Provide safe storage for all materials. Cover stored pipe that will be exposed to sunlight for periods longer than 6 months. Cover with canvas or other opaque material with provision for adequate air circulation. PVC pipe shall not be stored close to heat sources, such as heaters, boilers, steam lines, or engine exhaust.

PART 3 EXECUTION

3.1 INSTALLATION

Follow the provisions of Section 330501 - Piping - General Provisions in addition to the following requirements:

A. Remove all dirt and foreign matter from pipe before lowering it into the trench. Do not place debris, hand tools, clothing or other materials in the pipe. Keep pipe clean during and after laying.

B. Lay pipe with the bell end pointing in the direction of work progress. Do not roll, drop or dump pipe or appurtenances into the trench.

C. Assemble push-on joints in accordance with the pipe manufacturer's recommendations. Assemble mechanical joints in accordance with the fitting manufacturer's recommendations.

D. Cut pipe with pipe saws, circular saws, handsaws, or similar equipment. Provide a smooth end at a right angle to the longitudinal axis of the pipe. Deburr, bevel, and re-mark insertion line on spigot ends. Match factory bevel length and angle for field bevels. When connecting to certain shallow depth bells, such as those on some cast iron fittings and valves, cut off the factory bevel and prepare a deburred, square cut end with a slight outer bevel.

E. Clean the sealing surface of the spigot end, the pipe bell, the coupler or fitting, and the elastomeric gaskets immediately before assembly. Do not remove factory installed gaskets for cleaning. Keep the joint free of dirt, sand, grit, grease or any foreign material. Apply approved lubricant when assembling gasketed joints in accordance with the pipe manufacturer's requirements. The use of improper lubricants can damage gaskets. Excessive lubricant use can make disinfection more difficult and cause taste and odor problems when the line is placed in service.

F. Good pipe alignment is essential for proper joint assembly. Align the spigot to the bell and insert the spigot into the bell until it contacts the gasket uniformly. Do not swing or "stab" the joint; that is, do not suspend the pipe and swing it into the bell. The spigot end of the pipe is marked by the manufacturer to indicate the proper depth of insertion. Avoid metal to plastic contact with the pushing the pipe home (use wood or other material to cushion moving the pipe.

G. Assemble pipe using the following types of joints:

1. Gasketed bell joint – Integral with the pipe or fitting

2. Gasketed coupling – A double gasketed coupling

3. Mechanical joint – Any of the several joint designs that have gaskets and bolts manufactured in accordance with AWWA standards.

H. Tracer Wire

1. Place tracer wire in accordance with Section 331405 - Tracer Wire.

2. The wire shall be contiguous except at test stations and valve boxes. No underground splices shall be allowed.

I. All pressure and leakage testing shall be done in accordance with Specification Section 33 01 12.11 – Pressure and Leakage Tests.

J. PVC pipe fittings shall employ ductile iron pipe fittings as per these Specifications. See detail drawings for transitions between different pipe materials.

K. Gaskets - Gaskets shall be as provided or recommended by the manufacturer and satisfy AWWA standard C111 in all respects. Where ductile iron pipe and PVC pipe are directly connected, the appropriate gasket material for this purpose shall be employed.

3.2 PIPES & FITTINGS

Follow the provisions of Section 330501 - Piping - General Provisions in addition to the following requirements:

A. All pipe and fittings shall be installed in the configuration shown on the plans, and shall be supported and restrained above ground with pipe clamps and braces and below ground with thrust blocks or restrained joints as called out on the project plans and/or as necessary to prevent movement of any kind under all anticipated service conditions and pressures.

B. All pipe installation shall be as per the manufacturer's recommendations for the pipe material used. All fittings shall be installed and secured with flanged or threaded connections or as shown on the drawings. All proper hardware, gaskets and appurtenances for each fitting shall be as recommended and supplied by the fitting manufacturer. All new materials shall be used.

C. All trenching shall conform to trench detail as shown on the plans. All pipe bedding, trench backfill and finishing shall be in accordance with trench details as shown on the plan and shall be as per the pipe manufacturer's recommendation for the pipe material being installed.

D. All AWWA C900 and C905 Pipe shall be installed in accordance with AWWA C605 "Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water" and in accordance with the manufacturer's directions and recommendations.

E. Push-On Joints

Clean the surfaces that the gasket will contact thoroughly, just prior to assembly using a bacteria free solution (bleach, potable water or NSF approved material). Insert the gasket into the groove in the bell. Apply a liberal coating of special lubricant to the gasket and the spigot end of the pipe before assembling the joint. Center the spigot end in the bell and push home the spigot end.

F. Mechanical Joints

Clean and lubricate all components with soapy water prior to assembly. Slip the follower gland and gasket over the pipe plain end making sure that the small side of the gasket and lip of the gland face the bell socket. Insert the plain end into socket. Push gasket into position with fingers. Seat gasket evenly. Slide gland into position, insert bolts, and tighten nuts by hand. Tighten bolts alternately (across from one another) to the recommended manufacturing rating or if not provided, to the following normal torques:

Bolt Size (inch)	Range of Torque-limiting (ft-lbs)
5/8	40 - 60
3/4	60 – 90
1	70 - 100
1-1/4	90 - 120

After field installation, all bolts shall receive petrolatum tape or petroleum wax protection or other approved coating material. Protection shall be applied before applying polywrap per Section - Polyethylene Wrap, if required.

G. Restrained Joints

1. Ball and Socket

Assemble and install the ball and socket joint according to the manufacturer's recommendations. Thoroughly clean and lubricate the joint. Check the retainer ring fastener.

2. Push-On

Assemble and install the push-on joint according to the manufacturer's recommendations. Thoroughly clean and lubricate the joint. Check the retainer ring fastener.
Protect pipe from damage from the jacking device (backhoe bucket, pipe jack, etc.) when “pushing home” any pipe by using wood or other suitable (non metallic)

material.

3. Mechanical Joint

Assemble and install the mechanical joint according to the manufacturer's recommendations. Thoroughly clean and lubricate the joint. Use approved restrained joint device on fittings and valves where required and approved for use.

H. Pipe Protection

Protect pipe from damage from the jacking device (backhoe bucket, pipe jack, etc.) when "pushing home" any pipe. Wood or other suitable material (non metallic) shall be used to push home the pipe.

I. Gaskets

Gaskets shall be as provided or recommended by the manufacturer and satisfy AWWA Standard C111 in all respects with the exception of requirements noted in Part 2.

J. Thrust Restraints

All pipe and fittings shall be properly restrained against horizontal and vertical movement due to internal pressure and pressure changes. Contractor shall utilize mechanical restraints, restraint joints, bracing, and/or thrust blocks to provide all necessary bracing and restraint to protect piping from movement in all service conditions. Method of restraint may be specified on project plans. If method of restraint is not specified on the plans, Contractor shall verify with Engineer appropriate restraint method.

3.3 FLUSHING AND TESTING

A. As a condition of acceptance of the completed pipe systems, the Contractor shall flush and test the new pipeline system as per AWWA standards and as outlined elsewhere in Section 330110.58. Pressure and leakage tests shall be done as outlined in Section 330112.11 - Pressure and Leakage Test of these Specifications. The authorized representative of the Engineer shall be present during the performance of all such work.

B. Prior to hydrostatic testing, the Contractor shall thoroughly flush all piping to remove sand, grit, fluids, construction waste, etc.

A. Pressure testing of above ground piping will not be required. Testing of above ground piping will be by observation of leaks.

** END OF SECTION **

DIVISION 33 - UTILITIES

SECTION 33 05 61
MANHOLES AND APPURTENANCES

PART 1 GENERAL

1.1 DESCRIPTION

A. Section includes: Description of requirements for materials and installation of cast-in-place and precast manholes as well as various appurtenances.

1.2 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK in this Section:

1.	ASTM A48	Standard Specification for Gray Iron Castings
2.	ASTM C150	Standard Specification for Portland Cement
3.	ASTM C478	Standard Specification for Circular Precast Concrete
4.	ASTM C923	Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and

PART 2 MATERIALS

2.1 MANHOLES

A. All manholes bases shall be precast or cast in place with precast reinforced concrete pipe sections, tapered sections and adjustment rings. Reinforced concrete parts shall conform to ASTM designation C478.

B. Precast manhole barrels, risers, cones, and grade rings shall conform to ASTM C478.

C. All manhole sections shall be fitted with external lifting pins, no through penetration holes will be permitted.

2.2 CONES

A. Standard cones conforming to ASTM C478 shall be used on all manholes unless otherwise specified on the plans. Cones shall be concentric unless otherwise specified on the plans.

2.3 JOINTS

A. Manhole joints shall be sealed against infiltration and exfiltration by means of joint sealing compound "Kent Seal™" as manufactured by Hamilton Kent, or approved equal. Appropriate primers and preparation as specified by manufacturers shall be used.

2.4 CONNECTIONS

A. For precast manhole bases, connection of the pipe to the manhole shall use a resilient connector conforming to ASTM C923 such as A-Lok, Kor-n-seal, or approved equal.

2.5 CASTINGS

A. All castings shall be grey iron conforming to ASTM designation A159 class G-3000 asphalt paint dipped.

B. Manhole castings shall be Phoenix Iron Works P-1067, South Bay Foundry SBF 1967, or approved equal for non-traffic loading, and P-1090, SBF 1900, or approved equal for traffic loading. Bolted manhole castings shall be Phoenix Iron Works P-1200, South Bay Foundry SBF-1900-BS, or approved equal.

C. Flushing hole (clean out) castings shall be phoenix Iron Works P-7103 or P-7104, South Bay Foundry 1248 or SBF 1247 or approved equal, depending on the type and size of pipe used.

D. Frames and covers for 48-inch manholes shall be 24-inch diameter.

E. Frames and covers for 60-inch manholes shall be 36-inch diameter. Covers shall be two piece nested with 24-inch diameter inside 36-inch diameter covers.

2.6 CONCRETE AND PATCHING MORTARS

A. Concrete shall conform to the State of California Standard Specifications in the latest edition and shall be class B unless otherwise shown on the approved plans or specified herein.

B. Patching and sealing mortars shall be of a portland cement base and shall be as of a type manufactured by Tamms Industries Co., Bellflower, California, under the brand name "Speed-Crete", or approved equal.

2.7 COUPLINGS AND SPECIAL FITTINGS

A. Flexible couplings shall be Calder Couplings Strong Back Shielded Couplings or approved equal. Tapping saddle shall be of cast iron material, o-ring type seal with stainless steel bands, or of PVC material with suitable seal and stainless steel bands. Tapping saddles shall be appropriate for the diameter and type of the sewer being tapped and shall be subject to approval by the Manager and/ or ENGINEER.

B. Stub-out fittings for tapping shall be of the type specified for use with the specific size and type of pipe by the pipe manufacturer. Installation shall be in accordance with the manufacturer's specifications and as approved by the Manager and/or ENGINEER.

C. All sanitary sewer cleanouts shall be constructed of SDR-35 PVC pipe and fittings.

2.8 CASINGS

A. Casings for underground pipelines shall be as required by the State of California Standard Specifications, latest edition.

2.9 NON SHRINKING GROUT

A. Grout shall be noncorrosive, nonmetallic, cement and aggregates as manufactured by EMBECO, Fondag, or approved equal.

B. Use only pre-mixed grout supplied dry in waterproof containers.

2.10 PORTLAND CEMENT CONCRETE

A. Portland cement concrete shall conform to Section 90 of the State Specifications except as herein modified.

B. Concrete shall be concrete and shall conform to either the 1 inch or 1-1/2 inch gradation at the option of the CONTRACTOR, unless otherwise specified in the plans.

C. Portland cement shall be Type II Modified and all cement used on a project shall be the same brand.

2.11 SANITARY SEWER SERVICE LATERALS

A. All sanitary sewer service laterals shall be constructed of 4" SDR-35 PVC pipe conforming to ASTM D3034. Connection of the lateral to the sewer main shall be facilitated through the installation of a SDR-35 PVC wye.

PART 3 EXECUTION

3.1 CAST IN PLACE CONCRETE MANHOLES

A. Cast Portion

1. The Contractor may, at his option, cast the lower portion of drainage manholes in place. The cast-in-place portion shall not be placed higher than 6 inches above the outside tops of the main incoming and outgoing pipes. Minimum and maximum

wall thickness for the cast-in-place sections shall conform to the following table:

Manhole Diameter	Min. Wall Thickness	Max. Wall Thickness
48"	5"	7"
60"	6"	8"
72"	7"	9"

2. Inside diameters of cast-in-place portions shall equal the diameter of the manhole specified. Standard precast manhole riser sections and/or cones shall be placed above the cast-in-place section to bring the manhole rim up to grade.

3. Maximum and minimum wall thickness for cast-in-place portion of manholes shall be strictly adhered to. Concrete on the cast portion may be placed neat against the earth, provided wall thickness requirements are met; otherwise, outside forms shall be required.

B. When and if water is encountered, or in the opinion of the ENGINEER, the base material is unsatisfactory, a minimum of 6 inches of 3/4" crushed rock will be required prior to manhole base construction.

C. The manhole base shall be of sound concrete, placed in accordance with good practice and of proper slump for use in this WORK. Precautions shall be taken to assure that sewer pipe entering and leaving the manholes does not move from the installed alignment and grade. Sufficient material should be placed on said sewer lines to prevent such movement. Appropriate plugs, as approved by the Manager/ENGINEER shall be placed in the ends of the pipes in order to prevent concrete from entering the lines during the manhole pour. In case of straight through lines, the pipe may be laid through the manhole excavation with the base being poured around the pipe. The upper half of the pipe shall then be cut or broken out to form the channel in an approved method.

D. The first manhole ring section shall be placed before the concrete is set. Care should be taken to set the manhole barrels at the appropriate time during the cure of the concrete to insure proper penetration and allow for sufficient clearance between the bottom of the barrel and top of the pipe. Initial setting and removal of barrels and rings or the use of a ring form to make the indentation in the base is subject to approval by the Manager/ENGINEER.

E. Sufficient care should be taken during the manhole pour operation to observe the rate of cure of concrete and to properly work the surfaces and channels so as to arrive at the required shapes and surfaces and to avoid poor results. The channels shall be shaped in flowing curves as indicated on the drawings to insure proper hydraulic characteristics for the flow of sewage. A smooth, clean, hand rubbed finish shall be given to the surfaces of the manhole base and to any joint mortar work. Transitions between different sizes of pipes shall be smooth and regular. Excessive concrete, mortar or improperly shaped or

surfaced channels shall be chipped back and built up again to insure the proper shape and surface. All cracks, joints, holes, etc., shall be sealed by mortar, sealing compounds or dry pack as approved by the Manager/ENGINEER to insure water tight manholes with workmanlike appearance.

F. During the pour of the manhole base, adequate care shall be taken to insure the proper bond between the sewer pipe and the concrete to prevent leakage.

G. Unless otherwise indicated, flow channels shall be provided in the sanitary sewer manhole base by the use of fillets. Special care shall be taken to form a smooth transition between inlets and outlets, with good hydraulic properties. Any sharp corners or significant departures from the dimensions indicated shall be cause for reconstruction. Pipe may be laid continuously through straight run manholes and the top ½ of the pipe subsequently cut out inside the manhole, prior to forming the channelization.

3.2 PRECAST CONCRETE MANHOLES

A. Precast concrete sections shall be inspected when delivered and all cracked or otherwise visibly defective units rejected.

B. Precast manhole bases must be placed on a minimum of 4 inches of 3/4" crushed rock.

C. Stubs or couplings provided in precast bases shall be of the same material as the pipe to which they connect unless otherwise approved by the ENGINEER.

3.3 MANHOLE INSTALLATION

A. Prior to construction of the manhole, compact the ground underlying the manhole base, using a mechanical tamper, with 3 passes minimum over the entire surface.

B. Care shall be taken in setting of barrels, tapered sections and risers to achieve good elevation control so that no more than twelve (12) vertical inches of grade rings are necessary to adjust the level of the manhole castings (12 inch maximum between top of tapered section and bottom of manhole casting.)

C. Backfill shall be placed uniformly around the outside of the manhole so as not to create differential forces and the possibility of dislodging the manhole sections.

D. Drop connection inside manholes shall be in accordance with the Standard Details and shall be constructed in a manner to leastwise restrict maneuverability within the manhole.

E. Pipe connections to manholes shall be made so that the pipe is flush with the inside of the manhole. Connections shall be finished so that the entrances are smooth.

F. Grouting

1. Preparation
   a. Clean deleterious material from all surfaces and hardware.
   b. Dampen surfaces before placing grout. Saturate equipment base foundations continuously with water 6 hours prior to grouting. Dampen surfaces before placing grout.

2. Mixing Grout
   a. Mix according to manufacturer's directions.
   b. Mix entire contents of container using a paddle-type mortar mixer or hand mix in mortar box.
   c. Mix grout near location of placement. Add water slowly, while mixing, to acquire proper workability and consistency.
   d. Mix grout 3 to 5 minutes after adding water, and place immediately.
   e. Retempering or adding Portland Cement will not be allowed.

3. Placing Grout
   a. Do not vibrate grout. Isolate vibrations from nearby equipment or shut down until grout takes initial set.
   b. Place grout rapidly and continuously.
   c. Place grout from 1 side only, if expelling entrapped air.
   d. Rod grout to facilitate flow.
   e. Pressure grouting will be permitted.
   f. Place grout within 15 minutes after mixing.
   g. Do not place grout on concrete which has cured less than 7 days.

4. Curing Grout
   a. Cure grout promptly after placing. Provide continuous water contact for 48 hours.

G. Pipe connections into the cone will not be permitted without approval by the ENGINEER.

H. The method of adjusting manholes to grade shall conform to Section 15-2.05A of the State Specifications.

1. When adjusting an existing manhole to grade and the total depth of the throat from the top of the frame to the bottom of the throat exceeds 24 inches, the upper section of the manhole shall be removed to the first full size manhole section. The upper portion shall be reconstructed.

2. Grade adjustments may be made by use of precast or cast in place grade rings. The minimum height of cast in place grade rings shall be 3 inches and the maximum height shall be 12 inches. The concrete pour shall not extend above the top of the base flange of the manhole frame.

I. Castings shall be chamfered or rounded and all exposed surfaces shall be smooth, unless otherwise shown.

J. Flushing branches shall consist of pipe and fittings of the same type as the sewer to which the flushing branch connects.

K. Sanitary sewer stubs shall be installed at the locations specified on the plans. The stubs shall extend a minimum of 6 feet from the manhole wall and shall consist of the same material as the sewer line leaving the connecting manhole.

L. All manholes under construction shall be covered in an appropriate manner to prevent the entry of any stormwater runoff, trench water, sand, earth, or any other foreign substances at any time during the construction or while the manhole is unattended.

3.4 INSTALLATION OF CASINGS; BORING AND JACKING

A. In case of installation of sewer line and casing, whether by trenching methods or by boring and jacking, the grade of the installed casing shall be checked with regard to the design slope of the sewer being installed. The sewer line shall be installed by the method outlined in the Johns-Mannville Sewer Installation Manual, latest edition, as amended by specific pipe manufacturer's recommendations, and approved by the Manager/ENGINEER. The pipe skids shall be shaped and installed in a manner so as to compensate for any misalignment or grade problems in the installed casings. All procedures and equipment used in the installation of a sewer in the casing shall be subject to prior review and approval of the Manager/ENGINEER. Any filling, sacking, drainage and protection of the casing ends shall be as directed by the Manager/ENGINEER.

3.5 CONNECTION OF SERVICE LATERALS TO SEWER MAIN

A. All lateral connections to new sewer mains shall consist of wyes or tees and installed in accordance with the plans for a specific depth of connection.

B. All lateral connections to an existing sewer main shall be made with Romac Style CB tapping saddles.

** END OF SECTION **

DIVISION 33 - UTILITIES

SECTION 33 05 97.22
TRACER WIRE

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Install electrically continuous tracer wire with access points as described herein to be used for locating pipe with an electronic pipe locator after installation. Tracer wire shall be installed on all mains and services, all wastewater lines and sewer mains and services and all wastewater force mains.

1.2 SUBMITTALS

A. Submit shop drawings and manufacturer's literature to the Engineer for approval in accordance with Specification Section 013300.

PART 2 PRODUCTS

2.1 TRACER WIRE MATERIAL

A. Tracer wire shall meet minimum State requirements.

B. Tracer wire to be twelve gauge minimum solid copper with thermoplastic insulation recommended for direct burial.

C. Tracer wire color shall be blue for all water construction and green for all wastewater construction.

2.2 TRACER WIRE ACCESS BOXES

A. For locations where valve boxes are not present, the tracer wire access point shall be composed of one Christy G5 valve box, or approved equal, installed at each proposed access point.

2.3 TESTING REQUIREMENTS

A. Contractor shall perform a continuity test on all tracer wire in the presence of Engineer or District representative. If the tracer wire is found to be not continuous after testing, Contractor shall repair or replace the failed segment of the wire at their own expense.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL REQUIREMENTS

A. Tracer wire shall be installed on all water and sewer mains and services. The wire shall be installed in such a manner as to be able to properly trace all mains without loss or deterioration of signal or without the transmitted signal migrating off the tracer wire.

B. Marking tape shall be installed in the same trench pipe during pipe installation. It shall be laid in the trench 12-inches above the pipe to ensure that it is not damaged during future repair operations.

C. The tracer wire shall be continuous between access points, no buried splices shall be allowed, and it shall be accessible at all tracer wire access points.

D. Tracer wire access points shall in general be no more than five-hundred feet and at every proposed concrete valve box collar (or manhole where required). Concentrations of multiple proposed valves near pipe intersections, i.e. tees or crosses, may require more than one access point assembly in each concrete valve box collar. Tracer wire access points shall be within public right-of-way or public utility easements.

E. At each valve location, a loop of wire is to be brought up inside of the valve box riser and looped inside the box.

F. At the point of connection between cast or ductile iron mains, with any non-iron main, the tracer wire shall be properly connected to the iron pipe with a cad weld or approved equivalent. Tracer wire welds shall be completely sealed with the use of an approved mastic type sealer specifically manufactured for underground use. Mastic shall be applied in a thick coat a minimum of 2 inches thick and shall be protected from contamination by the backfill material with the use of a plastic membrane.

G. Tracer wire shall be laid flat and securely affixed to the pipe at 10 foot intervals. The wire shall be protected from damage during the execution of the Work. No breaks or cuts in the tracer wire or tracer wire insulation shall be permitted. At service saddles, the tracer wire shall not be allowed to be placed between the saddle and the main.

H. Except for approved spliced-in connections, tracer wire shall be continuous and without splices from each tracer wire access point. Where any approved spliced in connections occur, 3M DBR water tight connectors, or approved equal, shall be used to provide electrical continuity.

I. At all main end caps, a minimum of 6 feet of tracer wire shall be extended beyond the end of the pipe, coiled and secured for future connections. The end of the tracer wire shall be spliced to the wire of a six pound zinc anode and is to be buried at the same elevation as the water main.

J. For directional drilling, auguring or boring installations, two #12 tracer wires shall be installed with the pipe and connected to the tracer wire at both ends, or cad welded to the existing iron pipe at both ends or cad welded to the steel casing pipe at both ends.

K. Spliced connections between the main line tracer wire and branch connection tracer wire shall only be allowed at water main tees, crosses or at iron or copper water services where a portion of the branch connection water main or water service is replaced with non-iron or non-copper material. The branch connection tracer wire shall be a single tracer wire properly spliced to the main line tracer wire. Where the existing branch connection is neither iron nor copper, then the new branch connection tracer wire shall be properly spliced to the existing tracer wire on the branch connection.

L. At all repair locations where there is existing tracer wire, the tracer wire shall be properly reconnected and spliced as outlined above.

** END OF SECTION **

DIVISION 33 - UTILITIES

SECTION 33 11 00.11
POLYVINYL CHLORIDE (PVC) PIPE

PART 1 GENERAL

1.1 DESCRIPTION

A. Section includes: Description of requirements for installation of polyvinyl chloride sewer pipe.

1.2 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK in this Section:

1.	ASTM D3034	Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
2.	ASTM F679	Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings (T-1 pipe minimum)
3.	ASTM D2241	Poly(Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
4.	AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12in.
5.	ASTM D3212	Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
6.	ASTM D2321	Underground Installation of Flexible Thermoplastic Sewer Pipe.

PART 2 MATERIALS

2.1 PIPES AND JOINTS

A. Polyvinyl Chloride (PVC) Pipe may be used conforming to one of the following specifications:

Diameter	Designation
4"	C900 DR18,
6"	C900 DR18, ASTM 3034 DR35

8"	C900 DR18, ASTM 3034 DR35
12"	C900 DR18, ASTM 3034 DR35
27"	ASTM F679 T-1 or T-2

B. Joints of PVC pipe shall consist of either an elastomeric gasket coupling or an integral bell and spigot with an elastomeric gasket. The joints shall have seal ring grooves or other approved means for positively holding the gaskets in place. The assembly of joints shall be in accordance with the pipe manufacturer's recommendations.

C. Connections to manholes and concrete structures shall be made by utilizing manhole adaptors or elastomeric seal rings embedded in the concrete.

D. All fittings such as wyes, tees, bends, reducers and connections shall be of the same material and manufacturer as the pipe.

E. No solvent cement joints shall be used.

F. All PVC shall have a home mark to indicate full penetration at the spigot when the joint is made. PVC and fittings shall not be stored with direct exposure to sunlight for any extended period of time. If storage for a long period is necessary, pipe and fittings shall be covered with opaque material, providing air circulation, or otherwise protected in a manner approved by the Manager and/or ENGINEER.

G. PVC pipe more than 2 years old from the date of manufacture shall not be used.

H. Only one single type of pipe shall be used in any given project unless otherwise approved by the Manager and/or ENGINEER.

2.2 COUPLINGS AND SPECIAL FITTINGS

A. Flexible couplings shall be Ceramicweld or Calder Couplings as manufactured by Joints, Inc., Gardena, California, or approved equal. Tapping saddle shall be of cast iron material, o-ring type seal with stainless steel bands, or of PVC material with suitable seal and stainless steel bands. Tapping saddles shall be appropriate for the diameter and type of the sewer being tapped and shall be subject to approval by the Manager and/ or ENGINEER.

B. Stub-out fittings for tapping shall be of the type specified for use with the specific size and type of pipe by the pipe manufacturer. Installation shall be in accordance with the manufacturer's specifications and as approved by the Manager and/or ENGINEER.

PART 3 EXECUTION

3.1 INSTALLATION

A. Pipe Laying

1. The pipe shall be laid in strict conformity with the prescribed line and grade, with grade bars set and each pipe length checked to the grade line. Three consecutive points on the same rate of slope shall be used at all times to detect any variation from a straight grade. In case any discrepancy exists, the work shall be stopped and the discrepancy immediately reported to the Engineer. In addition, when requested by the Engineer, a string line shall be used in the bottom of the trench to insure a straight alignment of the sewer pipe between manholes. The maximum deviation from grade shall not exceed 1/4" inch.

2. For trenches less than 5 feet deep, the trench width shall be determined as the pipe O.D. + 16".

3. Pipe laying shall proceed upgrade with the bell ends of the pipe placed up stream. Each section of pipe shall be laid true to line and grade and in such a manner as to form a water tight concentric joint with the adjoining pipe. The interior of the sewer shall be kept clear of all dirt and debris during the work process. Plugs shall be placed in the open end of pipe during all waiting periods in the construction process.

4. The trench box shall not extend below the top of pipe.

5. Rock shall be excavated so that it is no closer than 6 inches from the bottom and sides of the pipe. The word “rock” in this case refers to large gravel formations where loose cobbles are more than 8 inches in diameter. These cobbles shall be removed from the trench and not included in the backfill.

6. Initial backfill and backfill material shall not have stones and/or rocks larger than 3 inches in diameter within 3 feet of the top of pipe.

7. Pipe shall not be laid when the condition of the trench or the weather is unsuitable. All open ends of sewer pipe and fittings shall be adequately and securely closed whenever the work is discontinued for more than ½ hour.

8. All pipe laying and joining, including the maximum deflection of joints in curved alignment shall be in accordance with the pipe manufacturer’s specifications and as directed by the Manager/ENGINEER. Pipe joining by the “Badger” method shall not be permitted.

9. All joint surfaces shall be cleaned before joining the pipes.

10. All loose material shall be removed from the new trench prior to placing the bedding material.

11. Bedding material shall be imported crushed rock, of which 100 percent shall pass a

3/4 inch sieve and not more than 10 percent will pass the No. 8 sieve.

12. Bedding shall extend at least 6 inches below the invert of the pipe.

13. The bedding shall give uniform support throughout its length. Pipe bedding should be excavated from beneath the bell ends or couplings of the pipes so as to avoid any bridging effect. No wedging or support of the pipe with wood or any other type of material than the approved bedding shall be permitted.

14. Initial backfill shall consist of screened native material of which 100 percent shall pass a 3/4 inch sieve.

15. Initial backfill shall be placed in an approved manner so that the pipe rests on a densely compacted bed of approved granular material. Slicing with a shovel tip, tamping with a T-bar, or use of other approved mechanical equipment may be used to compact the material around the haunches of the pipe.

16. Jetting will not be permitted.

17. All pipes must be anchored or have sufficient material placed on the top of the pipe to prevent the pipe from moving out of line or grade.

18. All necessary precautions shall be taken to prevent uplift or floating of the pipe prior to completion of the backfilling operation. The CONTRACTOR shall assume full responsibility for any damage due to this cause and shall restore and replace the pipe to its specified condition and grade at no cost to the DISTRICT.

19. If the trench width is greater than 6 pipe diameters, initial backfill shall be compacted to a point at least 2.5 pipe diameters for either side of the pipe.

** END OF SECTION **

DIVISION 33 - UTILITIES

SECTION 33 11 00.15
DUCTILE IRON PIPE

PART 1 GENERAL

1.1 DESCRIPTION

A. Section includes: Description of requirements for installation of ductile iron sewer pipe.

1.2 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK in this Section:

1.	AWWA C105	Polyethylene Encasement for Ductile-Iron Pipe Systems
2.	AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3 in. through 48 in.
3.	AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
4.	AWWA C151	Ductile-Iron Pipe, Centrifugally Cast

PART 2 MATERIALS

2.1 PIPES AND JOINTS

A. Ductile iron pipe shall conform to AWWA C151 for a minimum working pressure of 150 psi unless otherwise specified. Laying length shall be the manufacturer's standard length, normally 18 feet. Shorter lengths may be used when required for closures and proper location of special sections.

B. The interior surface of all ductile iron pipe shall be coated at the factory with an amine cured novalac epoxy containing at least 20% by volume of ceramic quartz pigment. The lining shall be PROTECTO 401 as produced by U.S. Pipe or approved equal.

1. The lining shall be applied by a certified firm with a successful history of applying linings to the interior of ductile iron pipe and fittings.

2. The method of surface preparation, application, and the number of coats shall all be in accordance with the written instructions of the lining manufacturer.

3. No material shall be used for lining which is not indefinitely recoatable with itself without roughening of the surface.

4. All lined pipe and fittings shall be handled from the outside of the pipe and fittings only. No forks, chains, straps, hooks, etc. shall be placed inside the pipe and fittings for lifting, positioning, or laying.

C. The exterior surface of all pipe and fittings shall have a bituminous coating of coal tar paint. Coal tar paint shall be Koppers “Bitumastic Super-Service Black”, Porter “Tarmastic 103", Tnemec “450 Heavy Tnemecol”, or approved equal. Surfaces to be painted shall be dry and application shall be in accordance with the manufacturer’s specifications and instructions.

D. All ductile iron joints shall be push-on type with rubber gaskets unless otherwise specified.

E. Gaskets shall be SBR (Styrene Butadiene Rubber) and stored in a cool location out of direct sunlight and away from contact with petroleum products. In cold weather, gaskets shall be warmed to facilitate installation.

2.2 COUPLINGS AND SPECIAL FITTINGS

A. Flexible couplings shall be Calder Couplings Strong Back Shielded Couplings or approved equal. All lateral connections to new sewer mains shall consist of wyes or tees and installed in accordance with the plans for a specific depth of connection. All lateral connections to an existing sewer main shall be made with Romac Style CB tapping saddles

B. Stub-out fittings for tapping shall be of the type specified for use with the specific size and type of pipe by the pipe manufacturer. Installation shall be in accordance with the manufacturer’s specifications and as approved by the Manager and/or ENGINEER.

PART 3 EXECUTION

3.1 INSTALLATION

A. Pipe Laying

1. The pipe shall be laid in strict conformity with the prescribed line and grade, with grade bars set and each pipe length checked to the grade line. Three consecutive points on the same rate of slope shall be used at all times to detect any variation from a straight grade. In case any discrepancy exists, the work shall be stopped and the discrepancy immediately reported to the Engineer. In addition, when requested by the Engineer, a string line shall be used in the bottom of the trench to insure a straight alignment of the sewer pipe between manholes. The maximum deviation from grade shall not exceed 1/4" inch.

2. Pipe laying shall proceed upgrade with the bell ends of the pipe placed up stream.

Each section of pipe shall be laid true to line and grade and in such a manner as to form a water tight concentric joint with the adjoining pipe. The interior of the sewer shall be kept clear of all dirt and debris during the work process. Plugs shall be placed in the open end of pipe during all waiting periods in the construction process.

3. Rock shall be excavated so that it is no closer than 6 inches from the bottom and sides of the pipe. The word "rock" in this case refers to large gravel formations where loose cobbles are more than 8 inches in diameter. These cobbles shall be removed from the trench and not included in the backfill.

4. Initial backfill and backfill material shall not have stones and/or rocks larger than 3 inches in diameter within 3 feet of the top of pipe.

5. Pipe shall not be laid when the condition of the trench or the weather is unsuitable. All open ends of sewer pipe and fittings shall be adequately and securely closed whenever the work is discontinued for more than ½ hour.

6. For trenches less than 5 feet deep, the trench width shall be determined as the pipe O.D. + 16".

7. All pipe laying and joining, including the maximum deflection of joints in curved alignment shall be in accordance with the pipe manufacturer's specifications and as directed by the Manager/ENGINEER.

8. All loose material shall be removed from the new trench prior to placing the bedding material.

9. Bedding material shall be imported crushed rock, with at least one fractured face, of which 100 percent shall pass a 3/4 inch sieve and not more than 10 percent will pass the No. 8 sieve.

10. Bedding shall extend at least 4 inches below the invert of the pipe.

11. The bedding shall be shaped to fit the barrel of the pipe and give uniform support throughout its length. Pipe bedding should be excavated from beneath the bell ends or couplings of the pipes so as to avoid any bridging effect. No wedging or support of the pipe with wood or any other type of material than the approved bedding shall be permitted.

12. Initial backfill shall consist of screened native material of which 100 percent shall pass a 3/4 inch sieve.

13. All joint surfaces shall be cleaned before joining the pipes.

14. All necessary precautions shall be taken to prevent uplift or floating of the pipe prior to completion of the backfilling operation. The CONTRACTOR shall assume full

responsibility for any damage due to this cause and shall restore and replace the pipe to its specified condition and grade at no cost to the DISTRICT.

** END OF SECTION **

DIVISION 33 - UTILITIES

SECTION 33 31 23
SEWER FORCE MAIN

PART 1 GENERAL

1.1 DESCRIPTION

A. Section includes: Description of requirements for installation of sewer force main pipe.

1.2 SPECIFICATIONS AND STANDARDS

A. Except as otherwise indicated, the current editions of the following apply to the WORK in this Section:

1.	AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12in.
2.	AWWA C600	Installation of Ductile-Iron Water Mains
3.	AWWA C605	Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings
4.	AWWA C110	Ductile-Iron and Gray Iron Fittings, 3 in. through 48 in.
5.	AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
6.	AWWA C151	Ductile-Iron Pipe, Centrifugally Cast

PART 2 MATERIALS

2.1 PIPE AND JOINTS

A. Polyvinyl Chloride (PVC) Pipe or Ductile-Iron pipe may be used.

1. Polyvinyl Chloride Pipe (PVC) shall be Pressure Class 150 and shall conform to AWWA Standards C900. Outside diameter (O.D.) pipe dimension shall be manufactured to cast iron pipe (CIP) equivalent. Pipe shall be furnished in minimum standard lengths of 20 feet.

2. Ductile-Iron Pipe shall be a minimum Pressure Class 150 and shall conform to AWWA Standards C151. All ductile-iron pipe and fittings shall have an interior lining and an outer coating in accordance with Section 33 11 00.15 of these Technical Specifications.

B. Joints of PVC pipe shall consist of either an elastomeric gasket coupling or an integral bell and spigot with an elastomeric gasket. The joints shall have seal ring grooves or other approved means for positively holding the gaskets in place. The assembly of joints shall be in accordance with the pipe manufacturer's recommendations.

1. Restrained joints between PVC and ductile-iron pipe shall be EBBA PV2000 Mechanical Joint Restraint Gland or approved equal.

C. All ductile iron joints shall be push-on type or mechanical joint with rubber gaskets unless otherwise specified.

1. Gaskets shall be SBR (Styrene Butadiene Rubber) and stored in a cool location out of direct sunlight and away from contact with petroleum products.

2. Restrained joints for ductile-iron pipe shall be wedge-type retainer glands such as EBBA “Megalug” or EBBA “Megaflange” or approved equal.

2.2 TRANSITION COUPLINGS

A. Transitions from asbestos cement pipe to ductile iron or to PVC pipe shall be accomplished by using a transition coupling. Transition couplings shall have interchangeable gaskets of virgin SBR that meets ASTM D2000 and shall be coated with fusion bonded epoxy. Transition couplings shall be Romac Industries, Inc. Style “501" or approved equal.

2.3 PIPE FITTINGS

A. All force main fittings shall be ductile-iron and shall conform to the requirements of AWWA C110. Fittings shall have a minimum pressure rating of 250 psi. Fittings shall have an interior lining in accordance with Section 015090 of these Technical Specifications.

