Las Virgenes Municipal Water District

Construction Specifications
for
1235-Foot Backbone Improvements Project
5 MG Tank

Issued for Bid

October 23, 2013

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NOTICE INVITING SEALED PROPOSALS (BIDS)
1235-Foot Backbone Improvements Project

5 MG Tank

NOTICE IS HEREBY GIVEN that the Board of Directors of Las Virgenes Municipal Water District invites and will receive sealed proposals (bids) up to the hour of 3:00 p.m. on December 3, 2013, for furnishing the work described in the Contract Documents. Bids received after the time stated in the Call for Bids will not be accepted and will be returned, unopened, to the bidder. The time shall be determined by the time on the receptionist telephone console in our Headquarters lobby. Proposals will be publicly opened and read aloud at the office of the District, 4232 Las Virgenes Road, Calabasas, California. Said bids shall conform to and be responsive to the Specifications and Contract Documents for said work as heretofore approved by the District.

*A **mandatory** pre-bid tour will be conducted at 9:00 a.m. on November 12, 2013. The meeting will begin at the Westlake Filtration Plant at 32601 Torchwood Place, Westlake Village, CA 91361. Attendance at the pre-bid conference is a condition precedent to submittal of the bid and the District will not consider a bid from any Bidder not represented at the pre-bid conference. Similarly, the District will not consider a bid from any Bidder not pre-qualified as a General Contractor. Questions regarding the project may be directed to Lindsay Cao, P.E., at 818-251.2163.*

Sets of Contract Documents may be obtained from the District Headquarter at 4232 Las Virgenes Road, Calabasas, CA 91302, or the District website at www.lvmwe.com.

Each bid must be on the District bid form and shall be sealed and filed with the secretary of the District at or before the time stated in the Notice.

All terms and conditions contained in the Specifications and Contract Documents shall become part of the Contract. The Board of Directors of Las Virgenes Municipal Water District reserves the right to reject any and all bids and to waive any and all irregularities in any bid. No Bidder may withdraw his bid after the said time for bid openings until 60-days thereafter or until the District has made a final award to the successful Bidder or has rejected all bids, whichever event first occurs.

The Board of Directors of the District reserves the right to select the schedule(s) under which the bids are to be compared and contract(s) awarded.

_____ _____

Dated

INFORMATION FOR BIDDERS

1. GENERAL

The work hereunder must be done in strict conformity with the plans and specifications adopted and approved by the District.

2. CONTRACT DOCUMENTS

(a) The Contract Documents shall consist of the following:

Notice Inviting Sealed Proposals (Bids)
Information for Bidders
Proposal or Bid Form
Noncollusion Declaration
Agreement
Addenda issued Prior to Bid Opening
Certificate(s) of Insurance
Workers Compensation Certificate
Bonds
Special Provisions
Plans and Specifications

(b) Terms and conditions contained in the Contract Documents are part of the contract. The governing board of the District may reject bids and to waive informalities in bids. No Bidder may withdraw a bid until the District has made a final award to the successful Bidder or has rejected all bids.

3. PROPOSALS

Bids shall be made upon the form of proposal furnished by the District and a part of the Contract Documents. Bids shall be properly executed and with all items filled in; the signatures of persons signing shall be in longhand. Erasures, interlineations or other corrections shall be authenticated by affixing in the margin immediately opposite the correction, the initials of a person signing the bid. The unit price and the total amount named by a Bidder for an item are not in agreement, the unit price alone shall be considered as representing the bidder's intention, and the totals shall be corrected to conform.

Persons bidding may submit bids on any of the schedules set forth in the bid form.

Bids shall not contain recapitulation of the work to be done. Alternative proposals will not be considered, except as called for. No oral, telegraphic or telephonic proposals or modifications will be considered.

Bids shall be accompanied by a Bidder bond in a form acceptable to the District or cash in the amount of 10% of the bid price.

Before submitting a bid, Bidders shall carefully examine all Contract Documents, shall visit the site of the work, shall fully inform themselves as to all the existing conditions and limitations, and shall include in the bid a sum to cover the cost of all items included in the contract. No allowance will be made because of lack of such examination or knowledge.

Bids shall be sealed in an envelope marked 1235-Foot Backbone Improvements Project 5_MG Tank addressed to the Secretary of the District, and be delivered thereto on or before the day and hour set for the opening of bids in the notice inviting sealed proposals, and shall bear the name of the bidder. It is the SOLE responsibility of the Bidder to see that his bid is delivered and received in proper time. Any bid received after that scheduled closing time for receipt of bids shall be returned to the Bidder unopened.

The District shall have a period of 60 days after the opening of bids within which to accept or reject the bids. If no bid is accepted within the period, or if the successful Bidder executes and delivers the necessary Contract Documents to the District, the District will return to each Bidder all checks and bonds received by the District from unsuccessful Bidders within 10 days after the execution of the contract and presentation of required certificates and bonds or within 10 days after being requested to do so by the Bidder if no bid is accepted within the period.

4. AGREEMENT AND BONDS

The form of contract which the successful bidder, as Contractor, will be required to execute is included in the Contract Documents, and should be carefully examined by the bidder. The agreement, bonds, and other documents to be executed by the Contractor shall be executed in original triplicates stamped according to law, one of which original triplicate shall be filed with the District, and the others with the District's Attorney and the District's Engineer.

The successful bidder, simultaneously with the execution of the agreement, shall furnish and maintain a payment bond in an amount equal to 100% of the contract price and a faithful performance bond in an amount equal to 100% of the contract price. The bonds shall be secured from a surety company satisfactory to the District and whose name is on file with the County Clerk of Los Angeles County as an approved and financially sound surety company, authorized to transact business in this State.

The bonds shall meet all of the requirements and contain the conditions required by Sections 3247 and 3248 inclusive, of the Civil Code, and other applicable provisions of the law and regulations of the State of California.

Failure to execute the contract and file acceptable bonds and proof of insurance coverage as provided therein within the time set forth herein shall be just cause for the annulment of the award and forfeiture of the proposal guarantee.

5. ADDENDA OR BULLETINS

Addenda or bulletins issued before the time to submit bids expires, or forming a part of the Contract Documents furnished to the Bidder for preparation of his bid, shall be covered in the bid and shall be made a part of the contract.

6. WITHDRAWAL OF BID

A Bidder may withdraw the bid personally or by a signed written request prior to the scheduled time for opening of the bids (but not after).

7. AWARD OR REJECTION OF BIDS

The contract will be awarded to the lowest responsible Bidder complying with these instructions and with the notice inviting sealed proposals. The District may reject bids or waive informality in bids. If in the judgment of the District a bid is unbalanced, or if the Bidder is not responsible, it shall be considered sufficient grounds for rejection of the entire bid.

The Owner reserves the right to omit certain bid items in their entirety at the Owner's discretion in making an award of contract.

8. BIDDERS INTERESTED IN MORE THAN ONE BID

No person, firm or corporation shall make or file, or be interested in more than one bid for the same work, unless alternative bids are solicited. A person, firm or corporation submitting a subproposal to a bidder, or who has quoted prices on material to a bidder, is not disqualified from submitting a subproposal or quoting prices to other Bidders.

9. OTHER REQUIREMENTS

Before award of the contract, a Bidder upon request shall furnish a recent statement of financial condition and previous construction experience or other evidence of qualifications.

Before entering into a contract, the Bidder to whom the contract has been awarded shall furnish satisfactory evidence of workers' compensation insurance and public liability and property damage insurance as specified in the special provisions.

Contractor's License requirement for this project is: Class A. General.

Electrical work must be performed by an Electrical Contractor holding a valid C-10 license.

Blasting work or excavation employing explosives shall be performed by a Blasting Contractor pre-qualified by the District. A list of pre-qualified Blasting Contractors may be obtained from the District. See the Notice Inviting Sealed Proposals for contact information.

PROPOSAL
TO
LAS VIRGENES MUNICIPAL WATER DISTRICT
FOR THE CONSTRUCTION OF
1235-Foot Backbone Improvements Project
5 MG Tank

Name of Bidder: _____

Business Address: _____

Phone No.: _____

The site of the work to be constructed and referred to herein is in the County of Los Angeles, California.

The work is to be in accordance with the specifications and Contract Documents and as shown on plans therefore entitled: 1235-Foot Backbone Improvement Project 5 MG Tank.

TO THE GOVERNING BOARD OF LAS VIRGENES MUNICIPAL WATER DISTRICT.

In compliance with your notice inviting sealed proposals (bids) and other documents, the undersigned Bidder proposes to perform the work and in a workmanlike manner, in strict conformity with the plans and specifications and other Contract Documents, including Addenda Nos. ^[_____], ^[_____], and ^[_____], on file in the office of the Secretary of the District for the contract lump sum prices and contract unit prices herein.

BID SCHEDULE

Item No.	Item Description	Estimated Quantity	Unit	Unit Price	Total
1	Mobilization, Including Schedule, Bonds and Insurance	1	LS		
2	Sheeting, Shoring, and Bracing	1	LS		
3	SWPPP Preparation and Implementation	1	LS		
4	Rock Excavation at Tank Site	14,672	CY		
4A	Monitoring for Blasting (tank and pipeline)	44	EA		
5	Fill at Tank Site	1	LS		
6	5 MG Tank	1	LS		
7	Tank Baffling	1	LS		
8	Inlet/Outlet Valve Vault (Vault, Valves, Expansion Joints, Hatches)	1	LS		
9	36” Steel Pipelines	1	LS		
10	42” Steel Casing (including pipe supports and head walls)	1	LS		
11	Additional Trench Excavation (Inlet/Outlet Pipeline Trench)	100	LF		
12	Additional Trench Excavation (16” and Smaller Pipe)	100	LF		
13	Lower 30” Raw Water and 8” Domestic Water Pipelines	1	LS		
14	Drainage Assembly (Sta.11+18.42)	1	LS		
15	Filtered Water Pipeline (30” Pipeline, Valves, Fittings, Combined Air Vacuum Assembly and Connections at Water Filtration Plant)	1	LS		
16	8” Domestic Assembly (Connections, Pipe, Isolation Valves, Backflow Protection, Meter and Motor Operated Valve	1	LS		
17	Ammonia System (Containment Pipelines, Manhole and two 4” Outlets)	1	LS		
18	Dam Access Road	1	LS		
19	Site Improvements	1	LS		
20	Electrical	1	LS		
21	Process Control And Instrumentation System	1	LS		
22	Site Irrigation and Landscaping	1	LS		
23	Permanent Rock Protection System	1	LS		
	TOTAL				

It is understood the foregoing quantities are approximate only and are solely for the purpose of facilitating the comparison of bids. The Contractor's compensation will be computed upon the basis of the actual quantities in the complete work, whether they are more or less than those shown.

State manufacturers name and address for each type of material upon which this proposal is based.

TYPE OF MATERIAL	*MANUFACTURER*

Contractor shall submit to District the following information:

(1) The name and location of the place of business of each subcontractor performing work, labor or render construction services and each subcontractor licensed by the State of California specially fabricating and installing improvements according to detailed drawings or the plans and specifications, in an amount in excess of one-half of one percent of the Contractor's total bid.

(2) The portion of the work to be done by each subcontractor.

Each Bidder shall list only one subcontractor for each portion of the work identified in the bid. Include a pre-qualified Blasting Contractor.

DIVISION OF WORK OR TRADE	*NAME OF SUBCONTRACTOR*	*LOCATION OF MILL, SHOP OR OFFICE*

SIGNATURE OF AUTHORIZED

OFFICER OF BIDDER: _____

PRINTED NAME: _____

DATED: _____

***NOTE**: If Bidder is a corporation, the legal name of the corporation shall be set forth above, together with the signature of the officer or officers authorized to sign contracts on behalf of the corporation. If Bidder is a co-partnership, the true name of the firm shall be set forth above, together with the signature of the partner or partners authorized to sign contracts on behalf of the co-partnership. If the Bidder is an individual, the signature shall be placed above. If a joint venture of a special partnership, the names of the general partners and special partners shall be submitted.*

NONCOLLUSION DECLARATION

The undersigned declares under penalty of perjury as follows:

1. I am employed by [_____] of [_____], the party making the foregoing bid as [_____].

2. The bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation.

3. The bid is genuine and not collusive or sham; that the Bidder has not directly or indirectly induced or solicited any other Bidder to put in a false or sham bid, and has not directly or indirectly colluded, conspired, connived, or agreed with any Bidder or anyone else to put in a sham bid, or that anyone shall refrain from bidding.