2.4 AIR RELEASE VALVES

A. Sewage air release valves shall be designed to operate while pressurized allowing entrained air in the force mains to escape through the air release orifice without spillage or spurt of sewage and to allow air to enter the force main when draining the line. Valve inlets shall be 2" NPT. The valve body shall be cast iron. The internal linkage and float shall be stainless steel. The air release valve shall be Crispin Model US10SB Universal Sewer Air Valve, as manufactured by Crispin-Multiplex Manufacturing Co., Berwick, PA., or approved equal. The outlets of the valves shall be connected to a 1" SCH 40 PVC vent pipe. Inlet and blowoff valves shall be provided with the air release valves. Backflushing attachments shall be supplied so that the interior body can be flushed periodically for proper operation.

B. Double-strap service saddles or tapping sleeves shall be used for connecting air release valves. Service saddles shall be double strap stainless steel saddles with ductile iron bodies. Bodies shall include a fusion bonded nylon finish to an average thickness of 12 mils. Nuts, studs and washers shall also be type 304 stainless steel. Saddles shall be Rockwell type 315 or approved equal.

2.5 VALVE BOX

A. Boxes for use in non-traffic areas shall be precast concrete with nominal interior dimensions of 17" x 30". Boxes shall have metal lids with bolting mechanisms to secure the lid. Boxes shall be furnished with bolts to secure the lid. Boxes shall be Christy model N36 with B36-61D cover, or approved equal.

B. Boxes for use in areas subject to vehicular loading shall be rated for H-20 loading. H-20 rated boxes shall be precast concrete with nominal interior dimensions of 17" x 30". Boxes shall have metal lids with bolting mechanisms to secure the lid. Boxes shall be furnished with bolts to secure the lid. Boxes shall be Christy model B1730 with B1730-51JH lid, or approved equal.

2.6 PIPELINE MARKING TAPE

A. Pipeline marking tape shall have a minimum thickness of 5 mils and shall be impervious to alkalis, acids, chemicals, and solvents. The tape shall have a 50-gauge solid aluminum foil core laminated between two layers of inert plastic film. The tape shall have a minimum width of three inches and a minimum tensile strength of 100 pounds per 3 inch wide strip. The tape shall be buried approximately one foot below grade over the force main and it shall have imprinted in permanent black ink with 1 inch letters “CAUTION FORCE MAIN BURIED BELOW” on green background.

2.7 LOCATOR WIRE

A. Pipeline locator wire shall be No. 12 AWG solid copper wire with THWN-2 insulation. The tracer wire shall be continuous between access points, no buried splices shall be allowed.

2.8 THRUST BLOCKS AND ANCHOR BLOCKS

A. Thrust and anchor blocks shall be constructed of portland cement concrete with a minimum 28-day compressive strength of 2,000 psi. Maximum aggregate size shall be 1-1/2 inches and maximum slump shall be 4 inches. Air entrainment is not required.

PART 3 EXECUTION

3.1 INSTALLATION

A. Pipe Laying

1. Ductile-iron pipe shall be installed in accordance with AWWA C600. Polyvinyl Chloride (PVC) pipe shall be installed in accordance with AWWA C605.

2. The pipe shall be laid in strict conformity with the alignment specified in the plans.

3. The trench width shall be determined as the pipe O.D. + 16".

4. Pipe laying shall proceed upgrade with the bell ends of the pipe placed up stream. The interior of the force main shall be kept clear of all dirt and debris during the work process. Plugs shall be placed in the open end of pipe during all waiting periods in the construction process.

5. Rock shall be excavated so that it is no closer than 6 inches from the bottom and sides of the pipe. The word "rock" in this case refers to large gravel formations where loose cobbles are more than 8 inches in diameter. These cobbles shall be removed from the trench and not included in the backfill.

6. Pipe shall not be laid when the condition of the trench or the weather is unsuitable. All open ends of force main pipe and fittings shall be adequately and securely closed whenever the work is discontinued for more than ½ hour.

7. All joint surfaces shall be cleaned before joining the pipes.

8. All loose material shall be removed from the new trench prior to placing the bedding material.

9. Bedding material shall be imported crushed rock of which 100 percent shall pass a 3/4 inch sieve and not more than 10 percent will pass the No. 8 sieve.

10. Bedding shall extend at least 6 inches below the invert of the pipe.

11. The bedding shall be shaped to fit the barrel of the pipe and give uniform support throughout its length. Pipe bedding should be excavated from beneath the bell ends or couplings of the pipes so as to avoid any bridging effect. No wedging or support of the pipe with wood or any other type of material than the approved bedding shall be permitted.

12. Initial backfill shall consist of screened native material of which 100 percent shall pass a 3/4 inch sieve.

13. Initial backfill shall be placed in an approved manner so that the pipe rests on a densely compacted bed of approved granular material. Slicing with a shovel tip, tamping with a T-bar, or use of other approved mechanical equipment may be used to compact the material around the haunches of the pipe.

14. All pipes must be anchored or have sufficient material placed on the top of the pipe to prevent the pipe from moving out of line or grade.

15. Where necessary to raise or lower the pipe due to unforeseen obstructions or other causes, the DISTRICT may change the alignment and/or the grades. Such changes shall be made by the deflection of joints or the use of additional fittings. However,

in no case shall the deflection of a joint exceed the maximum deflection recommended by the pipe manufacturer.

** END OF SECTION **

SECTION 33-32-00

SANITARY SEWERAGE EQUIPMENT

PART 1 GENERAL

1.1 DESCRIPTION

A. Work Included: Furnish and install all materials and perform all labor necessary for the complete, tested, and operational submersible sewage pumping station as shown on the plans and herein specified.

1.2 SUBMITTALS

A. Submittals required under this Section shall be in accordance with Section 013300 of the General Requirements.

B. Shop Drawings: Submit shop drawings for approval of the pumps and related equipment specified in this section.

1. Certified shop and installation drawings and data regarding pump and motor characteristics and performance. The data shall include performance curves, based on actual shop test, for head, capacity, efficiency, and horsepower.

2. Motor data and motor performance curve showing torque, current, HP input, HP output, efficiency, and power factor.

3. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and parts lists. Operation and maintenance manuals shall be provided.

PART 2 PRODUCTS

2.1 SEWAGE PUMPS

A. Pumping Station

1. Two, single-stage submersible, non-clog centrifugal pump/motor units shall be supplied and installed in the pumping station.
2. Submersible sewage pumps shall be installed in a circular precast concrete wet well as described in Part 2.02 of this Section.

B. Pump Performance:

1. The pumps shall be submersible, centrifugal, Flygt NP 3171 SH 3~275, 4", 195 mm impeller, 35 HP 3500 RPM motor. The pumps shall have the pump/flow characteristics as shown on the following Performance Data table. The pumps shall be equipped with 2" guide rail brackets to allow the pumps to be used with the 2" stainless steel guide rails. Each pump shall be capable of pumping at full speed the specified conditions as described below in the table. Characteristics shall meet the following conditions:

Full Speed Performance Data	Requirements
Number of Pumps	2
Phase 1: Operating Point @ Full Speed	377 gpm@ 183 ft TDH
Pump Speed, rpm	3500
Motor Horsepower, HP	35
Voltage, volts/Phase	460/3
Min. Pump Efficiency	45%
Pump Discharge Size	4"
Min. Spherical Solids Handling Size	3"
Impeller Diameter, mm	195
Motor Frame	284T

C. Pump Construction

1. The pump system including the pump, motor and power cable shall be approved for use in areas classified as hazardous locations and shall be FM and CSA Certified as Class I Group C&D Div1 Explosion-Proof with a T4 temperature rating.

2. Each pump shall be capable of handling raw, unscreened domestic sewage consisting of water, fibrous materials, and up to 76mm (3-inches) diameter spherical solids. The pump(s) shall be capable of handling liquids with temperatures to 40 degrees C continuous, 70 degrees C intermittent. Bearings shall be oil-lubricated and designed for 50,000 hours operating at minimum flow. Product shall be furnished with oil filled Inverter Duty Motors per NEMA MG-1, Part 31 with stator winding of the open type with Class H spike resistant magnet wire and a minimum 1.2 service factor.

3. The volute, seal plate, adapter, motor housing and motor housing cap shall be constructed of high quality, ASTM A-48 Class 30 cast iron. Impeller shall be

furnished in ASTM A-536 ductile iron with a keyed, tapered shaft bore. Pump (s) shall be coated with two coats of DuPont Corlar® amido amine modified polymer satin gloss epoxy with a total 10 mil minimum thickness in the manufacturer's standard color. All exposed hardware shall be 300 series stainless steel including the lifting bail. The pump construction shall contain no points of critical clearance nor require periodic adjustment or replacement to maintain operating efficiency. Discharge connection shall be a standard 125 pound 4 inch flange, slotted to accommodate 4" ANSI or 100mm ISO flanges. The pump shaft shall be 416 stainless steel with a tapered impeller fit to reduce rotor imbalance and minimize stress risers associated with stepped shafts. All gaskets shall be of the angular gland compression o-ring type eliminating critical slip fits and the possibility of damage during service associated with sliding o-ring sealing arrangements.

The impeller shall be of a single vane design with pump out vanes on the back side. The impeller shall be dynamically balanced to ISO G6.3 specifications. The matching volute shall be provided with a replaceable bronze wear ring at the inlet.

4. The tandem mechanical shaft seals shall be of the single spring design operating in an intermediate oil-filled seal cavity. Pump-out vanes in the back of the impeller shroud shall be large enough to efficiently expel solids away from the seal area. The materials of construction shall be silicon carbide vs. silicon carbide for the pump-end seal and carbon vs. ceramic for the motor-end seal, lapped and polished to a tolerance of one light band, 300 series stainless steel hardware, and Buna-N elastomeric parts. The pump-end seal shall be pinned in place to prevent rotation of the stationary seat and shall seal to the pump housing via an o-ring to maximize heat transfer. Cup mounted seats shall not be considered equal. The seal shall be commercially available and not a pump manufacturer's proprietary design. A moisture sensor detection system consisting of two probes shall be integrated within the oil-filled seal chamber which is isolated from the motor chamber. Units sensing moisture within the motor chamber are not considered acceptable. Moisture sensing devices utilizing one probe and grounding through the pump case or utilizing a float device are not acceptable. The leads for the moisture detector shall be contained within the power cable.

5. The pump shaft shall be of 416 stainless steel, keyed and tapered for the matching impeller. The lower bearing shall be of the double row ball type, locked in position to accept radial and axial thrust loads, and the upper bearing of the single ball type for radial loads. Bearings shall operate in an oil bath environment for superior lubrication, cooling and life.

6. The pump motor shall be sized to be non-overloading throughout the entire pump curve. The rotor and stator assembly shall be of the standard frame design and the stator pressed into the motor housing for mechanical stability. The motor

shall be constructed with the windings operating in a sealed environment containing clean dielectric oil. Manufacturer to supply submergence requirements for continuous operation.

Motors shall be dielectric oil filled for optimal thermal management and maximum bearing life. Air-filled motors with grease-filled bearings shall not be acceptable. The motor windings shall be of Class H, spike-resistant insulation. The motor shall meet the NEMA Design B standard and be Inverter Duty Rated per NEMA MG1, part 31.

7. Three thermal sensors (one per phase) shall be embedded in the end coil of the stator windings, wired in series and used to monitor stator temperatures. This shall be used in conjunction with an external motor overload protection device and wired to the control panel through the single power cable.

   The pump shall be equipped with (15/22/30) m. of a CSA-qualified submersible power cable constructed in accordance with type W guidelines and shall include the moisture and temperature sensor leads. For 30 kW and less, the cable entry system shall consist of a voltage-selectable expanding rubber plug held in place by a cast stainless steel plate indicating voltage and max amps. For higher kW, cord connection shall be through a flared stainless steel compression plate and a double gland with an internal stress relief bracket to a terminal strip for easy connection without opening the motor enclosure.

8. All nuts and bolts exposed to sewage or corrosive atmosphere shall be Type 316 stainless steel.

9. Guide rails and bases shall be an integral part of the pumping unit and the pump casing shall have a machined flange to connect with the discharge connection. Discharge connection shall be bolted to the floor of the wet well and so designed as to receive the pump-connecting flange without the need of any bolts, gaskets, or nuts. The guide rails shall be Schedule 40 stainless steel, 2 inches in diameter. The discharge elbow shall be no less than 4-inches and connect to the 6-inch force main (above ground) via a reducer as needed.d

D. Pump Accessories

1. Pump station shall be provided with the following accessories, installed as shown on the plans or as recommended by the pump manufacturer:

   a. Access cover, size, and reinforcement as shown on the plans and specified herein.
   b. Two 2-inch guide rails per pump (stainless steel).
   c. Upper guide bar brackets (stainless steel).

d. Intermediate guide bar brackets (stainless steel).
e. Safety cable hooks (stainless steel).
f. Cable holders (stainless steel).
g. Cable support grips (stainless steel).
h. Anchor bolts, Type 316 (stainless steel).
i. Redundant Off Float, Redundant On Float & Redundant High Water Alarm Float as specified in Section 26-89-00.
j. Reactive Air System and Level Sensor as specified in Section 26-89-00

2.2 WET WELL

A. Wet Well

1. Wet well shall be precast concrete manhole in conformance with Section 03 01 00 Manholes and Appurtenances of these Technical Specifications. Manhole components shall conform to ASTM C-478 and AASHTO M-199. Flat tops and base slabs shall be designed for H-20 traffic loading. Wet well shall be minimum 120" inside diameter and 142" outside diameter (11" walls). The wet well interior shall be coated with an epoxy or resin coating system in conformance with Section 09 90 00 Protective Coatings of these Technical Specifications. Wet well manhole components shall be as manufactured by Jensen Precast or approved equal.

2. Wet well top slab shall be precast concrete with access hatch frames embedded. The underside of the top slab, interior to the wet well, shall be coated with an epoxy or resin coating system in conformance with Section 09 90 00 Protective Coatings of these Technical Specifications. Wet well access hatches shall be Occupational Safety and Health Act (OSHA)-compliant aluminum or steel non-skid deck plate with powder-coated, non-reflective finish reinforced to support American Association of State Highway and Transportation Officials (AASHTO) H-20 loading. Access hatches shall be provided with spring-assist as necessary such that no more than 50lb force is required for opening any hatch door. Wet well access shall include fall protection grates, and shall be provided with a recessed lock box. Safety netting will not be allowed at any wet well. All hardware and mounting brackets inside the wet well shall be stainless steel minimum grade 316.

   The wet well base shall be precast concrete, and shall be sized to provide resistance to buoyancy forces associated with a groundwater level elevation equal to the finished grade elevation. A minimum 12-inch-thick layer of aggregate base shall be used for bedding underneath the base, or as appropriate for the geotechnical conditions at the site.

A. Classifications

1. The interior wet well space and limited exterior space around vents and openings shall be classified as Class 1, Division 1 hazardous areas per NFPA 820. All equipment located within these Class 1 Division 1 spaces shall be approved for hazardous classification and shall be explosion-proof. Conduits from the wet well shall be sealed at an above grade sump termination panel (Tessconnex or equal) mounted on the exterior of the electrical control building. No conduits shall connect the wet well with any control panel without an explosion-proof seal.

B. Calculations

1. The wet well supplier shall submit calculations and information providing dimensions, weights, and reinforced concrete collar/footing dimensions required such that buoyant uplift can be prevented. Weight of the wet well plus the submerged weight of the backfill and collar/footing must be greater than, or equal to, 115 percent of the buoyant uplift when empty. The weight of the pumps cannot be included in the calculations.

2.3 ODOR CONTROL

A. The wet well shall have installed a 4-inch diameter Schedule 80 PVC vent pipe along with a 3-inch galvanized steel vent stack with odor control unit attached as shown on the Drawings. The vent stack odor control unit shall be an Orenco Systems Model CF3.

2.4 OVERFLOW TANKS

A. Four overflow storage tanks shall be installed as shown on the Drawings. The overflow tanks shall be double-wall fiberglass tanks. The size of the tanks shall be nominal 10,000 gallon capacity, 8-foot diameter (O.D.) and approximately 31'-6.5" in length. Tanks shall include two 30" nominal access openings as shown and the tanks shall include a 4-inch vent which are connected between the tanks and connected to wet well air filter as shown. The tanks shall have two 6" diameter FRP flanged inlet and outlet fittings with bottom support as shown on the drawings. Each tank shall include a concrete deadman anchoring system including turnbuckles and hold down straps as supplied by the manufacturer. The tanks shall be as manufactured by Xerxes Corporation, or approved equal. Local contact for Xerxes Tanks is: (David Holmes, Xerxes Corporation, 7 Glenoak Ct, Chico, CA 95926; Office: 800-661-8265, Mobile: 530-864-0438).

B. Handling, Installation and Testing of Fiberglass Overflow Tanks. The fiberglass overflow storage tanks shall be installed as detailed in the Xerxes Installation Manual and Operating Guidelines. Xerxes fiberglass tanks shall be installed using either pea gravel or crushed stone as backfill material as detailed in their installation manual. Tank spacing and the installation of deadman anchors shall be installed in accordance with Xerxes Instruction Manual.

PART 3 EXECUTION

3.1 INSTALLATION

A. Equipment and accessories shall be installed in accordance with approved written procedures submitted with the shop drawings, and as indicated on the drawings, secure in position and alignment, and neat in appearance.

3.2 INSPECTION AND TESTING

A. After installation but prior to acceptance of the pumping equipment, each unit shall be given a running test during which it shall demonstrate its ability to operate within vibration limits and without overheating and to meet the performance data listed herein. Tests shall include electrical, head and discharge measurements sufficient to duplicate the head-discharge and efficiency curves submitted with the shop drawings. The CONTRACTOR shall submit a test plan to the ENGINEER for approval prior to final performance tests.

B. The pump manufacturer shall perform the following inspections and tests in accordance with Hydraulic Institute type B standards before shipment from the factory:

1. A check of the motor voltage and frequency shall be made as shown on the name plate.
2. A motor and cable insulation test for moisture content or insulation defects shall be made per CSA and FM criteria.
3. The pump shall be run to determine that the unit meets five pre-determined hydraulic performance points.
4. A performance curve from the production line test showing head versus flow shall be included in the Installation and Operation Manual shipped with each pump.
5. A written report shall be available showing the aforementioned tests have been performed in accordance with the specifications.

C. START-UP: The pump(s) shall be tested at start-up by a qualified representative of the manufacturer. A start-up report as provided by the manufacturer shall be completed before final acceptance of the pump(s).

D. After installation but prior to acceptance of the pumping equipment, each unit shall be given a running test during which it shall demonstrate its ability to operate within vibration limits and without overheating and to meet the performance data listed herein. Tests shall include electrical, head and discharge measurements sufficient to duplicate the head-discharge and efficiency curves submitted with the shop drawings.

E. The CONTRACTOR shall submit a test plan to the ENGINEER for approval prior to final performance tests.

All defects revealed by the tests shall be corrected at the CONTRACTOR'S expense and the tests shall be repeated until satisfactory results are obtained.

F. Sewer mains, manholes, and appurtenances shall be tested in accordance with the LOAPUD Standards.

G. The CONTRACTOR shall furnish all labor, piping, equipment, pressure gauges and materials necessary for conducting the tests, including necessary clean water.

3.3 TRAINING

A. A factory representative who has complete knowledge of proper operation and maintenance of the equipment furnished shall be provided for one (1) working day to instruct representatives of the DISTRICT on the proper operation and maintenance of the equipment. The instruction may be done at the same time as the inspection of the installation and test run, provided the test is successful, and the operating and maintenance instructions furnished have been approved by the ENGINEER.

END OF SECTION

SECTION 33 33 00
VALVES AND APPURTENANCES

PART 1 GENERAL

1.1 SCOPE OF WORK

A. This section includes technical specifications for all valves and appurtenances to be furnished and installed in the project as shown on the plans, and as necessary for quality completion of the project, whether shown on the plans or not.

1.2 RELATED WORK

A. Section 330501 Piping and Accessories
B. Section 333200 Sanitary Sewerage Equipment

1.3 STANDARDS

A. All materials included in this section shall be new, quality materials and shall conform to all applicable specifications of ASTM and AWWA Standards.

B. All installation, methods and workmanship shall conform in all respects to the above referenced standards as applicable and to the product manufacturer's recommendations.

PART 2 SUBMITTALS

A. Submittals for all equipment and products under this Section are required.

B. Furnish manufacturer's installation and operation manuals for all products.

PART 3 MATERIALS

3.1 GENERAL

A. All valves shall conform to their respective AWWA Standards.

3.2 GATE VALVES

A. Gate valves for buried installations, 4-inches and larger, shall comply with AWWA C515. Gate valves shall open with counter clockwise rotation of the handwheel. Buried valves and valves located in vaults shall have non-rising stem with 2-inch operating nut, turning counterclockwise to open, with the "Open" and an arrow cast in the metal to indicate the direction to open. The body, bonnet and stuffing plate shall be coated with fusion bonded epoxy, applied in accordance with AWWA C550. Gate valves 3" and larger shall be M&H Series 7000 or approved equal.

3.3 CHECK VALVES

A. Swing check valves shall be swing lever and weight type with a high strength cast iron body with reinforced ANSI B 16.1/125# flanges, with a resilient Buna-N disc seat. The pivot shaft shall be stainless steel and all internal components shall be replaceable in the field without removing the main valve from the pipeline. Swing check valve shall be Kennedy Swing Check Valve, or approved equal.

3.4 PLUG VALVES

A. Plug valves shall be eccentric, quarter turn plug valves with fusion bonded epoxy coated ductile iron body, stainless steel bushing, PTFE washer, EPDM O-Ring, BUNA-N coated ductile iron plug, ductile iron bonnet, and stainless steel bolts and washers. The plug valve shall have a nickel welded seat and shall be designed in compliance with ANSI/AWWA C517 and coated with NSF/ANSI 61 fusion bonded epoxy. The plug valve shall be Class 150# ANSI B16.5 flanged ends. The plug valve shall have a 2-inch operating nut. The plug valve shall be Flomatic 5400 Series Flo-E-Centric , or approved equal.

3.5 AIR RELEASE VALVE

A. Wastewater air release valve shall be automatic float operated valve designed to release accumulated air from a piping system while the system is in operation and under pressure. The body shall have 2” NPT connection and ¼” ball valve drain.

The wastewater air release valve shall be a 2-inch valve as manufactured by A.R.I. Optimal Flow Solutions #S-025 Automatic Air Release Valve.

3.6 PRESSURE GAUGES

A. See Specification Section 26-89-00-2.2

3.7 LINK SEAL

A. All pipe penetrations through the wet well and valve vaults (cast or core-drilled penetrations) shall be sealed with a modular seal. The seal shall be Link-Seal Model S-316, or approved equal. The seal element shall be EPDM and all nuts and bolts shall be 316 stainless steel.

3.8 RESTRAINED FLANGE COUPLING ADAPTER (RFCA)

A. Requirements:

1. Adapter shall be manufactured of ductile iron conforming to ASTM A536-80.

   a. The adapter shall be such that it can connect plain end pipe to flanged pipe or fitting with a restrained joint.

b. Adapter shall use twist off nuts, sized same as tee-head bolts.

c. The adapter shall have a pressure rating equal to that of the pipe on which it is used.

d. The restrained flanged coupling adapter (RFCA) shall be specifically recommended for use with the pipe material being connected to.

B. Manufacturers: the following or approved equal

1. Romac Industries, Inc.

Ductile Iron Pipe: RFCA

PVC Pipe: RFCA-PVC

PART 4 INSTALLATION

4.1 GENERAL VALVE ASSEMBLIES

A. Pipeline valve assemblies shall be installed in accordance with the manufacturer's recommendations, AWWA C600, and these technical specifications. Valves shall be laid in sequence with adjacent pipe and fittings. Pipe ends shall be cut where required to create a tight, flush fit against the valve shoulder.

B. All buried valves shall be furnished with valve boxes in accordance with details shown on the Plans. The box and extensions shall be centered over the valve operating nut and perpendicular to the valve centerline. The box and extensions shall be placed so as not to transmit any shock or stress to the valve or adjacent pipe. Backfill shall be carefully tamped around each valve box and extension to the undisturbed trench face.

** END OF SECTION **

SECTION 26 00 00
GENERAL ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. All general provisions of the Contract Documents apply to all work specified in this Division 26 Electrical.

B. Furnish all necessary labor, materials, equipment and incidentals required to install a complete and operational electrical system according to the intent of this specification and the accompanying drawings, whether itemized or not.

C. Examine the specification and drawings for mechanical equipment and provide all starters, circuit breakers, switches, pushbuttons and appurtenances, which are not specified to be with the mechanical equipment. Erect all electrical equipment not definitely stated to be erected by others, furnish and install conduit, wire and cable and make connections required to place all equipment in complete operation.

D. Where mechanical and process equipment is provided with specialty protective relays, the relays shall be incorporated into the controls at no additional cost to the Owner.

E. The general extent of the electrical work includes, among others, the furnishing and installing of the following items:

1. Service enclosure, panelboard, motor controllers and disconnects.
2. Control panel, autodialer and instrumentation.
3. Transfer switch and generator.
4. Complete circuiting and connections for all motors, including their remote control and indicating devices.
5. All supports, bases, anchors, sleeves, hangers, conduit seals, and the like, all electrical work shown and/or specified, not particularly mentioned above.
6. Complete grounding system.
7. Significant documentation, including submittal, instruction, operations and maintenance manuals.
8. Significant field services including pre-start-up check-out, testing, calibration, start-up, communications testing and training.
9. Conduit, Fittings and Conductors.
10. Power, control, alarm, and instrumentation wiring for all equipment specified in Divisions 22 and 26.

F. Throughout this Contract, provide protection for materials and equipment against loss or damage in accordance with provisions elsewhere in these Contract Documents. Throughout this Contract, follow manufacturer's recommendations for storage. Protect everything from the effects of weather. Prior to installation, store items in clean, dry, indoor locations. Store in clean, dry, indoor, heated locations items subject to corrosion under damp conditions, and items containing electrical insulation, such as transformers, conductors, motors, and controls. Energize all space heaters furnished with equipment. Provide temporary heating, sufficient to prevent condensation, in transformers, pedestals, switchgear, switchboards, motors, and motor controls, which do not bare space heaters.

G. Following installation, protect materials and equipment from corrosion, physical damage, and the effects of moisture on insulation. When equipment intended for indoor installation is installed at the Contractor's convenience in areas where it is subject to dampness, moisture, dirt, or other adverse atmosphere until completion of construction; ensure that adequate protection from these atmospheres is provided that is acceptable to the Construction Manager. Cap conduit runs during construction. Energize all space heaters furnished with equipment.

H. All temporary wiring for the motors and equipment shall have disconnect means, overcurrent protection, and conduit or metal wireways as required by the National Electrical Code, except that jacketed flexible cables may be exposed on equipment.

I. Provide an experienced field supervisor to monitor work progress and to attend regular project meetings. Reference the General Conditions for specific requirements.

J. Removal of Salvaged Material: Use reasonable care in removing salvaged electrical material to avoid all unnecessary damage. Handle equipment to be removed and salvaged with special care to avoid damage of any nature. Repair any unnecessary damage to salvaged equipment at the Contractor's expense. Deliver all such material to the DISTRICT's storage area, and neatly stockpile as directed.

K. The work includes significant documentation, engineering, start-up services and training. Review the specific requirements throughout Division 26 with due diligence.

1.2 CODES AND STANDARDS

A. All Work shall conform to the following codes:

1. National Electrical Code - Latest Edition
2. NFPA 70E – Electrical Safety
3. NFPA 101 - Life Safety Code - Latest Edition
4. Uniform Building Code - Latest Edition
5. Local Electrical Code
6. NETA Standards for Testing

7. Any additional codes enforced at the job site

B. The Contractor shall furnish without extra charge any additional material and labor which may be required for compliance with these laws, rules, and regulations, even though the work is not mentioned in these particular specifications or shown on the drawings.

C. The Contractor shall apply and pay for all permits required by any of the legally constituted public authorities for the installation or construction of the work included under this Division. The Contractor shall arrange and pay for any inspections or examinations so required and deliver certificates of all such inspections to the Engineer. When these specifications call for materials or construction of a better quality or larger sizes than required by the above mentioned rules and regulations, the provisions of the specifications shall take precedence.

1.3 ARC FLASH ANALYSIS AND SIGNAGE

A. Any circuits or equipment, on the site, fed from a utility service shall have an arc flash analysis performed. The arc flash analysis shall be based on based on calculations performed per 1584a standards published by the IEEE 1584 working group. The worst case Incident Energy released shall be determined and boundaries shall be marked for Arc Flash Protection. Markings and hazard signage and labels shall conform to OSHA 29 CFR 1910 132(d) and other applicable requirements. Working distances, required PPE Level, shock hazard voltage and limited, restricted and prohibited approach distances shall be posted. The arc flash hazard analysis shall utilize results from a short circuit study and from a protective device co-ordination study. All study results shall be presented in a bound report with all assumptions, methodology, equipment lists with component ratings, electrical one-lines used, calculations and resulting requirements.

B. Submit a short circuit study adequate to support the arc flash analysis and the coordination study.

C. Submit protective device coordination study with recommended coordinated settings for adjustable breakers with a check list for confirming implementation.

D. Submit label for review by DISTRICT prior to affixing to the equipment.

1.4 QUALITY OF MATERIALS

A. All electrical materials used on this project shall be new and free from defects.

B. All electrical materials used on this project shall conform where applicable, to the following standards, unless otherwise noted:

1. NEMA - National Electrical Manufacturers Association

2. ANSI - American National Standards Institute

3. UL - Underwriters Laboratories, Inc.

C. Each type of material shall be of the same manufacturer and quality throughout

the work.

1.5 SUBSTITUTIONS

A. Specific brand names and catalog numbers are used to describe materials in order to establish standards of performance and quality or to match existing equipment. Refer to Section 01 33 00 regarding the procedure for submitting substitutions.

B. The decision of the Engineer shall govern as to what is equal to the item specified. Equality will be judged on the basis of the following:

1. Conformance with description or performance required.
2. Equal in quality.
3. Comparable in appearance and artistic effect where these are considerations.
4. Comparable operation, maintenance and performance.
5. Equal in longevity and service under conditions of climate and usage.
6. Conformance with space allocations and requirements for operations from mechanical or electrical services provided without necessitating changes in details and construction or related work.
7. Compatible with existing equipment and spare parts stock.

C. If the Engineer considers it necessary, tests to determine the quality of the proposed materials shall be made, at the expense of the Contractor, by an unbiased laboratory, satisfactory to the Engineer.

D. Any material, article, or method judged by the Engineer equal to that specified will be approved, provided the Contractor submits a single written request, in triplicate, to the Engineer, within 45 days after contract award, with the following information for each item:

1. Name of manufacturer or supplier.
2. Trade or brand name.
3. Type, model, style, and/or catalog number.
4. Size or capacity rating.

E. The Contractor assumes full responsibility for including complete, correct data in this one request and shall also attach completely referenced diagrams descriptive and technical data sheets for the Engineer's determination of equality or suitability of appearance of any substitution item. Only one such request may be submitted. The Engineer's rejection of any substitute shall automatically require the Contractor to furnish the specified item without further discussion or delay.

1.6 MATERIAL, EQUIPMENT AND SHOP DRAWING SUBMITTALS

A. Submittals shall be prepared in accordance with General Conditions, Section 01 33 00.

B. The following information shall be clearly marked on each shop drawing, catalog data sheet, specification sheet, etc. submitted:

1. Project Title.
2. Date.
3. Submitted By.
4. Identification of item represented.

C. Shop drawings shall be drawn to scale or completely dimensioned and shall give all information required to completely describe the item. Shop drawings of switchboards, panels, and motor control centers shall all be submitted on 11" x 17" or 24" x 36" size sheets at one time. 8-1/2" x 11" sheets will not be accepted. Drawings shall show front views, plan views, elementary wiring diagrams and numbered terminal blocks. Drawings shall be submitted for existing equipment requiring modifications as called for on drawings.

D. The Contractor shall carefully check all his shop drawings for compliance with this Specification and the Plans.

E. In the event that certain shop drawings are rejected by the Engineer, they will be so noted and returned to the Contractor for resubmittal. Resubmittals are to be made within 14 days.

F. If the shop drawings show variation from the contract requirements because of standard shop practice or other reasons, the Contractor shall make specific mention of such variations in order that if acceptable, suitable action may be taken for proper adjustment of the Contract. The Contractor will not be relieved of the responsibility for executing the work in accordance with the Contract, even though the shop drawings have been reviewed.

G. The Engineer's review of shop drawings will be for general design and arrangement only, and shall not relieve the Contractor from responsibility for errors of any sort in shop drawings or schedules. The Contractor shall verify all dimensions and job site conditions affecting the work, and shall be responsible for furnishing and installing the proper materials required by the Contract, whether or not indicated on the shop drawings.

H. Work requiring shop drawings shall not be started before receipt of the Engineer's written approval.

I. Provide complete interconnection wiring diagrams. Interconnections drawings shall show for each piece of equipment and all wiring between all devices, panels, cabinets, terminal boxes, control equipment, motor control centers and any other devices and equipment including equipment provided in other Divisions of the Specifications as well as equipment provided by the DISTRICT. Each inter-connection diagram shall show the following as a minimum: each conduit number, wire label, wire color code and terminal number, as actually installed; each motor, starter, cubicle, disconnect, switch, panel, cabinet, instrument, device, and all other equipment; and grounding points.

J. Commercial Warranties: Pursuant to the General Provision of the contract, prior to final payment, the Contractor shall furnish to the Engineer a listing of all manufacturers of their materials and equipment. The list of these warranties must include the time period of each warranty, i.e. 6 months, 1 year, and the like. One copy each of those warranties whose time period exceeds 1 year shall be submitted with the listing.

K. Submit seismic calculations for the anchor systems for each item specified herein which weighs in excess of 400 pounds (wet, or operating weight). Calculations shall include seismic horizontal and vertical forces as well as dead load or live load calculations, as applicable. Calculations shall include details, which show size and material of anchor bolts, spacing requirements, grout and filler specifications, strap material, spacing and fastening requirements, and any miscellaneous information required to properly secure the item of equipment. Calculations shall be stamped by a Structural Engineer registered in the State of California.

L. Submit a single complete package for all products on the following list:

1. Conduit, fittings, supports, conductors, vaults and boxes.
2. Service meter enclosure, panelboard, transformer, motor controllers and disconnects.
3. Generator and transfer switch.
4. Light fixtures, receptacles and switches.
5. Control panel including instruments.
6. Seismic Calculations and anchor recommendations.
7. Arc Flash Analysis and Signage with short circuit study, protective device coordination study and circuit breaker settings.

1.7 OPERATION AND MAINTENANCE MANUALS:

A. The CONTRACTOR shall provide an Operation and Maintenance manual in pdf file format on a disk prior to completion of the Work. Provide hard copies for training. The hard copy manuals shall be bound and covered and be 9 inch by 12 inch in size. Provide a table of contents and one section for each item of equipment specified herein. All pages shall be nearly assembled and fit within the manual cover.

B. For each section provide the following information, as applicable:

1. An itemized list of all data provided.
2. Name and location of the manufacturer, the manufacturer's local representative, the nearest suppliers, and spare parts warehouse.
3. Recommended installation, adjustment, start up, calibration, and troubleshooting procedures.
4. Recommended lubrication, lubrication intervals, and an estimate of yearly

quantity needed.

5. Recommended step-by-step procedures for all modes of operation.
6. Complete internal and connection wiring diagrams.
7. Recommended preventive maintenance procedures and schedule.
8. Complete parts lists, by generic title and identification number, with exploded views of each assembly.
9. Recommended spare parts and special tools.
10. Disassembly, overhaul, and reassembly instructions.
11. All approved shop drawing information pertinent to facility operation and maintenance.
12. Equipment calibration data, calibration sheets including equipment/instrument description.
13. Approved submittal information.

C. Record (as-built) submittal information covering all Contractor supplied equipment.

D. As-built drawings, containing complete wiring diagrams, shall be submitted with the Operation and Maintenance manuals described above.

E. As built Contract Documents Drawings shall be marked with red pencil to show electrical work revisions and actual routes of embedded or buried conduit, which may differ from the Drawings. Refer to the General Conditions for additional requirements.

F. Test results/reports shall be contained within the Operation & Maintenance manual and shall be placed under each respective equipment item tested.

1.8 AS BUILT RECORD DRAWINGS

A. The Contractor shall keep an accurate legible record of all changes and conduit relocations made during construction and shall make up a separate legible record copy of Contract Drawings at completion of the project. A working copy of as-built drawings shall be maintained on site at all times during construction.

1.9 INTERPRETATION OF DRAWINGS

A. Any error or omissions of detail in either the drawings or the specifications shall not relieve the Contractor from correctly installing all materials necessary for complete and operating electrical system.

B. The Contractor shall inspect the site and verify all measurements and conditions and shall be responsible for the correctness of same. No extra compensation will be allowed because of differences between work shown on the drawings and measurements at the site.

C. The electrical drawings are diagrammatic, but shall be followed as closely as existing conditions and work of other contractors will permit. All deviations from

the drawings required to make the work conform to structures as constructed, and to the work of others, shall be made at the Contractor's expense.

D. The Contractor shall examine the civil, structural, mechanical, architectural and manufacturer's drawings for the various equipment in order to determine exact routing and final terminations for all conduits and cables. Conduits shall be stubbed up as near as possible to equipment enclosure.

1.10 LOCATIONS AND ENCLOSURES

A. Provide equipment, materials, and wiring methods suitable for the type of locations in which they are located.

B. Definitions of types of locations and types of enclosures to be provided:

1. Dry locations: All indoor areas that do not fall within the definitions below for wet, damp, hazardous, nor corrosive locations and which are not otherwise designated on the drawings. Provide NEMA 1A or NEMA 12 enclosures.

2. Wet locations: All locations exposed to the weather, whether under a roof or not, unless otherwise designated on the drawings. Provide NEMA 3R enclosures.

3. Damp locations: All indoor [or outdoor] spaces wholly or partially underground, or having a wall or ceiling forming part of a channel or tank, over or near water areas, or any area subject to water spray, unless otherwise designated on the drawings. Provide NEMA 4X (SS) enclosures.

4. Corrosive location: Provide NEMA 4X (non-metal) enclosures.

5. Hazardous locations: NEMA 7 rated enclosures.

6. Below grade locations: All electronic or otherwise equipment sensitive to moisture or flooding shall be mounted in a NEMA 6P rated enclosure.

1.11 MATERIAL AND EQUIPMENT INSTALLATION

A. All equipment shall be located and installed so that it will be readily accessible for operation and maintenance. The OWNER reserves the right to require minor changes in location of outlets or equipment, prior to roughing in, without incurring any additional costs or charges.

B. All electrical equipment and appurtenance facilities, which are separately mounted or anchored, shall be so installed as to be in conformance to all requirements of the Uniform Building Code, latest edition, both for vertical and seismic loading. Provide housekeeping pads for floor or pad mounted equipment.

C. Follow the manufacturer's installation recommendations unless otherwise indicated. Keep copy of the manufacturer's installation instructions available on the job site for review at all times.

1.12 SEISMIC REQUIREMENTS

A. All electrical, mechanical, and instrumentation equipment and appurtenant

facilities which are separately mounted or anchored shall be so installed as to be in conformance to all requirements of the California Building Code, both for vertical and seismic loading. This requirement applies, but is not limited to, such items as light fixtures, electrical and instrumentation panels, tanks, pumps, piping, pipe supports and hangers, generator, motors, fans, ventilating ducts and equipment, and other similar equipment or facilities in excess of 400 pounds.

B. All components of this facility shall be considered essential for the purpose of determining seismic force values. The seismic zone shall be considered Zone 4 for this project.

1.13 UTILITY COORDINATION

A. Coordinate the new electrical service.

B. The Contractor shall pay all costs for utility work shown on the Plans and described in the Specifications. The Contractor shall coordinate the completion of forms, even where the DISTRICT is filling out the majority of the form. The Contractor is responsible for providing trenching, conduit, concrete encasement, risers, primary and secondary conductors, medium voltage terminations, transformers, transformer pads, pullropes, poles, pull sections and meters per base requirements. The Contractor is responsible for coordinating inspections, site visits and all paperwork to completion.

C. Provide temporary power during construction. Remove temporary power equipment at end of the project.

1.14 CUTTING AND PATCHING

A. Do not cut or notch any structural member or building surface without specific approval of the Engineer. Carefully carry out any cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, paving, or other surfaces required for the installation, support, or anchorage of materials and equipment. Following such work, restore surfaces neatly to new condition using skilled craftsmen of the trades involved, at no additional cost to the DISTRICT.

1.15 INSPECTION

A. The Contractor shall cooperate with the Engineer and shall provide assistance at all times for the inspection of the electrical work. Remove covers, operate machinery, or perform any reasonable work, which in the opinion of the Engineer, will be necessary to determine the quality or adequacy of the work.

B. If any material does not conform with these specifications the Contractor shall, within three days after being notified by the Engineer, remove the materials from the premises.

C. Work shall not be closed in or covered before inspection and approval by the Engineer. Cost of uncovering and making repairs where uninspected work has been closed in shall be borne by the Contractor.

1.16 SUPERVISION AND WORKMANSHIP

A. The Contractor shall employ a competent electrical foreman on the job throughout

the entire period of construction to see that his work is carried on without delay and completed as rapidly as possible.

B. Before the start of construction and in conjunction with the schedule of other Contractors, the Electrical Sub-Contractor shall furnish to the Engineer a tentative construction schedule showing the order of the work, the pedestal and control panel shop drawings submittal dates, scheduled manufacturing dates, and the anticipated delivery dates.

1.17 COOPERATIVE WORK WITH OTHERS

A. The Contractor shall cooperate with others, with due regard to their work, towards promotion of rapid completion of project. If any cooperative work must be altered due to lack of proper supervision of such, or failure to make proper provision in time by Contractor, then he shall bear expense of such changes as necessary to be made in work of others.

B. Labor and materials, including templates, sleeves, anchors, concrete inserts and the like shall be furnished in ample quantities at such times as necessary to ensure uninterrupted progress of work.

C. Contractor shall cease work at any particular point temporarily and transfer his operations to such points or execute such portions of work as directed, when in the judgment of the Engineer it is necessary to do so.

PART 2 PRODUCTS

2.1 ANCHORS AND FASTNENERS

A. Fasteners and anchors for securing equipment to walls, floors and the like shall be stainless steel. When fastening to walls, floors, and the like, provide capsule anchors, not expansion shields. Size capsule anchors to meet load requirements.

B. Where seismic calculations have been submitted and approved, provide recommended fasteners and anchors.

C. Where manufacturer provide specialty braces to meet seismic requirements for their equipment, install the braces per the manufacturers' recommendations.

2.2 EQUIPMENT IDENTIFICATION

A. All panelboards, motor contollers, control panels, internal control panel components, all disconnect switches and circuit breakers, transformers, push buttons, controls, instruments, boxes, etc. shall be properly identified with a descriptive nameplate. Nameplates shall be made of 1/6 inch laminated plastic with black background and white letters. Size of letters shall be 1/4 inch high, minimum. Letters shall be machine engraved. All nameplates shall be screw mounted with oval head machine screws tapped into metal. Adhesive material shall not be used. Every cubicle in the motor control center shall be provided with a nameplate with 1/2" high lettering.

2.3 SPARE PARTS, CONSUMABLE ITEMS, AND TOOLS

A. The contractor shall supply all spare parts prior to functional acceptance test. All

parts shall be sealed in plastic bags and delivered to the site in a heavy-duty plastic storage box.

B. In addition to spare parts described elsewhere in these Specifications, provide:

1. Fuses. Provide 20 percent of each size and type used rounded to the next whole number, but no less than three of each size and type.

2. Indicating Lamps. Provide 20 percent of each size and type used rounded to the next whole number, but no less than 10 of each type.

PART 3 EXECUTION

3.1 CLEANING

A. After all other work has been accomplished pedestals, starters, panelboards, control panels and all other electrical equipment shall be cleaned of all dust, dirt, grease, plaster, paint or other marks, by the Contractor. All meter enclosures, panelboards, motor controls, control panels, switchboards and motor control centers shall be "touch-up" painted to match original colors.

3.2 TESTING, GENERAL

A. Testing, test plans, and test reports shall be provided by the Contractor as specified herein. The Contractor shall perform tests as required to demonstrate that the equipment and systems covered in this Specification operate safely and meet the requirements of these Specifications: reference the Specification Section 01 77 00. The Contractor shall provide labor, instruments, and other material to complete the tests.

1. Perform the Operational Readiness Test and Functional Acceptance Test.

2. Perform independent testing services for the electrical system prior to Functional Acceptance Test.

3. Perform other specific test required by Specification Sections in Division 26.

4. Perform support activities for the final facilities, described throughout the Specifications (i.e. additional factory and field testing).

B. Operational Readiness Test (ORT)

1. Point-to-Point Wire Check. After installation, termination, and identification of conductors, perform a point-to-point wire check to verify that all wiring has been properly installed and identified, and that there are no shorts between wires, shields, and ground. Lift wires from terminals as required to perform this test.

2. Insulation Test. Perform a megger test on all control and power wiring. The Engineer shall be notified at least 1 week prior to the insulation test so that the testing maybe witnessed.

3. Motor Test. Submit test data showing (for every motor): Perform a winding resistance check of each phase. Amperes in each phase with motor loaded;

motor nameplate amperes; Thermal overload element rating and catalog number. At time of test record voltage at switchboard for all three phases. Check for correct rotation of mechanical equipment.

C. Functional Acceptance Test (FAT)

1. The Contractor shall perform the FAT after he has delivered written notice to the Engineer that the ORT has been completed.

2. The Contractor shall inform the Engineer at least 2 weeks prior to the FAT so that the Engineer may witness the test.

3. The FAT shall operate all equipment and systems over the full operating range, shall demonstrate proper operation of alarms and indicators, and, in general, shall demonstrate that the equipment and systems meet the requirements of the Drawings and Specifications.

4. If any equipment or system fails the FAT, the Contractor shall correct the problem and shall repeat the test until it is successful.

5. The FAT shall be performed in the presence of the Engineer.

D. Final System Testing

1. Provide resources and personnel, on site, as necessary, to support the effort required to complete testing of the facility in a timely manner.

2. Personnel include an electrician and a control system start-up technician.

3.3 TRAINING

A. The Contractor shall provide four man-hours for general training of the operation of the electrical and control systems to DISTRICT personnel.

B. Instructions shall consist of the functional description of each piece of equipment, including calibration and setting of set points. Demonstration of the operation of each system shall be included.

C. The Contractor shall provide all manuals and study materials required for the training of DISTRICT's personnel.

3.4 WARRANTY

A. The Contractor shall leave the entire electrical system in proper working order and shall, at his own expense, replace any work, material, or equipment furnished by the firm which develops defects within one year from the date of acceptance.

B. The control system supplier shall have a staff of experienced personnel available to provide service on 2 working days notice during the warranty period. Such personnel shall be capable of fully testing and diagnosing the hardware and software delivered; and of implementing corrective measures.

C. If the control system supplier fails to respond in 2 working days, the DISTRICT at its option will proceed to have the warranty work completed by other resources; the total cost for these other resources shall be reimbursed in full by the Contractor. The use of other resources, as stated above, shall not change or relieve

the Contractor or supplier from fulfilling the remainder of the warranty requirements.

D. Prior to "final acceptance", the Contractor shall furnish to the Engineer a listing of warranty information for all manufacturers of materials and equipment used on the project. The listing shall include the following:

1. Manufacturer's name, service contact person, phone number, and address.
2. Material and equipment description, equipment number, part number, serial number, and model number.
3. Manufacturers warranty expiration date.
4. Completed test forms.

* * END OF SECTION * *

SECTION 26 79 00
STANDBY ENGINE GENERATOR AND TRANSFER SWITCH

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Applicable provisions of Section 26 00 00 are incorporated herein as though fully set forth at length.

B. This Section covers the work required to furnish, install, start up, test, and document a standby engine-generator, including fuel system, starting system, cooling system, exhaust system, control system, sound attenuating enclosure and other items required for a complete operating system as shown on the Drawings and as specified herein.

C. The Contractor is responsible for securing all the required permits with the local air board.

1.2 UNIT RESPONSIBILITY

A. The CONTRACTOR shall cause the supplier of the standby generator to take unit responsibility for the entire standby generator systems, including all of the items specified in this Section, and to provide a complete and operable system which meets all requirements of these Contract Documents. The standby generator supplier shall be responsible for the selection, design, manufacture, and testing of the equipment specified herein, and to ensure complete compatibility of the elements of the standby generator system with one another and with other equipment in the facility.

B. The generator set shall be certified by the engine manufacturer to be suitable for use at the installed location and rating, and shall meet all applicable exhaust emission requirements at the time of commissioning at the location installed for standby duty. Provide certification that the engine-generator complies with requirements of the EPA and Local Air Quality Management District.

C. The generator will be installed on a site near 2500 feet above sea level. The units shall meet the requirements of the specifications at the elevation they are installed.

D. The unit shall be mounted on a pad. The pad will be sized for a future 250 KW unit.

1.3 GENERAL

A. The standby generator shall be an engine-driven generator set rated to serve continuously during interruption of prime power. Speed shall not be greater than 1,800 rpm. The set shall operate on diesel fuel and shall be liquid cooled.

B. Each unit shall consist of an engine directly connected to a generator and mounted on a steel base, and shall include all necessary engine and generator

auxiliaries, accessories, and controls required to provide electrical output as specified herein. Minimum required accessories and controls include a controls and alarm panel, external water jacket heater, silencer, batteries, and battery charger. The unit shall be the product of a supplier regularly engaged in the assembly of generator sets. The component parts of the unit shall be the products of firms regularly engaged in the manufacture of these parts. All materials shall be new and of current manufacture.

C. The supplier of the generator set and the manufacturers of the component parts shall have service and spare parts facilities located within 150 miles of the installation that can provide regular service, inspection, spare parts, and emergency service.

D. Departures from Drawings. Submit to the DISTRICT, in writing for review, details of any necessary proposed departures from these Contract Documents, and the reasons therefore, as soon as practicable and within 30 days after the award of the Contract. Make no such departures without the prior written approval of the DISTRICT.

1.4 SUBMITTALS

A. Submit material or equipment data in accordance with the Specification Section 26 00 00, General Requirements, Electrical.

B. In addition to the general requirements, the submittal for each generator shall include the following:

1. Bill of Materials. A listing shall include all of the panels, racks, instruments, components, and devices provided under this Section.

2. Equipment list tabulating all components furnished, followed by the manufacturer's name, manufacturer's model number, and a cross reference to its location on the Shop Drawings.

3. Drawings and descriptive (catalog) data and brochures of each item of equipment.

4. Dimensional drawings and weights of each item of equipment.

5. Certified foundation and anchor bolt plans for all floor-mounted equipment.

6. Diesel engine data.

a. Manufacturer

b. Model

c. Revolutions per minute (rpm)

d. Rated capacity brake horsepower (bhp)

e. Make and model of governor

f. Piston displacement (cubic inches)

g. Guaranteed fuel consumption rate in gallons per hour at full load, 3/4 load, ½ load.

7. Generator data:
   a. Manufacturer
   b. Model
   c. Rated kVA
   d. Rated kW
   e. Voltage
   f. Temperature rise above 40 degrees C ambient
   g. Detailed generator sizing calculation
   h. Generator efficiency, including excitation losses at 80-percent power factor at full load, 3/4 load and 1/2 load
   i. Satisfactory voltage dip/motor starting [sizing] calculations
8. Engine-generator unit and accessories:
   a. Weight of skid-mounted unit
   b. Overall length
   c. Overall width
   d. Overall height
   e. Exhaust pipe size
   f. Cubic feet per minute (cfm) of air required for combustion and ventilation
   g. Heat rejected to room by engine and generator in Btu/hr
   h. Cooling air volume required
   i. Total efficiency of the unit.
9. Generator circuit breaker:
   a. Catalog data
   b. Recommended trip settings for all adjustable settings
   c. Short-circuit interrupting ratings
10. Electrical Drawings
   a. Complete elementary and connection diagrams of all electrical circuits and devices, including generator winding data and connection diagrams. Include battery charger and water jacket power requirements.

b. Complete drawings and descriptive data, both mechanical and electrical or control panels.

11. Manufacturer's certificate of satisfactory installation is required for work under this Section.

12. Catalog and installation information on fuel fill and monitoring system, fuel tank, exhaust mounting brackets, battery, battery cabinet, battery charger, water jacket heater, voltage regulator and governor.

13. Satisfactory voltage dip [starting] calculations and confirmation that after derating for elevation the submitted generators are adequate to start and run the loads as described.

14. Testing procedures, syllabus of training and a schedule.

1.5 OPERATING AND MAINTENANCE MANUALS

A. The CONTRACTOR shall provide an electronic copy of an Operation and Maintenance manual in pdf format for each generator prior to completion of the Work.

B. For each section provide the following information, as applicable:

1. An itemized list of all data provided.

2. Name and location of the manufacturer, the manufacture's local representative, the nearest suppliers, and spare parts warehouse.

3. Recommended installation, adjustment, start up, calibration, and troubleshooting procedures.

4. Recommended lubrication, lubrication intervals, and an estimate of yearly quantity needed.

5. Recommended step-by-step procedures for all modes of operation.

6. Complete internal and connection wiring diagrams.

7. Recommended preventive maintenance procedures and schedule.

8. Complete parts lists, by generic title and identification number.

9. Recommended spare parts and special tools.

10. Disassembly, overhaul, and reassembly instructions.

11. All approved shop drawing information pertinent to facility operation and maintenance.

1.6 WARRANTY

A. The work and equipment covered in this Section shall be guaranteed for a period of 2 years minimum from the date of acceptance thereof against defective materials, design, and workmanship.

1.7 PERFORMANCE REQUIREMENTS

A. As a minimum, the standby generator at the site shall have the following continuous ratings (as used herein, the term "continuous" shall mean for the duration of a utility company power outage at the facility):

1. 150 KW (minimum) at 0.8 pf.
2. 480/277 Volts, three phase, four wire plus ground.
3. 60 Hz.
4. Not to exceed safe operating temperatures when operating at full load in an ambient temperature of 50 degrees C.
5. The generator shall be capable of starting the loads shown on the drawings (assume single 35 HP induction motor with a NEMA code letter F and RVSS motor controllers) with less than a 15 percent voltage dip with a second similar pump 35 HP pump and 5 KW of single phase miscellaneous load energized. Provide an engine and generator combination capable of meeting the voltage dip requirements: 150 KW minimum. Confirm the engine-generator combination has the capacity to start and run the load, as described, at 2500 feet elevation without derating
6. The standby generator system maximum time for recovery to rated frequency shall be 10 seconds after full-rated load is applied in one step.
7. Under steady-state conditions, after a maximum of 3 minutes of operation the standby generator system long-time frequency drift shall not exceed 0.5 Hz.
8. Under steady-state conditions, after a maximum of 3 minutes of operation the standby generator system voltage regulation shall be better than 2 percent for any load between no load and full load.

1.8 TECHNICAL REQUIREMENTS FOR SMART CONTROLLER INTERFACE

A. Each standby generator system shall include generator run status and fail alarm dry contact outputs rated 0.5 Amps at 120 Volts, 60 Hz, non-inductive.

B. All alarm and status contacts shall be brought out to terminal strips and numbered and identified on a wiring diagram.

PART 2 PRODUCTS

2.1 GENERAL

A. Unless otherwise indicated, provide all first-quality new materials, free from any defects, and suitable for the intended use and the space provided. Provide equipment approved by NFPA and UL wherever standards have been established. As a minimum provide equipment that meets the requirements of UL 508 (Electric Industrial Control Equipment), UL 142 (Sub Base Fuel Tanks), UL 1 36 Battery Chargers, UL 2200 Generator Sets and UL 499 (Heaters).

B. Furnish and install all incidental items not specifically shown or specified which

are required by good practice to provide the complete systems specified herein.

C. Where two or more units of the same class of material or equipment are required, provide products of a single manufacturer. Component parts of materials or equipment need not be products of the same manufacturer.

2.2 STANDARD PRODUCTS

A. Unless otherwise indicated, provide materials and equipment which are products of manufacturers regularly engaged in the production of such materials and equipment. Provide the manufacturer's latest design that conforms to these Specifications.

2.3 MECHANICAL ASSEMBLY

A. The standby generator set shall consist of an industrial engine and single-bearing generator mounted on a structural steel skid-type base assembly with lifting holes and accessory mounting provisions. The engine and generator shall be coupled together through a flexible metallic coupling which permits alignment of the two units. The couplings shall be properly guarded to prevent injury to personnel.

B. The standby generator skid shall incorporate a mounting configuration to accommodate nominal uneven floor surfaces without imposing misalignment forces on the engine or generator.

C. The unit shall include a secure sound attenuating weatherproof enclosure.

1. The weatherproof enclosure shall be completely lined with sound deadening material. This material must be of a self extinguishing design with a reflective surface for enhanced serviceability.

2. The enclosure shall be made of steel with a minimum thickness of 16 gauge. The enclosure is to have hinged, removable doors to allow access to the engine, alternator and control panel. The hinges shall allow for door fit adjustment. Hinges and all exposed fasteners will be stainless steel. The use of pop-rivets weakens the paint system and not allowed on external painted surfaces. Each door will have lockable hardware with identical keys. The enclosure shall be coated with electrostatic applied powder paint, baked and finished to manufacturer's specifications. The color will be manufacturer’s standard.

3. The genset silencer shall be mounted on or in the enclosure.

4. Provide sound attenuating enclosure. Submit supporting technical data: 78 dBA (nominal, or less) at 23 feet.

2.4 ENGINE

A. The engine shall be diesel, four-cycle, fuel injection, compression ignition, liquid cooled with an integrally mounted heat exchanger, and shall operate satisfactorily on a commercial grade of diesel fuel (CARB).

B. The engine manufacturer shall certify the engine to be suitable for use at the

installed location, at the installed rating, and shall meet all applicable exhaust emission requirements at the time of commissioning at the location installed for standby duty. Provide certification that the engine-generator complies with requirements of the EPA and Local Air Quality Management District: Tier 4 requirements.

C. The engine shall be rated for continuous operation under a constant load equal to the generator-set rating plus the load of all connected accessories.

D. The engine speed shall be controlled by an isochronous governor.

E. The engine shall be provided with crankshafts, which shall be statically and dynamically balanced and fully counterbalanced. Crankshafts shall be drilled for full-pressure lubrication to all bearings. All crankshaft bearing surfaces shall be hardened. There shall be one more main bearing than there are crankshaft throws. Intake and exhaust valves shall be heat-resistant alloy steel with Stellite-faced exhaust valve inserts.

F. The engine shall receive a prime coat and two coats of industrial paint suitable for the intended use.

G. The engine shall be equipped with a pressurized lube oil system and a full-flow filter system consisting of an oil pickup strainer located upstream of a replaceable filter.

H. Engine air intake shall be provided with a dry air cleaner of adequate capacity to effectively remove dirt and abrasives from the combustion air. The dry-type filter shall be arranged for easy removal and replacement of the filter element.

I. All exposed rotating parts of the engine shall be provided with guards for protection of personnel.

J. Governor

1. An electronic governor system shall provide automatic isochronous frequency regulation.

2. The governor and control system shall actively control the fuel rate as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed.

3. The governor system shall include a programmable warm up at idle and cooldown at idle function. While operating in idle state, the control system shall disable the alternator excitation system.

2.5 ENGINE COOLING SYSTEM

A. The engine shall be cooled by means of an engine-mounted heat exchanger. The heat exchanger shall include a solenoid valve to control potable water. The potable water will be at a temperature between 2 degrees C and 20 degrees C. The heat exchanger shall be sized to maintain safe operation at 50-degree C maximum ambient temperature, with the engine at full load. The engine cooling

system shall be filled with a solution of antifreeze with corrosion inhibitor as recommended by the engine manufacturer. An external water jacket heater (120 VAC) shall be provided to maintain the engine water at 35 degrees C at all times the engine is not running. Jacket water heater shall be provided with isolation valves. If a different configuration is required to meet the manufacturer's standards and/or this Specification, power distribution changes shall be made at no cost to the DISTRICT.

2.6 ENGINE FUEL SYSTEM

A. The fuel system shall include an engine-driven fuel pump and primary and secondary filters which shall be easily accessible for servicing. Filters shall have replaceable elements. Primary fuel filter shall be capable of filtering 15- to 25-micron particles and secondary unit filtering particles of 5 microns or smaller.

B. Flexible connectors of braided steel construction shall be furnished for connection of fuel lines to engine. The connectors shall be no less than 18 inches long.

C. Provide a skid mounted, sub-base, double wall, fuel tank for the engine-generator which meets the requirements of UL 142. The fuel tank shall be a standard product of the manufacturer of the engine generator set. Each tank shall be sized for 48 hours of operation at 50% loading (35 HP and 35 HP + 5 KW assuming 150 KW unit), minimum capacity. The tank shall include a mechanical gage, high and low level sensors with output contacts, overfill/spill containment device at fill point and light and horn annunciation when full.

D. The fuel tank shall be vented and shall include insect screens and flame arresters.

2.7 ENGINE STARTING SYSTEM

A. The engine shall be started automatically by a 12 or 24 Volt dc electric starting system with positive engagement drive.

B. Provide a heavy-duty lead-acid storage battery set. The battery set shall be of sufficient capacity to provide for continuous 1-1/2 minutes total cranking time at 20 degrees F without recharging. The batteries shall be provided with a battery tray and batteries shall be secured.

C. A current-limiting automatic 2-rate, temperature compensated, UL listed battery charger shall be furnished to automatically recharge batteries. It shall include overload protection, silicon-diode full-wave rectifiers, voltage surge suppressors, dc ammeter and voltmeter with plus or minus 2 percent accuracy, and fused ac input. The ac input voltage shall be 120 volts, 60 Hz. Rated output of the battery charger shall be no less than 10 amperes dc. The charger shall include an autoboost circuit to equalize the batteries after an AC power failure or low battery voltage condition. The battery charger shall be manufactured by Sens or equal.

2.8 ENGINE EXHAUST SYSTEM

A. The engine exhaust system shall include an exhaust silencer, gas-proof and

seamless stainless steel flexible exhaust connection, exhaust outlet piping, and a raincap. An exhaust condensation trap with manual drain valve shall be provided. Insulation shall be provided on all portions of the engine exhaust piping and muffler system inside of enclosure.

B. The exhaust silencer shall be a residential grade silencer. All exterior components of the exhaust silencer shall be fabricated of aluminized steel and coated with high heat resistant silicone aluminum paint. Guards shall be provided in accordance with State safety requirements to protect personnel from accidental contact from the exhaust manifolds, turbochargers, exhaust pipe, etc. A rain cap shall be provided for the exhaust piping tip.

2.9 ENGINE INSTRUMENTS

A. The engine instruments shall include an oil pressure gauge, coolant water level and a water temperature gauge plus manufacturer's recommended alar indicators.

2.10 GENERATOR

A. The generator shall be heavy-duty industrial type suitable for standby duty under the conditions specified. The generator shall meet all applicable NEMA and UL standards for standby generator, including temperature rise and short-circuit ratings.

B. The generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc.

C. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system and shall be UL1446 listed. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees Centigrade.

D. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage up to 5 percent above or below rated voltage.

E. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.

F. The subtransient reactance of the generator shall not exceed 13.0 percent, based on the standby rating of each of the generator sets.

G. The generator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic, and no 3rd order harmonics or their multiples. Telephone influence factor shall be less than 40.

H. The generator shall be suitable for use in a solidly grounded system. The neutral

shall not be grounded at the generator.

I. Provide an output circuit breaker, rated as shown on the Drawings, in a separate enclosure for each generator.

J. The generator sets shall include a full wave rectified automatic solid state digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from mis-operation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter.

1. The voltage regulation systems shall be equipped with three-phase line to neutral RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The systems shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate, and be capable of being curve-matched to the engine torque curve with adjustments in the field.

2. The voltage regulators shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.

2.11 CIRCUIT BREAKERS

A. The generator circuit breaker shall be integral with the standby generator and shall be provided in NEMA 1 deadfront enclosures. The circuit breakers shall be of the indicating type providing ON, TRIPPED, and OFF positions of the operating handle. Breakers shall be labeled. Include provisions for padlocking the circuit breakers in the OFF position. Interlock enclosure to prevent opening the cover with the circuit breakers in the ON position, and provide defeater mechanisms. The circuit breakers shall be quick-make, quick-break, with thermal-magnetic action. The circuit breakers shall meet the requirements of Specification Section 26 06 00, Miscellaneous Electrical Equipment.

2.12 CONTROL PANELS

A. Provide an engine-generator control panel for each generator. The panels shall be shock-mounted to the generator set that is factory built, wired, and tested by the generator manufacturer. The control panels shall be capable of operating the generator sets in compliance with these Specifications. Provide an emergency “STOP” pushbutton.

B. With the mode selector switch in AUTO, the system shall perform as specified under FUNCTIONAL REQUIREMENTS.

C. With the mode selector switch in HAND, the generator set shall be started and stopped by the manual start-stop pushbutton control in the control panel.

D. When the mode selector switch is moved to OFF, it shall not be possible to start the generator set, and, if the generator set is running, it shall stop.

E. The control panels shall operate on dc battery voltage; shall include NEMA 1, vibration isolated, dead front, 14-gauge steel enclosures; and shall be constructed so that all components can be adjusted and replaced from the front. Control wiring shall be stranded copper and shall be brought to master terminal blocks for termination of external wiring. Identify control wiring with wire labels and terminal points with appropriate markers. Arrange wiring neatly cut to proper length, bundle wires, and tie them down securely. Wiring shall not be spliced or tapped except at device terminals or on terminal blocks. The control panel shall include the following equipment:

1. Manual start-stop control.
2. Three-position mode selector switch, with positions labeled AUTO, OFF, and HAND.
3. GENERATOR RUNNING indicating light and normally open contact.
4. READY indicating light and normally open contact.
5. The generator set control shall indicate the existence of the following alarm and shutdown conditions on an alphanumeric digital display panel:
    a. low oil pressure (alarm)
    b. low oil pressure (shutdown)
    c. oil pressure sender failure (alarm)
    d. low coolant temperature (alarm)
    e. high coolant temperature (alarm)
    f. high coolant temperature (shutdown)
    g. high oil temperature (warning)
    h. engine temperature sender failure (alarm)
    i. low coolant level (alarm or shutdown--selectable)
    j. fail to crank (shutdown)
    k. fail to start/overcrank (shutdown)
    l. overspeed (shutdown)
    m. low DC voltage (alarm)
    n. high DC voltage (alarm)
    o. weak battery (alarm)
    p. low fuel-daytank (alarm)
    q. high AC voltage (shutdown)

r. low AC voltage (shutdown)

s. under frequency (shutdown)

t. over current (warning)

u. over current (shutdown)

v. short circuit (shutdown)

w. over load (alarm)

x. emergency stop (shutdown)

6. Separate alarm (normally open) contacts for high coolant temperature, low coolant level, low oil pressure, high oil temperature, overspeed, generator fail, fail to start, generator not in "AUTO", battery voltage low, and battery voltage high.

7. Separate gauges for indicating oil pressure, oil temperature, and water temperature.

8. Separate meters for Voltage, Amps and frequency (all 2 percent accuracy class).

9. Running time meter.

2.13 LIFTING LUGS

A. Equipment over 100 pounds in weight shall be provided with lifting lugs.

2.14 ANCHOR BOLTS AND TIEDOWN LUGS

A. Furnish and install anchor bolts and tiedown lugs. As a minimum requirement, furnish and install anchor bolts and tiedown lugs as recommended by the manufacturer and approved by the DISTRICT.

B. Submit seismic calculations based upon the requirements of 26 00 10, General Electrical Requirements.

2.15 SPARE PARTS, CONSUMABLE ITEMS, AND TOOLS

A. Provide the following spare parts for each generator, as a minimum:

1.	2 sets	Lube oil filter element
2.	2 sets	Fuel filter element
3.	1 set	Air cleaner element
4.	1 set	V-belts (complete set)

2.16 GENERATOR MANUFACTURERS

A. The standby engine generator and skid-mounted assemblies shall be as manufactured by Caterpillar D150-10 -C7.1 (industrial 150 KW engine with upsized alternator) with weatherproof enclosure, integral fuel tank and residential Grade exhaust system.

PART 3 EXECUTION

3.1 INSTALLATION

A. The generator set, including all auxiliaries and accessories, shall be installed in accordance with the manufacturer's instructions and recommendations. Antifreeze and oil of the type and amount recommended by the manufacturer shall be furnished and added to the engine.

B. Keep a copy of the manufacturer's installation instructions available on the job site for review at all times.

C. Provide a housekeeping pad for the engine-generator set.

D. Mount all devices which an operator may need to read or operator between 42 and 72 inches above the finished floor.

E. Installation shall be checked and approved by the engine-generator set supplier.

F. Mount the transfer switch were shown on the drawings. The Contractor shall coordinate efforts between vendors to arrange for the transfer switch to be mounting in the factory.

3.2 START-UP SERVICES

A. A manufacturer/supplier's representative shall be present at the job site for a minimum of one day. Include for each generator the following start-up services:

1. One site visit of 1 day for assistance during installation, assistance during system startup, testing and training of DISTRICT Personnel.

3.3 TESTING

A. After each installation has been completed, Contractor shall conduct tests required by Section 26 00 00, General Requirements, Electrical.

B. In addition, testing, test plans, and test reports shall be provided by the CONTRACTOR as specified herein. The CONTRACTOR shall perform tests as required to demonstrate that the equipment and systems covered in this Section operate safely and meet the requirements of these Specifications. The CONTRACTOR shall provide labor, instruments, fuel, and other material to complete the factory, operational readiness, and functional acceptance tests.

1. Test plans and test reports shall be treated as formal submittals and shall meet all applicable requirements of the submittals.

2. Tests and test plans shall be in the cause and effect format. The person conducting the test shall initiate an action (cause) and, upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied.\

C. Factory Test (FT)

1. The generator sets, together with all controls and safety devices, shall be tested at the manufacturer's plant per standard manufacturer’s testing.

D. Operational Readiness Test (ORT)

1. Prior to startup, the complete standby generator systems, including standby generator, and fuel systems, shall be inspected, tested, and documented to show that it is ready for operation.

2. The CONTRACTOR shall prepare a test plan for the ORT and shall submit it for review at least 30 days before the ORT is performed.

3. The ORT shall demonstrate on a paragraph-by-paragraph basis that the complete interconnected standby generator system can start up and run through its normal operating and shutdown sequence as described in the rawings and Specifications.

4. If any component or subsystem fails the ORT, the CONTRACTOR shall correct the problem and shall repeat the test until it is successful.

5. After completion of the ORT, the CONTRACTOR shall prepare a test report and shall submit it for review. The ORT shall be successfully completed and the test report submitted to and reviewed by the DISTRICT before the FAT (functional acceptance test) is performed.

E. Functional Acceptance Test (FAT)

1. Once the facility has been started up and is operating, a witnessed FAT shall be performed on the complete standby generator systems to demonstrate that it is operating as specified and meets the requirements of the Specifications.

2. The CONTRACTOR shall prepare a test plan for the FAT and shall submit it for review at least 30 days before the FAT is performed. The test plan shall include a copy of the proposed test log sheet to record load data, temperatures, pressures, fuel consumption, and all other test data.

3. Each specified function shall be demonstrated on a paragraph-by-paragraph basis.

4. The FAT shall operate all equipment and systems over the full operating range, shall demonstrate proper operation of alarms and indicators, and, in general, shall demonstrate that the equipment and systems meet the requirements of the Drawings and Specifications.

5. The FAT shall demonstrate under actual operating conditions that operation is satisfactory without overheating of any part and that the equipment is free from excessive vibration throughout the entire range of speed and load.

6. The generator set shall be operated at rated standby service load for a period of not less than 2 hours, and all necessary adjustments shall be made by the generator-set supplier. This test shall demonstrate the ability of the set to satisfactorily carry its rated load and to meet requirements for motor starting.

7. Testing shall include checking of all automatic controls for proper functioning. The CONTRACTOR shall supply the fuel required for the tests and shall supply a load bank to supplement available loads in order to test the set under the specified loadings. Load banks with unity power factor are suitable for the FAT.

8. With the station load at normal operating level, a power failure shall be initiated by opening the main circuit or breaker supplying the normal power to the pump station. The following records shall be maintained throughout the tests: time of day, coolant temperatures, cranking time until prime mover starts and runs, time required to come up to operating speed, voltage and frequency overshoot, time required to achieve steady-state condition with the transfer switch transferred to the emergency position, voltage, frequency, current, oil pressure, ambient air temperature, kilowatts, power factor, and battery charger rate at 5-minute intervals for the first 15 minutes and at 15-minute intervals thereafter. Continue this load test for 2 hours, observing and recording load changes and the resultant effect on voltage and frequency. Return normal power, and record the time delay on retransfer and the time delay on prime mover cool-down period and shutdown.

9. Upon completion of the above portion of the test, allow the prime mover to cool for 5 minutes. Then apply full-rated load (nameplate kW) consisting of pump station load. This full-load pickup shall be in one step immediately upon reaching rated speed.

10. If any equipment or system fails the FAT, the CONTRACTOR shall correct the problem and shall repeat the test until it is successful.

11. A manufacturer's service representative for the standby generator manufacturer shall be present during the FAT.

12. The FAT shall be performed in the presence of the Engineer.

13. After completion of the FAT, the CONTRACTOR shall prepare a test report and shall submit it for review. The standby generator system will not be accepted before the FAT is successfully completed and the test report submitted to and reviewed by the DISTRICT.

F. TRAINING

1. Upon completion of the FAT, final adjustments shall be made to the equipment as necessary. Fuel and oil filters shall be replaced, oil shall be changed, fuel tanks shall be refilled, and the proper operation of all equipment shall be demonstrated to the DISTRICT. DISTRICT personnel shall be instructed in the maintenance and operation of the equipment. These final adjustments and instructions shall be carried out by the generator-set supplier.

** END OF SECTION **

SECTION 26 04 00
RACEWAY AND FITTINGS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The work under this section includes all equipment, labor and material necessary to furnish and install a complete raceway system including fittings, boxes and supports.

B. Raceway shown in the schedule with multiple conduits shall be used for installing different types of conductors; for example power (120, 208, 240 and 480 VAC) conductors in the first conduit, control (discrete 24 and 120 VAC) conductors in the second and signal (analog 4-20 mA, 24 VDC and other instrumentation) conductors in the third.

1.2 QUALITY ASSURANCE

A. All raceway shall comply with applicable standards of the Underwriter's Laboratories, Inc.

B. Conduits, entering the bottom of pad mounted equipment under enclosure structural members design to be flush with the pad, shall be removed, reworked and reinstalled properly, so the conduit enters the manufacturer’s recommended conduit area, unobstructed. These modifications to conduit and pad shall be at the Contractor’s expense.

C. Do not cut, bend or deform, pedestal, switchboard, motor control center, control panel or equipment enclosure steel to accommodate conduits.

1.3 SUBMITTALS

A. The Contractor shall submit, in accordance with the requirements of Section 26 00 00 the following materials and information:

B. A list of materials to be furnished, the name of the suppliers and the date of delivery of materials to the site.

C. Catalog data sheets and manufacturer’s information all equipment described in this Specification Section.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and equipment to project site in manufacturer's original packaging with labeling showing product name, brand, model, project name, address, and Contractor's name. Store in a location as agreeable with Site Engineer, secure from weather or accidental damage.

PART 2 PRODUCTS

2.1 CONDUIT

A. Rigid Steel Conduit (RSC)

1. Rigid steel conduit shall be hot dip galvanized on the exterior and may be zinc or enamel on the interior meeting the requirements of UL-6 and ANSI C80.1.

2. Couplings, locknuts, and all other fittings shall be hot dip galvanized. All couplings and locknuts shall be of the threaded type only.