4. The Bidder has not in any manner, directly or indirectly, sought by agreement, communication, or conference with anyone to fix the bid price of the Bidder or any other bidder, or to fix any overhead, profit, or cost element of the bid price, or of that of any other bidder, or to secure any advantage against the public body awarding the contract of anyone interested in the proposed contract.

5. All statements contained in the bid are true.

6. The Bidder has not, directly or indirectly, submitted the bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid, and will not pay, any fee to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof to effectuate a collusive or sham bid.

DATED:_____ By: _____

AGREEMENT FOR THE CONSTRUCTION OF
1235-Foot Backbone Improvements Project
5 MG Tank

As of _____, Las Virgenes Municipal Water District, herein "Agency," and [***Contractor's name***], herein "Contractor," agree as follows:

GENERAL

SECTION 1. SCOPE OF WORK

Contractor will furnish labor, equipment and materials and will perform work for the construction of the facilities described in the plans and specifications.

SECTION 2. CONSIDERATION

Agency shall pay Contractor the sum set forth in Contractor's bid for the performance of the work.

SECTION 3. PAYMENTS

(a) Monthly progress payments shall be as follows:
   (1) On or about the 25th day of each month, Contractor shall submit to the Agency's Representative, an invoice including an estimate of the cumulative amount and value of the work performed by Contractor prior to that date and subsequent to prior estimates. The estimate may include the value of acceptable materials and equipment delivered to the work site. The estimate shall be based on certified copies of paid invoices by the Contractor.
   (2) The Agency's Representative shall review the request as soon as practicable to determine whether the payment request is proper. A payment request found not to be a proper payment shall be returned within seven days after receipt accompanied by a written description of the reasons why the request is not proper.
   (3) Agency shall pay Contractor, 95% percent of the invoice amount reduced by: amounts due to Agency for equipment, services or materials furnished by Agency; amounts of claims or liens by the Agency or others, and amounts required to be deducted by federal, state or local governmental authorities.
   (4) If the Agency fails to make progress payment within 35 days after receipt of an undisputed and properly submitted invoice, the Agency shall pay to the Contractor interest at the legal rate set forth in Code of Civil Procedure Section 685.101(a) from seven days after receipt of the invoice by the Agency until paid.

(5) Progress payments do not signify acceptance of the work, or any portion of the work. Payments do not preclude Agency from demanding and recovering damages for failure to fully perform.

(b) On satisfactory completion of the work, Agency shall pay Contractor ninety percent of the value of the actual work less prior monthly progress payments.

(c) Within thirty days after recordation of a notice of completion, the undisputed amounts withheld by the Agency shall be released. Completion occurs on the acceptance by the governing body of the Agency; or the filing of a notice of cessation of labor.

(d) Notwithstanding the foregoing, contractor may receive payment in full, other than retention for claims by the Agency or third parties, if the contractor deposits approved securities or enters into an agreement with an escrow agent to hold earned retentions. The substitution of securities or the use of an escrow account shall be in the form and manner permitted by law.

SECTION 4. CONTRACT DOCUMENTS

The complete contract includes the Contract Documents set forth herein, to wit: the Notice Inviting Sealed Proposals, Information for Bidders, Proposal or Bid Form, Non-collusion Declaration, this Agreement, Certificate of Insurance, Workers' Compensation Certificate, Plans and Specifications, and Addenda issued prior to Bid Opening.

SECTION 5. COMPLIANCE WITH PROVISIONS OF LAW

(a) This Agency is subject to laws relating to public agencies which are part of this contract though fully set forth herein.

(b) Contractor shall comply with laws relating to the work.

SECTION 6. ATTORNEY FEES

The Court shall award reasonable costs and expenses, including attorney fees, to the prevailing party in an action or proceeding to enforce this Agreement.

SECTION 7. NOTICES

Notices required or permitted shall be given by personal delivery, by first class mail, postage prepaid, or facsimile transmission:

To: [***Contractor***], Contractor
[***Address of Agency***]
[***Contractor's Address***]

To: ***Las Virgenes Municipal Water District, Agency***
4232 Las Virgenes Road, Calabasas, California

SECTION 8. CONFLICT WITH PLANS AND SPECIFICATIONS

Conflict between the plans and specifications and this contract shall be brought to the attention of the Agency which shall resolve such conflict.

SECTION 9. ASSIGNMENT

(a) Contractor shall not assign this contract or payments under this contract.

(b) Contractor and each subcontractor hereby assign to the Agency rights, title, and interest in and to causes of action under Section 4 of the Clayton Act (15 U.S.C.A. Sec. 15) or under the Cartwright Act (Chapter 2 (commencing with Section 16700) of Part 2 of Division 7 of the Business and Professions Code), arising from purchases of goods, services, or materials for this contract or the subcontract. This assignment shall be made and become effective without further acknowledgment by the parties at the time the Agency tenders final payment to the Contractor.

SECTION 10. SECTION HEADINGS

Section headings are for the convenience of the parties and shall not affect the interpretation of this contract.

SECTION 11. AUTHORITY OF AGENCY REPRESENTATIVE

Agency's representative shall decide questions about the quality or acceptability of materials furnished and work performed, manner of performance and rate of progress of the work, the interpretation of the plans and specifications and the fulfillment of the contract by the Contractor.

WAGES, HOURS, AND WORKING CONDITIONS

SECTION 12. PREVAILING WAGES

(a) A determination of the general prevailing rates of per diem wages and holiday and overtime work where the work is to be performed is on file at the Agency's offices. Contractor and subcontractors will not pay less than the prevailing rates of wages. Contractor will post one copy of the prevailing rates of wages at the job site.

(b) Contractor shall forfeit as penalty to the Agency the sum of fifty dollars for each calendar day or portion thereof, and for each workman paid less than the prevailing rates under the contract or subcontractor.

SECTION 13. TRAVEL AND SUBSISTENCE PAYMENTS

Travel and subsistence payments shall be paid to each worker as defined in the applicable collective bargaining agreements filed with the Department of Industrial Relations for the particular craft, classification or type of work.

SECTION 14. HOURS OF WORK

(a) Eight hours labor constitutes a legal day's work. Workers shall be paid at a rate of one and one-half times the basic rate of pay for work in excess of eight hours during a calendar day or forty hours during a calendar week of the foregoing hours.

(b) Contractor shall keep and make available an accurate record showing the name each worker and hours worked each day and each week by each worker.

(c) As a penalty for failure to pay overtime when required, the Contractor shall forfeit to the Agency twenty-five dollars for each worker for each calendar day during which such worker works more than eight hours and is not paid overtime, and for each week during which such worker works more than forty hours and is not paid overtime.

SECTION 15. APPRENTICES

Contractor shall comply with the Labor Code concerning the employment of apprentices.

SECTION 16. SUBCONTRACTORS

Contractor shall comply with the *Subletting and Subcontracting Fair Practices Act* of Public Contracts Code.

SECTION 17. DISCRIMINATION

The Contractor shall not refuse to employ or promote any person, and shall not discriminate against any person with respect to compensation or terms and conditions of employment, and shall not discipline or discharge any person employed because of the person's race, religion, creed, color, national origin, ancestry or sex. The Contractor shall not refuse to accept otherwise qualified employees as indentured apprentices solely on the grounds of race, religion, creed, color, national origin, ancestry or sex.

SECTION 18. SAFETY

Contractor and subcontractors shall comply with the provisions of the Safety and Health Regulations for Construction, promulgated by the Secretary of Labor under the *Contract Work Hours and Safety Standards Act*, as set forth in Title 29, C.F.R. and by the California Division of Industrial Safety.

SECTION 19. CHARACTER OF WORKERS

Only competent workers shall be employed on the work. Workers who are incompetent, intemperate, troublesome, disorderly or otherwise objectionable, or who fail to perform work properly and acceptably, shall be immediately removed from the work by the Contractor and not re-employed.

INSURANCE, INDEMNIFICATION AND BONDS

SECTION 20. INSURANCE

(a) Before beginning the performance of the work, Contractor shall purchase and maintain insurance to protect the Contractor and the Agency from claims: (i) arising from Contractor's operations under the contract by the Contractor, a subcontractor or anyone employed by them, or anyone for whose acts any of them may be liable; (ii) under workers compensation, disability benefits and other similar benefit acts; (iii) for damages because of bodily injury, occupational sickness, or disease, or death of the Contractor's employees, or persons other than the Contractor's employees; (iv) for damages insured by usual personal injury liability coverage sustained by a person as a result of an offence related to employment of such person by the Contractor, or other persons; (v) for damages, other than the work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom; (vi) for damages because of bodily injury, death of a person or property damage arising from ownership, maintenance or use of a motor vehicle; (vii) involving contractual liability insurance applicable to the Contractor's obligations; and (viii) for damage to work in progress.

(b) The insurance required shall be written for not less than limits of liability specified in the Contract Documents or required by law, whichever is greater. The insurance shall be purchased from companies authorized to do business in the jurisdiction where the project is located. Coverages shall be written on an occurrence basis without interruption from the date of commencement of the work until date of final payment or until termination of coverage required to be maintained after final payment. Agency, its officers, agents and employees shall be named as additional insured.

(c) Certificates of insurance executed by the carrier(s) and acceptable to the Agency and copies of the policy shall be filed with the Agency prior to the commencement of the work. The Certificates and the insurance policies shall provide the policies will not be canceled or allowed to expire until at least thirty days prior written notice has been given to the Agency. If the insurance coverages are required to remain in force after final payment and are reasonably available, an additional certificate evidencing continuation of such coverage shall be submitted with the final application for payment. Information concerning reduction of coverage shall be furnished by the Contractor with reasonable promptness in accordance with the Contractor's information and belief.

(d) Contractor shall require each subcontractor to maintain policies of insurance covering the hazardous, and under the conditions, mentioned above and having the Agency, its officers, agents, volunteers and employees as additional insurers. Copies of the subcontractor's certificates of insurance and policies shall be filed with the Agency.

SECTION 21. INDEMNIFICATION

(a) Contractor shall indemnify and save the Agency, its officers, agents, volunteers and employees, free and harmless from costs, damages or liability, including attorney fees, arising out of any act or omission to act, including any negligent act or omission to act by Contractor, its officers, agents, subcontractors and employees with respect to the performance of the work or the Contractor's obligations under this contract.

(b) In addition to the foregoing, Contractor shall pay Agency costs, including attorney fees, incurred by the Agency in handling, responding to, or litigating stop notice

claims or other demands against money due to the Contractor or against the Contractor's payment bond by Contractor's officers, agents, employees or subcontractors.

SECTION 22. PAYMENT BOND

(a) Before beginning the performance of the work, Contractor shall file a payment bond with the Agency for its approval and acceptance. The payment bond shall be in the sum of ten percent of the contract price.

(b) The payment bond shall be in substantially the form of the bond attached hereto. The bond shall be executed by a representative of the surety having no financial interest in the contractor. The payment bond shall be separate and distinct from any other bond required by this contract.

SECTION 23. PERFORMANCE BOND

(a) Before beginning the performance of the work, Contractor shall file a performance bond with the Agency for its approval and acceptance. The performance bond shall be in the sum of ten percent of the contract price. The bond shall be payable by surety or sureties to Agency if Contractor fails to fully perform his obligations hereunder.

(b) The performance bond shall be in substantially the form of the bond attached hereto. The bond shall be executed by a representative of the surety having no financial interest in the contractor. The performance bond shall be separate and distinct from any other bond required by this contract.

PERFORMANCE

SECTION 24. TIME FOR COMPLETION

(a) All work under this Contract shall be completed within four hundred and twenty (420) calendar days after the date of the Notice to Proceed (hereafter "Completion Date"). The term "calendar days" includes Saturdays, Sundays, and holidays.

(b) The Agency expects the project to be completed on or before the Completion Date. If the work is not done by the Completion Date, the Agency will suffer damage and will incur substantial additional costs. Some of these damages and costs are and will be impractical and infeasible to determine, and some will be ascertainable. If the Agency determines, in its sole judgment, the failure to complete the work by the Completion Date is due to unforeseeable causes (which causes include Acts of God, or the public enemy, acts of the Government, acts of another contractor in the performance of another contract with the Agency, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, unusually severe weather, or delays of Subcontractors due to such causes) or is due to causes within the control of the Agency, the fault or negligence of the Agency, then the Contractor shall not be liable for the Agency's liquidated damages or other damages or costs resulting from the failure to complete the work by the Completion Date. If the Agency determines, in its sole judgment, the failure to complete the work by the Completion Date is due to foreseeable causes, causes within the control of the Contractor, the fault or negligence of the Contractor, or weather conditions which are normal for the area and the season, the Contractor and the Contractor's Surety shall be liable for payment to the Agency of **both** of the following:

(i) Fixed and liquidated damages, which are not a penalty, equal to $150 for each calendar day of delay beyond the Completion Date.