3. Bushings for standard weight rigid steel conduit shall be non-metallic for 1 inch and smaller. For conduits larger than 1 inch, insulated metallic bushings shall be used.

B. Plastic Coated Rigid Steel Conduit (PCRSC)

1. Plastic coated rigid steel conduit and fittings shall be hot dip galvanized prior to the plastic coating. The galvanized surfaces shall be coated with an epoxy-acrylic primer before plastic coating. The plastic coating shall be applied by the dip method. Minimum thickness of the exterior coating shall be 40 mils. The interior of conduit and fittings and all male threads shall be coated with 2 mils of urethane. PCRSC shall be manufactured by Rob Roy, Ocal or equal.

2. Couplings, locknuts, and all other fittings shall be hot dip galvanized and plastic coated. All couplings and locknuts shall be of the threaded type only. All couplings shall have longitudinal ribs 40 mils in thickness. Condulets shall be supplied with stainless steel screws. All screws shall be encapsulated in plastic.

3. Enclosure sealing hubs shall be similarly coated and be manufactured by Meyers type or equal.

4. Bushings for standard weight rigid steel conduit shall be non-metallic for 1 inch and smaller. For conduits larger than 1 inch, insulated plastic coated metallic bushings with grounding connection, where required, shall be used.

5. All damaged coatings shall be repaired according to the manufacturer's instructions.

C. Flexible Metallic Conduit (Flex)

1. Flexible metallic conduit shall be hot dipped galvanized steel.

2. Neoprene jacketed flexible metallic conduit shall be used in all damp or weatherproof locations where flexible conduit is required.
Fittings for flexible metallic conduit shall be hot dipped galvanized or sheradized, squeeze type. Fittings which use a screw to bind against tubing will not be accepted. Fittings for neoprene jacketed flexible conduit shall be of the screw in type.

D. Flexible Non-Metallic Conduit (NMFlex)

1. Flexible non-metallic conduit and fittings shall be heavy duty PVC.

Conduit shall consist of PVC spiral surrounded by flexible PVC.

2. Flexible non-metallic conduit shall be liquid tight and fittings shall be corrosion resistant with stainless steel retaining rings. Provide sealing gaskets at all threaded connections. NMFlex shall be manufactured by Thomas and Betts or equal.

E. Polyvinylchloride Conduit (PVC)

1. PVC Conduit shall be rigid heavy weight type, Schedule 40 when encased in concrete or schedule 80 when exposed or not encased in concrete. PVC conduit shall be supplied complete with PVC fittings. PVC conduit shall be manufactured by Carlon or equal.

2. Utility company conduits may require oversized Schedule 80 in part or in whole.

F. Electrical Metallic Tubing (EMT) is not allowed on this project.

2.2 CONDUIT SUPPORTS

A. Pipe hangers for individual conduits shall be factory made, consisting of a pipe ring and threaded suspension rod. The pipe ring shall be malleable iron, split and hinged, or shall be spring-able steel. Rings shall be bolted to or interlocked with the suspension rod socket.

B. Pipe racks for groups of parallel conduits shall be constructed of galvanized structural steel preformed channels of length as required. Racks or channel shall be suspended on threaded rods and secured with nuts above and below the cross bar or bolted to concrete walls with stainless steel anchors.

C. Pipe straps shall be the two piece bolted type. Pipe straps shall be coated to be compatible with the conduit (and coating) installed.

D. Conduit support components shall be manufactured by Unistrut, B-line or equal. Channel and associated hardware shall be stainless steel.

2.3 CAST BOXES

A. Cast boxes shall be galvanized, threaded, cast malleable iron. Cast boxes shall be manufactured by Appleton, Feraloy, Crouse-Hinds, type FS or FD, or equal. Hub arrangements on threaded fittings shall be the most appropriate for the conduit arrangement required in each case to avoid unnecessary conduit bends and fittings.

B. Use plastic coated cast boxes with plastic coated conduit.

2.4 UNDERGROUND VAULTS, PULLBOXES AND HANDHOLES

A. Provide underground vaults, pullboxes and handholes, where shown on drawings or required by length of conduit runs. Underground vaults and pullboxes shall be pre-fabricated concrete type shall be manufactured by Christy Concrete Products, Brooks or equal. All pullboxes shall have standard brass holddown bolts and hardware. Vaults and boxes located in paved areas or other areas over which vehicles normally may travel shall have traffic covers. All covers shall be labeled

appropriately, i.e. ELECTRICAL, SIGNAL, TELEPHONE, etc...\ Provide cable supports in vaults and large boxes. Cable supports, saddles, arms, and racks mounted in pullboxes shall be manufactured by Underground Devices or equal.

2.5 WIRE TROUGH

A. Wire trough shall be NEMA 4 with neoprene gaskets on the hinged doors or removable covers. Box and gutter sizes, metal thickness, and installation details shall comply with the National Electrical Code. Wire gutter shall be manufactured by Hoffman or equal.

2.6 DUCT SEAL

A. Duct seal shall be non-hardening compound designed for sealing between conduit and electrical cable. Duct seal shall be manufactured by O.Z., Gedney DUX or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. General. Unless otherwise specified or indicated, wiring shall consist of insulated conductors installed in raceways of the types indicated. Provide pullboxes or conduit bodies in addition to those shown on the Drawings to limit the number of bends as required by the NEC.

1. Minimum size conduit installed on this project shall be 3/4 inch.
2. Use the following types of conduit for the locations listed, unless indicated otherwise:
    a. Use galvanized rigid steel conduit (GRS) for all exposed, dry locations.
    b. Use plastic-coated steel conduit (PCRSC) outdoors in wet and damp locations, and below grade for direct-buried conduit where sand encased.
    c. Use rigid polyvinyl chloride (PVC) conduit for concealed locations, for embedded conduit and conduit installed below grade in concrete encased duct banks, except use plastic coated steel conduit (PCRSC) at least 5 feet on both sides of penetrations through building footings and outside walls, under equipment mounting pads, where embedded in exterior light pole foundations, and where conduit changes from underground to exposed or from embedded to exposed. Use PVC conduit in corrosive spaces and where required by a utility company.
    d. Use liquidtight flexible metal conduit (flex) with steel fittings for the last 18 to 36 inches of conduit run to a piece of equipment where required to isolate vibration or to facilitate maintenance or adjustment.

e. Electrical metallic tubing (EMT) shall not be used on this project.

B. Conduit Installation

1. Conduit system installation shall meet or exceed the requirements of the 2014 NEC. Raceways shall be concealed or exposed, as indicated, and shall be at least 6 inches away from parallel runs of flues and steam or hot water pipes. Group raceways in same area together. Raceways shall be supported at intervals required by the NEC and shall have exposed runs installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Avoid field-made bends and offsets where possible, but where necessary make with an approved hickey or conduit bending machine. Heating of conduit to facilitate bending shall not be acceptable, except as noted hereinafter. Changes in direction of runs shall be made with symmetrical bends or cast metal fittings. Do not install crushed or deformed raceways. Avoid traps in raceways where possible. Take care to prevent the lodging of plaster, dirt, or trash in raceways, boxes, fittings, and equipment during the course of construction. Raceways shall be entirely free of obstructions or shall be replaced. All conduit shall be reamed, deburred, and cleaned for proper introduction of wires and cables. Immediately after installation, plug or cap all conduit ends with watertight and dust tight conduit seals until the time for pulling wires. In block walls, do not run conduit in the same horizontal course with reinforcing steel.

2. Install bushings on the ends of all conduits, except where conduits terminate in threaded hubs on cast boxes or cabinets. Provide plastic inserts where conduits terminate in threaded holes in cast boxes. Provide suitable expansion fittings for raceways crossing expansion joints in structures or concrete slabs, or provide other suitable means to compensate for expansion and contraction.

3. All conduit supports, fasteners, and accessories for metal conduit shall be galvanized steel.

4. Conduit shall be of the greatest practicable single length between joints. Joints shall be made up with approved jointing compound. Do not use red lead as a joint compound. Do not use nails to fasten conduit. Do not use wire in lieu of straps or hangers, and do not notch structural members for the passage of raceways except with prior approval of the Engineer.

5. Install and equip conduit, boxes, and fittings installed outdoors or in other wet or damp locations so as to prevent water from entering the conduit. Provide sealing hubs. Do not run conduit in equipment foundation pads.

6. Provide a suitable seal inside each conduit or raceway entering buildings and structures, raceways entering boxes and enclosures in wet or hazardous locations.

7. Empty ducts and conduits shall be identified at both ends and shall be capped and provided with a 1/8-inch-minimum nylon cord, unless noted otherwise.

8. The Contractor shall run a mandrel through all unexposed conduits immediately prior to wire or pullstring installation to ensure conduits are clear of debris and foreign objects.

9. For PVC conduit, use factory made ells where applicable. Use approved heating methods for forming all other bends (less than 12 degrees). Provide expansion joints as required or as recommended by the manufacturer. When joining PVC conduit to metallic fittings, use approved PVC terminal adapters. When joining PVC conduit to rigid steel conduit, use an approved PVC female adapter. PVC conduit joints shall be solvent-welded with solvent recommended by the conduit manufacturer. Where PVC conduit is used, a separate grounding conductor shall be run with the conductors.

10. Concealed, embedded, and buried conduits shall emerge at right angles and shall have none of the curved portion of a bend exposed, unless otherwise approved by the Engineer. Where slabs are on grade, install conduit beneath the slab and not in the slab. Where ells are required to penetrate floor slabs, the ells shall be galvanized rigid steel conduit.

11. Where conduit size is 4 inches or less, final connection to motors, motor heaters, wall- or ceiling-mounted fans and unit heaters, dry transformers, and to other equipment where flexible connection is desired or required to minimize vibration or to facilitate maintenance or removal of equipment, shall be made with flexible conduit. Length shall be 18 to 36 inches, unless otherwise approved by the Engineer.

12. Flexible conduit shall never be used as a ground. Flexible conduit shall be secured with conduit clamps or equivalent means except where the flexible conduit is fished and where sections less than 4 feet in length are used in concealed areas for lighting fixtures.

13. Exposed conduit shall be neatly installed parallel to or at right angles to the structural members.

14. Exposed conduit stubbing up through the floor into the bottom of exposed panels, cabinets or equipment shall be lined up, properly spaced and shall be straight and plumb. Conduits shall be installed at sufficient depth below the floor to eliminate any part of the bend above.

15. Maintain at least 12 inches of separation between conduits carrying power and instrumentation cables.

16. Provide large radius elbows and LBs when entering existing buildings and enclosures.

17. Provide a suitable seal inside each conduit or raceway entering buildings and structures, raceways entering boxes and enclosures from chemical storage rooms. Seal inside the conduit with oakum or suitable plastic expansible compound to prevent passage of insects, rodents, gasses, and liquids.

18. Where flexible equipment cords are utilized for final connection to

equipment use a compression type seal fitting: Crouse-Hinds CGB or equal.

C. Underground and Embedded Conduit

1. In general, trenches with two or more underground conduits shall be red concrete-encased PVC conduits (duct bank). In general, a single underground conduit in trench shall be sand encased PVC coated rigid steel conduit (PCRSC). Conduit under concrete slabs and foundations may be PVC conduit with PVC coated rigid steel conduit transitions and risers. Underground conduits provided for utility company cabling shall meet the requirements of the serving utility

2. Except as otherwise indicated, underground and embedded conduit shall be 24 inches deep, except conduit under building slabs may be just below the slab. Do not embed conduit in slabs. Conduit installation shall meet the requirements of the NEC.

3. Separate parallel runs of four or more conduits in a single trench or embedded duct bank with preformed, nonmetallic spacers designed for the purpose. Install spacers at 6 feet or at intervals not greater than that specified in the NEC for support of the type of conduit used. Support conduits installed in fill areas suitably to prevent accidental bending until backfilling is complete.

4. Groups of conduit shall be arranged substantially as shown on the Drawings, but minor changes in location or cross sectional arrangement shall be made as necessary to avoid obstructions, etc. Where conduit runs cannot be installed substantially as shown because of conditions not discoverable prior to digging of trenches, the condition shall be referred to the Engineer for instructions before further work is done. Underground conduit work shall be coordinated with other construction work.

5. All underground conduit shall be mandrelled prior to pulling wires/cables.

D. Trenching and Backfill

1. Unless otherwise noted, conduit shall have a minimum cover of 24 inches. Trench bottoms shall be free of rocks and other hard objects. For direct buried cable and when rocks that cannot be removed are encountered at the trench bottoms, sand bedding material shall be used for a depth of 3 inches below the conduit. In any case, bedding material shall be used for the zone 6 inches above the direct burial conduit.

2. Bedding material shall contain no rocks larger than 3/4 inch in diameter and shall be free from roots and debris.

3. Where conduit trenches are located in roads or in structural backfill, the compaction requirements shall be as required by the agency that has jurisdiction for those areas. Where conduit trenches are located in an area where backfill material specifications are more rigid than those of this Section, the trench backfill shall meet the more rigid specification. In any

event, trench backfill compaction shall be as required by the Specifications.

4. Conduits shall be placed parallel in the bottom of the trench. Where conduits are required to cross, they shall be separated by a minimum of 3 inches of bedding material. Where more than one level of conduit are placed in the same trench, they shall be separated by a minimum of 3 inches of bedding material.

5. Conduit trenches in paved or improved areas shall be installed and backfilled before the area is paved or improved.

6. For trenches through existing paving, the paving shall be saw cut in order to obtain a neat vertical edge for repaving. Saw cuts shall be parallel and shall be a minimum of 6 inches outside of the trench area. Unless covered by other sections of the Specifications, paving shall be replaced in accordance with the original paving Specifications.

7. All existing improvements damaged as a result of the Contractor's operation shall be reconstructed by the Contractor at no cost to the Owner.

E. Penetrations

1. Penetrations may be cast in place or run through blockouts or holes, except where waterproof penetrations are required. Dry pack with non-shrink grout around conduits run through blockouts or holes.

2. Where a waterproof penetration through a concrete structure is shown on the Drawings or called out elsewhere in the Specifications, an approved malleable-iron watertight entrance sealing device shall be provided. Each end of the device shall have a gland type sealing assembly with pressure bushings which may be tightened at any time, except where a concrete envelope is specified or shown on the Drawings. Where there is a concrete envelope specified or shown on the Drawings, a sealing gland assembly may be on the more accessible side only. The device shall be securely anchored into the concrete with one or more integral flanges. The sealing device shall be OZ/Gedney Type WSK, or equal.

F. Boxes

1. Provide each outlet in the wiring or raceway systems with an outlet box to suit the conditions encountered. Each box shall have sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of the NEC. Provide flush or recessed fixtures with separate junction boxes when required by the fixture terminal temperature requirements. Boxes used with concealed conduits shall be flush mounted, unless otherwise indicated. Boxes must be accurately placed for finish, independently and securely supported by manufactured box hangers. Fixture outlets shall be located symmetrically.

   a. Install cast boxes outdoors, in wet or damp locations, with exposed conduit and with embedded and buried conduit. Cast boxes installed with threaded conduit shall have threaded hubs. Cast boxes installed

with PVC or plastic coated conduit shall be similarly coated.

b. Boxes in concealed conduit systems, other than in cast-in-place concrete and exterior faces of walls or where weatherproof devices are required, shall be galvanized or cadmium plated steel.

2. Underground pullboxes shall be sized by contractor in accordance with NEC. Underground pullboxes shall be precast concrete type as shown on the Drawings complete with steel traffic covers, extension rings and concrete bases. Entire box shall be sealed to prevent entrance of mud and rainwater. Conduits shall enter box horizontally, not vertically. Conduit entry shall be grouted in place with approved insulated bushings. Seals shall be installed in conduits around conductors to prevent water from entering the conduit system.

3. Unless otherwise shown on the Drawings, install boxes in a rigid and satisfactory manner, and support boxes independently of the conduit. For frame construction, use bar hangers; on concrete or brick, fasten directly to the surface using bolts or expansion shields; on hollow masonry units, use toggle bolts or expansion shields; and on steelwork, use machine screws. Threaded studs driven in by a powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields. Where boxes are flush mounted in walls, if not embedded in concrete, the hole shall be no larger than required to receive the box. Set flush mounted sheet steel boxes flush with the finished surface, providing them with suitable extension rings or plaster covers as required. Mounting hardware in industrial areas shall be galvanized.

3.2 ELECTRICAL CONTINUITY

A. The entire electrical raceway system shall form a continuous metallic electrical conductor from service point to every outlet and shall be grounded by connection to the main service ground.

B. Rigid steel conduit shall have threads filled with conductive sealant before screwing into fittings.

C. A ground wire shall be installed in all conduits.

3.3 TRENCH SETTLING

A. If at any time during a period of one year dating from the date of final acceptance of the project, there shall be any settlement of conduit trenches, the Engineer may notify the Contractor to immediately provide additional fill and to make such repairs or replacements in paving, planting, or structures, as may be deemed necessary at the Contractor's expense.

3.4 TRENCHING

A. Verify the location of all existing cables, conduits, piping, and other equipment in or near the areas to be trenched, prior to starting trenching. Repair any equipment damaged during trenching. Trenches shall not be left unattended unless the area is fenced or barricaded to restrict entry to the area. Call an Underground Service

firm before trenching.

3.5 TESTING

A. After installation has been completed, Contractor shall conduct tests required by Section 26 00 00, General Requirements, Electrical.

* * END OF SECTION * *

SECTION 26 05 00
WIRE AND CABLE

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required to install wire and cable for a complete operable electrical system as shown on Drawings.

1.2 QUALITY ASSURANCE

A. All wire and cable shall comply with applicable standards of the Underwriter's Laboratories, Inc.

B. Conductors, including insulation, cabling, jacket, filler, shielding, covering, and testing, shall meet applicable requirements of IPCEA and NEC.

1.3 SUBMITTAL

A. Submit complete description of all power, signal, communication and instrumentation cables including name of the manufacturer, type of insulation, type of conductor, and size and catalog number of control, instrument signal cables.

B. The Contractor shall submit, in accordance with the requirements of Section 26 01 01 the following materials and information:

C. A list of materials to be furnished, the name of the suppliers and the date of delivery of materials to the site.

D. Catalog data sheets and manufacturer’s information all equipment described in this Specification Section.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and equipment to project site in manufacturer's original packaging with labeling showing product name, brand, model, project name, address, and Contractor's name. Store in a location as agreeable with Owner, secure from weather or accidental damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS LABELING

A. Electrical conductors shall be delivered to the job site plainly marked or tagged on 24 inch centers as follows:

1. Underwriters Laboratories Label
2. Gauge
3. Voltage
4. Kind of Insulation

5. Name of Manufacturer

6. Trade Name

B. Conductor labels shall be white PVC tubing with machine printed black marking. Tubing shall be sized to fit conductor insulation. Adhesive strips are not acceptable.

1. Labels shall be manufactured by Panduit, Thomas & Betts, or equal.

2.2 POWER AND CONTROL CONDUCTORS

A. Insulation for all conductors shall be rated at 600 Volts.

B. All low voltage wiring shall be type THWN/THHN unless shown otherwise.

C. All conductors shall be sized for operation at 75 degrees C maximum operating temperature.

D. Unless specifically noted otherwise herein, all conductors for general wiring shall be a minimum of 98% conductivity, stranded, soft drawn copper. Aluminum or aluminum alloys are not acceptable.

E. 120 Volt control conductors may be #14 AWG, and shall be stranded.

F. Battery cables shall be fine stranded, high capacity, flexible conductors.

2.3 SPECIALTY CABLES

A. Instrumentation signal cables shall be of the type used for process control with twisted shielded pairs (TSP) of triads with PVC jacket an overall shield over the multiple pairs or triads. Two conductor (pair) cable shall have black-clear insulation, three conductor cable shall have black-red-clear insulation. The instrumentation cable shall be rated 600 Volts at 60 degrees C or better. The size of the instrumentation cable shall be AWG No. 18 with seven strands minimum. All instrumentation cables shall be UL listed. Shield shall be an aluminum-backed synthetic material providing 100-percent shielding, with a copper drain wire. The cable shall be rated 90 degrees C minimum. Twisted shielded pair (TSP) cable shall be manufactured by Belden, Alpha or equal.

B. Telephone Cable (TIC) shall consist of 2 to12 pairs with 24 AWG conductors of soft bare copper. Conductors shall have thermoplastic compound insulation and shall be color coded per the telephone industry standards. The entire cable assembly shall have an outer jacket of black polyethylene that is resistant to abrasion, moisture, weather and environmental cracking. Cable shall be suitable for installation in conduit or direct burial and shall be manufactured by Alpha, Belden or equal.

C. Data cable (Cat 5) shall consist of 4 bonded pairs, each pair shielded, with 23 AWG conductors of soft bare copper and drain wire. Conductors shall have thermoplastic compound insulation and shall be color-coded per the telephone industry standards. The entire cable assembly shall contain a foil shield and have an outer jacket of black polyethylene that is resistant to abrasion, moisture, weather and environmental cracking. Cable shall meet the requirements for

Category 5 data transmission cable, be suitable for installation in conduit or direct burial and shall be manufactured by Alpha, Belden or equal. Data outlets shall be rated Category 5 shielded. Termination methods shall be similarly rated.

D. Coaxial Cable (Coax) Cable shall be sized for length of run and application. Cable shall be suitable for installation in conduit and outside in free air, exposed to the elements: it shall be watertight. The cable shall be manufactured by Times Microwave, Series LMR or equal.

E. Other specialty cables shall be provided by the manufacturer of the equipment or instrument they connect to.

2.4 PULLING LUBRICANT AND ROPES

A. Wire pulling lubricant shall be "Flax-soap", "minerallac" or equal.

B. Pullropes shall be 3/16" stranded nylon rated for 800 lbs.

2.5 CONNECTION

A. Motor connection and splice kits shall be 3M series DB or equal.

B. Wire nuts for joints, splices and taps for conductors #8 and smaller shall consist of a cone shaped expandable coil spring insert, insulated with a teflon or plastic shell. Threaded or crimp types will not be accepted. All wire nuts shall be taped. Use "Skotchlock", "Hydent", or equal.

C. Lugs and connectors for conductors #6 and larger shall be compression types of one piece tubular construction with flat rectangular tongues. Two hole lugs shall be used for sizes 4/0 and larger. Fittings for copper conductors shall be tin-plated copper.

D. Electrical tape shall be UL approved plastic.

E. Splices shall not be installed in raceway. Splice wires in approved boxes or condulets only.

2.6 GROUNDING WIRE

A. Ground wires, number 1/0 AWG or larger shall be tinned stranded bare copper cable. All smaller ground wires shall be insulated with green color insulation.

PART 3 EXECUTION

3.1 CLEANING

A. All debris and moisture shall be removed from both new and existing raceways, boxes, and cabinets before installing wire or cable.

3.2 PULLING

A. No oil, grease or similar substances shall be used to facilitate the pulling in of conductors. Use a specifically approved wire pulling compound.

B. No wire or cable shall be pulled in until all construction, which might damage insulation or fill conduit with foreign material is completed.

C. Wire shall be pulled into conduits with care to prevent damage to insulation, using basket pulling grips to avoid slipping of insulation on conductors. Nylon rope or other "soft" surfaced cable must be used for pulling in conduits other than steel.

3.3 CONNECTIONS

A. Use a kit for motors with #8 and larger feeder conductors.

B. Joints, splices and taps in dry locations for feeder conductors #10 and smaller shall be made with twist-on connectors suitably sized for the number and gauge of the conductors.

C. Furnish and install proper lugs in all panelboards, pedestals and gutters as required to properly terminate every cable. Where paralleled conductors, or conductors of large size are to terminate on a breaker, a short length of copper cable (of capacity of the breaker) shall be connected to the breaker, and the proper compression type lug installed to connect this cable to the feeder cable. The cutting of cable strands to fit the breaker will not be permitted.

D. Only crimping tools approved by the manufacturer of the terminals or lugs shall be used.

E. Uninsulated lugs and wire ends shall be insulated with layers of plastic tape equal to insulation of wire. Wire in pedestals, panels, cabinets, pullboxes and wiring gutters shall be neatly grouped together with cable ties or other methods acceptable to the Engineer.

F. In underground location, joints, splices and taps shall be insulated by the "Skotchcast" epoxy-resin method. In-line splices may be insulated by approved waterproof "shrink tube" method. Splices shall be made if specifically approved by the City (on a case by case basis).

G. In panels, pullboxes, gutter, etc. conductor shall be neatly fanned out and tagged with wire markers. Conductors installed as part of this project but for connection to equipment to be installed in the future shall be 50% longer than the estimated final connection length, neatly coiled and sealed for storage in the equipments respective pullbox.

H. At outlets, junction boxes, pullboxes, fittings, etc., conductors shall be looped or pigtailed to extend at least six inches without splice beyond such wiring enclosures, and where used, pigtails added to loops for connection to fixtures or devices shall be at least six inches long.

I. Conduit shall be capped during construction by means of manufactured conduit seals or caps to prevent entrance of water or debris, and shall remain closed until ready for use

J. Splices shall not be installed in raceway. Splice wires in approved boxes or condulets only.

3.4 COLOR CODING AND LABELING

A. Color Coding of Low-Voltage Building Wire: Provide color coding throughout the entire network of feeders and circuits (600 volts and below) as follows:

Phase	120/208(or 240) Volts	277/480 Volts
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green

AC control wire shall be red or pink.

DC control wire shall be light blue or violet.

DC power supply wires shall be red. DC analog signal wires shall be black if positive and white (or clear) if negative. DC system signal commons shall be white.

Equipment grounds shall be green.

B. In addition to color coding, all power, control, and alarm wiring shall be numbered and identified by means of wire markers at all pedestals, switchboards, MCCs, panelboards, gutters, junction boxes, pull boxes, receptacle outlets, light outlets, manholes, disconnect switches, and circuit breakers. These markers shall correspond to numbers on shop drawings and wiring diagrams. Wire markers shall consist of machine engraved numbers applied by an approved marking device. Provide Brady heat shrink labels or equal.

1. All individual conductors shall be labeled origin, destination and sequence number. The information shall be separated by slashes (/). The origin and designation shall be designated with the names shown on the Contract Documents. The sequence number shall be a unique sequential number for that particular cable run. At the PLC wire labels shall include the rack, slot and terminal number.

2. Multi-conductor cables shall be labeled origin, destination and sequence number. The information shall be separated by slashes (/). The origin and designation shall be designated with the names shown on the Contract Documents. The sequence number shall be a unique sequential number for that particular cable run. Twisted shielded cables shall be considered multiconductor cables.

3.5 SEALING CONDUCTORS IN CONDUITS

A. All conduits containing conductors shall be sealed as the conduit enters motor control centers, pull boxes and vaults. Power conductor, control conductors, and instrumentation conductors shall be bundled and supported separately and independently in pullboxes.

3.6 TESTING

A. After installation has been completed, Contractor shall conduct tests required by Section 26 00 00, General Requirements, Electrical. Contractor shall furnish necessary instruments and personnel required for testing.

* * END OF SECTION * *

SECTION 26 06 00
MISCELLANEOUS ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required, and install, complete ready for operation, and field test the miscellaneous electrical equipment as shown on the Drawings and/or specified herein.

1.2 QUALITY ASSURANCE

A. All equipment and components shall comply with applicable standards of the Underwriter's Laboratories, Inc.

B. Provide enclosures suitable for the type of location in which they are located per Specification Section 26 00 00, General Requirements, Electrical

1.3 SUBMITTAL

A. The Contractor shall submit, in accordance with the requirements of Section 26 00 00 the following materials and information:

B. A list of materials to be furnished, the name of the suppliers and the date of delivery of materials to the site.

C. Catalog data sheets and manufacturer’s information for all equipment covered by this Specification Section.

D. Submit metering equipment and devices to the utility company in compliance with their requirements.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and equipment to project site in manufacturer's original packaging with labeling showing product name, brand, model, project name, address, and Contractor's name. Store in a location as agreeable with Site Engineer, secure from weather or accidental damage

PART 2 PRODUCTS

2.1 TERMINAL BLOCKS

A. Terminal blocks shall be side entry, snap-in type for mounting on DIN rail. End clamps and end cover plates shall be provided to hold terminal blocks in place. All components shall be rated for 600 Volts.

B. At each starter or control panel terminate all alarm, control, and any other wiring at identified numbered terminal blocks. AC and DC terminals shall be separated. Power terminal blocks shall be separated from controls and instrumentation terminal blocks. Provide a ground terminal point for each cable shield. Stacked terminal blocks will not be accepted.

C. Fuses shall be incorporated into the terminal blocks when not shown on a door or panel face. Fuse blocks shall include blown fuse indicator and be disconnecting type.

D. Provide 20% spare terminal, but not less than ten points with each terminal block.

2.2 RELAYS

A. Control relays shall be plug-in type with hold-down clamps and led indicators, unless noted otherwise. Plug-in relays shall be UL listed, enclosed, with contacts rated 10 amps at 120-volts-60 Hz, and 28 volts DC. Enclosures shall be clear plastic. Relays shall operate reliably at 80 percent of rated coil voltage. Coil burdens shall be not greater than 1.5 watts for DC coils or 2.6 VA for 60-Hz coils. The relays shall be IDEC RR Series, or equal.

B. Machine tool type relays shall be rated B300. Machine tool relays shall be manufactured by Allen-Bradley, Cutler-Hammer, Square D or equal.

C. Time delay relays with required ranges up to 180 seconds shall be enclosed and shall operate properly at any voltage within plus or minus 15 percent of the nominal voltage rating, and shall have a time delay on energization or deenergization, as required, which is knob-adjustable over the range 2 to 180 seconds. They shall have double-pole double-throw contacts rated 10 amps at 120 volts, 60 Hz. Time delay relays shall be manufactured by Idec RTE series, or equal.

D. Intrinsically safe relays (ISRs). Intrinsically safe relays shall be UL approved for Class 1, Division 1 hazardous area applications. Relays shall be manufactured by Gem, or approved equal.

E. Phase/Power Failure Relays (PFR) shall detect phase over voltage and under voltage conditions. Provide an adjustable drop out settings and an adjustable time delay on drop out. Phase failure relays shall be manufactured by Diversified SLD-440-ALE or equal. Provide a by-pass switch for the PFR output contact to the PLC.

2.3 PILOT DEVICES

A. Indicating pilotlights shall be low voltage transformer operated, with integral push to test button. Lamps shall be LED. Pilotlights shall be rated NEMA 4/4X and be 30.5 mm in diameter. Pilotlights shall be manufactured by Eaton Allen-Bradley or equal.

B. Selector switches and pushbutton switches shall be heavy duty type and match pilotlights. Switches and pushbuttons shall be rated NEMA 4/4X and be 30.5 mm in diameter. Switches and pushbuttons shall be manufactured by Eaton, Allen-Bradley Series or equal.

C. Running time meters shall be non-reset, 0-99,999.9 hour range, 120 VAC manufactured by Redington/Engler.

D. Control Stations shall be manufactured by the same manufacturer as the pilot devices and rated NEMA 4 unless shown otherwise..

2.4 WIRING DEVICES

A. Light switches shall be specification grade and shall be manufactured in accordance with UL 20. Switches shall be single pole, rated for 20 amps at 277 VAC. Switches shall be Hubbell 1221, Leviton 1201-2, or equal.

B. Receptacles shall be duplex and rated 20 amps at 120 VAC, 2 pole, 3 wire, NEMA type 5-20R and specification grade. Receptacles shall be Hubbell, Leviton or equal, GFI type where shown on the Plans.

C. Where surface mounted, provide a [FS style] cast box and cover plate.

D. Device cover plates shall be suitable for the environment in which they are installed. Stainless steel cover plates inside and weatherproof covers outside. Where weather protection is required with a plug in the receptacle, clear plastic bubble covers shall be provided.

2.5 DISCONNECTS

A. Heavy duty, motor rated switches fused or non-fusible as indicated on the Drawings, shall be provided as required. General duty switches will not be allowed. Switches shall have "Quick-break" actuating mechanisms and shall be enclosed as required by the conditions of installation. The cover shall be interlocked with the switch such that the enclosure cannot be opened with the switch in the "on" position. The "on" and "off" positions shall be clearly marked by the manufacturer. The switch shall be capable of being locked in the open position. Provide enclosures suitable for the specific type of location in which they are installed. Disconnect switches shall be manufactured by Cutler-Hammer, Square D or equal. Disconnect switch enclosures shall meet the requirements of Specification Section 26 00 00.

2.6 OVERCURRENT PROTECTIVE DEVICES

A. Circuit breakers shall be of the proper type and rating for each application. They shall be molded case, thermal-magnetic, with inverse time characteristic response - temperature compensated. Motor circuit protectors shall be similar to circuit breakers except with adjustable magnetic trip and no thermal trip. The fault current intertupting rating shall not be less than that shown on the Drawings (65,000 ASYM minimum). Provide auxiliary contacts were shown on the Drawings. Circuit breakers having a frame size of 225 Amps or less shall be molded case type with thermal magnetic non-interchangeable, trip free units. Thermal magnetic molded case circuit breakers shall be Cutler-Hammer Series C K-Frame Type HFD, or equal. The interrupting capacity of all main, feeder and branch circuit breakers shall be rated for a minimum of 65,000 RMS symmetrical Amps at operating voltage.

B. Circuit breakers feeding motors starters shall be molded case instantaneous only motor circuit protector unless shown otherwise on the Drawing. Motor circuit protectors shall be rated for 600 VAC. Motor circuit protectors shall be Cutler-Hammer Series C Type HMCP, or equal. The interrupting capacity of all motor circuit protectors shall be rated for a minimum of 65,000 RMS symmetrical Amps at operating voltage. The CONTRACTOR is responsible to provide correct motor

circuit protector size, trip rating and setting for all installed equipment.

C. Circuit Breakers shall be manufactured by Eaton, Allen-Bradley, Square D or equal. Enclosures shall meet the requirements of Specification Section 26 00 00.

D. Panelboard circuit breakers shall be bolt on type unless noted otherwise. Multiple pole breakers shall be manufactured as a single unit. Use of "tandem" circuit breakers or "two in the space normally occupied by one" will not be acceptable. The fault current intertupting rating shall not be less than that shown on the Drawings (10,000 ASYM minimum).

E. Enclosed circuit breakers shall be as indicated on the Drawings and as required by Section 26 00 00. The enclosures shall have been manufactured specifically for the type of circuit breaker provided and shall be UL listed.

F. Fuses shall be provided for all fuse holders as shown on the Drawings and specified herein. They shall be current-limiting, non-renewable as indicated on the Drawings - Fusetron or Limitron type manufactured by Bussman or equal. Provide spare fuses for each size and class of fuse used.

2.7 PANELBOARDS

A. All panelboards shall comply with applicable standards of the Underwriter's Laboratories, Inc. (UL) and shall be UL listed. They shall be manufactured and tested in accordance with the applicable sections of the latest editions of NEMA PB-1, UL-67, and the NEC.

B. Panelboards shall be of a type and rating as shown on the Drawings. They shall be dead front with hardware for accepting molded case bolt-on circuit breakers of the maximum size allowable in each space. The entire assembly including circuit breakers shall be rated for not less than the available short circuit current shown on the Drawings (10,000 Amps symmetrical when not otherwise indicated).

C. Branch circuit connections to the main buses shall be of the distributed phase type as indicated on the panel schedules. Circuit numbering shall be labeled as indicated. Main buses and branch circuit straps shall be copper or electrical grade aluminum with tin or copper plating. Non-platted aluminum current carrying parts will not be accepted. Solid neutral and ground buses shall be provided as required in each panelboard. A separate isolated ground bus shall be provided where shown on the Drawings.

D. For copper feeder conductors, mechanical or compression lugs, listed for use with copper conductors, may be used. All lugs (main and branch) shall be UL listed for use with 75 degree C wire.

E. Enclosures shall be suitable for the conditions encountered. Enclosures shall be surface or flush mounted as indicated. Panelboards shall be suitable for the location in which they are installed. Enclosures shall meet the requirements of Specification Section 26 00 00. Panelboards installed in motor control centers shall utilizes the MCC manufacturer’s standard enclosure design.

F. A removable panelboard circuit directory with plastic cover shall be provided on the door.

G. Panelboards shall be manufactured by Cutler-Hammer, Square D or equal.

2.8 FUSES

A. Fuses shall be provided for all fuse holders as shown on the Drawings and specified herein. They shall be current-limiting, non-renewable as indicated on the Drawings. They shall be Fusetron or Limitron type manufactured by Bussman or approved equal.

2.9 TRANSFORMERS

A. Transformer shall be convection cooled NEMA 1 or NEMA 3R enclosed units designed specifically for energy efficient operation and not greater that 80 deg. C temperature rise over 40 deg. C ambient. Enclosure temperature rise may not exceed 35 deg. C. over 40 deg. C ambient.

B. Manufacturer shall guarantee that sound level will not exceed NEMA standard for the KVA rating of the transformer. Applicable NEMA standards are as follows: 40 db. The core shall be mechanically isolated from the enclosure with rubber vibration absorbers.

C. The windings, for three phase transformers, shall be separate primary and secondary coils factory connected in Delta primary and grounded WYE secondary configuration. A secondary system grounding lug shall be provided prewired to WYE "neutral" and transformer enclosure. Single phase transformers shall have 120/240 Volt secondary with a grounded neutral.

D. Primary taps shall be full capacity, with a minimum of two 2-1/2% above and below rated voltage.

E. Transformers shall be manufactured by Jefferson, Square D, Cutler-Hammer, or approved equal.

2.10 UTILITY METER ENCLOSURE

A. The metering equipment, main service disconnect section and pull section shall be provided as shown on the Drawings and shall be rated for voltage as shown on the singleline diagram with current rating as shown on the Drawings and 22,000 Amps RMS symmetrical, unless shown otherwise. The metering equipment shall be UL listed and shall be equipped with a metering socket and shall meet the requirements of the serving utility company. Metering equipment shall be manufactured by Circle AW, Cutler-Hammer, Square D or equal.