(ii) Ascertainable costs and damages incurred by the Agency resulting from the failure to complete the work by the Completion Date, including, but not limited to supervision, engineering, inspection, incidental and overhead expenses directly related to the Contract.

(c) Within ten days from the beginning of the event or reason which will prevent the work under this contract from being completed by the Completion Date, the Contractor shall notify the Agency in writing of the cause of delay and shall request an extension of the Completion Date.

(d) Upon receipt from the Contractor of a request for extension of the Completion Date, the Agency shall ascertain the facts and extent of the delay. The Agency may extend the Completion Date if the Agency determines, in its sole judgment, the findings justify an extension and such extension is in the best interest of the Agency. Such an extension will increase the Agency's financial obligations and costs incurred for supervision, engineering, inspection, incidental and overhead expenses directly related to the Contract and which accrue as a result of the extension. If the Agency extends the Completion Date and determines, in its sole judgment, the extension is needed due to unforeseeable causes (which causes include Acts of God, or the public enemy, acts of the Government, acts of another contractor in the performance of another contract with the Agency, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, unusually severe weather, or delays of Subcontractors due to such causes) or is due to causes within the control of the Agency, the fault or negligence of the Agency, then the Contractor shall not be liable for the Agency's damages or costs resulting from such extension. If the Agency extends the Completion Date and determines, in its sole judgment, the extension is needed due to foreseeable causes, causes within the control of the Contractor, the fault or negligence of the Contractor, or weather conditions which are normal for the area and the season, then the Contractor and its Surety shall be liable for an shall reimburse Agency for such costs before the final payment.

(e) The Agency may deduct the liquidated damages and any additional costs and damages for which the Contractor is liable under this Section, from progress payments or from the final payment. The payment of progress payments before and after the Completion Date shall not constitute a waiver of liquidated damages or of additional damages or costs for which the Contractor is liable under this Section. Release of any Bonds shall be contingent upon payment of these amounts.

SECTION 25. ACTS OF GOD

Contractor is not responsible for the cost of repairing or restoring damage to the work exceeding five percent of the contract price and determined to have been proximately caused by earthquakes in excess of the magnitude of 3.5 on the Richter Scale and tidal waves if damaged work is built in accordance with accepted and applicable building standards and the plans and specifications.

SECTION 26. UTILITY RELOCATION

(a) As between the parties, Agency is responsible for the timely removal, relocation or protection of existing main or trunk line underground utility facilities located on the job site, if such utilities are not identified by the Agency in the plans and specifications. As to such unidentified utilities, Contractor shall be compensated for: the costs of relocation; repairing damage not due to the failure of Contractor to exercise reasonable care; removing or relocating such utilities not included in the plans and specifications with reasonable accuracy, and equipment on the project necessarily idled during such work. Contractor shall not be assessed liquidated damages for delay in completion of the project, when the delay is caused by the failure of the Agency or the owner of the utility to remove or relocate the facilities.

(b) The Agency is not required to indicate the presence of existing service laterals or appurtenances when the presence of such utilities on the work site can be inferred from other visible facilities, such as buildings, metering junction boxes, on or adjacent to the work site.

(c) Contractor shall immediately notify the Agency and utility in writing, if the Contractor discovers utility facilities not identified by the Agency in the contract plans or specifications.

SECTION 27. PUBLIC CONVENIENCE

(a) Contractor's operation shall cause no unnecessary public inconvenience. The access rights of the public shall be considered at all times. Unless otherwise authorized, traffic shall be permitted to pass through the work or an approved detour shall be provided. Safe, adequate, continuous and unobstructed pedestrian and vehicular access shall be maintained to fire hydrants, residences, commercial and industrial establishments, churches, schools, parking lots, service stations, motels, fire and police stations, and hospitals, unless other arrangements are made satisfactory to the owners.

(b) Vehicular access to residential driveways shall be maintained to the property line except when necessary construction precludes such access for reasonable periods of time.

(c) Grading operations, roadway excavation and embankment construction shall provide a reasonably satisfactory surface for traffic. When rough grading is completed, the roadbed surface shall be brought to a smooth even condition satisfactory for traffic.

(d) The Contractor shall comply with applicable state and local requirements for closure of streets. Contractor shall provide barriers, guards, lights, signs, temporary bridges, flagmen and watchmen advising the public of detours and construction hazards. Contractor shall comply with additional public safety requirements arising during construction. Contractor shall furnish and install, and upon completion of the work promptly remove, signs and warning devices.

(e) At least forty-eight hours in advance of closing or partial closing or of reopening any street, alley or other public thoroughfare, Contractor shall notify the police, fire, traffic and engineering departments of jurisdictional agencies involved and comply with their requirements.

SECTION 28. EXCAVATIONS

(a) Contractor shall submit for Agency approval, 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 the excavation of trenches five feet or more in depth. The plan shall be at least as effective as that required by the Construction Safety Orders of the California Division of Industrial Safety. If the plan varies from the shoring systems standards established by Safety Orders, the plan shall be prepared by a registered civil or structural engineer.

(b) At the close of each working day, Contractor shall completely backfill open excavation and cover the same with temporary asphalt mix in accordance with normal practice in the industry and the rules, regulations, laws and ordinances of the State of California and the City of Westlake Village.

(c) If the work involves digging trenches of excavations extending deeper than four feet below the surface, the Contractor shall promptly, and before the conditions are disturbed, notify the Agency, in writing, of any: (1) material the Contractor believes hazardous waste, as defined in Section 25117 of the Health and Safety Code, and required to be removed to a Class I, Class II, or Class III disposal site; (2) subsurface or latent physical conditions at the work site differing from those indicated; or (3) unknown physical conditions at the work site of unusual nature, different material from those ordinarily encountered and generally recognized as inherent in the work of the character provided in the contract. The Agency shall promptly investigate the conditions. If the Agency finds the conditions are as alleged by the Contractor and conditions cause a change in the Contractor's cost, or the time required for performance, the Agency shall issue a change order. If a dispute arises whether the Agency's findings are correct, the Contractor shall proceed with the work. The Contractor shall retain rights by contract or law pertaining to resolution disputes and protests between the parties.

(d) Contractor shall comply with underground service alert regulations.

SECTION 29. EXTRA WORK

(a) The Agency may require changes in, additions to, or deductions from the work to be performed or to the materials to be furnished under this contract. No extra work shall be performed or change made except pursuance of a written order from the Agency stating the extra work or change is authorized, and setting forth the basis upon which payment is to be made. No claim for additional compensation shall be valid unless pursuant to such a change order. Nothing in this section shall excuse the Contractor from proceeding with the prosecution of the changed work. When required by the Agency, the Contractor shall furnish an itemized breakdown of the quantities and prices used in computing the value of any ordered change.

(b) Adjustments in the amounts to be paid to the Contractor by reason of any such change, addition or deduction shall be determined by one or more of the following methods:

- By an acceptable lump sum proposal from the Contractor.

- By unit prices contained in the Contractor's original bid and incorporated in the Contract Documents or fixed by subsequent agreement between the Agency and the Contractor.
- By ordering the Contractor to proceed with the work and to furnish daily reports of extra work. The reports shall itemize all costs for labor, material, and equipment rental. The reports for workmen shall include hours worked, rates of pay, names and classification; and for equipment shall include size, type, identification number and hours of operation. Records and reports shall be made immediately available to the engineer upon his request.

(c) When the Agency orders extra work and there is an agreement between the Agency and the Contractor to perform the work, the Agency may approve the method used by the Contractor to accomplish the work. At the request of the Agency, the method to be used shall be memorialized in a writing prior to work being performed.

(d) If the contractor contends a proposed change is a substantial revision in the character of the work, the question shall be immediately submitted to an arbitrator for decision. The arbitrator's decision will be final and conclusive unless it is fraudulent, capricious, arbitrary or so grossly erroneous as to imply bad faith. Each party shall advise the other in advance of the arbitration of the material on which the party intends to rely and give the other a reasonable opportunity to refute or supplement such factual material.

SECTION 30. CLEAN-UP

On completion of the work, Contractor shall remove debris and surplus materials from the work site.

SECTION 31. MATERIALS

(a) Unless otherwise specified, shown, or permitted by the Agency, materials and equipment incorporated in the work shall be new and current manufacture. The Agency may request the Contractor to furnish manufacturer's certificates to this effect.

(b) Materials furnished and work performed shall be subject to inspection and testing by Agency's authorized agents at Agency's expense. If such inspection and testing reveals non-compliance with the requirements of this contract, the Contractor shall bear the cost of necessary corrective measures and the cost of subsequent inspecting and testing.

(c) The inspection of the work shall not relieve the Contractor of the obligations under the contract. Even though equipment, materials, or work required under the contract have been inspected, accepted, and estimated for payment, the Contractor shall replace or repair such equipment, materials, or work found to be defective or otherwise not to comply with the requirements of the contract up to the end of the maintenance and guarantee period.

SECTION 32. PERMITS AND LICENSES

(a) Contractor shall apply for and procure permits and licenses necessary for the work.

(b) Contractor shall give notices necessary and incidental to the due and lawful prosecution of the work and shall comply duly with the terms and conditions of permits and licenses.

(c) Contractor shall pay charges and fees in connection with permits and licenses.

SECTION 33. LAND AND RIGHTS OF WAY

(a) Agency shall provide land and rights-of-way where the work is constructed.

(b) Contractor shall procure additional rights-of-way desired by the Contractor to facilitate construction. Contractor shall enter into written agreements with property owners for such purposes and provide Agency with copies of the agreements.

(c) Except as provided above relating to utility relocation, when the work is to be performed in the vicinity of existing improvements, such improvements shall not be disturbed or damaged except for such removal or relocation in the land and rights-of-way provided by the Agency or unavoidable to accommodate the work.

SECTION 34. PLANS AND WORKING DRAWINGS SUBMITTED BY AGENCY

(a) The approved plans shall be supplemented by working drawings necessary to control the work adequately. Such drawings shall be consistent with the Contract Documents. Such drawings delivered to the Contractor shall be deemed written instructions to the Contractor.

(b) The Agency will furnish to the Contractor copies of drawings and specifications reasonably necessary for the execution of the work. The Contractor shall keep one set of drawings and specifications in good order available to the Agency's representative at the site of the work.

(c) The plans for the work show conditions supposed or believed by the Engineer to exist. It is not intended or inferred the plans constitute a representation such conditions actually exist. The Agency, its officers, agents and employees shall not be liable for loss sustained by the Contractor as a result of variance of the conditions as shown on the plans and the actual conditions revealed during the progress of the work.

SECTION 35. SHOP DRAWINGS SUBMITTED BY CONTRACTOR

(a) Shop drawings are drawings, diagrams, illustrations, schedules, performance charts, brochures and other data prepared by the Contractor or any subcontractor, manufacturer, supplier or distributor, and illustrating some portion of the work.

(b) The Contractor shall review, stamp with approval, and submit for review by the Agency's representative shop drawings for material and equipment to be incorporated into the work. Drawings shall be submitted in quadruplicate to the Agency's representative and be accompanied by a letter of transmittal listing the drawings submitted. Drawings shall show the name of the project, the name of the Contractor, the names of suppliers, manufacturers and subcontractors. Shop drawings shall be submitted with promptness and in orderly sequence to cause no delay in the work.

(c) Shop drawings shall be complete. If the shop drawings show deviations from the requirements of the plans and specifications because of standard shop practices or

other reasons, the deviations and the reasons therefor shall be set forth in the letter of transmittal.

(d) By approving and submitting shop drawings, the Contractor represents material, equipment and other work shown thereon conforms to the plans and specifications except for the deviations set forth in the letter of transmittal.

(e) Within ten calendar days after receipt of the drawings, the Agency will return two prints of the drawings to the Contractor with comments. If noted by the Agency, the Contractor shall correct the drawings and resubmit in the same manner as the original submittal. The Contractor shall direct attention in the letter of transmittal accompanying resubmitted shop drawings to revisions other than the corrections requested by the Agency's representatives on previous submittals.