2.11 AUTOMATIC TRANSFER SWITCH

A. The electrically operated, mechanically held, transfer switch shall be mounted and wired as shown on the Drawings.

B. The transfer switch shall be 480/277 Volt, three phase, 60 hertz, three pole, with solid neutral operation in ambient temperatures of 40 to 100 degrees F. The transfer switch shall be double throw, actuated by an electrical operator connected to the transfer mechanism. The transfer switch shall be rated for all classes of load, both inductive and non-inductive, at 600 Volts, and tungsten lamp load not to exceed 30 percent of the continuous rating at 600 Volts. The transfer switch

shall be designed, built, and tested to close on an inrush current up to and including 20 times the continuous rating of the switch without welding or excessive burning of the contacts. The transfer switch shall be capable of 50 operations at 6 times the continuous rating and capable of enduring 6000 operations at two times rated current, at a rate of six per minute, without failure. The electrically operated transfer switch shall have a withstand current rating that is equal to or exceeds 30,000 Amperes RMS symmetrical at 480 Volts.

C. The controls shall direct the operation of the transfer switch. The ATS panel's sensing and logic shall be controlled by a built-in microprocessor for maximum reliability, minimum maintenance, and inherent digital communications capability. The control panels shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the control panel to be disconnected from the transfer switch for routine maintenance. The control panels shall be completely enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance Sensing and control logic shall be provided on plug-in printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers.

D. The voltage of each phase of the normal source shall be monitored, with pickup adjustable from 85% to 100% and dropout adjustable from 75% to 98% of pickup setting. Repetitive accuracy of all settings shall be +/- 2% or better over an operating temperature range of -20^{o}C to 70^{o}C. Voltage and frequency settings shall be field adjustable in 1% increments without the use of tools, meters or power supplies.

E. A time delay shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Adjustable from 0 to 3 seconds. A time delay shall be provided on transfer to emergency, adjustable from 0 to 5 minutes for controlled timing of transfer of loads to emergency. A time delay shall be provided on retransfer to normal, adjustable from 0 to 30 minutes. Time delay shall be automatically bypassed if emergency source fails and normal source is acceptable. Also, provide bypass switch. A time delay shall be provided on shutdown of engine generator for cool down, adjustable from 0 to 60 minutes.

F. Other Features include a set of DPDT gold contacts rated 10 Amps, 32 VDC and shall be provided for a low voltage engine start signal with the ATS. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred. Also provide a "commit/no commit to transfer" selector switch to select whether the load should be transferred to the standby generator if the normal source restores before the generator is ready to accept the load.

G. A momentary type test switch shall be provided to simulate a normal source failure.

H. Terminals shall be provided for a remote contact, which opens to signal the ATS to transfer to emergency and for remote contacts, which open to inhibit transfer to

emergency and/or retransfer to normal.

I. Auxiliary contacts, rated 10 amps, 480VAC shall be provided consisting of one contact, closed when the switch is connected to normal source and one contact closed, when the switch is connected to emergency source. Provide auxiliary contacts with the ATS. These contacts will be wired to the control panel. Indicating lights shall be provided, one to indicate when the switch is connected to normal source and one to indicate when the switch is connected to emergency source.

J. Terminals shall be provided to signal the actual availability of the normal and emergency sources, as determined by the voltage sensing pickup and dropout settings for each source.

K. Automatic transfer switches shall be manufactured ASCO or equal.

2.12 MOTOR CONTROLLERS

A. Size per applicable Electrical Codes. Accept the minimum NEMA size shall be size 1. Where a combination starter is required, use a type with circuit breaker disconnecting device unless shown otherwise.

B. Running Overload Protection: An overload relay shall be installed in each ungrounded motor circuit leg. They shall be sensitive to motor current only, have inverse time characteristics, and be of the manual reset type with a reset button operable from the outside of the starter enclosure. They shall be temperature compensated type. Select the overload relay heaters as required by the applicable Electrical Code only after the actual nameplate data for the motor has been determined.

C. Provide and install all control devices not otherwise provided for. This includes specifically: control transformers, pilot devices, push buttons and selector switches, auxiliary contacts, etc., which are required to be mounted on or within the starter enclosure. Each starter contactor shall be provided with at least one extra N.O. auxiliary contact.

D. All motor starters shall be installed in enclosures suitable to the conditions and provided with a nameplate identifying the equipment controlled.

E. Provide phase failure relays for motor loads over 25 horsepower.

F. Provide and install any specialty relays required by the various pump manufacturers at no extra cost to the Owner.

G. NEMA rated starters shall be manufactured by Cutler-Hammer, Square D, Allen-Bradley or equal.

H. Where mechanical or process equipment is provided with a specialty protective relay, the relay shall be incorporated into the motor controls at no additional cost to the Owner.

2.13 REDUCED VOLTAGE SOLID STATER MOTOR CONTROLLERS

A. Reduced voltage solid state (RVSS) motor controllers shall be solid state devices.

The starters shall utilize SCRs to control output voltage level. The controller shall start at zero Volts and ramp-up to full Voltage to produce a soft start effect.

1. Ambient Conditions: Environment – enclosure mounted, rated to run at its rated load in an ambient temperature as high as of 50^{o}C, at an altitude 6,000 feet maximum, without derating and relative humidity 95% maximum.

2. The control module shall consist of all the circuitry required to control the power components. The control logic shall provide for the following functions: soft start with kick-start, soft start with current limit and full voltage start. The logic circuitry shall be designed to operate at 85-260 Volts, 60 Hz. The voltage shall be supplied from a control power transformer. The primary side of the transformer shall be connected to line Voltage. The primary and secondary shall be fused. The acceleration ramp time shall be DIP switch selectable from 2-30 seconds. The kick-start shall be adjustable via a rotary digital switch with 10 settings from 5%-90% of locked rotor torque. The kick-start shall be provided with an adjustable time pulse of current limit prior to the normal start mode. The current shall be held at 500% of full load for a time adjustable with 9 settings between 0.4 and 2 seconds via a rotary digital switch. This feature shall be field defeatable.

3. The energy saver function shall automatically reduce the output voltage of the power module during periods when the motor is lightly loaded. The energy saver feature shall be field defeatable. The energy saver function shall automatically reduce the output voltage of the power module during periods when the motor is lightly loaded.

4. The following protection shall be provided during starting and running modes: start fault, line fault, temperature fault and stalled motor. When these conditions are detected, starting of the controller shall be inhibited or the controller shall shut down if running.

5. Dual function LED indicators shall be provided for advisory status and fault annunciation. The LEDs shall be color coded and include: control voltage present, starting, running, energy saver, stopping, start fault, stalled motor fault, temperature fault and line fault. The controller shall include an up to speed output contact.

6. The power module shall consist of three clamped semiconductor stacks - silicon controlled rectifiers (SCR). The SCRs shall have a peak inverse Voltage rating of 1400 Volts. The power module shall be mounted on a single heatsink. The heatsink shall be isolated form the power module and include provisions for grounding. The power module shall have a service factor of 1.15.

B. Reduced voltage solid-state motor controllers shall be manufactured by Allen-Bradley, SMC plus or equal.

2.14 SURGE PROTECTION DEVICE.

A. The surge protection devices (SPD) shall be designed to protect all AC electrical circuits and connected equipment from destructive, damaging or disruptive effects of lightning induced transients, normal utility load switching activities and internal generated transients. The surge suppression device shall be parallel configured, solid state, voltage clamping components demonstrating threshold suppression characteristics. Clamping components shall be metal oxide varistors. All suppression devices shall be encapsulated and mounted in a NEMA RATED enclosure. The unit shall be rated for 120 KA per phase and 60 KA per mode minimum. The device shall have all normal mode (L-L and L-N) and common mode (L-G and N-G) circuit paths protected with suppression components. The device shall be rated for 240/120 V systems, shall include a remote alarm form C contact. The device for the facility service entrance shall be installed in accordance with the manufacturer's recommendations. The manufacturer shall provide a ten year warranty. The SPD unit shall be manufactured by Square D, Eaton, Leviton or equal.

2.15 ENCLOSURES

A. Provide NEMA rated enclosures where shown on the drawings, required by these Specifications or required by the NEC. Enclosures shall be Tesco, Hoffman or equal.

2.16 PEDESTAL ENCLOSURES

A. Furnish and install all equipment as shown on drawings in a low profile 60 inch high, U.L. listed weatherproof, vandal resistant, NEMA 3R, pedestal style switchboard and instrument enclosures. Enclosure shall consist of sections with dead front interior and hinged gasketed exterior doors. Outer enclosure shall be constructed of 12 gauge hot dipped galvanized steel. Doors shall be equipped with 316 stainless steel handles with 3-point roller bearing latches and hasps for OWNER padlocks. Concrete base with anchor bolts to meet applicable seismic requirements shall be provided.

B. Provide LED lights, door switch, GFCI receptacle, PFR power fail relay, strip heater, thermostat and heat shield (if required). All openings shall be sealed to prevent entrance of insects and rodents. Finish shall be polyester dry powder, electrostatically applied and baked on at 380 deg. F. Color shall be white interior doors and light brown (camel) exterior. The painting process shall include five stages of metal preparation using dip tanks as follows: 1) Alkaline cleaner, 2) Clear water rinse, 3) Iron phosphate application, 4) Clear water rinse, and 5) Inhibitive rinse to seal phosphated surfaces. All bussing and wire shall be copper. All wire shall be stranded with locking spade pressure connectors and labeled with clip-on permanent plastic wire markers. All circuit breakers and dead front mounted devices (lights and switch) shall be equipped with engraved nameplates.

C. The enclosure shall be compartmentalized such that the programmable pump controller and power sections are isolated from each other. The compartments containing the programmable controller and power sections shall be separated by barriers behind the inner dead front door. Doors shall be hinged on the same side and shall open to greater than 90 degrees. All dead front latches are 1/4 turn adjustable with 1/8" thick latching dog and knurled knob.

D. Thermostatically controlled heating and cooling systems shall be provided, if required, and as approved by the OWNER'S REPRESENTATIVE to maintain suitable climate conditions within the control panel as required to provide proper operation of the panel and to comply with the Drawings and Specifications.

E. Provide ventilation fan cover and/or sunshield, finished to match the enclosure, where shown on the drawings.

F. Arrange outer doors that allow operators to stand in front of both the control/ instrumentation section and power/motor control section at the same time.

G. Provide generator receptacle and interlock for generator breaker where shown on the Drawings.

H. Provide intrusion switch where shown on the Drawings.

I. A ground bus shall be provided in the service equipment. It shall be connected to the grounding electrode system by exothermic welded stranded copper grounding conductors. Screw type lugs shall be provided for connection of equipment grounding conductors.

J. Provide interior lighting and switches for each pedestal section. The luminaries shall be the size and type normally supplied with the specified spaces. As a minimum, the luminaries shall be a rapid start LED strip type fixture with lamps. A lens or guard shall be furnished and installed over each lamp. The fixture ballasts shall be capable of providing reliable starts with ambient temperatures down to 30 degrees. Ballast noise shall not exceed 50 dBA.

K. Provide a receptacle in each pedestal section. Receptacles shall be of specification grade and of NEMA configuration and rated 2 pole, 3 wire grounding, 20 amperes, 125 volts. All external and dead front receptacles shall be installed on ground fault interrupter circuits "GFCI".

L. The electric service meter compartment shall be arranged as shown to meet the electric utility company requirements.

M. Provide neutral bar for grounding.

N. Provide guard over power company watt-hour meter with hinged access cover that has a hasp for utility company padlock.

O. Provide wire and lugs for service entrance as required by utility company.

P. The pull section and utility compartments shall be accessible only by the utility company.

Q. Provide a meter base, test perch with test by-pass and other materials, as required by the electric utility, which will provide service to the facility, for installation of metering equipment and attachment of service conductors.

R. Power wiring, power distribution blocks and all other power components shall be rated for 30 KAIC unless otherwise noted.

S. Pedestals shall be manufactured by TESCO Class 24-000, Pacific Utility Products or Equal.

2.17 WET WELL TERMINATION BOX ENCLOSURE

A. Provide NEMA rated pump termination boxes where shown on the drawings. Termination box shall include two sections. Each section shall include a vandal resistant, padlockable door. The enclosure shall be constructed of 316 stainless steel and rated NEMA 3R. All hardware shall be stainless steel. The first section will include a ventilated space suitable for a Class 1, Division 2 hazardous area. Conduits entering this space shall include a Rotex compression fitting suitable for creating a mechanical barrier between for equipment cables to pass through from a Class 1, Division 1 area to a Class 1, Division 2 hazardous area. This section shall also contain instructions for installation and maintaining the integrity of the barriers. The second section shall include pump cable termination blocks (power and controls): this section shall be an unrated area. Blocks shall be rated for a minimum of 150% of pump FLA and rated for the type of conductors used. The barrier between the rated and non-rated hazardous area shall comprise of a second mechanical barrier for equipment cables to pass from a Class 1, Division 2 area to an unrated area. The second barrier shall be a Rotex compression style sealing plate capable of creating a barrier with multiple cables of varying size. All compression points shall include blank plugs for installation when cables are removed. Provide Tesco 24-SP-SS or similar custom manufactured unit with all accessories and hardware shown or described.

2.18 FASTENERS

A. When fastening to pads, concrete walls, floors, and the like, provide capsule anchors, not expansion shields. Size capsule anchors to meet load requirements. Minimum size capsule anchor bolt shall be 3/8 inch diameter. Use 316 stainless steel hardware in the wet well and 304 stainless steel hardware elsewhere, unless noted otherwise.

2.19 PORTABLE GENERATOR RECEPTACLE

A. The portable generator receptacle shall match [connect to] the District's existing 100 A portable generator plugs, be reverse service with angle adapter and back box.

2.20 AUTODIALER

A. Furnish and install an autodialer and program on site as directed by the OWNER'S REPRESENTATIVE.

1. The Autodialer shall monitor four input alarm channels and also internally monitor AC power source. The four input channels shall be configured as digital (dry contract) or analog inputs. The autodialer shall include digitally recorded programming support messages, station identification message, power failure alarm message, and four default alarm messages. Application specific, user recorded messages may be digitally recorded to replace the default station identification message and four default alarm messages.
2. The automatic dialer shall be a self-contained, solid state device and UL listed. The autodialer shall continuously monitor the presence of main power and the status of four independent alarm input channels, which may be programmed for N.O. or N.C. dry-contact (or logic levels) inputs or for

4−20 mA analog inputs. Each of the four input channels shall be programmable to alarm on any of the following: OPEN circuit, CLOSED circuit, or analog HIGH and / or LOW alarm set points. Alarms shall be capable of independently being programmatically turned OFF. On AC power failure and/or on violation of alarm criteria for any of the four alarm inputs, the dialer shall go into alarm status and begin alarm dialing and alarm notification. Dialing shall continue until the alarm(s) is (are) acknowledged.

3. Unless alarm notification is by pager, notification shall be by playback of high resolution digitally recorded alarm voice messages. Each alarm shall cause the playback of its specific custom message. Analog alarm messages shall include the percent-of-full-scale of the analog inputs. Alarm acknowledgement shall be accomplished by pressing the 9-button on the telephone touch pad or by using the switch on the dialer front panel. Call-back alarm acknowledgement capability shall be available in the event that alarm notification is by numeric pager. The dialer shall re-alarm and resume alarm dialing after a programmable period of time has elapsed after an alarm(s) has been acknowledged but the fault(s) causing the alarm(s) not remedied.
4. The dialer shall respond to inquiry calls from any telephone and shall provide a status report of alarm input point status (OPEN, CLOSED, or analog PERCENT) and main power status. The report shall include alarm status for each point (normal, alarm, and alarm acknowledged but fault not remedied). A warning message shall be provided if no phone numbers have been programmed for alarm notification or if the switch on the dialer front panel is set to DISARMED rather than READY.
5. The dialer shall be FCC approved. It shall operate on a standard cell phone and shall be capable of calling from one to eight phone numbers, each up to 60 digits in length. Dialer shall be programmed using a standard touch tone telephone handset that shall be connected to the dialers through the RJ11 programming port. After programming, the programming telephone shall be disconnected and removed from the dialer. Pre-programmed speech shall provide entry guidance and confirmation of programmable features. Coded programming using function codes shall provide direct access to specific programmable items.
6. The autodialer enclosure shall be NEMA-12 and shall be capable of surface or flush mount. Enclosure shall have LED lights indicating main power failure, DISARMED status, phone line fault, phone off hook, alarm input line status (Normal, Fault with alarm trip delay not timed out, Unacknowledged Alarm, and Acknowledged Alarm).
7. Main power for the dialer shall be 105−135 VAC (GAC option). Backup power to allow dialer operation should main power be lost shall be by an internal 6 V, 4 AH gel cell rechargeable battery and precision voltage controlled charger, option GBB. A trickle charger shall be provided. Battery backup shall be 20 hours. User program storage shall be by an internal lithium battery rated for 10 years from date of shipment. Dialer operating system and default voice messages shall be stored in non-volatile memory.

B. The unit shall be covered by a Two (2) Year Warranty covering parts and labor performed at the Factory.

C. The autodialer shall be RACO Guard-It with cellular wireless telephone communications or equal.

D. Provide cellphone and antenna to match autodialer and complete the operational system.

2.21 LIGHT FIXTURES

A. Lighting fixtures should be provided as scheduled, however; fixtures of similar design, having equivalent mechanical characteristics and virtually identical luminous intensity distributions and luminances over the angles of interest (in at least the perpendicular and parallel planes), may be submitted for approval. Sufficient photometric and mechanical data must be provided with the submittal for a substitute fixture to allow for meaningful comparison with the specified item. A sample of any or all substitute lighting fixtures may be required to be furnished to the Engineer for physical evaluation to determine the acceptability of the substitute item. When making substitute fixture submittals, allow sufficient time for this process.

PART 3 EXECUTION

3.1 INSTALLATION

A. Equipment installation, including supports, anchors, and restrainers, shall meet the requirements specified in Section 26 00 00, General Requirements, Electrical.

B. Install freestanding equipment in accordance with the manufacturer's recommendations. Secure freestanding equipment rigidly to floors or mounting pads with anchor bolts, expansion shields, or other approved means. Install wall mounted equipment in a similar manner, plumb, with appropriately sized anchors.

C. Lighting fixtures shall be installed as indicated on the Drawings. Provide all brackets, hangers, poles, masts, bases and other hardware as may be required for each particular condition of installation.

3.2 TRAINING

A. A factory trained service technician shall instruct operating personnel in the operation, maintenance and adjustment of the all systems. The training shall be four hours in length.

3.3 TESTING

A. After installation has been completed, Contractor shall conduct tests required by Section 26 00 00, General Requirements, Electrical.

* * END OF SECTION * *

SECTION 26 07 00
UTILITY SERVICE

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The CONTRACTOR shall provide utility services as described in the Specifications and shown on the Drawings. Provide and install all service entrance equipment, vaults, pads, pullboxes, raceways, risers, ground rods, receptacles, cabinets, supporting structures, pullropes, bollards and other facilities as required by the serving utilities.

B. The CONTRACTOR shall make the "application for service" for new service and coordinate all service requirements with the various utility companies in accordance with their rules and requirements. Obtain Drawings of actual service equipment installation requirements from the utilities prior to construction. Submit equipment and devices to the utility company in compliance with their requirements.

C. The CONTRACTOR shall provide temporary power during construction. Pay for equipment rental, fuel, power, etc. Remove temporary facilities after completion of construction.

D. The CONTRACTOR’s effort shall include significant coordination with the various utility companies and the OWNER.

E. RELATED WORK SPECIFIED ELSEWHERE

1. Division 3, Concrete
2. Division 2, Earthwork, Trenching
3. Section 26 00 00, General Electrical Requirements
4. Section 26 04 00, Raceway Systems
5. Section 26 09 00, Electrical Grounding

1.2 QUALITY ASSURANCE

A. Like materials provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance and manufacturer’s service.

B. All work and material provided shall be in strict accordance with each utility company's rules, requirements, and standards, but in no case less than the requirements of this Specification. Coordinate all work, outages, etc., with the various utilities, the OWNER and others to prevent unnecessary delays in the progress of construction.

1.3 SUBMITTAL

A. Submit all utility equipment to the appropriate utility for review and approval

prior to formal submission.

B. The CONTRACTOR shall furnish catalog data and shop drawings in accordance with the requirements of Section 26 00 00.

PART 2 PRODUCTS

2.1 GENERAL

A. All materials shall be as specified by the utilities, but in no case less than the requirements of this Specification.

B. Revenue Metering and visual isolation of metering must comply with PG&E Standards.

C. The electric service meter compartment shall be arranged as shown to meet the electric utility company requirements. Provide neutral bar for grounding volt three phase, four wire service. Provide guard over power company watt-hour meter with hinged access cover that has a hasp for utility company padlock. Provide wire and lugs for service entrance as required by utility company.

D. The metering equipment shall be UL listed and shall be equipped with a metering socket and shall meet the requirements of the serving utility company. Enclosure shall be rated NEMA 3R. Metering equipment shall be manufactured by Tesco, Pacific Utility Products, Meyer, IEM, Circle AW, Cutler-Hammer, Square D or equal

E. Where specifically required by the utility companies, provide a sand bed in utility trenches per their standards.

F. Provide, conduit, pullboxes, backboards, ground rods, risers, meters, service disconnects and transformer pads per the utility companies' requirements.

PART 3 MATERIALS

3.1 INSTALLATION

A. Installation of all structures and equipment shall be in strict accordance with utility company standards.

B. Warning tape shall be laid in Utility trenches at a depth of 12 inches below finished grade and at least 6 inches above installed equipment. It shall be laid on the compacted backfill for the full length of the trench. Do not stretch the tape. Use wide yellow Brady "Identoline" stating: CAUTION BURIED ELECTRICAL LINE. Installation of identification tape under building slabs is not required.

* * END OF SECTION * *

SECTION 26 09 00
GROUNDING SYSTEM

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Applicable provisions of Section 26 00 00 are incorporated herein as though fully set forth at length.

B. Ground Power system, electrical equipment and raceway grounding and bonding, and specialized systems including testing.

C. Work Included: Furnish all labor, material, equipment, tools and services necessary for the installation, connection and testing of all grounding as specified herein and as shown on the Drawings.

1.2 STANDARDS

A. American Society for Testing and Materials (ASTM) Publication:

1. B228 Copper Clad Steel Conductors Specification
2. D178 Specifications for Rubber Insulating Matting

B. National Electric Code (NEC)

C. International Electrical Testing Association (NETA) Publication:

D. ATS - Acceptance Testing Specifications for Electrical Equipment Power Systems

1.3 SUBMITTALS

A. Submit material or equipment data in accordance with the Product Information category of the General Conditions and the submittal requirements of Section 26 00 00.

B. Manufacturer’s product data for the following:

1. Connection methods and details.
2. Ground Rods.
3. Ground rod wells.

1.4 QUALITY ASSURANCE

A. Comply with the following codes and standards, and section 26 00 00:

1. IEEE 81- Recommended guide for measuring ground resistance and potential gradients in the earth.
2. NEMA.
3. UL Listings.
4. MIL Handbook 419.

PART 2 MATERIALS

2.1 GENERAL SYSTEM DESCRIPTION

A. The grounding systems shall consist of the ground rods, grounding conductors, ground bus, ground fittings and clamps, and bonding conductors to water piping and structural steel as shown on the Drawings. One system shown provides service and separately derived system grounds. A second system is an electronic ground system to provide for the discharge of static electricity. All are bonded together.

B. Ground all electrical equipment, conduits, supports, cabinets, and switchgear in accordance with National Electrical Code and as shown on the drawings, the intent being a complete system ground and equipment ground.

2.2 SYSTEM COMPONENTS

A. Ground Rods: Ground rods shall be cone pointed copper clad Grade 40 HS steel rods conforming to ASTM B228. The welded copper encased steel rod shall have a conductivity of not less than 27% of pure copper. Rods shall be not less than 3/4-inch in diameter and 10 feet long, unless otherwise indicated. The manufacturer's trademark shall be stamped near the top.

B. Ground Conductors: Buried conductors shall be medium-hard drawn bare copper; other conductors shall be soft drawn copper. Sizes over No.6 AWG shall be stranded. Coat all ground connections except the exothermic welds with electrical joint compound, non-petroleum type, UL listed for copper and aluminum applications.

C. Ground Connections: Connection to ground rods and buried connections shall be by exothermic weld. Lugs for attachment of cables to steel enclosures shall be of the binding post type with a 1/2-13NC stud. Each post shall accommodate cables from #4 AWG to #3/0 AWG.

D. Ground Rod Boxes: Boxes shall be a 9-inch-diameter precast concrete unit with hot-dip galvanized traffic covers. Units shall be 12-inches deep. Covers shall be embossed with the wording "Ground Rod."

E. Ground rod wells shall be 8” inch diameter constructed of reinforced concrete with a reinforced concrete removable cover stamped “GROUND” as manufactured by Christy or equal.

F. Ground Bus: Ground bus shall be a high conductivity copper alloy strap measuring 3/16-inch by 3/4-inch and of lengths as shown on the Drawings. Bus shall be predrilled and tapped to accept 8-32” brass machine screws on 12-inch centers or with greater density if required.

PART 3 EXECUTION

3.1 INSTALLATION

A. Ground all equipment for which a ground connection is required per NEC

whether or not the ground connection is specifically shown on the Drawings.

B. Where mechanical lugs are not welded or fastened with threaded bolt, surfaces shall be thoroughly cleaned and paint scraped to bare metal before connections are made to insure good metal-to-metal contact.

C. Grounding conductors shall be so installed as to permit shortest and most direct path from equipment to ground. Ground connections shall be accessible for inspection and made with approved solderless connections braced (or bolted) to the equipment or structure to be grounded.

D. An equipment grounding conductor must be installed in each conduit with power conductors or, in the case of multi-conductor cable, run inside the sheath.

E. Where generators and transformers are indicated on the drawings to be grounded solidly to a separate grounding electrode located at the equipment in addition to the ground connection, this grounding electrode shall be bonded to the system ground through the equipment grounding conductor(s) and/or a separate grounding conductor as indicated on the drawings.

F. A main system ground, bare copper conductors, size as indicated, shall be run in PVC conduit from the pedestal to a ground point outside the pad and an electrode ground under the pad as indicated on the drawings. This ground shall be extended to metallic water piping.

G. Connections to ground rods shall be as noted on Drawings or be exothermically welded. Ground rod connections shall be in a ground rod well for inspection purposes.

H. All bonds between the grounding electrode conductors and the grounding electrodes must be accessible for inspection and routine maintenance. No buried ground connections (except rebar bonds) shall be accepted.

I. All enclosure doors with 120 VAC mounted devices shall be bonded to the enclosure ground bus.

J. Where ground rods must be driven to depths over 8 feet, increase rod diameter used, sufficiently to prevent the rod from bending or being damaged.

K. All direct buried conductors shall be minimum of 30” below grade.

L. Bond metallic water piping at its entrance into each building. Ground separately derived electrical system neutrals to the metallic water piping in addition to the system driven ground, per NEC requirements.

M. Provide a ground wire in every conduit carrying a circuit of over 50 volts to ground.

N. Make embedded or buried ground connections, taps and splices with exothermic welds. Coat ground connections.

O. Effectively bond structural steel for buildings to the grounding system using exothermic welds.

3.2 TESTING

A. Conduct ground resistance tests using a ground megohmmeter with a scale reading of 25 ohms maximum. Resistance between ground and absolute earth shall not exceed 25 ohms and shall be measured using the fall of potential method with a three or four terminal ground resistance tester. A minimum of ten (10) ground resistance tests shall be measured at 30-foot intervals from the service-grounding electrode.

B. The test results shall be plotted on a curve and submitted in the report. The ground resistance test shall be conducted in the presence of the Engineer before the equipment is placed in operation. Use of salts, water or compounds to attain the specified ground resistance is not acceptable.

C. Test methods shall conform to NETA Standard ATS using the three electrode method. Conduct tests only after a period of not less than 48 hours of dry weather.

D. Furnish to the Owner a test report with recorded data of each ground rod location included on a drawing with date of test, weather conductions and the measured resistance.

* * END OF SECTION * *

SECTION 26 61 00
CONTROL PANEL

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, equipment and incidentals, including a SCADA remote unit, communication components, associated equipment, hardware and software necessary to provide a complete and operational control system.

B. The CONTRACTOR is responsible for the testing, startup and training.

C. The CONTRACTOR shall provide, connect and test instruments.

D. The CONTRACTOR shall provide field services associated with all components covered by this Specification Section.

1.2 SUBMITTALS

A. Submittals shall include those set forth in Specification Section 26 00 00, General Requirements, Electrical.

B. Provide operating and maintenance instructions as specified in Section 26 00 00, Electrical Requirements, General. This shall include complete technical manual, programming, wiring diagrams. Provide drawings and diagrams showing final as-built conditions.

1.3 MANUFACTURER'S DIRECTIONS

A. Manufacturer's directions shall be followed in all cases where manufacturers of articles used furnish directions covering points not shown on the drawings or herein specified.

1.4 WARRANTY

A. Guarantee all work for one year from date of acceptance against all defect in material, equipment, and workmanship.

1.5 SITE CONDITIONS

A. General Environment. The programmable logic controller shall withstand anticipated environmental conditions of -20 degrees to 65 degrees C operating temperature and 5 percent to 95 percent humidity non-condensing. Electro-magnetic interference (EMI) and radio frequency interference (RFI), as may be anticipated in a typical industrial environment, shall not impede proper functioning of the control systems. EMI and RFI is expected from two-way radios, variable frequency drives, lightning strikes, motors, transformers, contactors, relays, etc.

B. Normal fluctuations of the 120 VAC 60 Hz power supply shall not cause improper operation of the CONTROLLER system. Normal fluctuations are voltage

excursions between 100 and 130V, or surges caused by switching of electrical loads.

1.6 QUALITY ASSURANCE

A. The custom control panel shall be built in accordance with the overall sizing and component layouts as detailed on the Drawings, and no deviations will be allowed without prior approval of the Engineer.

B. The Controller and control panels shall be UL labeled as industrial control panel.

C. All devices and components of a similar type or function (i.e., circuit breakers, control relays, timers, etc.) shall be the product of one manufacturer unless otherwise noted.

D. The Control panel shall be manufactured by Aqua Sierra Controls, Tesco or approved equal.

PART 2 PRODUCTS

2.1 CONTROL PANEL ENCLOSURE

A. Furnish and install all control equipment, as shown on drawings, in U.L. listed NEMA enclosures: Tesco, Hoffman or equal.

2.2 CONTROL PANEL CONSTRUCTION

A. Control Panels shall be so constructed for the application of a UL Listing Label by an approved UL Control Panel Assembly Facility. All electrical connections shall be properly inspected and torqued in compliance with ISO specifications. External connections to the control panel shall be by way of numbered terminal blocks. Control Panels shall be properly checked and load tested with power applied. A control panel test log shall be supplied with the control panel. Control Panels shall be supplied from a UL approved control panel assembly facility with all of the required labels properly attached.

B. Control Panel Enclosure Specific Construction Requirements

1. Enclosure shall be sized according to physical and functional device requirements.
2. Enclosure seams shall be continuously welded and ground smooth.
3. Enclosure door opening flange trough shall exclude liquids and contaminants.
4. Enclosure shall include an integral body grounding stud and sub-panel mounting studs.
5. Enclosure door shall have hidden hinges for a clean, aesthetic appearance.
6. Enclosure door opening angle shall be standard, full access, 135 degree opening radius.
7. Enclosure door shall be interchangeable and removable by pulling a captive hinge pin.
8. Enclosure door shall have a high-impact thermoplastic data pocket mounted on the inner side of the enclosure door.
9. Enclosure door shall have a seamless, foam-in-place, one-piece gasket to provide an oil-tight, dust-tight seal against contaminants.
10. Enclosure shall have a three-point latching system with a zinc die-cast

handle that is painted with black textured polyester powder paint.

11. Enclosure handles shall be capable of being padlocked.
12. Steel sub-panel shall be white.
13. When enclosure cut-outs for instruments and other devices are required, holes shall be cut, punched, or drilled and finished with rounded edges.
14. A door stiffener shall be used where applicable to prevent door deflection under instrument loading or operation.

C. Wiring for AC and DC control circuits shall be Type THWN stranded copper and shall be sized for the applied voltage and current. Unless otherwise noted, control circuit wiring shall not be smaller than No. 14 AWG. Cable wiring for analog signal circuits shall be twisted, shielded pairs of stranded copper conductors that shall not be smaller than No. 18 AWG. Wiring for special signalling equipment such as communications, digital data, and multiplexed signals shall be provided by the equipment supplier. Wiring shall be numbered and marked at each termination point. Terminal blocks for internal or external wiring shall be DIN rail mounted, individual screw compression type terminals with machine printed labels. Provide wire barriers: IBOCO or equal.

D. Nameplates are defined as inscribed, plastic plates mounted above or near a panel face mounted component. Unless otherwise noted, nameplates shall be engraved, rigid, laminated plastic with an adhesive back. Nameplate color shall be white with black letters. Component Labels are defined as printed, vinyl labels mounted above, below or near a sub-panel (back) mounted component for identification. Printed vinyl labels shall be white in color with black letters and an adhesive back.

E. Provide LED light fixture and switch.

F. There shall be a 120VAC, 15 Amp GFCI rated convenience receptacle mounted on the dead front swing door of the control panel. Receptacle circuit shall be protected by a thermal magnetic circuit breaker.

G. There shall be a 120VAC, 50 watt enclosure heater inside the control panel.

H. Provide Remote Telemetry Unit per Specification Section 26 63 00.

I. Other components shall be provided as described in Specification Division 26.

J. Space shall be provided for instruments indicated as furnished by others to be mounted and wired by the control panel manufacturer. These units shall be shipped to the control panel manufacturer in sufficient time for wiring. Coordination of instrument delivery shall be the responsibility of the CONTRACTOR.The instruments and controls to be located on each panel are shown on the instrumentation drawings, electrical schematics, and/or in the individual Specification.

PART 3 EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the manufacturer's instructions and located as shown on the Drawings. The CONTRACTOR shall be responsible for

coordinating the equipment, performing the installation and start-up in a timely manner, and assuring a fully operable and function-tested system.

3.2 GROUNDING

A. Ground transfer switch directly to the service entrance ground source in accordance with NEC.

3.3 PROGRAMMING SERVICES AND DOCUMENTATION

A. The programmer shall provide programming documentation that fully describes the program function and application.

3.4 FIELD SERVICES

A. Provide field services to support the start-up of the system including the control panel and instruments. Provide two days of start-up services minimum.

B. Provide start-up services for all instrumentation components.

3.5 TRAINING

A. Provide training on site for minimum of 4 hours.

3.6 TESTS

A. Testing shall be provided as described in Specification Section 26 00 00, General Requirements, Electrical.

* * END OF SECTION * *

SECTION 26 63 00
REMOTE TELEMETRY UNIT

PART 1 GENERAL

1.1 SCOPE OF WORK

A. The CONTRACTOR shall furnish all labor, materials, equipment and incidentals, including RTU/PLC, communication components and associated equipment required, to install complete and ready for operation, and field test the RTU/PLC, radio and SCADA modifications as shown on the Drawings and/or specified herein.

B. The SCADA system modifications and Remote Telemetry Unit/Programable Logic Controller shall meet all the requirements of Section 26 61 00, Control Panels.

C. The CONTRACTOR is responsible for the factory and field testing and startup.

D. The CONTRACTOR shall program the existing SCADA system for the new site to match other similar existing lift stations in the DISTRICT's collection system. The CONTRACTOR shall match the existing SCADA displays and functionalities as much as possible to provide a smooth transition for OWNER personnel in integrating the new facility into the existing system.

E. Provide a point to point radio study providing final height for the antenna mast and antenna mounting height.

F. Provide a system for disabling the generator when pumps are not required and the UPS battery power is available.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Section 26 00 00, General Electrical Requirements

B. Section 26 09 00, Electrical Grounding

C. Section 26 06 00, Miscellaneous Electrical Equipment

D. Section 26 61 00, Control Panel

E. Section 26 89 00, Instrumentation

1.3 CONTRACTOR SUBMITTALS

A. The following information shall be provided in accordance with Section 26 00 00, General Electrical Requirements.

B. A copy of this specification section, with any addendum updates included, and all referenced and applicable sections, with any addendum updates included, shall be submitted with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.

Checkmarks shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the CONTRACTOR, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance on the part of the CONTRACTOR with the specifications. The submittal shall be accompanied by a detailed, written justification for each deviation. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

C. Submittals shall be provided to confirm that materials to be used comply with information specified herein.

D. Upon receipt of approved hardware submittals and commencement of SCADA System configuration and programming, the CONTRACTOR shall submit a digital copy of the static SCADA screen displays and pop-ups for a development review. Upon favorable review of progress, development shall continue towards factory testing and delivery milestones.

E. Submit radio study and recommendations.

F. Provide operating and maintenance instructions as specified in Section 26 00 00. This shall include a complete technical manual, programming, all wiring and interconnection wiring diagrams, including but not limited to RTU/PLC hardware, communications, power, and network. Provide drawings and diagrams showing final as-built conditions.

G. Provide the services of a qualified factory trained field DISTRICT'S REPRESENTATIVE to test and put the system into operation, and instruct DISTRICT's personnel.

1.4 QUALITY ASSURANCE

A. The CONTRACTOR shall furnish all of the hardware and software including custom programming, for RTU/PLC and SCADA system.

B. The RTU/PLC shall be completely inspected and subjected to a factory test prior to shipment.

C. The SCADA system modifications, remote telemetry unit and communication equipment shall be guaranteed against defects of design, material, and workmanship for a period of one (1) year from the date of acceptance by the DISTRICT. The SCADA system integrator shall be Tesco or preapproved equal.

D. The SCADA RTU/PLC shall be the product of a manufacturer regularly engaged in the design, production, and support of complex RTU/PLC and SCADA systems. The supplier shall demonstrate experience of at least 100 similar installations. The RTU/PLC supplier shall have been in business for twenty-five years. All equipment shall include a 1 year warranty. The system shall be manufactured by Tesco L2000 series or preapproved equal.