(f) The review by the Agency's representative is for general conformance with the design concept of the project and general compliance with the plans and specifications and shall not be construed as relieving the Contractor of the full responsibility for: providing materials, equipment, and work required by the Contract; the proper fitting and reconstruction of the work; the accuracy and completeness of the shop drawings; selecting fabrication processes and techniques of construction; and performing the work in a safe manner.

(g) No portion of the work requiring a shop drawing submittal shall be commenced until the submittal has been reviewed by the Agency's representative and returned to the Contractor with a notation indicating re-submittal is not required.

SECTION 36. SUPERVISION BY THE CONTRACTOR

Before starting the work, the Contractor shall designate, in writing, a representative having authority to act for the Contractor. An alternate representative may be designated. (A joint venture shall designate only one representative and alternate.) The representative or alternate shall be present at the work site when work is in progress. Orders or communications given to this representative shall be deemed delivered to the Contractor. In the absence of the Contractor or designated representative, directions or instructions may be given by the Agency's representative to the superintendent or foreman having charge of the specific work to which the order applies. Such order shall be complied with promptly and referred to the Contractor or the representative.

SECTION 37. INSPECTION

(a) The Agency's representative shall have access to the work during construction and shall be furnished with reasonable facility for gaining knowledge of the progress, workmanship and character of materials used and employed in the work.

(b) When the Contractor varies the period during which work is carried on each day, Contractor shall give notice to the Agency's representative so proper inspection may be provided. Work done in the absence of the Agency's representative is subject to rejection.

(c) No materials shall be installed until approved by the Agency's representative. Installations to be backfilled shall be inspected and approved by the Agency's representative prior to backfilling. The Contractor shall give notice in advance of backfilling to the Agency's representative so proper inspection may be provided.

(d) If the Agency's Representative is required to conduct inspections of Contractor's work between the hours of 5 p.m. and 8 a.m., or is required to conduct inspections on Saturdays, Sundays or holidays, then the Agency will incur additional costs for inspection. If the Agency's Representative is required to conduct inspections between the hours of 5 p.m. and 8 a.m., or inspections on Saturdays, Sundays or holidays due to the actions or conduct of Contractor, and if the actions or conduct of Contractor are not otherwise authorized or addressed in the Specifications or in a Change Order, the Contractor shall be liable for the Agency's additional inspection costs. The Agency may deduct these additional inspection costs from progress payments or from the final payment.

SECTION 38. REMOVAL OF DEFECTIVE AND UNAUTHORIZED WORK

(a) Rejected work shall be removed and replaced by the Contractor in an acceptable manner and no compensation will be allowed for such removal or replacement. Work done beyond the lines and grades shown on the plans or established by the Agency's representative, or work done without written authority will be considered as unauthorized and not be paid for. Such work may be ordered removed at the Contractor's expense.

(b) Upon failure on the part of the Contractor to comply promptly with an order of the Agency's representative under this section, the Agency's representative shall have authority to cause defective work to be removed and replaced, and unauthorized work to be removed, and to deduct the costs from monies due the Contractor.

SECTION 39. ERRORS OR DISCREPANCIES NOTED BY CONTRACTOR

(a) If the Contractor finds discrepancy between the specifications and the drawings, and the physical conditions at the site of the work, or finds errors or omissions in the drawings or in any survey, Contractor shall promptly notify the Agency in writing of such discrepancy, error or omission. If the Contractor observes drawings or specifications at variance with applicable law, ordinance, regulation, order or decree, Contractor shall promptly notify the Agency in writing of such conflict.

(b) On receipt of any such notice, the Developer shall promptly investigate the circumstances and give appropriate instructions to the Contractor. Until such instructions are given, work done by the Contractor, after Contractor's discovery of such error, discrepancy or conflict, will be at Contractor's own risk and Contractor shall bear costs arising therefrom.

SECTION 40. EQUIPMENT

The Contractor must furnish adequate equipment and facilities to perform properly the work in a workmanlike manner in accordance with these specifications. Such equipment and facilities must be in a good state of repair and maintained in such state during the progress of the work and shall meet requirements of applicable ordinances and laws. No worn or obsolete equipment shall be used, and in no case shall the maker's rating of capacity for equipment be exceeded.

SECTION 41. STORAGE OF MATERIALS

Materials for use in the work shall be stored by the Contractor to prevent damage from exposure to the elements, admixture of foreign materials or from any other cause. The Contractor is responsible for damage to or loss of materials by weather or other causes.

MISCELLANEOUS

SECTION 42. GUARANTEES

Contractor guarantees work from defect in workmanship for the period of one year from the date of acceptance by the Agency and shall repair and replace such work, together with other displaced work, without expense to the Agency, ordinary wear and tear, usual abuse or neglect excepted. Agency may have the defects repaired and made good at the expense of the Contractor, if Contractor fails to comply with the above-mentioned conditions within a week after being notified in writing.

SECTION 43. RISK OF LOSS PRIOR TO FINAL ACCEPTANCE

Except as set forth above relating to acts of God, risk of loss from total or partial destruction of the work, prior to final acceptance, shall be borne by Contractor regardless of the cause. Contractor shall repair or replace such damages or destroyed work, to its prior undamaged condition before being entitled to additional progress payments or final payment. Total or partial destruction or damage shall not excuse Contractor from completion of the work.

SECTION 44. TERMINATION: CONTRACTOR AT FAULT

(a) The Agency may declare the Contractor in default, should the Contractor fail to meet the requirements of the Contract, or be placed in bankruptcy, or should a receiver be appointed for Contractor's properties, or should Contractor make an assignment for the benefit of creditors. In such event, the Agency will notify the Contractor in writing. On receipt of such written notice, the Contractor shall preserve site construction materials, equipment and plant, and undertake immediate steps to remedy such default.

If the Contractor fails to remedy such default within five calendar days after receipt of such written notice, the Agency may terminate the Contractor's right to proceed with the work as to which default has occurred. Upon receipt of such written notice, the Contractor shall for that work affected by any such termination:

(1) assist the Agency in making an inventory of materials and equipment in storage at the site, en route to the site, in storage or manufacture away from the site, and on order from suppliers;

(2) assign to the Agency, subcontracts, supply contracts and equipment rental agreements all as designated by the Agency; and

(3) remove from the site, all construction materials, equipment and plant listed in said inventory other than such construction materials, equipment and plant which are designated in writing by the Agency to be used by the Agency in completing such work.

(b) The Agency may complete the work to which notice applies by contract or otherwise, and may take possession of the materials, plant, tools, equipment, supplies and property furnished by the Contractor which is designated by the Agency in writing for such purpose.

(c) The expense of completing such work, together with a reasonable charge for administering a contract for such completion, shall be charged to the Contractor. Such expense shall be deducted by the Agency out of such monies as may become due to the Contractor. If this expense exceeds the sum otherwise payable under the Contract, the Contractor and Contractor's sureties shall be liable. Upon written notice from the Agency, the Contractor promptly pays to the Agency, the amount of such excess. The Agency shall not be required to obtain the lowest bids for completing such work, but may make such expenditures as in the Agency's sole judgment will best accomplish such completion.

SECTION 45. TERMINATION: CONTRACTOR NOT AT FAULT

Agency may terminate the contract upon ten days written notice to the Contractor, if Agency finds reasons beyond the control of the parties make it impossible or against the Agency's interests to complete the work. In such a case, the Contractor shall have no claims against the Agency, except for the value of work performed to the date of termination, and the cost of materials and equipment on hand, in transit, or on definite commitment, as of the date of termination if such materials and equipment would be

needed in the work. The value of work performed and the cost of materials and shipment delivered to the site shall be determined by the Agency in accordance with the procedure prescribed for the making of a final estimate and payment.

SECTION 46. RESOLUTION OF CERTAIN CLAIMS

(a) Notwithstanding the foregoing, a demand of $375,000, or less, by the Contractor for a time extension; payment of money or damages arising from the work done by or on behalf of the Contractor pursuant to this contract; or payment of an amount which is disputed by the Agency shall be processed in accordance with Public Contracts Code Sections 20104 *et seq*. relating to informal conferences, non-binding judicially supervised mediation and judicial arbitration.

(b) A single written claim shall be filed under this section prior to the date of final payment for all demands, including demands not subject to Public Contracts Code Sections 20104 et seq. arising out of the contract.

(c) Within thirty (30) days of the receipt of the claim, the Agency may request additional documentation supporting the claim or relating to defenses or claims the Agency may have against the Contractor. If the Amount of the claim is less than $50,000, the contractor shall respond to the request for additional information within fifteen (15) days after receipt of the request. The contractor shall respond to the request within thirty (30) days of receipt if the amount of the claim exceeds $50,000 but is less than $375,000.

(d) Unless further documentation is requested, the Agency shall respond to the claim within forty-five (45) days if the amount of the claim is less than $50,000 or within sixty (60) days if the amount of the claim is more than $50,000 but less than $375,000. If further documentation is requested, the Agency shall respond within the same amount of time taken by the Contractor to respond or fifteen (15) days, whichever is greater, after

receipt of further information if the claim is less than $50,000. If the claim is more than $50,000 but less than $375,000 and further documentation is requested by the Agency, the Agency shall respond within the same amount of time taken by the Contractor to respond or thirty (30) days, whichever is greater.

(e) If the Contractor disputes the Agency's response, or the Agency fails to respond, the Contractor may demand an informal conference to meet and confer for settlement of the issues in dispute. The demand shall be served on the Agency within fifteen (15) days after the deadline of the Agency to respond or within fifteen (15) days of the Agency's response, whichever occurs first. The Agency shall schedule the meet and confer conference within thirty (30) days of the request.

(f) If the meet and confer conference does not produce a satisfactory request, the Contractor may pursue remedies authorized by law.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement, or caused it to be executed as of the day, month and year first above written.

DISTRICT

BY: _____ *DATE:* _____
President

ATTEST: _____
Secretary

APPROVED: _____
Attorney for Owner

CONTRACTOR

BY: _____ *DATE:* _____
Authorized Representative of Contractor

PRINTED NAME: _____

TITLE: _____

SEAL IF CORPORATION:

WORKERS' COMPENSATION CERTIFICATE

I am aware of the provisions of Section 3700 of the Labor Code which requires every employer to be self-insured against liability for workers compensation or to undertake self-insurance in accordance with the provisions of that Code, and I will comply with such provisions before commencing the performance of this contract.

DATED: [_____]

[.....]

[.....]

NOTE: If Contractor is a corporation, the legal name of the corporation shall be set forth above, together with the signature of the officer or officers authorized to sign contracts on behalf of the corporation. If the Contractor is a partnership, the true name of the firm shall be set forth above, together with the signature of the partner or partners authorized to sign contracts on behalf of the co-partnerships. If the Contractor is an individual, the name of the firm shall be set forth together with the signature.

PAYMENT BOND

KNOW ALL MEN BY THESE PRESENTS:

WHEREAS, the Governing Board of Las Virgenes Municipal Water District (herein "Agency"), on _____, awarded to ^[***Name of Principal***] (herein the "Principal"), a contract for the ***1235-Foot Backbone Improvements Project - 5 MG Tank Project.***

WHEREAS, Principal is required to furnish a bond in connection with contract so if Principal or its subcontractors shall fail to pay for materials or supplies, for the performance of the work, or for labor done thereon, or for amounts due under the Unemployment Insurance Act, the Surety on the bond will pay the same.

NOW, THEREFORE, the Principal and _____, (herein "Surety"), are held and firmly bound unto the Agency in the penal sum of [_____ ($_____)] dollars, lawful money of the United States of America, for the payment of which sum well and truly to be made, we bind ourselves, our heirs, executors, administrators, and successors, jointly and severally, firmly by these promises.

THE CONDITION OF THIS OBLIGATION IS SUCH if Principal, its subcontractors, heirs, executors, administrators, successors, or assigns, shall fail to pay for materials, provisions, provender or other supplies or teams used in, upon, for or about the performance of the work contracted to be done, or for work or labor thereon of any kind, or fail to pay the persons named in California Civil Code Section 3181, or amounts due under the Unemployment Insurance Code with respect to work or labor performed under the contract, or for amounts required to be deducted, withheld, and paid over to the Employment Development Department from the wages of employees of the Contractor and subcontractors pursuant to Section 13020 of the Unemployment Insurance Code with respect to such work and labor, and other laws of the Sate of California and rules and regulations of its agencies, then Surety will pay the same in or to an amount not exceeding the amount hereinabove set forth, and also will pay, in case suit is brought upon this bond, such reasonable attorney fees as shall be fixed by the court, pursuant to Section 3181 of the California Civil Code.

This bond shall inure to the benefit of the persons named in Section 3181 of the California Civil Code, so as to give a right of action to them or their assigns in any suit brought upon this bond, such reasonable attorney fees as shall be fixed by the court, pursuant to Section 3181 of the California Civil Code.

No change, extension of time, alteration, or addition to the terms of the contract, or the work to be performed thereunder, or the specifications accompanying the same, shall affect Surety's obligation on this bond. Surety waives notice of such change, extension of time, alteration, or addition to the terms of the contract, or to the work or to the specifications.

IN WITNESS WHEREOF, three identical counterparts of this instrument, each of which shall be deemed an original, have been duly executed by the Principal and Surety above named on the [_____] day of [_____, _____].

[_____]	[_____]
(Principal)	(Surety)
By: _____	By: _____
	(Attorney-in-fact)

PERFORMANCE BOND

KNOW ALL MEN BY THESE PRESENTS:

WHEREAS, the governing board of Las Virgenes Municipal Water District (herein "Agency"), on [_____], awarded to [***Name of Principal***], (herein "Principal"), a contract for ***1235-Foot Backbone Improvements Project - 5 MG Tank Project.***

WHEREAS, Principal is required under the terms of the contract to furnish a bond for the faithful performance of the contract;

NOW, THEREFORE, the Principal and _____, (herein "Surety"), are held firmly bound unto the Agency, (herein "Agency"), in the penal sum of [_____] dollars ($[_____]) lawful money of the United States of America, for the payment of which sum well and truly to be made, we bond ourselves, our heirs, executors, administrators and successors, jointly and severally and firmly by these promises.

THE CONDITION OF THIS OBLIGATION IS SUCH that if the above-bounden Principal, or its heirs, executors, administrators, successors or assigns shall in all things stand to and abide by, and well and truly keep and perform the covenants, conditions, and agreements in the contract, including but not limited to the payment of liquidated damages, and any alteration thereof made as therein provided, on its part to be kept and performed at the time and in the manner therein specified, and in all respects according to their true intent and meaning, and shall indemnify and save harmless the Agency, its officers and agents, as therein stipulated, this obligation shall become null and void; otherwise it shall be and remain in full force and virtue.

Surety stipulates and agrees no change, extension of time, alteration, or addition to the terms of the contract, or to the work to be performed thereunder, or the specifications accompanying the same, shall affect its obligation on this bond. Surety waives notice of such change, extension of time, alteration or addition to the terms of the contract, or to the work or to the specifications.

Surety agrees in case suit is brought on this bond, Surety will pay Agency's reasonable attorney fees to be fixed by the court.

IN WITNESS WHEREOF, three identical counterparts of this instrument, each of which shall be deemed an original, have been duly executed by the Principal and Surety above named, on the [_____] day of [_____, _____].

[_____]	[_____]
(Principal)	(Surety)
By: _____	By: _____
	(Attorney-in-fact)

(Attach Acknowledgment)

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SECTION 007300 SUPPLEMENT TO GENERAL PROVISIONS (CA092205C)

1.01 DEFINITIONS

Whenever the following terms occur in the contract documents, their meaning is as follows:

OWNER	Las Virgenes Metropolitan Water District 4232 Las Virgenes Road Calabasas, CA 91302
GOVERNING BODY	Owner's Board of Directors
ENGINEER	AECOM Technical Services, Inc. and its Subsidiaries 1220 Avenida Acaso Camarillo, CA 93012 (805) 388-3775
SECTIONS 007300 to 019999	The Special Provisions - Part I, Special Conditions. Modifications to general requirements of the specifications.
SECTIONS 020000 to 489999	The Special Provisions - Part II, Construction Details. Numbered section subjects are selected for indexing convenience only and do not indicate division of work among trades or subcontractors.

1.02 TERMS

Command type sentences used in the contract documents refer to and are directed to the Contractor.

1.03 LVMWD STANDARD PLANS AND SPECIFICATIONS

Unless otherwise noted in the contract documents, all work and material shall conform to the requirements of the "LVMWD Standard Plans and Specifications for the Construction of Water Main Facilities."

1.04 ACCESS OF OWNER'S REPRESENTATIVE'S PERSONNEL TO CONFINED SPACES IN STRUCTURES UNDER CONSTRUCTION

A. The Contractor shall provide the following assistance to the personnel of the Owner's Representative when said personnel must enter confined spaces in structures under construction or structures which have not been accepted by the Owner.

1. Training program for the Owner's Representative's personnel relevant to the specific structures being entered.

2. Testing equipment and personnel to operate said equipment for testing the atmosphere in the confined spaces for oxygen deficiency, explosive gases, and toxic gases.
3. Authorized competent person to stand by each confined space while entrants are inside the space.
4. Safety equipment (breathing apparatus, harnesses, and rescue equipment) in good working order.
5. Communication equipment.
6. Access equipment (hoists and ladders).
7. Signs.
8. Alarm system.
9. Ventilation system.

B. The Contractor shall identify confined spaces on the project, mark them with warning signs per OSHA requirements, and notify the Owner's Representative that these structures now exist.

1.05 EXISTING CONDITIONS AND EXAMINATION OF CONTRACT DOCUMENTS

The bidder represents that he has carefully examined the contract documents and the site where the work is to be performed and that he has familiarized himself with all local conditions and federal, state and local laws, ordinances, rules, and regulations that may affect in any manner the performance of the work. The bidder further represents that he has studied all surveys and investigation reports about subsurface and latent physical conditions pertaining to the jobsite, that he has performed such additional surveys and investigations as he deems necessary to complete the work at his bid price, and that he has correlated the results of all such data with the requirements of the contract documents. The submittal of a bid shall be conclusive evidence that the bidder has investigated and is satisfied as to the conditions to be encountered, including locality, uncertainty of weather and all other contingencies, and as to the character, quality, quantities, and scope of the work.

The plans and specifications for the work show subsurface conditions or otherwise hidden conditions as they are supposed or believed by the Engineer/Architect to exist; but it is not intended or to be inferred that the conditions as shown thereon constitute a representation that such conditions are actually existent. Except as otherwise specifically provided in the contract documents, the Owner, the Engineer/Architect, and their consultants shall not be liable for any loss sustained by the Contractor as a result of any variance of such conditions as shown on the plans and the actual conditions revealed during the progress of the work or otherwise.

Where the Owner or the Engineer/Architect or their consultants have made investigations of subsurface conditions in areas where the work is to be performed, such investigations were made only for the purpose of study and design. The conditions indicated by such investigations apply only at the specific location of each boring or excavation at the time

the borings or excavations were made. Where such investigations have been made, bidders or Contractors may inspect the records as to such investigations subject to and upon the conditions hereinafter set forth. The inspection of the records shall be made at the office of the Engineer/Architect.

The records of such investigations are not a part of the contract and are shown solely for the convenience of the bidder or Contractor. It is expressly understood and agreed that the Owner, the Engineer/Architect, and their consultants assume no responsibility whatsoever in respect to the sufficiency or accuracy of the investigations; the records thereof; or of the interpretations set forth therein or made by the Owner's consultants, the Engineer/Architect or his consultants in the use thereof by the Engineer/Architect, and there is no warranty or guarantee, either express or implied, that the conditions indicated by such investigations or records thereof are representative of those existing throughout such areas, or any part thereof, or that unlooked-for developments may not occur, or that materials other than, or in proportions, densities, or other characteristics different from, those indicated may not be encountered.

When a log of test borings showing a record of the data obtained by the investigation of subsurface conditions by the Owner, the Engineer/Architect, or their consultants is included with the plans or other documents, it is expressly understood and agreed that said log of test borings does not constitute a part of the contract, represents only the opinion of the Owner or the Engineer/Architect or their consultants as to the character of the materials encountered by them in the test borings, is included in the plans or other documents only for the convenience of bidders, and its use is subject to all of the conditions and limitations set forth in this article.

The availability or use of information described in this article is not to be construed in any way as a waiver of the provisions of the first paragraph in this article and a bidder or Contractor is cautioned to make such independent investigations and examination as he deems necessary to satisfy himself as to conditions to be encountered in the performance of the work.

No information derived from such inspection of records of investigations or compilation thereof made by the Owner, the Engineer/Architect, or their consultants will in any way relieve the bidder or Contractor from any risk or from properly fulfilling the terms of the contract nor entitle the Contractor to any additional compensation.

1.06 SUPERVISION AND SUPERINTENDENCE

The Contractor shall supervise and direct the work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the work in accordance with the contract documents. The Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction, but the Contractor shall not be solely responsible for the negligence of others in the design or selection of a specific means, method, technique, sequence, or procedure of construction which is indicated in and required by the contract documents.

The Contractor shall be responsible to see that the completed work complies with the contract documents.

The Contractor shall designate and keep on the work at all times during its progress a competent superintendent who shall not be replaced without written notice to the Owner's Representative. The superintendent will be the Contractor's representative at the site and shall have authority to act on behalf of the Contractor. All communications given to the superintendent shall be as binding as if given to the Contractor. During periods when the work is suspended, the Contractor shall make appropriate arrangements for any emergency work which may be required.

Whenever the superintendent is not present on any particular part of the work where the Owner's Representative may desire to inform the Contractor relative to interpretation of the plans and specifications or to disapproval or rejection of materials or work performed, the Owner's Representative may so inform the foreman or other worker in charge of the particular part of the work in reference to which the information is given. Information so given shall be as binding as if given to the superintendent.

1.07 UTILITIES

The Engineer/Architect has endeavored to determine the existence of utilities at the site of the work from the records of the owners of known utilities in the vicinity of the work. The positions of these utilities as derived from such records are shown on the plans. The service connections to these utilities may not be shown on the plans.

The Contractor shall make his own investigations, including exploratory excavations, to determine the locations and type of existing service laterals or appurtenances when their presence can be inferred from the presence of other visible facilities, such as buildings, meter and junction boxes, on or adjacent to the site of the work. If the Contractor discovers utility facilities not identified in the plans or specifications or in a position different from that shown in the plans and specifications, he shall immediately notify in writing the Owner's Representative and the owner of the utility facility.

1.08 SAFETY

In accordance with generally accepted construction practices, the Contractor shall be solely and completely responsible for conditions of the jobsite, including safety of all persons and property during performance of the work, and the Contractor shall fully comply with all state, federal and other laws, rules, regulations, and orders relating to safety of the public and workers.

The right of the Engineer/Architect or the Owner's Representative to conduct construction review or observation of the Contractor's performance will not include review or observation of the adequacy of the Contractor's safety measures in, on, or near the construction site.

1.09 PERSONAL LIABILITY

No director, officer, employee, or agent of the Owner, the Engineer/Architect, the Owner's Representative, or their consultants shall be personally responsible for any liability arising under or by virtue of the contract.

1.10 INDEMNITY

The indemnification provided by the Contractor to the District under Section 21 of the General Provisions shall apply as well to the Engineer/Architect, the Owner's Representative, and their consultants, directors, officers, agents, and directors.

1.11 CONTRACTOR'S INSURANCE

A. General: The Contractor shall not commence or continue to perform any work unless he, at his own expense, has in full force and effect all required insurance. The Contractor shall not permit any subcontractor to perform work on this project unless the Worker's Compensation Insurance requirements have been complied with by such subcontractor.

The types of insurance the Contractor shall obtain and maintain are Worker's Compensation Insurance and Employer's Liability Insurance, Liability Insurance, Builders' Risk "All Risk" Insurance and, if so determined by the Owner at the time of award of the contract, Earthquake and Tidal Wave Insurance, all as set forth herein.

Worker's Compensation Insurance and Employer's Liability Insurance and Liability Insurance shall be maintained in effect for the full guarantee period.

B. Worker's Compensation Insurance And Employer's Liability Insurance: The Contractor shall provide employer's liability insurance in the amount of at least one million dollars ($1,000,000) per accident for bodily injury and disease. Upon execution of the Agreement, the Contractor shall provide a certificate(s) of insurance certifying that he has obtained full Worker's Compensation Insurance coverage. At the same time, the Contractor shall provide the insurance endorsement(s) on the forms provided as part of the contract documents. This insurance shall be in strict accordance with the requirements of the most current and applicable state Worker's Compensation Insurance laws.

C. Liability Insurance: Upon execution of the Agreement, the Contractor shall provide a certificate(s) of insurance showing that he has Liability Insurance coverage.