E. The RTU/PLC and SCADA system supplier shall have a service organization

available upon 24 hour notice and stock applicable spare parts within 100 mile radius of the project site.

F. The CONTRACTOR shall be responsible for the compatibility, installation, and start-up of the RTU/PLC, SCADA and associated equipment.

G. The CONTRACTOR and the system supplier shall meet with the DISTRICT for four hours to discuss coordination issues related to programming, communication, factory test and start-up/testing of the SCADA system prior to factory testing of the equipment.

H. The CONTRACTOR and system supplier shall provide all field services including installation oversight, testing, start-up and training.

1.5 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. The following references are part of this Section. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail. The latest edition of the following references at the time of bid shall be used.

1.6 SCADA TESTING

A. General

1. The CONTRACTOR shall perform a factory test of SCADA system equipment and all necessary site testing and adjustment of the complete, assembled SCADA system as specified herein. The CONTRACTOR is responsible for providing all personnel, equipment, instrumentation, and supplies necessary to perform all required testing. Written notification of any planned testing shall be given to the DISTRICT'S REPRESENTATIVE at least 14 days prior to any test, and in no case shall notice be given until after the CONTRACTOR has received written approval of the specific test procedures.

B. Factory Test

1. Procedures

a. The test procedures shall define all the tests required to ensure that the system meets technical, operational, and performance specifications. The test procedures shall identify all capabilities and functions to be tested. The test procedures shall be developed by the CONTRACTOR based on the design documentation. Test Procedures shall include the testing of all SCADA, RTU/PLC hardware/software interfaces of CONTRACTOR furnished SCADA system equipment. Each software module, application program, graphic element, and communication protocol shall be tested including as to how these interfaces are coordinated with field devices, CONTRACTOR developed interface software and CONTRACTOR-furnished hardware and software. The final procedures shall be provided to the observers prior to the commencement of testing.

2. Factory System Testing

a. CONTRACTOR shall test the operation and display of all application software based on a simulation of 100% percent of total input/output count, both analog and discrete. Discrete input simulation shall consist of jumpering inputs and observing the specified action at the RTU. Discrete outputs shall consist of forcing control outputs at the RTU/PLC from the [temporary test] SCADA application and observing the associated output action using a multimeter. Analog points and ranges shall be checked at 0, 10, 50, 90 and 100% of full scale using a multimeter or calibration tester. Testing shall show that the monitoring and control application software associated with the input/output points, and internal programmed controls and data, perform the process control functions and SCADA display indication, control, trending, alarm dial out and reporting of the System.

3. Field System Testing

a. The CONTRACTOR shall perform start-up, field, performance verifications, and endurance tests of SCADA system equipment and all necessary site testing and adjustment of the complete SCADA system as specified herein. The CONTRACTOR is responsible for providing all personnel, equipment, instrumentation, and supplies necessary to perform all required testing. Written notification of any planned testing shall be given to the DISTRICT'S REPRESENTATIVE at least 14 days prior to any test. All testing shall be coordinated with the DISTRICT and discussed during progress meetings.

b. Overall system testing shall be similar to that of factory testing. Control verification shall be live field conditions. Discrete/analog and control testing with RTU/PLC and field equipment shall be verified with DISTRICT personnel present to assist in manipulation of process equipment. All final field SCADA, I/O and control testing verification shall be witnessed by the DISTRICT'S REPRESENTATIVE.

1.7 GENERAL SYSTEM DESCRIPTION

A. Lift Station Site

1. Tesco L2000 or approved equal with communication components, UPS and controls.

B. Programming

1. Provide programming which shall include configurations, screen building, report generation, trend setup and auto-dialer programming, radio study, radio license application filing, antenna alignment and radio communications testing, as-built drawings, start-up services, four hours of operator training, setup workstation computers to connect to server, setup

workstation backup and startup for all stations.

PART 2 PRODUCTS

2.1 SITE CONDITIONS

A. General Environment. The remote terminal unit shall withstand anticipated environmental conditions of 0 degrees to 55 degrees C temperature and 10 percent to 95 percent humidity. Electro-magnetic interference (EMI) and radio frequency interference (RFI), as may be anticipated in a typical industrial environment, shall not impede proper functioning of the RTU and SCADA systems. EMI and RFI is expected from two-way radios, variable frequency drives, lightning strikes, motors, transformers, contactors, relays, etc.

B. Power Source (unless shown otherwise):

1. Normal fluctuations of the 120 VAC 60 Hz power supply shall not cause improper operation of the RTU and SCADA systems. Normal fluctuations are voltage excursions between 100 and 130V, or surges caused by switching of electrical loads.

2. On loss of station AC power, the RTU shall initiate an orderly shutdown of its control functions while powered by a UPS. On restoration of power, the RTU shall restart the system in an orderly and controlled sequence.

3. No erratic operation of any RTU output device is allowed during start-up, shutdown, operation, or on loss of or restoration of power.

4. The RTU shall include uninterruptible power source functionality. Power supplies shall keep batteries at a float charge. The batteries shall not be damaged by deep discharges.

C. Surge Protection. All control and RTU components, power supplies, CPU and all I/O devices shall have built-in surge withstand capacity to prevent damage from electrical surges on any connected line.

D. Supply interfacing relays whenever loads exceed 0.5 Amp continuous or 1.0 Amp spikes [or surges]. Supply DC interfacing relays when using DC output module to control AC loads. Supply analog isolation modules whenever a loop contains more than 3 devices or more than one grounded [common] device.

2.2 SCADA RTU/PLC

A. The RTU/PLC shall have all the characteristics and features listed herein. All these features shall be readily available as an integral part of the RTU/PLC and shall be standard catalog items for the product. The use of any third party hardware or software add-on products to meet this specification is not acceptable. The L2000 RTU/PLC from Tesco Controls, Incorporated or preapproved equal.

1. The RTU/PLC itself and support for the controller shall be available directly from the manufacturer. Programming services shall be available direct from the manufacturer as a normal practice. The manufacturer shall also produce a Supervisory Control and Data Acquisition (SCADA) system

that integrates directly with the RTU/PLC, supporting the controller's native communications protocol, to take full advantage of its capabilities.

2. The RTU/PLC manufacturer shall provide a 1 year warranty with the unit. A 5 year warranty and a 10 year warranty shall be available at additional cost. These warranties shall be available in writing directly from the manufacturer before bid acceptance. A warranty or service contract from a source other than the RTU/PLC manufacturer is not an acceptable substitute. The warranty shall provide for direct on-site replacement of the entire plug-in RTU/PLC, complete with the original program and configuration. The manufacturer shall provide personnel to perform the warranty service, at no additional cost to the purchaser. The replacement controller shall be available within 24 hours, installed and running at the station, without requiring that the original unit first be removed and returned to the factory.

3. The RTU/PLC manufacturer shall provide telephone support for questions related to any aspect of the controller, including general use, application-specific issues, programming, and use of the programming software. This support shall be available directly from the manufacturer at no extra charge with the purchase of a controller.

4. The RTU/PLC should be constructed using a card cage architecture incorporating a 96 pin 3U DIN VME standard backplane interconnection. The printed circuit cards shall be designed to slide into the card rack and interconnect with the VME backplane. A high density I/O card with a mix of I/O types as well as an I/O card for each individual I/O type shall be available. The system shall operate with a minimum of 2 cards and shall be easily expandable to 20 cards. The RTU/PLC shall be solidly mountable, but shall be capable of being removed easily in the field. Card cages with a capacity of 2 to 20 slots shall be readily available. All field wiring to the I/O cards shall be done at externally mounted terminal blocks with ribbon cable interconnects to the relative I/O card.

5. The RTU/PLC shall operate correctly under an ambient temperature range of -40 to +200 degrees F without requiring forced air or other special cooling measures. Coatings on connectors, component leads, and other materials used in the construction of the RTU/PLC shall be substantially resistant to atmospheres containing significant amounts of Hydrogen Sulfide gas and Chlorine gas. Each component shall have passed testing and be certified in writing by the manufacturer to be acceptable for use in water treatment and waste water treatment environments.

6. The RTU/PLC shall have a low-power shut-down mode suitable for use with standby diesel engine generator or other sites where power consumption is critical.

B. Card Architecture

1. Processor Card -
   a. The RTU/PLC shall be microcontroller-based, using a

microcontroller that, at minimum, supports the following: 25/33 MHz clock rate Flat (non-segmented) memory addressing RISC Communication Co-Processor Serial DMA channel Dual-ported RAM Watchdog timer 4 configurable timers with interrupt capability 3 serial ports with separate baudrate generators 2 ethernet RJ45 ports Write-protect enable/disable

b. The RTU/PLC shall use a real-time, preemptive, multitasking operating system, contained in Read Only Memory (ROM). The ROM shall also contain all firmware that is not specific to a particular job or application, such as operator interface and communications firmware.

c. Application-specific programming and data shall be contained in battery-backed RAM. The RAM shall be low standby power, CMOS static RAM. The backup battery shall maintain RAM contents when the RTU/PLC is not connected to an external power source. The backup battery shall be a Lithium cell capable of continuously powering the RAM in a standby state for a minimum of 10 years with no loss of data. The RTU/PLC shall be available with a total of at least 1 megabytes of RAM.

d. The RAM shall be divided into two sections - write-protected, and non write-protected. The boundary between these two sections shall be user definable.

e. Critical information, including the application program, control constants (setpoints), and configuration information shall be stored in write-protected RAM. The controlling of write-protected RAM shall be an integral feature of the micro-controller allowing writes to the write-protected memory only after a proper registration sequence. The RTU/PLC shall contain a watchdog timer circuit that will reset the micro-controller within 1 second of detecting a firmware failure. To provide a means of checking data integrity, the RTU/PLC shall compute a CRC-16 value on the contents of write-protected RAM whenever the data is changed and store the CRC value in a reserved location of write-protected RAM. An ongoing self test process shall periodically recompute the CRC and check it against the stored CRC during normal operation.

f. Non write-protected RAM shall be used as a scratch area to hold temporary information and data values that are subject to constant change.

g. A dedicated TELCO style communications port shall be readily available for maintenance port operations using a laptop computer. Up to five additional communication ports shall be available for telemetry operations. A fault relay connector shall be readily available to provide closed contacts in the event of an internal failure or power loss.

2. High Density Input/Output Card

a. The RTU/PLC shall support the following high density card with the listed characteristics:

b. Analog input: senses voltage or current (selectable for 0-5V or 4-20

mA) minimum 12-bit resolution differential, isolated available with at least 6

c. Analog output: sources voltage or regulates current (selectable for 0-5V or 4-20 mA) minimum 12-bit resolution differential, isolated in current mode available with at least 2

d. Digital input: senses a contact open/closed condition 7500 V optically isolated LED annunciators for each input on card faceplate available with at least 16

e. Digital output: 10A relay contact LED annunciators for each output on card faceplate available with at least 8

3. Sequence of Events Card

a. The RTU/PLC shall support the following SOE card with the listed characteristics: Digital input: senses a contact open/closed condition event timestamp accuracy to 1mS, user defined event window sequence of events reporting 7500 V optically isolated LED annunciators for each input on card faceplate available with at least 16 and Digital output: 10A relay contact LED annunciators for each output on card faceplate available with at least 16

4. Analog Input Card

a. The RTU/PLC shall support the following analog input card with the listed characteristics: Analog input: senses voltage or current (selectable for 0-5V or 4-20 mA) minimum 12-bit resolution differential, isolated available with at least 16

5. Analog Output Card

a. The RTU/PLC shall support the following analog output card with the listed characteristics: Analog output: sources voltage or regulates current (selectable for 0-5V or 4-20 mA) minimum 12-bit resolution differential, isolated in current mode available with at least 8

6. Digital Input Card

a. The RTU/PLC shall support the following digital input card with the listed characteristics: Digital input: senses a contact open/closed condition 7500 V optically isolated LED annunciators for each input on card faceplate available with at least 32

7. Digital Output Card

a. The RTU/PLC shall support the following digital output card with the listed characteristics: Digital output: 10A relay contact LED annunciators for each output on card faceplate available with at least 32

C. Input/Output Characteristics

1. The RTU/PLC shall provide built-in digital filtering of analog inputs. The filter constants shall be adjustable from the keyboard and through the communications ports. Each analog input shall have an independent filter constant. The RTU/PLC shall provide a virtually infinitely variable wide range of adjustment from no filtering to extreme filtering. Each analog output shall have the ability to maintain output or zero output when

entering standby mode. Each digital output shall be turned off when entering standby mode.

D. Field Wiring Terminal Blocks

1. The terminal blocks shall support the following listed characteristics:
   a. pull-apart two piece wiring blocks for fast and easy wiring/re-wiring
   b. separate wiring blocks for each I/O type and each wire point fully labeled
   c. versatile internal or external analog power source
   d. digital outputs shall have socketed 10A relays with LED "ON" indicators entire terminal block shall snap on/off standard track mount
   e. onboard passive circuit protection to protect RTU/PLC
   f. shall be available with a built-in isolated current loop power supply, powered from the 12V DC main power. The current loop power supply shall be capable of producing at least 24V DC and 161 mA.
   g. 3 distinct classes of lightning protection shall be available: Standard Class A lightning protection shall consist of dual MOVs at each AI/AO individually fused AI/AO power source fused DI source and common with clamping diodes onboard spare fuses for all fuse types Class AA lightning protection shall, in addition to Class A, include dual gas discharge tube at each AI/AO Class AAA lightning protection shall offer the most comprehensive protection full 500 joule 12 stage lightning protection at each AI/AO

E. Power Supply

1. The RTU/PLC shall be powered by a 12V/5V DC power supply, with an allowed operating range of at least +/- 10%. A 12V battery backup of the 12V DC shall be available such that the 5V DC is also maintained by the 12V battery.

F. Operator Interfaces

1. The RTU/PLC shall be available with the choice of at least two operator interface units that easily flush-mount in the enclosure door.
2. The compact model shall have at least the following attributes:
   a. 60 *Brite Lite* LED annunciators with adjacent site-specific label descriptions
   b. 8 *Brite Lite* LED mode annunciators and communication activity annunciators
   c. 8 character *Brite Lite* alphanumeric display of at least 0.5 inches high
   d. 4 keys to easily traverse a user-friendly menu tree that allows full control of operation
   e. 4 user-programmed macro keys with adjacent site specific label descriptions
3. The full display model shall have at least the following attributes:
   a. 360 *Brite Lite* LED annunciators with adjacent site-specific label descriptions
   b. 8 character *Brite Lite* alphanumeric display of at least 0.5 inches

high

c. 4 key to easily traverse a user-friendly menu tree that allows full control of operation

d. 32 keys for full front panel programming

e. 4 user-programmed macro keys with adjacent site specific label descriptions

4. The operator interfaces and site specific nomenclature and labels shall be completely covered with a mylar overlay that is impervious to corrosive atmospheres and wash-down environments.

G. Keyboard

1. The keyboard construction shall be sealed membrane type, using a stainless steel backing plate, and shall be impervious to atmospheres containing Hydrogen Sulfide and Chlorine gases. The keys shall provide tactile feedback. Both keyboard options shall provide a menu-based operator interface, allowing the operator to perform at least these functions, without process interruption:

a. Examine and change setpoints

b. Examine analog input and output registers

c. Examine and change timers and counters

d. Examine and change analog input filter constants

e. Calibrate analog inputs and outputs

f. Force digital outputs on and off

g. Override analog inputs and outputs

h. Examine control program

2. The full keyboard shall, in addition, allow the operator the ability to change the control program, and provide direct access to major functions without the use of menus. Either keyboard shall be available with at least 4 macro function keys. These macro keys shall be programmable to perform actions that would normally require multiple keystrokes on the normal keyboards. The programming shall be supported both by downloading through a communication port, and directly through the full keyboard.

H. LED Character Display

1. The RTU/PLC shall be available with an alphanumeric *Brite Lite* LED display capable of displaying at least 8 characters at a time using at least 15 segments per character. This display shall be at least 0.5 inches in height and shall be readable from a distance of at least 25 feet. The LED character display shall be used for showing the values of registers, inputs, outputs and other data. It shall also be used to display English language menu options to implement the menu system described above.

I. LED Annunciators

1. The RTU/PLC shall be available with individual *Brite Lite* LED's arranged in columns, which shall be usable to display the on/off state of digital inputs and outputs (physical or internal). The LED's shall also be usable for bar graph displays. The mapping of LED's to digital inputs and outputs shall be completely configurable, allowing any random arrangement, including the ability to map any number of LED's to a single input or output to achieve maximum visibility.

J. Mode LED's

1. The RTU/PLC shall be equipped with at least the following mode display *Brite Lite* LED's:
   a. SBY lighted when in standby mode
   b. CMD lighted when in command mode
   c. RUN lighted when in run mode
   d. MEM lighted when write-protected memory is open
   e. CAL lighted when in calibration mode
   f. XMT lighted when a message is being transmitted via a communications port RCV lighted when a message is received via a communications port
   g. ERR lighted when an error condition is detected by the controller
2. The XMT/RCV LED's shall be configurable to selectively show activity on any combination of the communications ports.

K. Bar Graph Displays
1. The RTU/PLC shall have the ability to display at least 4 bar graphs on the *Brite Lite* LED annunciators. The bar graphs shall be individually configurable with respect to the following characteristics:
   a. Display position (anywhere on the 380 LED's)
   b. Height (allowing a range of at least 10-80 LED's)
   c. Value to be displayed (allowing any analog input or output register scale)
   d. Values representing the low point and high point of the bar graph scale engineering units
2. Each bar graph shall allow up to 4 markers to be displayed to show a related value. Each marker shall be assignable to any setpoint, analog input, or analog output register, such that when the value of the register changes, the position of the marker shown on the bar graph changes appropriately. The markers shall flash in order to be discernible from the rest of the bar graph display. If the value being monitored by the bar graph should go beyond the defined endpoints (under range or over range), the LED at that end of the bar graph shall flash to indicate the condition.

L. Operating Modes
1. The RTU/PLC shall have two basic modes of operation as described below:
   a. RUN: Actively controlling, running application-specific control program Sensing input signals Generating outputs under program control Peer-to-peer message initiation is enabled Polling is enabled
   b. STANDBY: Not actively controlling, application-specific control program is stopped Continues to sense input signals Analog outputs held at current level or set to zero Digital outputs go to off state Initiation of peer-to-peer messages is disabled Polling is disabled

M. Programming
1. Language
   a. The RTU/PLCshall be programmable using the IEC 1131-3 “Standard for Automation Programming Languages” which includes a full implementation of the following five languages: Sequential Function Chart Structured Text Instruction List

Function Block Diagram Ladder Diagram

b. The IEC 1131-3 program development environment shall at a minimum include the following features: Native Microsoft Windows Application Operate on a PC platform running Microsoft Windows 3.11/95/NT Allow Upload/Download of all program code Full Graphic Editor Tools optimized for creating and editing source programs Animated Graphic Tools Off-Line Simulation Tools On-Line Debugger Tools Documentation Tools Archive Tools Library Management Tools Project Management Tools Password Protection Tools for Projects and Libraries

2. In addition to the above IEC 1131-3 languages the controller shall have the ability to execute a higher-level BASIC-like programming language which is native to the controller.
3. The native programming language shall at the least support the following attributes:
4. The programming language shall be line number oriented, with an allowed range of line numbers of at least 65,000. The language shall support the ability to:
   a. Event subroutines that execute automatically upon change of input signal
   b. Create multiple execution loops within the program
   c. Create multiple subroutines
   d. Nest subroutines to at least 10 levels
   e. Make a direct jump to a specified line number
   f. Use built-in math functions, including log, inverse log, sine, cosine, tangent, min, max
   g. Use parenthesis to specify precedence in expression evaluation, nested to at least 10 levels
   h. Use indirection in register reference, where the specific register number referred to in an expression is stored in another register
   i. Execute code segments based on specified events that are monitored by the operating system to ensure immediate response to critical events. The RTU/PLC shall support the definition of at least 25 individual events. These events shall be definable as: Change of state on a digital input or output Logical truth condition of an arbitrary expression involving any register type (such as "ANALOG INPUT 7 > SETPOINT 17 + SETPOINT 18")

N. Registers

1. The RTU/PLC shall have at least the following preformatted register types arranged in a global system database, with the quantity of each register type selectable to at least the numbers given:
   a. Setpoint (for storing constants, at least 1000)
   b. Analog input (physical or internal, at least 1000 total)
   c. Analog output (physical or internal, at least 1000 total)
   d. Digital input (physical or internal, at least 1000 total)
   e. Digital output (physical, at least 64)
   f. Index (for indirection and general purpose use, at least 1000)
   g. Timer/counter (at least 1000 total)

2. The RTU/PLC shall store setpoint, analog input and analog output registers in 32-bit precision IEEE 754 standard format, providing the ability to represent numbers in the range +/- 3.37 x 1038. Index registers shall be stored as 32-bit precision unsigned integer values, providing the ability to represent numbers in the range 0 to 4,294,967,295. Timer/counter registers shall be stored as 32-bit precision unsigned values, supporting at least the following sub-types:
   a. Seconds timer (times in seconds with 10 mS or better resolution, up to 497 days)
   b. Hours timer (times in hours with 2 second or better resolution, up to 272 years)
   c. HMS timer (hours, minutes, seconds format, with 0.5 second or better resolution, up to 68 years)
   d. Event counter (integer value register supporting increment/decrement, range 0 – 4,294,967,295)
3. The RTU/PLC shall provide a counter type that may be associated with one of the 16 interrupt-driven digital inputs, in order to count pulse trains. The RTU/PLC shall support a pulse counting frequency of at least 1 kHz on a single input.
4. The RTU/PLC shall provide a timer type that may be associated with digital outputs, in order to produce variable duration output pulses. The range of pulse durations shall be at least 20 mS to 994 days, with 20 mS resolution.

O. Communications

1. The RTU/PLC shall have the ability to simultaneously support at least 3 serial communication ports 2 Ethernet/IEEE 802.3 RJ45 ports. Any of these serial ports shall be usable for both communications of telemetry data and control program/configuration upload/download and support baud rates of 230,400 bps or higher. The ports shall be configurable to support the following media:
   a. Full handshake RS-232 (at least 2 ports must be configurable this way)
   b. Direct Modem available with radio interface, supporting Bell 202 standard
2. In addition to the three (3) RS232 serial ports the RTU/PLC shall have two (2) Ethernet ports for a total of five (5) communications channels. All five (5) communications channels shall have the capabilities of independent operation. Each channel shall have the following capabilities:
   a. Poll/Response
   b. Quiescent (Unsolicited) Master Polling
   c. Message Store and Forward
   d. Automatic Port Escalation with Recovery
   e. Message Retries
   f. Communication Statistics and Diagnostics
3. The RTU/PLC design shall incorporate Dual Ethernet Design using 10BASE-T interface and TCP/IP industry standard Network Protocol with the following features:
   a. Redundant Hot standby Ethernet (Primary Network and Secondary

Fail Over Communications)

b. Standard 10BaseT Interface (10Mbps data transmission, over twisted-pair cable with RJ45 connectors)
c. Complies to IEEE 802.3 Specifications (Local Area Networks or Wide Area Networks)
d. Separate LED Line Status Indicators (Each port to confirm Frame Transmit, Receive, Link, Collision, and Interferance)
e. Individual IP Configuration (Multi Network Configurations)
f. Built-in PING Response (Test connectivity and verification of IP Address)
g. Multi Protocol Support (Modbus, Data Express, Data Express Plus)
h. Telemetry Message Routing (Communicate across all channels, i.e. RS232 to Ethernet and Ethernet to RS232)

P. Protocols

1. The RTU/PLC shall implement the Ethernet/IEEE 802.3 protocol. When the RTU/PLC wishes to transmit, it will check for activity on the LAN. When the LAN becomes silent for a specified period, the RTU/PLC will begin transmission. During transmission, the RTU/PLC will continually check for a collision on the LAN. If a collision is detected, the RTU/PLC will cease transmission. The RTU/PLC will then wait a random period of time before attempting to transmit again.
2. The RTU/PLC shall support serial communications using at least 3 different protocols. The de facto standard MODBUS RTU protocol with both integer and floating point messages shall be supported. The RTU/PLC shall also support a protocol capable of taking advantage of the advanced features available in the RTU/PLC (that ModBus would not be able to support). These protocols shall be able to coexist simultaneously on the same port.
3. The RTU/PLC shall support poll/response, polling master, quiescent, report-by-exception and message routing communications, as described in the following sections. Any of these communications modes shall be usable alone or simultaneously in any combination.

Q. Quiescent Communications

1. Using quiescent (peer-to-peer) communications, the RTU/PLC shall provide the ability to initiate messages transmitting register values under operator definable conditions. Quiescent communications operation shall be configured via a table such that listed registers may be sent to a peer RTU/PLC or other system based on an elapsed time interval, a change of state, or change by a threshold amount. The threshold values shall be storable in any analog input, output or setpoint registers. This table shall be downloadable via a communication port.

R. Report by Exception Communications

1. The RTU/PLC shall support a means of report-by-exception communications, where only those registers of interest that have changed since the last reporting are transmitted. All register types shall be supported. The RTU/PLC shall use a table to identify the registers that are to be transmitted via report-by-exception and individual thresholds that are used to determine significant change. This table shall be downloadable via

a communication port.

S. Message Routing

1. The RTU/PLC shall provide the ability to route received messages that are destined for another unit. The routed message can be received and sent in any combination of communication ports and physical media. Using this method the controller shall provide the ability to transfer messages between two or more units that are not directly connected, but that are both connected to the routing controller.

T. Failure Recovery

1. The RTU/PLC shall have the ability to switch to alternate communications paths in the event of failure of the primary path. There shall be no practical limit on the number of different paths that the RTU/PLC may try in order to deliver the information. These alternate paths shall be definable to be a different destination unit on the same port, or the same or different unit on a different port. In the event that the original communications path becomes available again, the RTU/PLC shall switch back to that path.

U. Redundant Message Elimination

1. The RTU/PLC shall automatically provide redundant message elimination when peer-to-peer and polled communications are used in combination. When a value is polled for and that same value is due to be reported via peer-to-peer communications, the conditions in the RTU/PLC shall be reset such that the peer-to-peer message doesn't immediately report the same information, but instead waits for the value to cross the threshold again, or pass the time interval.

V. Engineering Unit Representation

1. The RTU/PLC shall have the capability to represent all analog input and analog output values directly in engineering units. Engineering units are defined to be "real world" IEEE 754 standard floating point numbers corresponding to physical measurements, such as pressure, depth and flow. The RTU/PLC shall not require the operator to manipulate analog inputs and analog outputs in terms of the "raw" 12-bit (0-4095) data corresponding directly to the analog-to-digital and digital-to-analog converters. To provide engineering unit representation, the RTU/PLC shall not require the use of any additional registers or require that a program statement, formula or any expression be written to convert raw data to engineering units. Telemetry communications shall use engineering unit representation in all messages.

W. Calibration and Multipoint Calibration

1. A simple menu-driven procedure shall be provided that allows the operator to calibrate an analog input or output to an engineering unit measurement scale. This procedure shall be usable from both the full and minimal keyboards. The calibration information shall be uploadable/downloadable via a communication port.
2. In calibrating an analog input/output, the RTU/PLC shall allow the operator to select points along the response curve of the input/output device and assign them a corresponding engineering unit value. The RTU/PLC shall allow the operator to use up to 16 calibration points in order to account for non-linearities in the response of the attached input/output device. During

the calibration process, the RTU/PLC shall display the value of the actual signal on the input/output in terms of milliamps or volts, depending on how the input/output is configured. For an analog input, the RTU/PLC shall also allow the operator to perform a rough calibration without actual signal values on the input, by manually selecting simulated voltage or current values.

X. Power Fail/Brownout Detector

1. The RTU/PLC shall have an integral hardware device that detects a brownout or imminent power fail condition. Upon detection of the 12V DC power supply voltage dropping below an adjustable threshold, this device shall generate an immediate interrupt signal to the micro-controller. The micro-controller shall respond to this interrupt by finishing any memory write operations in progress, then going into a safe execution loop where no memory write operations are occurring.

Y. Security

1. The RTU/PLC shall be capable of being configured to require password entry before access to functions that would change the control characteristics or basic operating mode (run/standby) of the RTU/PLC. Multiple passwords shall be supported, with at least 100 allowed. Each password shall allow an independent set of privileges. A default list of privileges shall be definable that apply when no operator has unlocked the RTU/PLC with his password. If the operator does not operate the keyboard within a selectable time period, the RTU/PLC shall log him out automatically. Passwords shall be maintainable from both the full and minimal keyboards, if the operator has the Administer Passwords privilege. The RTU/PLC shall also support uploading and downloading of password configuration information via the communications ports.

Z. Data Archiving

1. The RTU/PLC shall provide a means of archiving register values into storage arrays. The register types that may be archived shall include:
2. For analog inputs and outputs, the RTU/PLC shall implement archiving using a data compression scheme such that each point stored represents the minimum, maximum, and average over the previous sample period. The sample period shall be configurable, allowing a range of at least 1 minute to 15 minutes. The RTU/PLC shall collect multiple samples, evenly spaced in time, within the sample period. The sample rate shall be configurable, allowing a range of at least 1 to 10 seconds. A second method of sampling shall be supported for analog inputs and outputs, where the data value is stored whenever it crosses a threshold from the previously stored value. The threshold shall be stored in a selectable analog input, output, or setpoint register. Digital inputs and outputs shall be stored upon change of state. The RTU/PLC shall allow the operator to define at least 25 separate registers to be archived, with individual timing and threshold parameters for each. The RTU/PLC shall provide direct read access through any communications port to the contents of each data archive. Each sample shall consist of a date and time stamp and the register value. The RTU/PLC shall also provide functions available through the communications port that allow an external SCADA or other system to reset specific archives and

obtain other necessary information about the data archives in use.

2.3 RADIO

A. Radio equipment shall be manufactured by Microwave Data Systems, SD9 “smart radio” or approved equal. The radios shall meet all of FCC part 94 out-of-band emission requirements and shall be capable of transmitting data at 9600 baud, operating half duplex. The R.F. transmitters shall be directly frequency modulated by a built-in digital modem from the digital data stream furnished by the PLC.

B. The radio assembly for each site shall consist of a non-protected transmitter, receiver, power supply and digital modem capable of operating in the 928 to 952 MHz band. Each assembly shall be capable of transmitting and receiving digital data at a rate of 9600 Baud over a 12.5 KHz FCC assigned channel. The radio shall include both Ethernet (10/100 BaseT) and serial (RS-232) connections and shall support encryption for radio traffic.

C. The antennas for all sites shall be heavy duty yagi type and shall have a frequency range of 928 to 960 MHz. A high gain Yagi or Omni-type antenna shall be used to transmit and receive data at the Remote Terminal Unit.

D. Transmission lines shall be Andrew Corporation Heliax Type LDF4-50A 1/2” diameter foam dielectric coaxial cable or approved equal.

E. The antenna mast/pole shall be hot dipped galvanized for corrosion protection. All mounting hardware shall be made of stainless steel.

F. Each radio shall be protected from electrical surge or transients entering through the coaxial cable by use of a coaxial cable surge protector. The coaxial cable surge protector shall meet or exceed the quality, reliability and performance of the IS-B50LN-C2 manufactured by Polyphaser.

2.4 GENERATOR CONTROL AND BACK-UP POWER SYSTEM

A. Provide Tesco generator control system to shut down the standby diesel engine generator when pumps aren’t required and restart when pumps are required or UPS batteries require charging: provide software module, float level switches and interfacing relays, as required to complete the system.

2.5 UNITERRUPTABLE POWER SUPPLIES

A. The uninterruptable power supplies (UPS) shall consist of desk top units securely mounted on channel. The units shall provide 120 volt uninterruptable power to the instrumentation and control equipment. Each UPS unit shall be modular in design with true electrical isolation and power conditioning. When utility power is available, rectifier/charger shall supply the load through the inverter and maintain the battery in a fully-charged "float" condition. When utility power drops below preset limits or fails the load shall be supplied from the battery through the static inverter. There shall be no output disturbance transmitted to the load. Upon return of the utility power, the rectifier/charger shall supply power to the load through the inverter while it recharges the battery. There shall be no output disturbance transmitted to the load.

B. The uninterruptable power supplies shall be manufactured by APC, Best or equal.

The UPS warranty shall be in effect no less than two (2) years after initial start-up. The battery manufacturer's standard warranty shall be passed to the end user.

C. Continuous Minimum Rating: Total 700 VA min (120 Vac). Maintain output voltage within specified limits at any load from full load to no-load. Supply full load power, at rated voltage, off of battery for 120 minutes.

D. UPS shall include dry contact outputs for failures and alarms as well as being incorporated into the generator control circuit. Contacts shall be relay type.

PART 3 EXECUTION

3.1 INSTALLATION

A. Follow the manufacturer's installation recommendations unless otherwise indicated. Keep copy of the manufacturer's installation instructions available on the job site for review at all times.

3.2 PROGRAMMING

A. All programming of the SCADA equipment and RTU/PLC shall be provided complete and operational.

B. General Requirements

1. All RTU/PLC control systems shall be configured to operate independent of SCADA workstation and master RTU/PLC status. The RTU/PLC shall be configured to operate failsafe in the event of a RTU/PLC failure.
2. The RTU/PLC shall accept pump sequencing/alternating and start/stop setpoints from the SCADA computer workstations.
3. Setpoints shall include deadbands to prevent excessive starting and stopping.
4. The RTU/PLC shall include logic to make a smooth transition from one pump sequence to another to prevent hydraulic transients.
5. The RTU/PLC shall monitor and transmit to the SCADA workstation all parameters, status and alarms.
6. Analog parameters shall be scaled in engineering units.
7. Orderly shutdown and restart on power failure/return. Sequenced/staggered start (independent time delays) of loads (in Auto) on restart on utility power and generator.
8. The RTU/PLC that require remote status information in order to execute control shall have backup control programs as defined herein. These emergency programs shall be resident in the RTU/PLC and shall activate on a communication failure or loss of a controlling signal (invalid).
9. All finished programs shall be fully documented and hardcopy printouts submitted as part of the O&M manual and include each program on disk.
10. The RTU/PLC with control programs with pumping unit(s) shall contain

adjustable delays (seconds) for start, start after stop (backspin), minimum runtime, and stop. RTU/PLC with control programs with multiple pumping units shall also provide for separate adjustable sequential start and stop delays (seconds) that parallel normal start and stop delays, and sequence/alternation selection.

11. Provide an "available" equipment status when the associated H-O-A hardware switch is in auto position and there are no control lockout alarms, for all controlled equipment interfaced with the RTU. Monitor "HAND" positions and provide indication of alarms, similar to "AUTO", when alarm conditions occur.

12. Provide a command-to-feedback fail alarm, when the associated H-O-A hardware switch is in auto position, for all controlled equipment interfaced with the RTU/PLC. The controller-based fail alarm shall be initiated if an equipment item is commanded to start/stop or open/close by the RTU and the appropriate pump run or, valve position status feedback (where available) or zero flow signal is not received within an adjustable time delay (seconds).

13. Installations with multiple pumps in which a pump becomes unavailable (not in fully automatic mode or has failed), the pump shall be tagged unavailable and control shall fail-over to the next sequence assigned pump. Upon availability being re-established to the unavailable pump, it shall be tagged available with lag pump setpoints and remain off until called to run or the replaced pump has stopped. It shall then be placed back into the original selected sequence.

14. The RTU/PLC with control programs with pumping unit(s) shall disable all control and control program affiliated alarms during a utility power fail. Upon power fail recovery, controls shall be re-enabled concluding an adjustable time delay (seconds).

15. The RTU/PLC with control programs with pumping unit(s), which requires remotely communicated analog data for control, shall disable all control and control program affiliated alarms during a communication failure concluding an adjustable time delay (minutes), unless otherwise noted. Upon communication restoration, controls shall be re-enabled.

16. Provide controller-based adjustable elapsed time meters (ETM) and number of starts with an adjustable reset for all motorized equipment interfaced with the RTU/PLC. The RTU/PLC shall transmit an alert to the SCADA when a motorized device exceeds a setpoint number of starts within a running 60 minute period of time (based on 6 minute intervals). Equipment run time and number of starts data shall be transmitted to the SCADA for graphic indication and reports.

17. Provide high, low and invalid (out-of-range) alarms for all analog points in the RTU/PLC whenever setpoint limits are exceeded for an adjustable time delay (seconds), and alarms for all hardwired alarm inputs after an adjustable time delay (seconds). Each associated alarm shall be generated

and transmitted to the SCADA for indication.

18. All analog signals shall be constantly processed, by each RTU/PLC, to provide minimum, maximum with time stamps and average values. Flows shall be totalized. Hourly pump runtimes and number of starts, flow totalization, minimum and maximum with time stamp, and average of each analog local and polled shall be placed in hourly holding registers for "today's" 24 hour period (adjustable end of 24 hour period setpoint, e.g. 2:00 am or 0200 hours). Upon reaching the end of the 24 hour period, the data shall be transferred to the "previous" 24 hour holding registers. Today's 24 hour period registers shall be reset to zero. The RTU/PLC shall hold the previous 24 hours of daily data, time and date stamped, total flow for the day and the previous 7 days of total daily flow, date stamped, to be retrieved by the SCADA for reports in the event of an extended communication failure.

19. All digital and analog alarms shall contain adjustable time delay (seconds) timeouts before alarming, unless otherwise noted.

20. Analog parameters shall be scaled in engineering units.

C. Pump Control Unit Programming (Mode)

1. The RTU/PLC pump control program shall include the following features:

   a. Triplex/Duplex/Simplex configurable. The RTU/PLC shall have the capability of being configured for one, two or three pumps.

   b. Local automatic control from transducer input, pump down. Back-up high level float call shall be independent of the RTU/PLC.

   c. Local manual control provided by HOA switch. HOA switches Alarms shall be reported back to central site computer. Alarms shall indicate that an HOA switch has been left in the HAND or OFF position.

   d. Remote control from the central site computer shall provide individual pump overrides and disables, station and alarm disables.

   e. Pump alternation function shall be provided. Alternation around non-operational pumps shall be provided.

   f. Alarm light outputs capable of driving 120 VAC loads to 3 amp.

   g. Float alarm reporting back to central site computer when floats are operating out of sequence. In the float mode each float position shall be capable of being transmitted to the central SCADA computer.