Included in such insurance shall be contractual coverage sufficiently broad to insure the matters set forth in the article entitled INDEMNITY except those matters set forth in the third paragraph thereof.

The Liability Insurance coverage shall include each of the following types of insurance:

1. General Liability: One million dollars ($1,000,000) per occurrence for bodily injury and property damage. If Commercial General Liability Insurance or other form with a general aggregate limit or products-completed operations aggregate limit is used, either the general aggregate limit shall apply separately to the project/location (with ISO CG 2503, or ISO CG 2504, or insurer's equivalent endorsement provided to the District) or the general aggregate limit and products-completed operations aggregate limit shall be twice the required occurrence limit.

2. Automobile Liability: One million ($1,000,000) per occurrence for bodily injury and property damage each accident limit.

D. The Liability Insurance shall include as additional insureds: the Owner, the Engineer, the Owner's Representative, and their consultants, and each of their directors, officers, agents, and employees. The insurance afforded to these additional insureds shall be primary insurance. If the additional insureds have other insurance which might be applicable to any loss, the amount of the insurance provided under this article on LIABILITY INSURANCE shall not be reduced or prorated by the existence of such other insurance.

E. Builders' Risk "All Risk" Insurance: Upon execution of the Agreement certificate(s) of insurance showing that he has obtained for the period of the contract Builders' Risk "All Risk" completed value insurance coverage (including flood but excluding earthquake and tidal wave) upon the entire project which is the subject of the contract and including completed work and work in progress. The Contractor shall provide Builder’s Risk Insurance (or Installation Floater) at 100% of the contract price. At the same time, the Contractor shall provide the insurance endorsement(s) on the forms provided as a part of the contract documents. Such insurance shall include as additional insureds: the Owner, the Engineer/Architect, the Owner's Representative, and their consultants, and each of their directors, officers, employees, and agents.

F. Contractor's Liability Not Limited By Insurance: Nothing contained in these insurance requirements is to be construed as limiting the liability of the Contractor or the Contractor's sureties.

1.12 LABOR CODE PERMITS

Per Section 6500 of the State of California Labor Code, the contractor shall obtain permits for:

A. Construction of trenches or excavations which are five feet or deeper and into which a person is required to descend.

B. The construction of any building, structure, falsework, or scaffolding more than three stories high or the equivalent height.

C. The demolition of any building, structure, falsework, or scaffold more than three stories high or the equivalent height.

D. The underground use of diesel engines in work in mines and tunnels.

1.13 USE OF EQUIVALENT PRODUCTS

Where specific brand names or models have been cited in the specifications, the use of equivalent quality products will be acceptable, unless the specified product is required to match other products in use on the same project, or unless the specified product is unique or novel and its use serves the public interest. The contractor shall have 35 days after award of the contract for submission of data substantiating a request for a substitution of “an equal” item.

1.14 SCHEDULE OF VALUES

A. For use in preparing estimates of completed work on which to base claims for partial payments, the Contractor under each schedule of work in the Bid Schedule shall prepare

an itemized breakdown of the contract price indicating quantities and unit prices for the various elements of the work.

B. The breakdown shall be a true representation of the contract price for work covered by the specifications and drawings and shall be subject to review by the Owner's Representative. An unbalanced breakdown will not be acceptable.

C. Values assigned to the price breakdown will be used only as a basis for partial payments and not as a basis for additions to or deductions from the contract price.

D. The Schedule of Values breakdown shall be submitted within two weeks of the Notice to Proceed, in conformance with Section 013300.

E. The itemized breakdown shall be in sufficient detail and based on measurable units that can be verified by the Owner's field representative.

1.15 PRECONSTRUCTION CONFERENCE: DESIGNATION OF AUTHORIZED REPRESENTATIVES

A. Before any work at the site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the work and to discuss the project schedule, schedule of values, submittal schedule, procedures for handling shop drawings and other submittals, processing Applications for Payment, and maintaining required records.

B. At this conference Owner and Contractor shall each designate, in writing, specific individuals to act as their respective representatives with respect to the services and responsibilities of each party under the Contract. Such individuals shall have the authority to transmit instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

C. Prepare and submit project schedule and schedule of values breakdown within two weeks following the Notice to Proceed, as specified. These schedules along with a list/schedule of planned submittals and a two-week look ahead for initial construction preparation, investigations, surveys and other project activities shall be brought to the conference.

1.16 PROGRESS PAYMENTS

A. Progress payment requests shall be submitted as noted in the Agreement. Progress payments shall include quantity take-offs for work completed to date. The list of quantities shall conform to the format of the Schedule of Values. Each quantity take-off shall be confirmed by the Owner's field representative.

Items of the Bid Schedule will not be paid for in part under progress payments unless anapproved breakdown is included and approved in the Schedule of Values and the quantity of work completed is confirmed by the Owner's field representative.

END OF SECTION

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LAS VIRGENES MUNICIPAL WATER DISTRICT

1235-Foot Backbone Improvements Project

5 MG Tank

SPECIFICATIONS

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SECTION 011100 COORDINATION OF WORK, PERMITS, AND REGULATIONS

1.01 DESCRIPTION

This section generally describes the project and includes work sequence and schedule, Contractor's use of premises, construction survey staking, permits, and regulations.

1.02 GENERAL NATURE OF WORK

The work involves construction of a 5-million-gallon, above-grade, pre-stressed concrete reservoir and two 36-inch diameter, 1,300-foot long steel inlet and outlet pipelines.

1.03 LOCATION OF PROJECT SITE

The project site is located in the City of Westlake Village, CA. The tank site is approximately 1,000 feet south of the Westlake Filtration Plant. The address for the Westlake Filtration Plant is: 32601 Torchwood Place, Westlake Village, CA 91361. The pipeline extends from the Westlake Filtration Plant, crosses over the Las Virgenes Reservoir dam, and connects with the new tank.

1.04 WORK SEQUENCE AND SCHEDULE

The work hours are 7 am to 4 pm, Monday through Friday, with no work on weekends or holidays without prior written approval of Owner. See Blasting Specification for hours applicable to blasting. Any inspection and testing costs incurred, by the Owner, made necessary by Contractor working outside of the hours noted above shall be deducted from the Contractor’s invoices.

1.05 CONTRACT SCHEDULE

After notification of award and before starting work, the Contractor will submit a Contract Schedule.

1.06 CONTENT OF CONTRACT SCHEDULE

The Contract Schedule, and subsequent updated Contract Schedules, will meet the following requirements:

1. Schedules must be suitable for monitoring progress of the Work.
2. Schedules must provide necessary data about the time for the Engineer’s decisions.
3. Schedules must represent a practical plan to complete the Work within the Contract Time.
4. Schedules must show the critical path method for completing the Work.
5. Schedule must be completed using Microsoft Project or Primavera version P6.

1.07 SHUTDOWNS

The Contract Schedule shall show shutdown times and durations of Westlake Filtration Plant and for the local on site water service required for connections and other work requiring shutdowns of service. See shutdown requirements later in this section.

1.08 EFFECT OF CONTRACT SCHEDULE

The Contract Schedule, and any updated Contract Schedules, will represent a practical plan to complete the Work within the Contract Time. At a minimum, monthly updates to the Schedule shall be provided to the Owners Representative. Extension of any schedule beyond the Contract Time will not be acceptable. Schedules showing the Work completed in less than the Contract may be acceptable if judged by the Engineer to be practical. Acceptance of such a schedule by the Engineer will not change the Contract Time. The Contract Time, not the Contract Schedule, will control in determining liquidated damages payable by the Contractor and in determining any delay.

If a schedule showing the Work completed in less than the Contract Time is accepted, the Contractor will not be entitled to extensions of the Contract Time for Excusable Delays or Compensable Delays until such delays extend the completion of the Work beyond the expiration of the Contract Time.

The Contractor will plan, develop, supervise, control, and coordinate the performance of the Work so that its progress and the sequence and timing of Work activities conform to the current accepted Contract Schedule. The Contractor will continuously obtain from Subcontractors information and data about the planning for and progress of the Work and the delivery equipment, will coordinate and integrate such information and data into updated Contract Schedules, and will monitor the progress of the Work and the delivery of equipment. The Contractor will act as the expeditor of potential and actual delays, interruptions, hindrances, or disruptions for its own forces and those forces of Subcontractors. The Contractor will cooperate with the Engineer in developing the Contract Schedule and updated Contract Schedules.

The Engineer’s review and comments about any schedule or scheduling data will not relieve the Contractor from its sole responsibility to plan for, perform, and complete the Work within the Contract Time. Review and comments about any schedule will not transfer responsibility for any schedule to the Engineer or the District nor imply their agreement with (1) any assumption upon which such schedule is based or (2) any matter underlying or contained in such schedule.

The Engineer’s failure to discover errors or omissions in schedules that have been reviewed, or to inform the Contractor that the Contractor, Subcontractors, or others are behind schedule, or to direct or enforce procedures for complying with the Contract Schedule will not relieve the Contractor from its sole responsibility to perform and complete the Work within the Contract Time and will not be a cause for an adjustment of the Contract Time or the Contract Sum.

The Contractor will perform the Work in accordance with the currently accepted Contract Schedule.

1.09 CONSTRUCTION SURVEY STAKING

See Section 015100.

1.10 PERMITS

A. The following applications and/or permits for permanent and temporary work have been or are being obtained by the Owner:

1. California Department of Water Resources Division of Safety of Dams (DSOD) – requirements have been included in the contract documents. See letter of approval in Appendix D.

2. California Department of Public Health – requirements have been included in the contract documents.

3. California Regional Water Quality Control Board (CRWQCB) – the Owner will file a Notice of Intent (NOI) and coordinate with the CRWQCB for the work to be under the General Construction Permit with support of the Contractor.

4. County of Los Angeles – Grading Permit (Exemption).

5. City of Westlake Village – Encroachment Permit (Exemption).

6. City of Westlake Village – Oak Tree Permit will be obtained by the Owner. The Contractor shall follow guidelines outlined in the permit. See permit in Appendix C.

B. Obtain and pay all fees for the following permits:

1. Las Virgenes Municipal Water District – Blasting Permit. Refer to Specifications Section 312310 for requirements. The permit with the Owner for blasting does not waive the Contractor's obligations for permits, licenses and notices to be filed with other agencies with jurisdiction, including:

a. Los Angeles County Sheriff's Department

b. Fire District

c. Local Fire Department

d. USA Dig Alert

e. Cal OSHA Division of Industrial Safety

f. U. S. Department of Transportation

g. U. S. Transportation Security Administration

2. Cal OSHA – Various worker safety permits such as trenching, cranes and scaffolding.

3. CRWQCB - General Construction Permit (NPDES Permit). The Contractor will prepare and submit the SWPPP to the Owner, including Best Management Practices in construction activities, monitoring runoff and other storm water control measures. See Specifications Sections 015721 and 015723 for requirements.

4. Contractor shall pay for and obtain other permits as required by governmental and utility agencies with jurisdiction as needed to complete the project.

C. Contact the permitting agencies listed below for current fees and requirements associated with required permits.

Name or Type of Permit	Name, Address, Telephone Number of Permitting Agency
CAL/OSHA Form 750 Scaffolding and Trenching Single Project Permit; Overhead Crane Certification	Los Angeles County 320 West 4th Street, Suite 850 Los Angeles, CA 90013 (213) 576-7451
South Coast Air Quality Management District (SCAQMD) – Permits for paint spray booths, bus vacuum equipment, parts cleaners, emergency generators, abrasive blasting systems, underground storage tanks for waste oil, underground storage tanks and dispensers for gasoline, diesel, engine oil, and automatic transmission fluid	South Coast AQMD P.O. Box 4944 21865 E. Copley Dr. Diamond Bar, CA 91765 (909) 396-2208
NPDES dewatering and discharge permit for discharging water for pressure testing, leakage testing, and disinfection outside the Westlake Reservoir drainage area	Los Angeles Regional Water Quality Control Board 320 West 4th Street, Suite 200 Los Angeles, CA 90013 (213) 576-6600
State Water Resources Control Board (SWRCB) – Construction Activities Storm Water General Permit (99-08-DWQ) (SWPPP)	State Water Resources Control Board Sacramento, CA (916) 341-5536
Las Virgenes Municipal Water District – Blasting Permit	4232 Las Virgenes Road Calabasas, CA 91302 (818) 251-2163
Construction Water for water obtained from Client-owned fire hydrants	4232 Las Virgenes Road Calabasas, CA 91302 (818) 251-2255

D. The permits contain requirements that affect the cost of project work and some permanent permits require supplementary work permits and fees to execute construction. Comply with the permit requirements and obtain and pay the fees involved with the supplementary work permits.

1.11 LICENSES

The prime contractor and subcontractors shall obtain and pay for a City of Westlake Village Business License. Detailed information concerning business license may be obtained from the City at (818) 706-1613.

1.12 CULTURAL RESOURCES

A. A California State-certified archaeologist, qualified paleontogist and Native American representative may be retained by and paid by the Owner to attend pre-grade meetings and to monitor earthmoving activities, including excavation and trenching at the site. The archaeologist shall carefully inspect this area to assess the potential for significant prehistoric or historic remains. If a site is uncovered, then a subsurface evaluation may be needed to assess the resource. Further subsurface investigation may be needed if the site is determined unique or important for its prehistoric information.

B. During construction activities, the archaeologist shall have the authority to temporarily divert or direct earthmoving to allow time to evaluate any exposed prehistoric or historic material. In accordance with Public Resources Code 5097.94, if human remains are found, the County coroner must be notified within 24 hours of the discovery. If the coroner determines that the remains are not recent, the coroner will notify the Native American Heritage Commission in Sacramento to determine the most likely descendent for the area. The designated Native American representative shall then determine in consultation with the property owner the disposition of the human remains.

1.13 SOILS INVESTIGATION

AECOM has arranged for the preparation of geotechnical studies of the project site prepared by Fugro West, Inc., and Revey Consulting. Information from these investigations are available for review by the Contractor at Las Virgenes Municipal Water District Headquarters.

The information provided is for the convenience of the bidders and/or Contractors and the information and data provided is not implied or warranted to represent present day conditions. All conclusions and deductions derived from said report shall be those of the bidder or Contractor. The bidders and/or Contractors are solely responsible for determining the existing soils and subsurface conditions and all conclusions and deductions shall be included in the contract bid amounts.

The report notes volcanic bedrock materials of the Conejo Volcanics Formation which presented significant difficulty in backhoe excavation. If the bidders or Contractor plans or conducts the use of blasting methods, such work shall be conducted by a pre-qualified Blasting Contractor and in accordance with Section 312310 and other requirements of the Plans and Specifications.

1.14 MITIGATED MEASURES

A. Las Virgenes Municipal Water District prepared an Initial Study and Mitigated Negative Declaration (MND) in October 2009, titled "LVMWD Report No. 2433.10, LVMWD Backbone System Improvement Project." The Contractor shall conform his construction activities to comply with the applicable mitigated measures noted in the MND. Certain activities will be the Owner's lead responsibility, but the Contractor shall provide access, safety measures and other accommodations, as needed, for the Owner's observers, representatives and staff involved in mitigated measures. The full MND is available from the District. See Notice Inviting Sealed Proposals for contact information.

B. The MND includes a Mitigation Monitoring and Reporting Program Checklist which is attached to these Specifications as Appendix B. The following table parallels the checklist and notes Contractor obligations for the various measures primarily designated for monitoring "During Construction" and includes blasting and traffic control plan measures. The Contractor's obligations for these measures are listed below.

1. Comply with Contract Documents. The design addresses this measure.
2. Construction activities shall comply with this measure.
3. The Owner has lead responsibility for this measure. Accommodate Owner's staff and representatives.

Mitigative Measure	**Contractor's Oligation**
Aes-1	1
Aes-2	1
Aes-3	1
Air-1	2
Air-2	2
Air-3	2
Cul-2	3
Cul-3	3
Cul-4	2
Cul-5	2
Cul-7	2
Noi-1	2
Noi-2	2
Noi-3	1
Noi-4	2
Noi-5	2
Noi-6	2
Noi-7	2
Noi-8	2
Noi-9	1
Tran-1	1

1.15 CONNECTION FEES

Pay for utility connection fees and assessment fees including electrical, water, gas, sewer, storm drain, and telephone. See Construction Facilities and Temporary Controls Section 015100 for construction water and utility requirements.

1.16 WORK ACROSS SADDLE DAM

Pipe Supports: Install pipe supports when the open water reservoir water surface is below elevation 1041. Coordinate schedule with Owner. Installation of the pipe supports may require dewatering. The open water reservoir elevations fluctuate over time with the peak water surface elevation = 1048.00. Alternate means of installation during period where the water surface is higher than 1041.00 will be considered by the Owner but also require approval from the State Division of Dam Safety. Lake water surface elevations are below elevation 1041.00 in September to October.

1.17 SHUTDOWNS

A. Only LVMWD personnel will be allowed to shutdown the existing piping when shutdowns are necessary. The Contractor shall notify the Owner in writing two weeks prior to needing a shutdown of the existing water main. Every effort will be made to accommodate the Contractor's desired date; however, the date of the shutdown will be subject to approval of the Owner to assure coordination with receiving water deliveries. If the shutdown is not practical on the requested dates, thus delaying the Contractor's work, no extra compensation under the contract will be due the Contractor as a result of such delay. Shutdowns are limited to a period of 6 hours.

B. Connections at the Westlake Filtration Plant (WFP) shall be made when the plant is offline. The plans is online from March 31st to October 1st.

C. The following timeframes outline shutdown periods where work on the existing potable water system can be performed:

1. 6" Potable Water Relocation (sheet C-08). This relocation is required for installation of the 36" inlet pipeline. The relocation shall occur while the WFP is offline. Other means of performing this work such as a hot top will be considered by the Owner.
2. 8" Potable Water Connection (Sheet C-08). This connection shall occur while the WFP is offline.
3. 30" Raw Water Relocation (Sheet C-08). This relocation to lower the existing 30" raw waterline shall occur while the WFP is offline.
4. Removal of 30" Filtered Water pipeline (Sheet C-08). This connection shall occur while the WFP is offline.
5. 30" Outlet Connection to Existing Pipeline from 5 MG Tank (Sheet C-08). This connection shall occur while the WFP is offline.
6. Filling of the 5 MG tank will be through the proposed 8" potable waterline connection as shown on Sheet C-08. Provide backflow protection when filling and

testing the 5 MG tank.

1.18 GROUNDWATER AND SURFACE WATER

A. Groundwater and surface water may be present in the vicinity of the work. Bidders and the Contractor shall determine through their own efforts, the extent of such items and must assume all responsibility for deductions and conclusions as to the effect such items will have upon the work.

B. Contractor shall be responsible for controlling all surface and subsurface water at stream crossings or other areas where such water is encountered. All trenches and excavations shall be dewatered to maintain a water level below the level of the trench bottom. All costs of dewatering, ditching, sheeting, flume construction or other measures required to satisfactorily complete the work shall be included in the bid items listed in the Bid Schedule.

C. See Section 312300 for dewatering requirements during excavation and grading operations.

1.19 TEMPORARY SEALING OF PIPE OPENINGS ON EXISTING PIPELINES

Required openings on the existing 6” or 8” water service lines, raw water, or filtered water pipelines shall be sealed during periods of inactivity to prevent the entrance of contaminants such as groundwater, dirt, debris, small animals, etc. Failure to seal said openings to the satisfaction of the Owner, shall be cause for requiring the Contractor, at his expense, to flush and disinfect the entire lengths of said existing pipelines that are suspected of being contaminated.

1.20 SCADA INTEGRATION

Section 405000 – Process Control and Instrumentation System (PCIS) General Requirements defines the Owner’s role for integrating the controls into their existing system. Refer to MSO Drawings in Appendix A as required in Section 405000 for providing the instrument control panel.

END OF SECTION

SECTION 012000 MEASUREMENT AND PAYMENT

1.01 WORK LISTED IN THE SCHEDULE OF WORK ITEMS

A. Work under this contract will be paid on a unit price or lump-sum basis as outlined on the Bid Form for the quantity of work installed.

B. The unit prices and lump-sum prices include full compensation for furnishing the labor, materials, tools, and equipment and doing all the work involved to complete the work included in the contract documents.

C. The application for payment will be for a specific item based on the percentage completed or quantity installed. The percentage complete will be based on the value of the partially completed work relative to the value of the item when entirely completed and ready for service.

1.02 WORK NOT LISTED IN THE SCHEDULE OF WORK ITEMS

A. The Agreement and items in the Supplement to General Provisions, general requirements, and specifications which are not listed in the schedule of work as items of the Bid Schedule are, in general, applicable to more than one listed work item, and no separate work item is provided therefor. Include the cost of work not listed but necessary to complete the project designated in the contract documents in the various listed work items of the Bid Schedule.

B. The bids for the work are intended to establish a total cost for the work in its entirety. Should the Contractor feel that the cost for the work has not been established by specific items in the Bid Schedule, include the cost for that work in some related bid item so that the Proposal for the project reflects the total cost for completing the work in its entirety.

1.03 MOBILIZATION, INCLUDING SCHEDULE, BONDS AND INSURANCE (ITEM 1)

Payment for mobilization including schedule, bonds and insurance shall be made at the time of the first progress payment after the Contractor has purchased bonds and insurance and has submitted a detailed construction schedule in Microsoft Project or Primavera Version P6 or greater and schedule of values.

1.04 SHEETING, SHORING, AND BRACING (ITEM 2)

Sheeting and shoring for worker protection will be paid as a separate item on a lump sum basis. Payment will include the cost to prepare plans, obtain permits, install, operate, maintain and remove the system. Payment shall be made proportional to work involving sheeting and shoring.

1.05 SWPPP PREPARATION AND IMPLEMENTATION (ITEM 3)

Payment for preparing, submitting and implementing the SWPPP in conformance with the MS-4 permit for Los Angeles County, including Best Management Practices in construction activities, monitoring runoff and other storm water control measures shall be made at the contract lump-sum bid price and shall be invoiced equally throughout the length of the contract.

1.06 ROCK EXCAVATION AT TANK SITE (ITEM 4)

Excavation, including excavation operations and monitoring, to establish the subgrade of the new 5 million gallon tank will be paid at the applicable unit price named in the Bid Form. Quantities of excavation for the tank will be measured by surveys provided by the Owner. Contractor shall provide a minimum 5-day notice to the Owner for coordinating quantity surveys 1) upon completion of clearing and grubbing to the depths of the lines and grades shown on the plans and 2) upon completion of excavation work at the tank site. Provide 4 working days following each notice for the Owner's survey work; provide site access for the Owner's surveyor during these periods; and allow an additional 4 days for quantities to be calculated and submitted for the Contractor to include in his payment request. Excavations in excess of that shown on the plans shall not be paid for unless pre-approved by the Owner in writing. If the Contractor chooses to verify or dispute the Owner's quantities, he can provide survey information in electronic CAD format from a surveyor with a valid California Surveyor's License. Such information to verify or dispute quantities for excavation shall be accompanied with spreadsheet calculations such that the Owner can resolve the quantities for payment. Payments for partial completion of excavation shall be based on quantity estimates as approved by the Owner's observer. Payment shall include all labor, equipment, and materials for clearing and grubbing, excavation, removal and disposal of deleterious or un-useable materials, temporary storage and movement of materials and other work incidental to excavation. Trenching, including excavation for pipelines and pipe supports shall be paid under separate bid items.

MONITORING FOR BLASTING (TANK AND PIPELINE)(ITEM 4A)

Monitoring for blasting (Tank and Pipeline) will be paid at the applicable unit price named in the Bid Form and shall include all labor, equipment, materials to perform the monitoring per the specifications. The unit price payment structure will be per individual residential unit where monitoring is performed per the Contact Documents. No additional payment for monitoring of the west saddle dam and Westlake Filtration Plant will be made. Payment includes but is not limited to the following; performing pre and post blast structure condition surveys, inspections and monitoring, providing written notifications, photo and video documentation, coordination with residents and project owner, installation, maintaining and monitoring of equipment and files, preparing and submitting daily reports to the owners representative and performing the inspections at the locations identified in the Contract Documents.

1.07 FILL AT TANK SITE (ITEM 5)

Fill at Tank Site shall include the placement of, moisture control, and compaction to the lines and grades shown on the plans. To the extent that there is excess material to be disposed, it shall be legally disposed of and included in the lump sum price for Item 5 “Fill at Tank Site.” Fill at Tank Site shall be paid for on a lump sum basis. Fill at Tank Site shall include approved soil free of unsuitable material, labor, equipment, and other work necessary to place material to the lines and grades shown on the plans. Fill in excess to the lines and grades shown on the plans or otherwise directed by the Construction Manager in writing shall not be measured for payment.