2. Control Strategy

   a. The two (2) current pumps shall be controlled based on wetwell level. Provide independent start and stop setpoints as well as high and low level alarms. Set up programming and I/O to easily add the

third pump in the future with operation similar to the first two pumps.

b. Sequencing.

1. Lead and Lag (plus future lag-lag) sequence selection shall be of sequential order (1-2, 2-1) or alternation sequentially of “available” pumps. Control logic shall not allow or assign selections where the lead pump is not “available”. Cycling of pumps due to a changed sequence selection shall not be allowed.

2. Alternation shall automatically alternate the sequence while “available” pump(s) are off and after achieving or exceeding a number-of-days adjustable setpoint. Once automatic alternation has been performed, alternation shall be reset until the next number-of-days setpoint is attained. Set pump to alternate once a day.

c. The RTU/PLC shall monitor the status of the hand-off-automatic (HOA) hardware switch, manual-off-auto software switch for each of the pumps and shall monitor the status of all permissive and alarm conditions to determine “availability”. If the level is above the adjustable start and stop setpoints, the lead pump is called on, after the start delay period, and the pump shall be started.

d. Pump Controls and Safety’s

1. Upon a utility power failure and recovery, pumping shall not resume for an adjustable time period. If multiple pumps were running at the time of the power failure and the wetwell level is at or above high alarm, normal start delays shall not inhibit automatic sequencing of the lag pump.

2. Upon failure of the level transmitter pump(s) shall remain at their current speed for an adjustable setpoint delay (seconds) before sequencing off. Upon receipt of a valid level signal or low level return to normal for an adjustable delay, automatic controls shall resume.

3. Upon receiving a Pump Alarm, a high motor [over] temperature alarm or determining a Command-to-Feedback Fail alarm, the pump shall shut down and lockout, the remaining running pump shall move up in the sequence, the sequence selection shall update to indicate the new lead pump, and the next pump in sequence shall start. The logic shall maintain the pump lockout of the failed pump until an alarm reset is received. Upon a reset being received, the pump shall be placed at the end of the “available” pump sequence queue and resume normal operation. Provide provisions for locking out a pump on moisture sensing.

3. Standby Generator and Transfer Switch Status Monitoring. Monitor and indicate transfer switch positions, standby generator run status and standby generator failure. Accumulate and indicate generator run hours.

   a. Monitor ATS generator required signal and disable when the pumps are not required and the UPS battery is capable of maintaining operation of the controls and instrumentation.

4. Monitor fuel level and alarm on high or low level.

D. Provide monitoring of all parameters, status points, alarm indication and logging, and provide setpoint modification capability at the SCADA workstation similar to other facilities in the DISTRICT: UPS, power failure, intrusion, etc ....

3.3 PROGRAMMING SERVICES

A. The RTU/PLC and SCADA workstation shall be programmed and tested. The programmer shall provide programming documentation that fully describes the application program function and application. The programming documentation shall clearly identify all programming functions, configurations, set-up and as-programmed ladder-logic rungs, function blocks, modules and structured text blocks. Documentation shall be prepared to present the information to both an experienced and inexperienced programming audience.

B. A comprehensive control description shall be provided for operations personnel inexperienced in programming. The control description shall be prepared in a narrative format that explains the operation of the program based on a process-by-process basis. The programming documentation shall be provided in three ring binders with a table of contents and tabbed accordingly. At a minimum the following sections shall be provided for each program:

1. System Overview: The system overview shall briefly describe the primary operation of the RTU/PLC and its functions. It shall identify the primary equipment and systems monitored and controlled by the RTU/PLC and delineate any communications requirements with additional RTU/PLC's or computing systems.

2. Control Descriptions: The control description shall be written as an operator's narrative of the control program broken into process blocks.

C. In addition to the required application programming and warranty service the CONTRACTOR shall provide an additional 2 hours of on site programming services.

D. Allotted programming hours are in addition to the requirements of the specification to provide for a complete and operational system. Programming allotment hours are to be utilized to provide for interfacing with equipment not specified or implied in the contract documents, enhancement of operation and interfacing with new equipment added during the course contract implementation.

E. Onsite programming service shall be defined and directed by the DISTRICT'S REPRESENTATIVE on a task basis during the course of construction. Programming hours shall be applied in the field and logged accordingly by the

DISTRICT'S REPRESENTATIVE.

F. Unused programming hours and shall be provided as a service contract during the warranty period.

3.4 TESTING

A. Test all systems upon completion of the work to demonstrate that equipment furnished and installed has connected functions electrically in the manner required.

B. General Requirements

1. Testing shall be provided as described in Section 26 00 00.

2. Do not energize RTU/PLC equipment before the manufacturer has check the installation.

3. Verify the level sensing elevation (to set offset) prior to programming level setpoints.

4. The CONTRACTOR shall contract with the manufacturer of the RTU/PLC equipment to provide a qualified manufacturer's service person to perform the following tasks:

a. Supervision Oversee the project regarding the installation of equipment.

b. Check the installation of all equipment prior to field testing and start-up.

c. Review the RTU/PLC logic at start-up. Additionally, read and record, then transfer all existing SCADA adjustable setpoints to the new SCADA System application.

5. Assist the CONTRACTOR in testing per Division 26. The CONTRACTOR shall perform thorough testing in close coordination with the DISTRICT'S REPRESENTATIVE. All status and control testing shall include verification with the SCADA displays. Field testing shall include:

6. Point-to-point wire checking of all RTU/PLC I/O circuits.

7. Verification of proper functioning of all analog I/O loops.

8. With all outputs disabled, manually activate each input device and check for status change at the appropriate input point.

9. With all outputs disconnected that would cause mechanical motion, use forcing to verify that each output is properly addressed.

10. Check program for proper logic, I/O and internal register address assignments, and timer, counter, and setpoint values.

11. Thorough function testing of the communication functions, including confirmation data is received by the SCADA system.

12. Closely monitor the systems when first placed in "AUTO" under RTU/PLC

control.

13. All hardware set-up modifications and program modifications shall be documented thoroughly and immediately.

14. Field test all control and indication functions as well as the communications system.

15. Confirm all information is properly transmitted to remote sites.

16. Operational readiness test (ORT) and the functional acceptance test (FAT).

17. SCADA modification testing.

18. Verification of correct SCADA trends and reports.

C. The CONTRACTOR shall coordinate with the RTU/PLC and Radio supplier to provide a qualified service person to perform the following tasks:

1. Verify communication links between sites, test the system and record the results.

2. Configure and troubleshoot system.

3. Demonstrate system under actual operational conditions.

4. Assist in operational readiness test (ORT) and the functional acceptance test (FAT).

3.5 TRAINING

A. Train DISTRICT personnel; provide eight hours of SCADA, RTU/PLC and Instrumentation on site training. The training shall be split into two duplicate four hour lessons on two different days, to allow for DISTRICT personnel scheduling conflicts. Training shall address application program operation, programming fundamentals, tuning, diagnostics setpoint manipulation and modes of operation. Applicable provisions of Section 26 00 00 are incorporated herein as though fully set forth at length.

* * END OF SECTION * *

SECTION 26 89 00
INSTRUMENTATION

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Provide and install all instruments, devices, wiring, terminal blocks, accessories, and enclosures as specified herein and as shown on Contract Drawings for the instrumentation system. The Contract Documents are intended as an outline for the work and are descriptive of the type of hardware and software configuration to be provided. Any error or omission of detail shall not relieve the Contractor from the obligations there under to provide and install in correct detail any and all materials necessary for a complete operational instrumentation system, at no additional cost to the DISTRICT.

B. Work includes that specified in Division 26, Electrical. Related Sections:

1. Section 26 00 00 – Electrical Requirements
2. Section 26 04 00 – Raceway Systems
3. Section 26 05 00 – Wire and Cable
4. Section 26 06 00 – Miscellaneous Electrical Equipment
5. Section 26 09 00 – Grounding.
6. Section 26 63 00 – Remote Telemetry Unit
7. Section 26 61 00 – Control Panels

C. The major components for in the instrumentation scope of work, which includes both the furnishing and installation of:

1. Level Transmitter and Reactive Air System
2. Level Switches
3. Pressure Gauges
4. Mag Meter Type Flowmeters
5. Accessories

D. The contract documents are not intended to cover every detail of materials, configuration, or construction. The Contractor shall furnish all tools, temporary utilities, materials, setup, parts, labor, and other incidentals necessary to fully complete the entire work, whether or not said details are particularly shown or specified, all at no additional cost to the DISTRICT.

E. Coordinate the installation of instruments and accessories in the control panel as shown on the Drawings.

1.2 REFERENCES

A. American National Standards Institute (ANSI).

B. National Electrical Manufacturers Association (NEMA).

C. Institute of Electrical and Electronic Engineers (IEEE).

D. Underwriter's Laboratory (UL).

E. California Electrical Code (CEC).

F. American Society for Testing Materials (ASTM).

1.3 QUALITY ASSURANCE

A. All equipment shall comply with applicable standards of the Underwriter's Laboratories, Inc.

B. Provide enclosures suitable for the type of location in which they are located per Specification Section 26 05 00, General Electrical Requirements.

1.4 SUBMITTALS

A. Provide submittals and drawings as specified in Sections 26 00 00 General Electrical Requirements..

1.5 OPERATION AND MAINTENANCE MANUALS

A. Provide operating instructions as specified in Section 16010, General Requirements, Electrical.

PART 2 PRODUCTS

2.1 GENERAL

A. It is the intent of the Contract Specifications and Drawings to secure the highest quality in all materials and equipment in order to facilitate operation and maintenance of the plant. All equipment and materials shall be new and the products of reputable suppliers having adequate experience in the manufacture of these particular items. For uniformity, only one manufacturer will be accepted for each type of product.

B. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection, and continuous or intermittent operation. All equipment shall be adequately stayed, braced and anchored; and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, and shall be of sturdy and durable construction suitable for long, trouble-free service. Light-duty, fragile and competitive grade devices of doubtful durability shall not be used.

C. Products that are specified by manufacturer, trade name or catalog number establish a standard of quality and do not prohibit the use of equal products of

other manufacturers provided they are approved by the Engineer prior to installation.

D. The equipment specifications have been prepared on the basis of the equipment first named in the Specifications. The Contractor shall note that the second named equipment, if given, is considered acceptable and equal equipment, but in some cases additional design, options, or modifications may be required, at no additional cost to the DISTRICT, to meet Specifications.

E. All equipment shall be designed and constructed so that in the event of a power interruption, the equipment specified hereunder shall resume normal operation without manual resetting or operator interaction when power is restored.

F. Signal transmission from remote or field electric and electronic devices shall be 4-20 mA, powered by a 24 VDC loop supply from the panel that is to receive the signal. Nonstandard transmission methods such as impulse duration, pulse rate, and voltage regulated will not be permitted except where specifically noted.

G. Outputs of equipment that are not of the standard signals as outlined, shall have the output immediately raised and/or converted to compatible standard signals for remote transmission.

2.2 PRESSURE GAUGES

A. The pressure gauges shall be 4-1/2 inch diameter bourdon tube type. The scale and range shall be as shown on the Process and Instrumentation diagrams. Gauge scales shall have a minimum of 5 major and 50 minor divisions. Major divisions shall be equally spaced and shall be in whole integers. Scale units (psi) shall be engraved on the scale face. Gauges shall have clear acrylic or shatterproof glass windows and shock resistant cases. Gauge accuracy shall be ± 1 percent of span. All wetted parts shall be Type 316 stainless steel. Pressure Indicator (gauge) 4.5"dial, Ashcroft 45-1279-SS-04L-XLL

2.3 REACTIVE AIR SYSTEM AND LEVEL TRANSMITTER

A. The Reactive Air System shall be configured and installed as shown on the Plans.

1. Air Compressor: The air compressor shall have a 1/6 HP motor driving a single stage, oil-less piston type compressor, air intake filter, and a cord with plug attached. Each compressor shall be mounted using rubber vibration isolators as directed by the Engineer. The air compressors shall be Bell and Gossett BLCT or ITT Pneumotive Model LGH 210-H02, or approved equal.

2. Air tubing inside the control panel shall be ¼” 316 stainless steel, model number Parker A-LOK or approved equal.

3. Pressure transmitters shall be Rosemount 2088G1-S22A1-M7.

4. Solenoid valve shall be ASCO model number 8320G202 or equal.

5. All components shall be mounted inside the control panel and nameplates shall be provided for each component.

B. Miscellaneous materials and devices shall be installed in the Reactive Air Bell

System as specified below and as shown on the drawings. The bell shall be Tesco CB 409 with 316 stainless steel mounting hardware. Provide extension pipe, 316 stainless steel bracket and hardware. Provide stabilizing weight/ballast.

C. Air tubing from the control panel to the sump shall be ¼" polyethylene black tubing, model number Parker EB-43-0100 with 4TIZ and 4NU4 fittings, or equal.

2.4 MAGNETIC FLOWMETER

A. The magnetic flowmeter shall be microprocessor-based and flanged. Each flowmeter shall include an element (tube), grounding rings, separately mounted transmitter and cables.

B. The element enclosure shall be a cast epoxy coated. The enclosure shall be NEMA 4 rated and suitable for exposure in outdoor conditions except where mounted below grade provide NEMA 6P enclosure. Provide ANSI class 150 carbon steel flanges. Provide grounding rings as recommended by the manufacturer. The electrode and liner shall be of materials recommended by the manufacturer.

C. The transmitter shall be mounted remotely and shall be microprocessor based: the transmitter shall be capable of being mounted 500 feet from the sensor element. The transmitter shall provide bi-directional 4-20 mA outputs proportional to flow rates and pulse outputs proportional to flows. The enclosure shall be NEMA 12 or 4.

D. The accuracy shall be at least 0.5% of flow rate over a 33:1 turn-down at all flow rates above 1 fps. Accuracy shall be verified by calibration in a flow laboratory traceable to the U.S. National Institute of Standards and Technology.

E. The flowmeter shall be capable of transmitting an isolated analog 4-20mAdc into 800 ohms.

F. A 2-line, backlit alphanumeric display shall include user-defined flow units and total flow. All menu advice and commands shall be visible on this display. The display shall be modular and rotatable 360 degrees, in 90 degree increments. Characters shall be at least 0.125" high for ease of readability. Display shall indicate flow units in gallons per minute (GPM).

G. The flowmeter shall have a switching power supply having an operating range from 77-265 Vac, 50/60 Hz. Power consumption shall not exceed 20 Watts.

H. The flowmeter shall be warranted against defective workmanship or materials for a period of two years from date of shipment.

I. Manufacturer: McCrometer UltraMag UM or approved equal.

2.5 LEVEL SWITCHES

A. The float level switches shall use the movement of a float, the weight of whose moving parts is less than that of the displaced process liquid, to actuate switches as the level rises and falls. The switches shall be integrally mounted within the float and connected to a terminal box by a waterproof electric cable. The unit

shall be mercury free.

B. The switch covering shall be made of indestructible polypropylene material. The cable shall be PVC coated. The switches shall be reversible such that the switching action operates on rising or falling level (three wire form C contact). The switch contacts shall be rated for 200 volts ac or dc and 16 amperes minimum, and shall be terminated with 14 AWG wires in a NEMA 4X terminal box with appropriate compression fittings. Provide intrinsically safe relays (ISR) for switches used in hazardous locations where shown on the Drawings.

C. Provide a 316 stainless steel cable management bracket and 316 stainless steel mounting hardware for adjusting the operating points of the float switches.

D. Float level switches and bracket shall be as manufactured by MJK 7030-202811 with cable lengths and 316 stainless steel installation and cable management hardware, as required, to complete the installation, or equal.

2.6 ACCESSORIES

A. Isolators. The current/current (I/I) and voltage/current (V/I) isolators shall have all solid state circuitry mounted in plug-in modules. Each isolator shall provide complete isolation and amplification of the 4-20 mA output signal from the 4-20 mA or 1-5 VDC input signal and the isolator power supply. The output signal shall be capable of driving a 600 ohm load. Accuracy shall be +/- 0.25% of span. The isolators shall be powered from a 120 VAC source. Isolators shall be intrinsically safe where shown on drawings. Each isolator shall have a seven year warranty. The isolators shall be as manufactured by AGM Electronics, Action Instruments, or equal.

B. Instrument valves shall be 1/4-inch, 3/8-inch or 1/2-inch from Whitey, Hoke or equal to match tubing material and size.

PART 3 EXECUTION

3.1 WORKMANSHIP

A. All instrumentation work in this contract shall conform to the codes and standards outlined herein.

B. The Contractor shall employ personnel who are skilled and experienced in the installation and connection of all elements, equipment, devices, instruments, accessories, and assemblies. All installation labor shall be performed by qualified personnel who have had experience on similar projects. Provide first class workmanship for all installations.

C. Ensure that all equipment and materials fit properly in their installations.

D. Perform any required work to correct improper installations at no additional expense to the DISTRICT.

E. The DISTRICT reserves the right to halt any work that is found to be substandard or being installed by unqualified personnel.

F. Rejected equipment or equipment without approved submittals shall be immediately removed from the delivery or job site by the Contractor.

3.2 INSTALLATION

A. Install and supply all products necessary, at no additional cost to the DISTRICT, to provide an operational system. This shall include the following:

B. Contract Drawings are intended to show the basic functional requirements of the instrumentation system and do not relieve the Contractor from the responsibility to provide a complete and functioning system.

C. Provide relays, signal converters, isolators, boosters, power conditioners, circuit cards, and other miscellaneous devices as required for the proper interface.

D. Provide analog loop isolators where required to eliminate "ground loops."

E. All wires shall be identified with machine printed labels. Plastic wire gutters shall be used for routing of wire bundles. Wiring shall be neat and laced with plastic tie wraps.

F. The instrumentation and accessory equipment shall be installed in accordance with the manufacturer's instructions and located as shown on the Drawings. When manufacturer's installation literature specifies a particular location or orientation in a process line due to measurement accuracy considerations, the installation shall be in conformance with the manufacturer's instructions.

G. Engineering scales and charts for all instruments shall be provided that match the range of instruments that monitor the process.

H. Instrument installation methods.

1. Install instruments at the location shown on the Plans or approved by the DISTRICT. Instruments shall be NEMA rated for the installed location.

2. Install level and plumb.

3. Instruments shall be provided with floor stands or wall brackets as shown or required.

4. Mounting hardware, stands, channels, and spacers shall be either galvanized steel, stainless steel, or non metallic to match the NEMA rated location.

5. All screws and bolts shall be stainless steel.

6. Tubing shall be install without splices. Tubing systems shall be pressure tested at 15 psig for 1 hour.

I. Wiring and raceway installation methods.

1. Instrumentation wiring shall be carried in conduits provided in compliance with the Division 16, electrical. All analog circuits shall be run as twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever three wire circuits are required. Triads are not to be formed by using two pairs. Terminal

blocks shall be provided at all instrument cable junctions and all wires shall be identified at such junctions. Instrumentation wiring shall be run without splices between instruments, terminal boxes, or panels.

2. The number of signal wires listed on the Drawings is approximate only, and the Contractor shall determine the required number of signal pairs or triads to properly connect the system furnished, especially when substituting equipment.

J. Wiring, grounding, and shielding methods.

K. It is important to observe good grounding and shielding practices in the generally noisy environment in this application. The following practices shall be observed unless modified by manufacturer's standards:

L. Each electronic equipment chassis shall be grounded to power ground.

1. All analog signals shall be transferred over shielded twisted pair cables.

2. All communication signals shall be transferred over shielded cables.

3. All shields of analog inputs and outputs of the PLC shall be connected at the PLC unit only. They shall not contact ground at any other point including the transmitters or receiving devices.

4. Status and alarm signals routed through noisy environment shall be transferred over shielded twisted pair cables.

5. Each shield which is not connected to ground shall be covered with a heat shrink insulating boot. Shields shall be connected together at each transition from one cable to another for a continuous effective shield circuit. All shields shall be connected on terminal blocks.

M. Mechanical Installation

1. Install new instruments and transmitters at locations as shown on Drawings.

2. Install and calibrate indicators/transmitter and connect to elements per manufacturer's recommendations.

3. Ground transmitters/elements per manufacturer's recommendations.

3.3 TESTING

A. The Contractor shall use the services of qualified testing personnel for the purpose of performing inspections and tests as herein specified and indicated on the Drawings. The procedures stated herein are guidelines for the intended tests, the Contractor shall be responsible to modify these tests to fit the particular application and insure personnel safety. It is the intent of these tests to assure that the instrumentation system is operational and is installed in accordance with design Documents.

B. Test plans and test reports shall be treated as formal submittal. Tests and test plans shall be in the cause and effect format. The person conducting the test shall

initiate an action (cause) and, upon the system's or subsystem's producing the correct result (effect), the specific test requirement will have been satisfied.

C. The Contractor shall be responsible for each supplier of equipment to provide the following minimum services for each type of instrument supplied. The supplier shall use a qualified instrumentation field technician (sales representatives are not acceptable) to perform services listed herein.

1. Advise and instruct Contractor on installation requirements.
2. Check, calibrate, and place equipment in operation.
3. All programmable devices shall be programmed and tested prior to startup. Programming shall be adjusted or changed as directed by the DISTRICT or Engineer, at no additional cost.
4. Coordinate with the DISTRICT and setup all alarm, process, and operation setpoints.
5. Perform the acceptance tests.
6. Visit the job as often as required and spend as much time as necessary to ensure an operational instrumentation system.
7. Be readily available by telephone to answer all questions on supplied equipment.
8. Provide training as specified in subsection labeled Training.
9. The Contractor shall insure each supplier of instrumentation assumes the responsibility for providing primary elements in a timely manner, for insertion into the process line, coordinating size and material type when applicable, overseeing the actual installation, calibration, and acceptance testing.

D. Operational Readiness Test (ORT)

1. Prior to startup, the complete instrumentation system shall be inspected, tested, and documented to show that it is ready for operation.
2. The Contractor shall prepare a test plan for the ORT and shall submit it for review at least 30 days before the ORT is performed.
3. The ORT shall demonstrate that the instrumentation system meets the requirements of the Specification which are nonloop-specific. Following are examples of nonloop specific functions.
    a. Capacity. Demonstrate that all components and subsystems have the specified capacity, including spare capacity.
    b. Timing. Include tests to demonstrate all specified timing requirements.
    c. Diagnostics. Include tests to demonstrate specified diagnostic capabilities and procedures.

4. If any component or subsystem fails the ORT, the Contractor shall correct the problem and repeat the test until it is successful.

5. After completion of the ORT, the Contractor shall prepare a test report and shall submit it for review. The ORT shall be successfully completed and the test report submitted to and reviewed by the Engineer before the FAT (functional acceptance test) is performed.

E. Functional Acceptance Test (FAT)

1. Once the facility has been started up and is operating, a witnessed FAT shall be performed on the complete instrumentation system to demonstrate that it is operating as specified and meets the requirements of the Specifications.

2. The Contractor shall prepare a test plan for the FAT and shall submit it for review at least 30 days before the FAT is performed.

3. The FAT shall operate all equipment and systems over the full operating range, shall demonstrate proper operation of alarms and indicators, and, in general, shall demonstrate that the equipment and systems meet the requirements of the Drawings and Specifications.

4. If any equipment or system fails the FAT, the Contractor shall correct the problem and shall repeat the test until it is successful.

5. The FAT shall be performed in the presence of the Engineer.

6. After completion of the FAT, the Contractor shall prepare a test report and shall submit it for review. The instrumentation system will not be accepted before the FAT is successfully completed and the test report submitted to and reviewed by the Engineer.

3.4 TRAINING

A. The Contractor shall provide an eight man-hour (total for both sites) for training of the operation of the instrumentation system to DISTRICT personnel.

B. Instructions shall consist of the functional description of each piece of equipment, including calibration and setting of set points. Demonstration of the operation of each system shall be included.

C. The Contractor shall provide all manuals and study materials required for the training of DISTRICT personnel.

3.5 WARRANTY

A. The instrumentation supplier shall have a staff of experienced personnel available to provide service on 2 working days notice during the warranty period. Such personnel shall be capable of fully testing and diagnosing the hardware and software delivered; and of implementing corrective measures.

B. If the instrumentation supplier fails to respond in 2 working days, the DISTRICT at its option will proceed to have the warranty work completed by other resources; the total cost for these other resources shall be reimbursed in full by the

Contractor. The use of other resources, as stated above, shall not change or relieve the Contractor or supplier from fulfilling the remainder of the warranty requirements.

C. Prior to "final acceptance", the Contractor shall furnish to the Engineer a listing of warranty information for all manufacturers of materials and equipment used on the project. The listing shall include the following:

1. Manufacturer's name, service contact person, phone number, and address.
2. Material and equipment description, equipment number, part number, serial number, and model number.
3. Manufacturers warranty expiration date.
4. Completed test forms.

* * END OF SECTION * *

Recording requested by: Lake Oroville Area Public Utility District **After Recording Return to:** Lake Oroville Area Public Utility District 1960 Elgin Street Oroville CA 95966	
	(SPACE ABOVE THIS LINE RESERVED FOR RECORDER USE)

REIMBURSEMENT AGREEMENT BETWEEN
LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
And
RIVER RANCH OROVILLE LLC
For Ophir Lincoln Lift Station and Force Main (Regional Facility]

THIS AGREEMENT, made and entered into this _____ day of_____, by and between LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT, a local public agency of the State of California, hereinafter referred to as "District", and _____, hereinafter referred to as "Developer".

WITNESSETH

WHEREAS, Developer is the owner, in fee, of that certain real property more particularly described in Exhibit “A”, attached, and located within Butte County, California; and,

WHEREAS, Developer intends to develop said property as more particularly shown on Exhibit "B", attached hereto and made a part hereof (the “Project”); and,

WHEREAS, Developer and District have, on the date of this Agreement, made a separate agreement titled ‘Development Agreement for Construction of Ophir Lincoln Lift Station and Force Main’ (the Regional Facility), the terms of which are incorporated herein; and,

WHEREAS, the Regional Facility will have not only the capacity to provide service to Developer’s Project, but also the capacity to provide service to persons outside of the Project who hereafter apply to District for sewer service and who are determined by District to benefit from the Regional Facility (Other Persons); and,

WHEREAS, Developer and District desire to enter into an agreement for reimbursement to Developer for a portion of its cost to construct the Regional Facility, on the terms set forth below.

NOW, THEREFORE, District and Developer agree as follows:

1. The Effective Date of this Agreement is the date of acceptance of the Regional Facility by District, in accordance with the terms of the Development Agreement, or two years after the date that this Agreement is made and entered, whichever first occurs.

2. The Term of this Agreement is ten years. The Term will commence on the Effective Date and end ten years thereafter. The Term will not be extended for any reason, including the occurrence of a force majeure, absent the express, written agreement of District and Developer.

3. Upon acceptance of the Regional Facility by District, as provided in the Development Agreement, and provided that Developer has satisfactorily performed all of its obligations under the Development Agreement, District will pay to Developer the sum of **two hundred and fifty thousand dollars and zero cents ($250,000.00)**.

4. Upon acceptance of the Regional Facility by District, and for the balance of the Term of this Agreement, District will impose on Other Persons a Reimbursement Fee in the amount of **one thousand four hundred sixty-five dollars and eleven cents ($1,465.11)** per Equivalent Dwelling Unit. The Reimbursement Fee will be due and payable by Other Persons prior to connecting a residential structure or other structure requiring wastewater discharge to the Regional Facility.

5. District will make reasonable effort to collect Reimbursement Fees from Other Persons. It is not required to initiate or defend legal action, to place or enforce liens, or to take other extraordinary action for collection purposes. The collected fees, **less 10% for District administrative costs,** will be remitted to Developer annually, on each anniversary of the Effective Date, during the Term of this Agreement.

6. The maximum total Reimbursement Fees payable to Developer is **one million seven hundred fourteen thousand one hundred and seventy-nine dollars and seventy cents ($1,714,179.70).**

7. The District's payment provided for in section 4, the Reimbursement Fee provided for in section 5, and total Reimbursement Fee provided for in section 6 each assume a total Regional Facility construction cost in the amount of **two million three hundred fifty-nine thousand seven hundred and sixty dollars and zero cents ($2,359,760.00)**. Upon completion of the Regional Facility, Developer shall provide District satisfactory evidence of the actual cost of construction. If the actual cost construction is less than **two million three hundred fifty-nine thousand seven hundred and sixty dollars and zero cents ($2,359,760.00)**, the payments provided for in sections 4, 5, and 6 will be reduced by a percentage equal to the percentage reduction in construction cost. Overpayments will be refunded or credited to District.

8. Except as provided in paragraph 3, above, nothing in this Agreement requires District to pay Developer unless or until Reimbursement Fees are collected by District.

9. Nothing in this Agreement limits District's discretion to deny or condition sewer service for Other Persons or to determine the facilities to be used in serving current customers or future applicants for sewer service.

10. Developer shall defend and indemnify District from any and all claims, causes of action demands and charges (Claims) by third parties, including but not limited to Claims by any public agency, Claims made by applicants for sewer service, arising directly or indirectly out of the construction of the Project or the Regional Facility, or the administration of this Agreement, and any actions for declaratory or injunctive relief challenging the construction of the Project or the Regional Facility, or the administration of this Agreement.

11. Each of the parties to this Agreement has had an equal opportunity to review this Agreement and, if desired, to consult with legal counsel. Therefore, the usual construction of agreements under California law, where an agreement is construed against the party drafting the agreement, shall not apply to this Agreement.

12. Each and every provision of this Agreement shall be binding upon and shall inure to the benefit of the respective successors and assigns of the parties, in the same manner as if such parties had been expressly named herein.

13. Notices or requests from any party to this Agreement to the remaining parties thereof shall be in writing and delivered or mailed, postage prepaid, to the following addresses:

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT
1960 Elgin Street
Oroville, California 95966
Attention: Scott McCutcheon, General Manager

DEVELOPER
River Ranch Oroville LLC
2998 Douglas Blvd., Suite 125
Roseville, CA 95661

14. Failure by a party to insist upon strict performance of any of the provisions of this Agreement by the other party, or the failure of a party to exercise its rights upon the default of the other party, shall not constitute a waiver of such rights.

15. The parties entering into this Agreement do not intend to create any agency, partnership, joint venture, trust, or other relationship with duties or incidents different from those of parties to an arms-length contract.

16. This Agreement shall be construed in accordance with and governed by the laws of the State of California. Any actions brought to enforce any provisions of this Agreement shall be brought in Butte County.

17. This Agreement shall be recorded with the Butte County Recorder.

18. The Recitals set forth at the beginning of this Agreement are incorporated into this Agreement as if fully set forth herein.

19. This Agreement, including the Development Agreement attached as Exhibit C, constitutes the entire understanding of the parties regarding the subject matter. The Agreement may be amended only by writing executed by both parties.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement on the day and year first above written.

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT:

_____
By: President

ATTEST:

_____
By: General Manager

DEVELOPER:

RIVER RANCH OROVILLE LLC,
a California limited liability company

By: W&R Wedgewood Apartments,
a California corporation,
its Manager

By: _____
Name: _____
Title: _____

EXHIBIT A

LEGAL DESCRIPTION OF THE PROPERTY

Real property in the unincorporated area of the County of Butte, State of California, described as follows:

THE NORTHEAST QUARTER OF SECTION 32, TOWNSHIP 19 NORTH, RANGE 4 EAST, M.D.B. & M.

EXCEPTING THEREFROM THE NORTH 660 FEET THEREOF AND THE SOUTH 1100 FEET THEREOF.

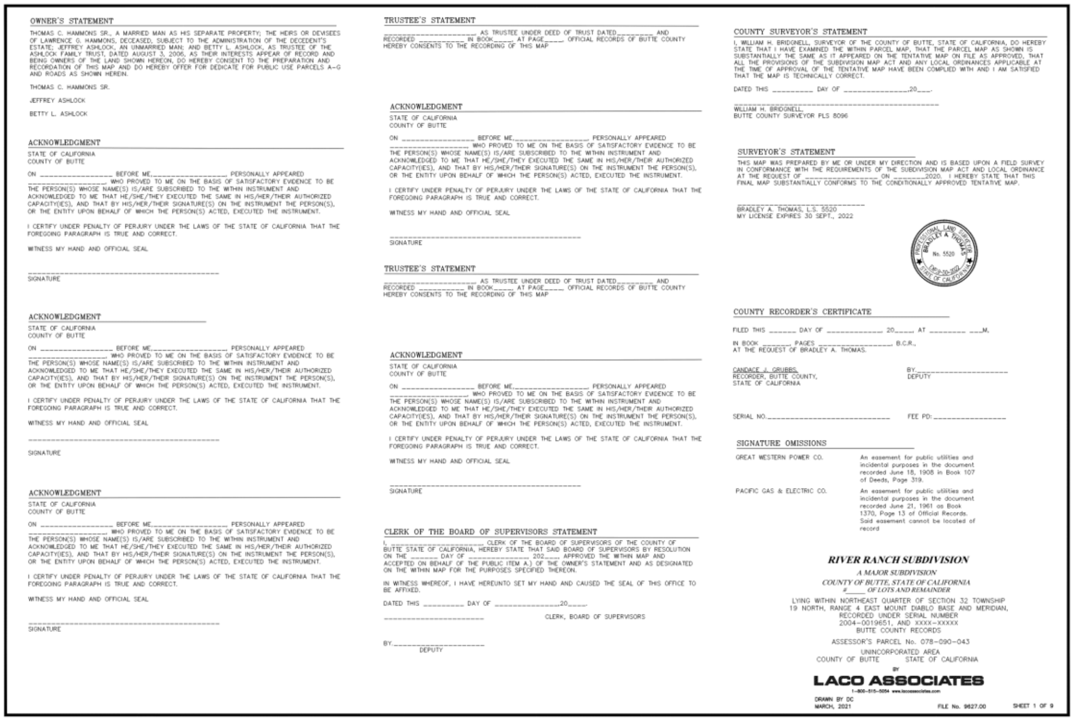
ALSO EXCEPTING THEREFROM THE FOLLOWING DESCRIBED PARCEL OF LAND, AS CONVEYED TO THE
COUNTY OF BUTTE BY GRANT DEED, RECORDED AUGUST 30, 1982, IN BOOK 2751, PAGE 299,
OFFICIAL RECORDS:

BEGINNING AT A POINT ON THE EAST LINE OF SECTION 32, FROM WHICH THE NORTHEAST CORNER
OF SAID SECTION 32 BEARS NORTH 00 DEG. 01' 29" WEST, 660.10 FEET; THENCE FROM THE POINT
OF BEGINNING, SOUTH 88 DEG. 58' 03" WEST, 2670.72 FEET TO A POINT IN THE CENTERLINE OF
LINCOLN BLVD.; THENCE SOUTHERLY ALONG SAID CENTERLINE OF LINCOLN BLVD., SOUTH 00 DEG.
04' 44" EAST, 894.80 FEET; THENCE LEAVING SAID CENTERLINE NORTH 88 DEG. 41' 30" EAST, 40.01
FEET; THENCE NORTH 00 DEG. 04' 44" WEST, 820.87 FEET; THENCE ALONG A TANGENT CURVE
CONCAVE SOUTHEASTERLY HAVING A RADIUS OF 30 FEET, A CENTRAL ANGLE OF 88 DEG. 57' 12" THE
ARC LENGTH OF WHICH IS 46.58 FEET; THENCE NORTH 88 DEG. 52' 28" EAST, 2601.28 FEET TO THE
EAST LINE OF SAID SECTION 32; THENCE NORTHERLY ALONG SAID EAST LINE NORTH 00 DEG. 01' 29"
WEST, 40.01 FEET TO THE POINT OF BEGINNING.

APN: 078-090-043 and 078-090-044

EXHIBIT B

DEPICTION OF THE PROJECT



OWNER'S STATEMENT

THOMAS C. HAMMONS SR., A MARRIED MAN AS HIS SEPARATE PROPERTY; THE HEIRS OR DEVISEES OF LAWRENCE G. HAMMONS, DECEASED, SUBJECT TO THE ADMINISTRATION OF THE DECEDENT'S ESTATE; JEFFREY ASHLOCK, AN UNMARRIED MAN; AND BETTY L. ASHLOCK, AS TRUSTEE OF THE ASHLOCK FAMILY TRUST, DATED AUGUST 3, 2006, AS THEIR INTERESTS APPEAR OF RECORD AND BEING OWNERS OF THE LAND SHOWN HEREON, DO HEREBY CONSENT TO THE PREPARATION AND RECORDATION OF THIS MAP AND DO HEREBY OFFER FOR DEDICATE FOR PUBLIC USE PARCELS A–G AND ROADS AS SHOWN HEREIN.

THOMAS C. HAMMONS SR.

JEFFREY ASHLOCK

BETTY L. ASHLOCK

ACKNOWLEDGMENT

STATE OF CALIFORNIA
COUNTY OF BUTTE

ON ________________ BEFORE ME,_________________, PERSONALLY APPEARED _________________, 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

ACKNOWLEDGMENT

STATE OF CALIFORNIA
COUNTY OF BUTTE

ON ________________ BEFORE ME,_________________, PERSONALLY APPEARED _________________, 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

ACKNOWLEDGMENT

STATE OF CALIFORNIA
COUNTY OF BUTTE

ON ________________ BEFORE ME,_________________, PERSONALLY APPEARED _________________, 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

TRUSTEE'S STATEMENT

____________________, AS TRUSTEE UNDER DEED OF TRUST DATED_________ AND RECORDED __________ IN BOOK_____, AT PAGE_____, OFFICIAL RECORDS OF BUTTE COUNTY HEREBY CONSENTS TO THE RECORDING OF THIS MAP

ACKNOWLEDGMENT

STATE OF CALIFORNIA
COUNTY OF BUTTE

ON ________________ BEFORE ME,_________________, PERSONALLY APPEARED _________________, 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

TRUSTEE'S STATEMENT

____________________, AS TRUSTEE UNDER DEED OF TRUST DATED_________ AND RECORDED __________ IN BOOK_____, AT PAGE_____, OFFICIAL RECORDS OF BUTTE COUNTY HEREBY CONSENTS TO THE RECORDING OF THIS MAP

ACKNOWLEDGMENT

STATE OF CALIFORNIA
COUNTY OF BUTTE

ON ________________ BEFORE ME,_________________, PERSONALLY APPEARED _________________, 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

CLERK OF THE BOARD OF SUPERVISORS STATEMENT

I, ____________________, CLERK OF THE BOARD OF SUPERVISORS OF THE COUNTY OF BUTTE STATE OF CALIFORNIA, HEREBY STATE THAT SAID BOARD OF SUPERVISORS BY RESOLUTION ON THE ______ DAY OF ______________, 202___, APPROVED THE WITHIN MAP AND ACCEPTED ON BEHALF OF THE PUBLIC ITEM A.) OF THE OWNER'S STATEMENT AND AS DESIGNATED ON THE WITHIN MAP FOR THE PURPOSES SPECIFIED THEREON.

IN WITNESS WHEREOF, I HAVE HEREUNTO SET MY HAND AND CAUSED THE SEAL OF THIS OFFICE TO BE AFFIXED.

DATED THIS _________ DAY OF ______________,20____.

______________________ CLERK, BOARD OF SUPERVISORS

BY.______________________
DEPUTY

COUNTY SURVEYOR'S STATEMENT

I, WILLIAM H. BRIDGNELL, SURVEYOR OF THE COUNTY OF BUTTE, STATE OF CALIFORNIA, DO HEREBY STATE THAT I HAVE EXAMINED THE WITHIN PARCEL MAP, THAT THE PARCEL MAP AS SHOWN IS SUBSTANTIALLY THE SAME AS IT APPEARED ON THE TENTATIVE MAP ON FILE AS APPROVED, THAT ALL THE PROVISIONS OF THE SUBDIVISION MAP ACT AND ANY LOCAL ORDINANCES APPLICABLE AT THE TIME OF APPROVAL OF THE TENTATIVE MAP HAVE BEEN COMPLIED WITH AND I AM SATISFIED THAT THE MAP IS TECHNICALLY CORRECT.

DATED THIS _________ DAY OF ______________,20___.

____
WILLIAM H. BRIDGNELL,
BUTTE COUNTY SURVEYOR PLS 8096

SURVEYOR'S STATEMENT

THIS MAP WAS PREPARED BY ME OR UNDER MY DIRECTION AND IS BASED UPON A FIELD SURVEY IN CONFORMANCE WITH THE REQUIREMENTS OF THE SUBDIVISION MAP ACT AND LOCAL ORDINANCE AT THE REQUEST OF ________________ ON _______2020. I HEREBY STATE THAT THIS FINAL MAP SUBSTANTIALLY CONFORMS TO THE CONDITIONALLY APPROVED TENTATIVE MAP.

____
BRADLEY A. THOMAS, L.S. 5520
MY LICENSE EXPIRES 30 SEPT., 2022

PROFESSIONAL LAND SURVEYOR
BRADLEY A. THOMAS
No. 5520
EXP 9-30-2022
STATE OF CALIFORNIA

COUNTY RECORDER'S CERTIFICATE

FILED THIS ______ DAY OF ____________ 20____, AT ________ ___M.

IN BOOK _______, PAGES ________________, B.C.R.,
AT THE REQUEST OF BRADLEY A. THOMAS.

CANDACE J. GRUBBS,
RECORDER, BUTTE COUNTY,
STATE OF CALIFORNIA

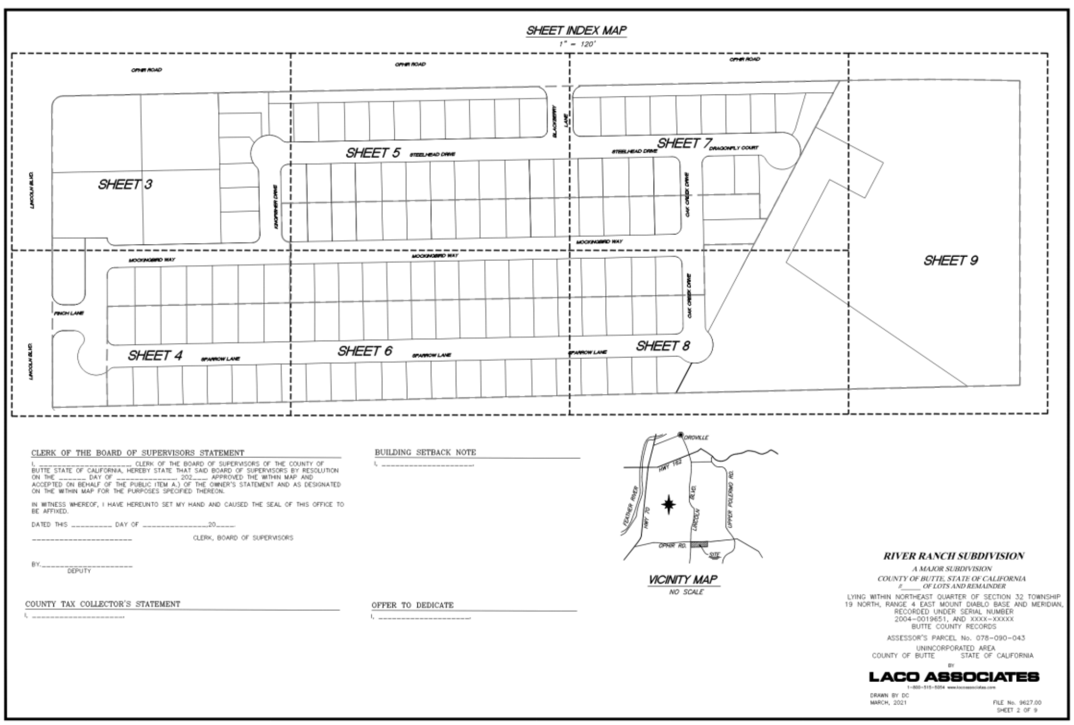
BY.____________________
DEPUTY

SERIAL NO.__________________________ FEE PD: _______________

SIGNATURE OMISSIONS

GREAT WESTERN POWER CO.	An easement for public utilities and incidental purposes in the document recorded June 18, 1908 in Book 107 of Deeds, Page 319.
PACIFIC GAS & ELECTRIC CO.	An easement for public utilities and incidental purposes in the document recorded June 21, 1961 as Book 1370, Page 13 of Official Records. Said easement cannot be located of record

RIVER RANCH SUBDIVISION
A MAJOR SUBDIVISION
COUNTY OF BUTTE, STATE OF CALIFORNIA
#_____ OF LOTS AND REMAINDER
LYING WITHIN NORTHEAST QUARTER OF SECTION 32 TOWNSHIP 19 NORTH, RANGE 4 EAST MOUNT DIABLO BASE AND MERIDIAN, RECORDED UNDER SERIAL NUMBER 2004–0019651, AND XXXX–XXXXX BUTTE COUNTY RECORDS
ASSESSOR'S PARCEL No. 078–090–043
UNINCORPORATED AREA
COUNTY OF BUTTE STATE OF CALIFORNIA
BY
LACO ASSOCIATES
1–800–515–5054 www.lacoassociates.com
DRAWN BY DC
MARCH, 2021
FILE No. 9627.00
SHEET 1 OF 9



CLERK OF THE BOARD OF SUPERVISORS STATEMENT

I, ____________________, CLERK OF THE BOARD OF SUPERVISORS OF THE COUNTY OF BUTTE STATE OF CALIFORNIA, HEREBY STATE THAT SAID BOARD OF SUPERVISORS BY RESOLUTION ON THE ______ DAY OF ______________, 202___ APPROVED THE WITHIN MAP AND ACCEPTED ON BEHALF OF THE PUBLIC ITEM A.) OF THE OWNER'S STATEMENT AND AS DESIGNATED ON THE WITHIN MAP FOR THE PURPOSES SPECIFIED THEREON.

IN WITNESS WHEREOF, I HAVE HEREUNTO SET MY HAND AND CAUSED THE SEAL OF THIS OFFICE TO BE AFFIXED.

DATED THIS _________ DAY OF ______________,20____.

______________________ CLERK, BOARD OF SUPERVISORS

BY.______________________
DEPUTY

BUILDING SETBACK NOTE

I, ____________________.

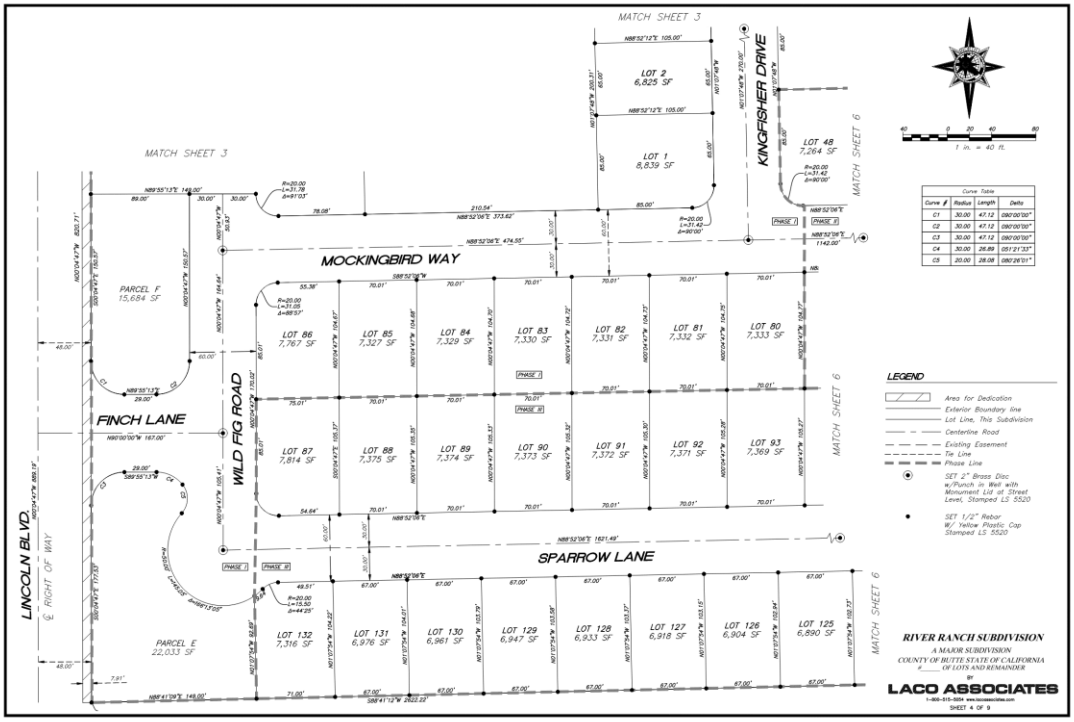
COUNTY TAX COLLECTOR'S STATEMENT

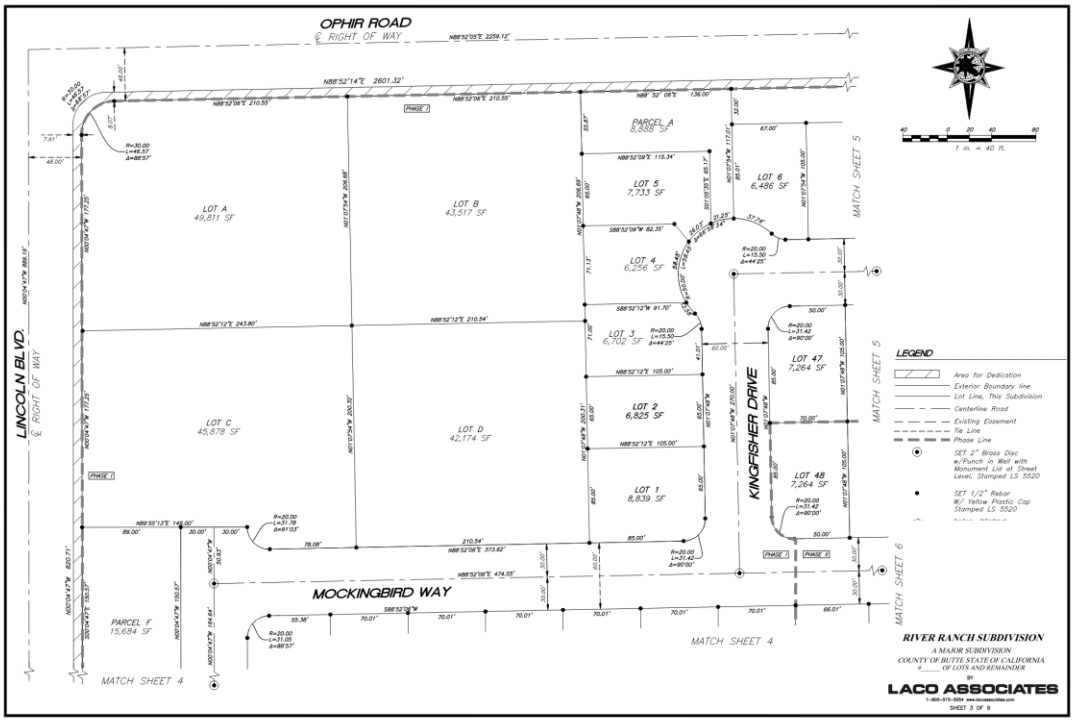
I, ____________________.

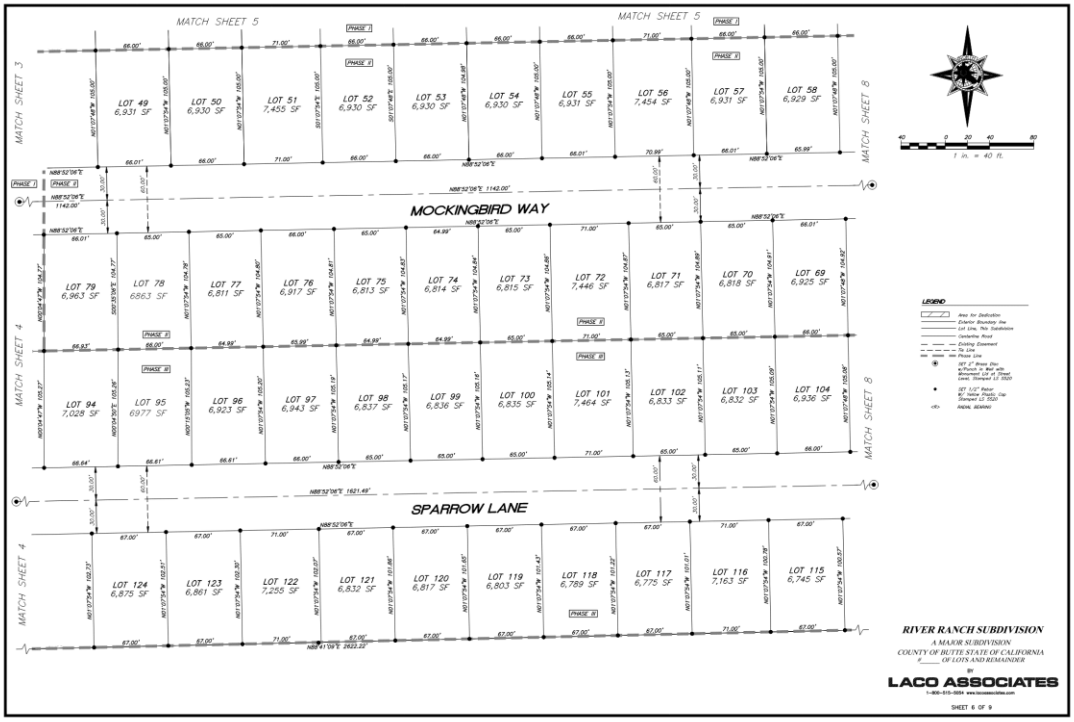
OFFER TO DEDICATE

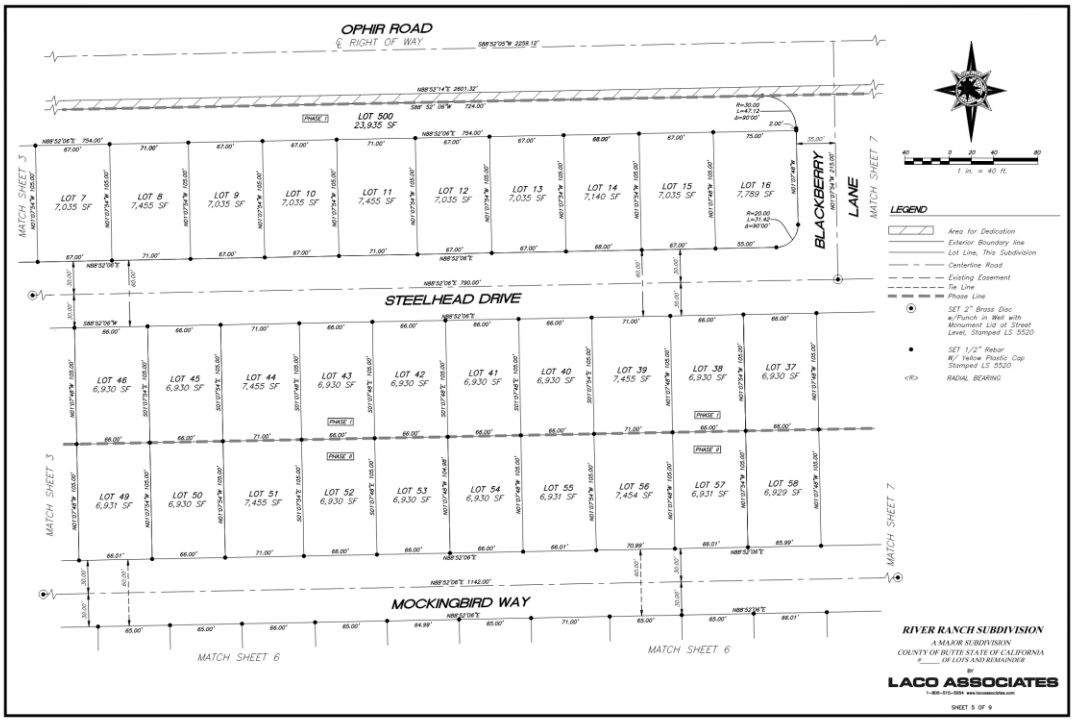
I, ____________________.

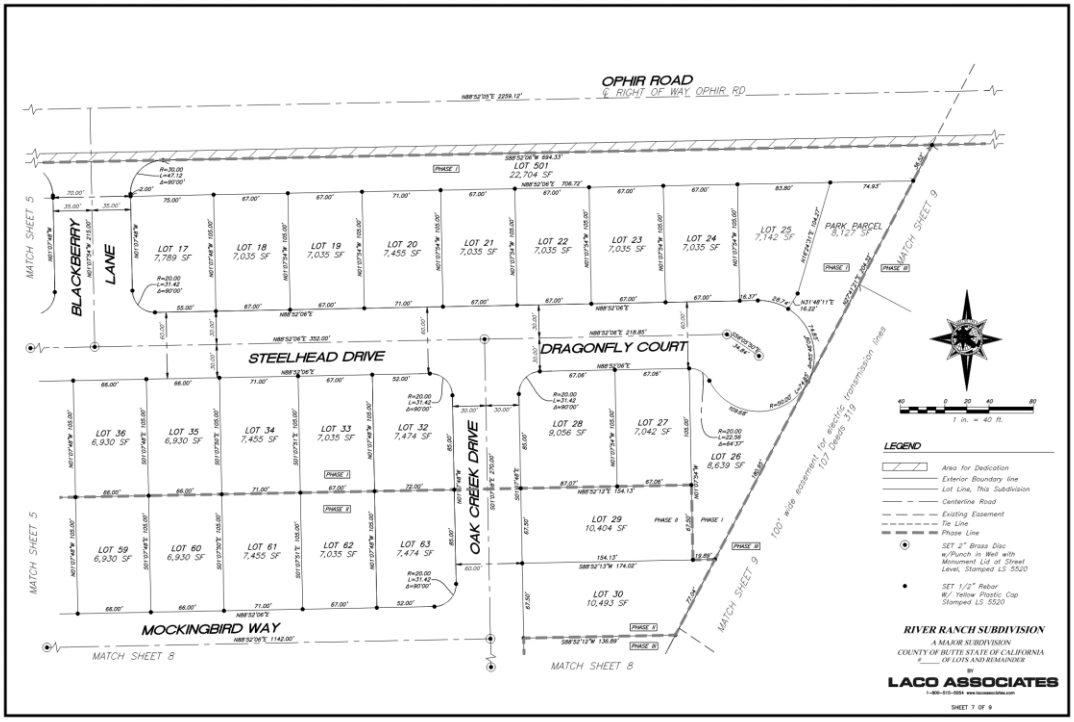
RIVER RANCH SUBDIVISION
A MAJOR SUBDIVISION
COUNTY OF BUTTE, STATE OF CALIFORNIA
#_____ OF LOTS AND REMAINDER
LYING WITHIN NORTHEAST QUARTER OF SECTION 32 TOWNSHIP 19 NORTH, RANGE 4 EAST MOUNT DIABLO BASE AND MERIDIAN, RECORDED UNDER SERIAL NUMBER 2004–0019651, AND XXXX–XXXXX BUTTE COUNTY RECORDS
ASSESSOR'S PARCEL No. 078–090–043
UNINCORPORATED AREA
COUNTY OF BUTTE STATE OF CALIFORNIA
BY
LACO ASSOCIATES
1–800–515–5054 www.lacoassociates.com
DRAWN BY DC
MARCH, 2021
FILE No. 9627.00
SHEET 2 OF 9

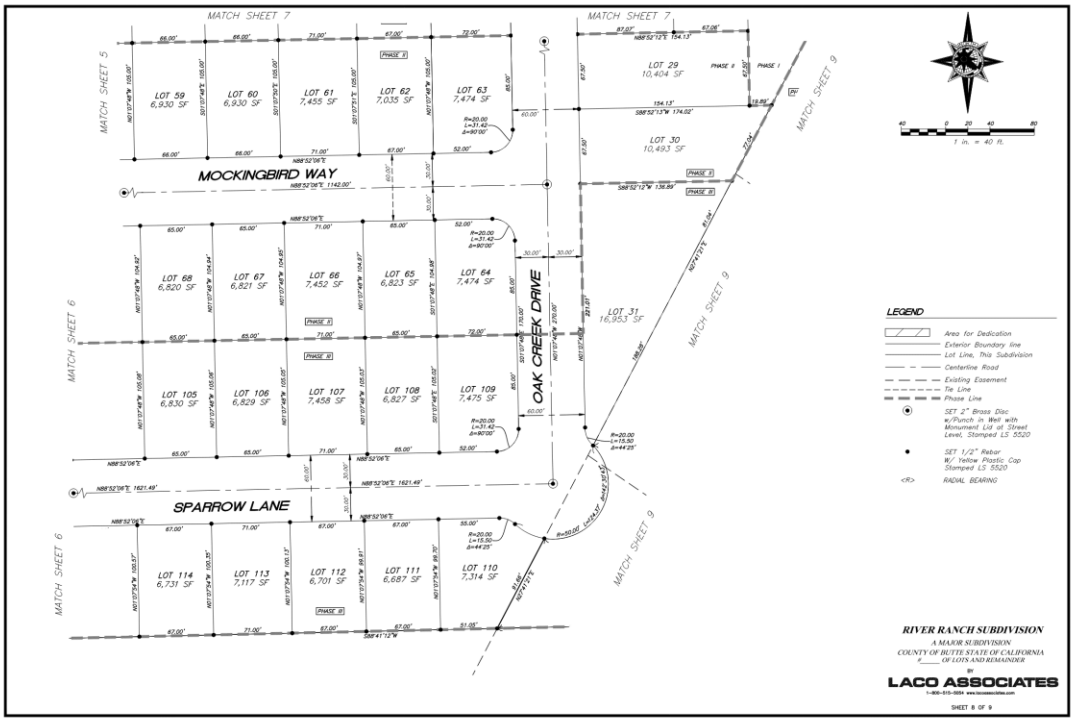

MATCH SHEET 3
LOT 2
6,825 SF
LOT 1
8,839 SF
KINGFISHER DRIVE
LOT 48
7,264 SF
MATCH SHEET 6
MOCKINGBIRD WAY
PARCEL F
15,684 SF
LOT 86
7,767 SF
LOT 85
7,327 SF
LOT 84
7,329 SF
LOT 83
7,330 SF
LOT 82
7,331 SF
LOT 81
7,332 SF
LOT 80
7,333 SF
FINCH LANE
WILD FIG ROAD
LOT 87
7,814 SF
LOT 88
7,375 SF
LOT 89
7,374 SF
LOT 90
7,373 SF
LOT 91
7,372 SF
LOT 92
7,371 SF
LOT 93
7,369 SF
SPARROW LANE
LINCOLN BLVD.
℄ RIGHT OF WAY
PARCEL E
22,033 SF
LOT 132
7,316 SF
LOT 131
6,976 SF
LOT 130
6,961 SF
LOT 129
6,947 SF
LOT 128
6,933 SF
LOT 127
6,918 SF
LOT 126
6,904 SF
LOT 125
6,890 SF
Curve Table
Curve # | Radius | Length | Delta
C1 | 30.00 | 47.12 | 090°00'00"
C2 | 30.00 | 47.12 | 090°00'00"
C3 | 30.00 | 47.12 | 090°00'00"
C4 | 30.00 | 26.89 | 051°21'33"
C5 | 20.00 | 38.08 | 090°26'01"
LEGEND
Area for Dedication
Exterior Boundary line
Lot Line, This Subdivision
Centerline Road
Existing Easement
Tie Line
Phase Line
SET 2" Brass Disc w/Punch in Well with Monument Lid at Street Level, Stamped LS 5520
SET 1/2" Rebar W/ Yellow Plastic Cap Stamped LS 5520
RIVER RANCH SUBDIVISION
A MAJOR SUBDIVISION
COUNTY OF BUTTE STATE OF CALIFORNIA
____ OF LOTS AND REMAINDER
BY
LACO ASSOCIATES
SHEET 4 OF 9

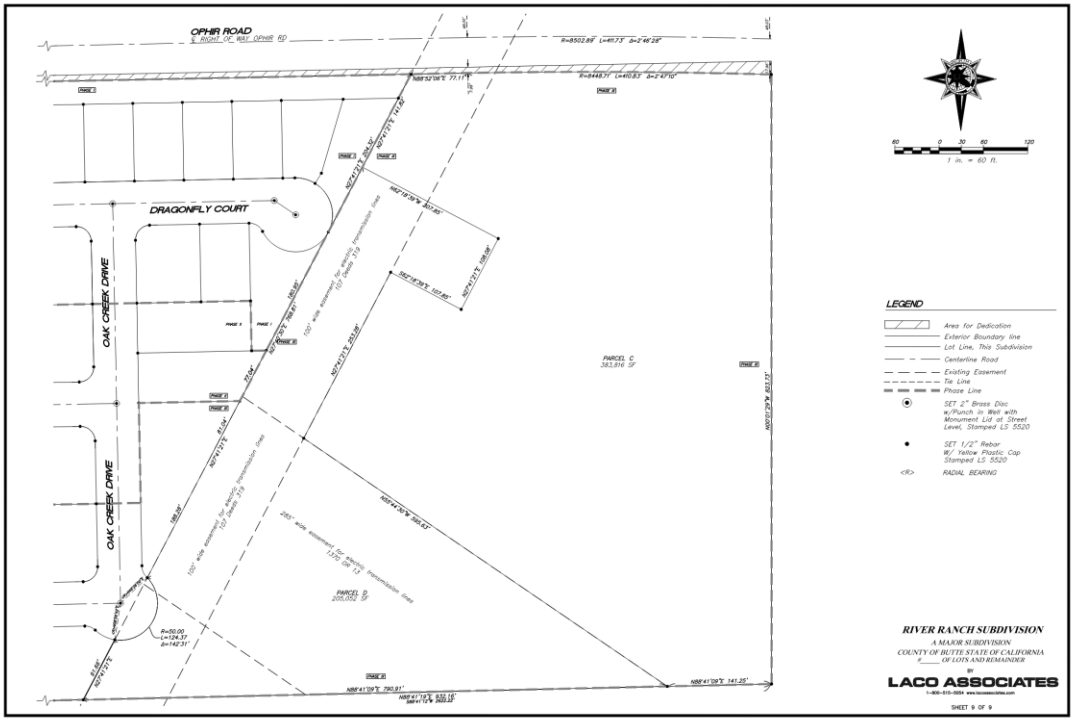

OPHIR ROAD
℄ RIGHT OF WAY
LINCOLN BLVD.
℄ RIGHT OF WAY
LOT A
49,811 SF
LOT B
43,517 SF
LOT C
45,878 SF
LOT D
42,174 SF
PARCEL A
8,888 SF
LOT 5
7,733 SF
LOT 6
6,486 SF
LOT 4
6,256 SF
LOT 3
6,702 SF
LOT 2
6,825 SF
LOT 1
8,839 SF
KINGFISHER DRIVE
LOT 47
7,264 SF
LOT 48
7,264 SF
MOCKINGBIRD WAY
PARCEL F
15,684 SF
MATCH SHEET 5
MATCH SHEET 6
MATCH SHEET 4
LEGEND
Area for Dedication
Exterior Boundary line
Lot Line, This Subdivision
Centerline Road
Existing Easement
Tie Line
Phase Line
SET 2" Brass Disc w/Punch in Well with Monument Lid at Street Level, Stamped LS 5520
SET 1/2" Rebar W/ Yellow Plastic Cap Stamped LS 5520
RIVER RANCH SUBDIVISION
A MAJOR SUBDIVISION
COUNTY OF BUTTE STATE OF CALIFORNIA
____ OF LOTS AND REMAINDER
BY
LACO ASSOCIATES
SHEET 3 OF 9


MATCH SHEET 5
MATCH SHEET 5
MATCH SHEET 3
MATCH SHEET 8
MATCH SHEET 4
MATCH SHEET 8
MATCH SHEET 4
MOCKINGBIRD WAY
SPARROW LANE
LOT 49 6,931 SF
LOT 50 6,930 SF
LOT 51 7,455 SF
LOT 52 6,930 SF
LOT 53 6,930 SF
LOT 54 6,930 SF
LOT 55 6,931 SF
LOT 56 7,454 SF
LOT 57 6,931 SF
LOT 58 6,929 SF
LOT 79 6,963 SF
LOT 78 6863 SF
LOT 77 6,811 SF
LOT 76 6,917 SF
LOT 75 6,813 SF
LOT 74 6,814 SF
LOT 73 6,815 SF
LOT 72 7,446 SF
LOT 71 6,817 SF
LOT 70 6,818 SF
LOT 69 6,925 SF
LOT 94 7,028 SF
LOT 95 6977 SF
LOT 96 6,923 SF
LOT 97 6,943 SF
LOT 98 6,837 SF
LOT 99 6,836 SF
LOT 100 6,835 SF
LOT 101 7,464 SF
LOT 102 6,833 SF
LOT 103 6,832 SF
LOT 104 6,936 SF
LOT 124 6,875 SF
LOT 123 6,861 SF
LOT 122 7,255 SF
LOT 121 6,832 SF
LOT 120 6,817 SF
LOT 119 6,803 SF
LOT 118 6,789 SF
LOT 117 6,775 SF
LOT 116 7,163 SF
LOT 115 6,745 SF
1 in. = 40 ft.
LEGEND
RIVER RANCH SUBDIVISION
A MAJOR SUBDIVISION
COUNTY OF BUTTE STATE OF CALIFORNIA
OF LOTS AND REMAINDER
BY
LACO ASSOCIATES
SHEET 6 OF 9


OPHIR ROAD
@ RIGHT OF WAY
LOT 500 23,935 SF
BLACKBERRY LANE
STEELHEAD DRIVE
MOCKINGBIRD WAY
MATCH SHEET 3
MATCH SHEET 7
MATCH SHEET 3
MATCH SHEET 7
MATCH SHEET 6
MATCH SHEET 6
LOT 7 7,035 SF
LOT 8 7,455 SF
LOT 9 7,035 SF
LOT 10 7,035 SF
LOT 11 7,455 SF
LOT 12 7,035 SF
LOT 13 7,035 SF
LOT 14 7,140 SF
LOT 15 7,035 SF
LOT 16 7,789 SF
LOT 46 6,930 SF
LOT 45 6,930 SF
LOT 44 7,455 SF
LOT 43 6,930 SF
LOT 42 6,930 SF
LOT 41 6,930 SF
LOT 40 6,930 SF
LOT 39 7,455 SF
LOT 38 6,930 SF
LOT 37 6,930 SF
LOT 49 6,931 SF
LOT 50 6,930 SF
LOT 51 7,455 SF
LOT 52 6,930 SF
LOT 53 6,930 SF
LOT 54 6,930 SF
LOT 55 6,931 SF
LOT 56 7,454 SF
LOT 57 6,931 SF
LOT 58 6,929 SF
1 in. = 40 ft.
LEGEND
RIVER RANCH SUBDIVISION
A MAJOR SUBDIVISION
COUNTY OF BUTTE STATE OF CALIFORNIA
OF LOTS AND REMAINDER
BY
LACO ASSOCIATES
SHEET 5 OF 9


OPHIR ROAD
(E RIGHT OF WAY, OPHIR RD)
BLACKBERRY LANE
STEELHEAD DRIVE
DRAGONFLY COURT
OAK CREEK DRIVE
MOCKINGBIRD WAY
PARK PARCEL 8,127 SF
LOT 501 22,704 SF
LOT 17 7,789 SF
LOT 18 7,035 SF
LOT 19 7,035 SF
LOT 20 7,455 SF
LOT 21 7,035 SF
LOT 22 7,035 SF
LOT 23 7,035 SF
LOT 24 7,035 SF
LOT 25 7,142 SF
LOT 26 8,639 SF
LOT 27 7,042 SF
LOT 28 9,056 SF
LOT 29 10,404 SF
LOT 30 10,493 SF
LOT 32 7,474 SF
LOT 33 7,035 SF
LOT 34 7,455 SF
LOT 35 6,930 SF
LOT 36 6,930 SF
LOT 59 6,930 SF
LOT 60 6,930 SF
LOT 61 7,455 SF
LOT 62 7,035 SF
LOT 63 7,474 SF
MATCH SHEET 5
MATCH SHEET 8
MATCH SHEET 9
100' wide easement for electric transmission lines 10/ Deeds 319
LEGEND
Area for Dedication
Exterior Boundary line
Lot Line, This Subdivision
Centerline Road
Existing Easement
Tie Line
Phase Line
SET 2" Brass Disc w/Punch in Well with Monument Lid at Street Level, Stamped LS 5520
SET 1/2" Rebar W/ Yellow Plastic Cap Stamped LS 5520
1 in. = 40 ft.
RIVER RANCH SUBDIVISION
A MAJOR SUBDIVISION
COUNTY OF BUTTE STATE OF CALIFORNIA
OF LOTS AND REMAINDER
BY
LACO ASSOCIATES
SHEET 7 OF 9


MATCH SHEET 7
MATCH SHEET 5
MATCH SHEET 6
MATCH SHEET 9
MOCKINGBIRD WAY
SPARROW LANE
OAK CREEK DRIVE
LOT 59 6,930 SF
LOT 60 6,930 SF
LOT 61 7,455 SF
LOT 62 7,035 SF
LOT 63 7,474 SF
LOT 64 7,474 SF
LOT 65 6,823 SF
LOT 66 7,452 SF
LOT 67 6,821 SF
LOT 68 6,820 SF
LOT 105 6,830 SF
LOT 106 6,829 SF
LOT 107 7,456 SF
LOT 108 6,827 SF
LOT 109 7,475 SF
LOT 110 7,314 SF
LOT 111 6,687 SF
LOT 112 6,701 SF
LOT 113 7,117 SF
LOT 114 6,731 SF
LOT 29 10,404 SF
LOT 30 10,493 SF
LOT 31 16,953 SF
LEGEND
Area for Dedication
Exterior Boundary line
Lot Line, This Subdivision
Centerline Road
Existing Easement
Tie Line
Phase Line
SET 2" Brass Disc w/Punch in Well with Monument Lid at Street Level, Stamped LS 5520
SET 1/2" Rebar W/ Yellow Plastic Cap Stamped LS 5520
<R> RADIAL BEARING
1 in. = 40 ft.
RIVER RANCH SUBDIVISION
A MAJOR SUBDIVISION
COUNTY OF BUTTE STATE OF CALIFORNIA
OF LOTS AND REMAINDER
BY
LACO ASSOCIATES
SHEET 8 OF 9


OPHIR ROAD
R=8502.89' L=417.3' Δ=2°48'28"
R=8448.71' L=410.83' Δ=2°47'10"
DRAGONFLY COURT
OAK CREEK DRIVE
OAK CREEK DRIVE
PARCEL C
383,816 SF
PARCEL D
205,052 SF
R=50.00'
L=124.37'
Δ=142°31'
60 0 30 60 120
1 in. = 60 ft.
LEGEND
Area for Dedication
Exterior Boundary line
Lot Line, This Subdivision
Centerline Road
Existing Easement
Tie Line
Phase Line
SET 2" Brass Disc w/Punch in Well with Monument Lid at Street Level, Stamped LS 5520
SET 1/2" Rebar W/ Yellow Plastic Cap Stamped LS 5520
<R> RADIAL BEARING
RIVER RANCH SUBDIVISION
A MAJOR SUBDIVISION
COUNTY OF BUTTE STATE OF CALIFORNIA
#_____ OF LOTS AND REMAINDER
BY
LACO ASSOCIATES
SHEET 9 OF 9

LAKE OROVILLE AREA PUBLIC UTILITY DISTRICT

Manager's Report

To: Board of Directors

From: Scott McCutcheon, General Manager

Date: July 22, 2021, 3:00 PM SPECIAL MEETING

RE: Item No. 5 – Board Members', Staff, and Manager Comments