1.08 5 MG TANK (ITEM 6)

5.0 MG Prestressed Concrete Tank shall be paid on a lump sum basis and shall include labor, equipment, design of the tank, materials, tank concrete and reinforcing, slurry fill under tank, ladders, vents, hatches, valves, piping, handrails, downspouts, formwork, sealing, coating, painting, disinfection, sampling pipeline, leak detection system, testing, subgrade work, filter material, and appurtenances necessary to install tank as shown in the drawings.

1.09 TANK BAFFLING (ITEM 7)

Tank Baffling shall be paid on a lump sum basis and shall include labor, equipment, materials, fitting, baffling, concrete curbs, fittings and appurtenances necessary to install the tank baffling as shown in the drawings.

1.10 INLET/OUTLET VALVE VAULT (VAULT, VALVES, EXPANSION JOINTS, HATCHES) (ITEM 8)

Inlet/Outlet Valve Vault (Vault, valves, Expansion Joints, Hatches) shall be paid on a lump sum basis and shall include labor, vault excavation, backfill, equipment, materials, fittings, and appurtenances necessary to install the Inlet/Outlet Valve Vault and appurtenances as shown in the drawings.

1.11 36” STEEL PIPELINES (ITEM 9)

This item shall be paid on a lump sum basis. The price for this item shall include full compensation for furnishing the inlet and outlet pipes, potholing, pipeline excavation, export of excess materials, monitoring, sawcuts, pavement removal and restoration, pipe zone material, pipe base material, street zone base material, testing, disinfection, labor, equipment, materials, valves, couplings, and all appurtenances, including pipe in the vault, necessary to install the pipe as shown in the drawings.

1.12 42” STEEL CASING (INCLUDING PIPE SUPPORTS AND HEADWALLS) (ITEM 10)

This item shall be measured for payment on a lump sum basis. The price for this item shall include full compensation for furnishing the inlet and outlet, casing, coating,

spacers, pipe supports, headwalls, excavation, backfill, labor, equipment, materials and appurtenances necessary to install the Casing, Supports, and Headwalls as shown in the drawings.

1.13 ADDITIONAL TRENCH EXCAVATION (INLET/OUTLET PIPELINE TRENCH) (ITEM 11)

Additional Trench Excavation and Stabilization shall be placed at locations deemed as unsuitable for support of the pipe and pipe bedding as determined by the Engineer. Payment will be made per lineal foot of Trench Excavation and Stabilization performed by the Contractor.

1.14 ADDITIONAL TRENCH EXCAVATION (16" AND SMALLER PIPE (ITEM 12)

Additional Trench Excavation and Stabilization shall be placed at locations deemed as unsuitable for support of the pipe and pipe bedding as determined by the Engineer. Payment will be made per lineal foot of Trench Excavation and Stabilization performed by the Contractor.

1.15 LOWER 30" RAW WATER AND 8" DOMESTIC WATER PIPELINES (ITEM 13)

This item shall be measured for payment on a lump sum basis. The price for this item shall include full compensation for furnishing the pipes, potholing, pipeline excavation, backflow devices, pavement removal and restoration, pipe zone material, pipe base material, street zone base material, testing, relocation and lowering of existing 6" water pipe, disinfection, labor, equipment, materials and appurtenances necessary to install the pipes as shown in the drawings.

1.16 DRAINAGE ASSEMBLY (STATION 11+18.42) (ITEM 14)

This item shall be measured for payment on a lump sum basis. The price for this item shall include full compensation for furnishing the pipe, trenching and monitoring, pipeline excavation, pipe zone material, pipe base material, testing, pipe, valves, disinfection, labor, equipment, materials and appurtenances necessary to install the pipes as shown in the drawings.

1.17 FILTERED WATER PIPELINE (30" PIPELINE, VALVES, FITTINGS, COMBINED AIR VACUUM ASSEMBLY AND CONNECTIONS AT WATER FILTRATION PLANT) (ITEM 15)

This item shall be measured for payment on a lump sum basis. The price for this item shall include full compensation for furnishing the pipes, potholing, pipeline excavation, pavement removal and restoration, pipe zone material, pipe base material, street zone base material, testing, disinfection, labor, equipment, materials and appurtenances necessary to install the pipes as shown in the drawings.

1.18 8” DOMESTIC ASSEMBLY (CONNECTIONS, PIPE, ISOLATION VALVES, BACKFLOW PROTECTION, METER & MOTOR OPERATED VALVE (ITEM 16)

This item shall be measured for payment on a lump sum basis. The price for this item shall include full compensation for furnishing the pipe, potholing, pipeline excavation, backflow devices, meter, pavement removal and restoration, pipe zone material, pipe base material, street zone base material, testing, disinfection, labor, equipment, materials and appurtenances necessary to install the pipes as shown in the drawings.

1.19 AMMONIA SYSTEM (CONTAINMENT PIPELINES, MANHOLE AND TWO 4” OUTLETS) (ITEM 17)

This item shall be measured for payment on a lump sum basis. The price for this item shall include full compensation for furnishing the pipe, manhole and conduit excavation, pavement removal and restoration, pipe zone material, pipe base material, street zone base material, testing, disinfection, labor, equipment, materials and appurtenances necessary to install the Ammonia System as shown in the drawings.

1.20 DAM ACCESS ROAD (ITEM 18)

AC Paved Access Road shall be paid for at the lump price as shown in the Bid Schedule. Payment for these items shall include full compensation for furnishing all labor, materials, equipment, adjustment of DAM monitoring points, and traffic control to provide the interim and final structural sections across the Saddle Dam.

1.21 SITE IMPROVEMENTS (ITEM 19)

Site Improvements shall be paid for at the applicable lump-sum price named in the Bid Schedule. Payment shall constitute full compensation for materials, labor, equipment, tools, rock rip rap, headwalls, free standing walls, overflow drain, storm drain, catch basins, roads, fencing, gates, v-ditches, curbs, gutters, excavation and backfill, drains, leak detection vault, manhole and appurtenances for future ammonia injection, valves, backflow devices, hot taps, pipelines, and piping not covered under the 5.0 MG Prestressed Concrete Tank bid items, and any other appurtenance necessary to construct the site improvements as shown in the plans.

1.22 ELECTRICAL (ITEM 20)

This item is a lump sum bid for furnishing and installing all electrical conduits, conduit supports, pull boxes, wires, circuit breakers and associated accessories, lighting, wiring devices, disconnect switches, grounding system, testing and start up activities as shown on the plans, in accordance with the technical specifications, and as required, to provide a complete and operation system.

1.23 PROCESS CONTROL AND INSTRUMENTATION (ITEM 21)

This item is a lump sum bid for furnishing and installing all instrumentation work including but not limited to, complete instrument enclosure, complete instrument control

panel, fiber-optic communications system, PLC programming, modifications to existing SCADA communications and Main PLC panel, modifications to SCADA program, testing and start up as shown on the plans and in accordance with the technical specifications to provide a complete and operation system.

1.24 SITE IRRIGATION AND LANDSCAPING (ITEM 22)

Site Irrigation and landscaping shall be paid for at the applicable lump-sum price named in the Bid Schedule. Payment shall constitute full compensation for materials, labor, equipment, tools, planting, fertilizers, valves, compost, hydroseeding, controllers, irrigation conduit, sleeves, fittings, irrigation pump, trees, shrubs, samples and any other appurtenance necessary to construct the irrigation and planting improvements as shown in the plans including maintenance requirements.

1.25 PERMANENT ROCK PROTECTION SYSTEM (ITEM 23)

Permanent Rock Protection System shall be paid for at the applicable lump-sum price named in the Bid Schedule. Payment shall constitute full compensation for the design and installation of the Permanent Rock Protection System including materials, labor, equipment and tools, necessary to construct the Permanent Rock Protection System as shown in the plans.

END OF SECTION

SECTION 013233 PRECONSTRUCTION DIGITAL AUDIO-VIDEO DOCUMENTATION

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and performance for preconstruction digital audio-video documentation.

1.02 VIDEO AND AUDIO QUALITY

A. Documentation shall be performed by a responsible commercial firm skilled and regularly engaged in the preparation of preconstruction color audio-video DVD documentation acceptable to the Owner.

B. Completed documentation shall reproduce bright, sharp pictures with accurate colors and shall be free from distortion or any other significant picture imperfection. The audio portion of the recording shall reproduce the commentary of the camera operator with proper volume, clarity, and be free of distortion.

C. The Owner's Representative, at the Owner's request, may accompany the commercial firm in performing the audio-video documentation. The accompanying personnel may direct the commercial firm to record certain features observed. Notify the Owner's Representative 48 hours in advance so that any accompanying personnel can be scheduled.

D. Construction shall not proceed until the Owner and Owner's Representative have reviewed the documentation and notified the Contractor of its acceptability. It is anticipated that such review will be completed within 10 days after submittal.

PART 2 - MATERIALS

2.01 RECORDING EQUIPMENT

Utilize a high-resolution digital video camera with extended still frame capability.

2.02 RECORDING MEDIA

Utilize new, color DVD having:

A. High resolution.

B. Extended still frame capability.

C. American TV Standard DVD playback capability.

PART 3 - EXECUTION

3.01 COVERAGE

A. Record coverage of surface features located in the construction's zone of influence including, but not limited to:

1. Roadways, driveways, sidewalks, speed bumps, fencing, utilities and bicycle paths for the following locations: Three Spring Drive from Triunfo Canyon Road to Torchwood Place, Torchwood Place and onsite private access road to the Westlake Filtration Plant and roads surrounding the Westlake Filtration Plant including Contractor staging and storage areas.

2. Buildings, walls, retaining walls, and riprap.

3. Culvert ends, dam riprap, and drainage structures.

4. Landscaping, trees, shrubbery, fences, and irrigation heads.

B. Record the individual features of each item with particular attention being focused upon the existence of any existing faults, fractures, or defects.

C. Control pan rate, rate of travel, camera height, and zoom rate to maintain a steady clear view.

D. Limit recorded coverage to one side of any street at any one time.

E. Create a single, continuous, unedited recording which begins and ends within each portion of a particular construction area. The recording shall proceed in the direction of ascending baseline stationing.

3.02 AUDIO CONTENT

A. Simultaneously record audio content during videotaping.

B. Audio recording shall assist in viewer orientation and in any needed identification, clarification, or description of features being recorded.

C. Audio recording shall only consist of camera operator commentary.

3.03 INDEXING

A. Permanently label each DVD with a sequential number and the project name.

B. Index each DVD with a digital record of the time and date of the recording which is continuously displayed as the DVD is played.

C. Prepare a written log which describes the contents of each DVD including:

1. Names of streets or easements.

2. Coverage begin/end station and location.

3. Recording date.

3.04 CONDITIONS

A. Record coverage during dry, clear weather and during daylight hours only.

B. Record coverage when the area is free of debris or obstructions.

C. Record coverage no more than 21 days prior to mobilization at the site.

END OF SECTION

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SECTION 013300 SUBMITTALS

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Operation and Maintenance Manuals: 019310.

1.02 SHOP DRAWINGS

A. Contract drawing reproduced for shop drawings will be rejected.

B. Submit six copies of shop drawings. The Owner's Representative will keep four copies and return two copies. If the Contractor desires more than two copies, he shall transfer the Owner's Representative's comments onto additional copies at his own expense. Clearly indicate the specification section and drawing number to which each shop drawing is referenced.

C. If the Contractor submits shop drawings of equipment by manufacturers other than those listed in the specifications, provide the following information with the submittal:

1. The name and address of at least three companies or agencies that are currently using the equipment.

2. The name and telephone number of at least one person at each of the above companies or agencies whom the Owner's Representative may contact.

3. A description of the equipment that was installed at the above locations. The description shall be in sufficient detail to allow the Owner's Representative to compare it with the equipment that is proposed to be installed in this project.

D. For materials originating outside of the United States for which tests are required, provide recertification and retesting by an independent domestic testing laboratory.

1.03 SAMPLES

A. Furnish samples of the various materials, together with the finish thereon, as specified for and intended to be used on or in the work. Send samples to the office of the Owner's Representative, carriage prepaid.

B. Submit samples before purchasing, fabricating, applying, or installing such materials and finishes.

C. Submit samples, other than field samples, in duplicate. A cover letter shall accompany the sample and shall list all items being transmitted, designating their particular usage and location in the project. One sample marked "Resubmittal Not Required" will be returned to the Contractor; rejected samples will not be returned.

D. Samples shall be submitted and resubmitted until acceptable. Materials, finishes, and workmanship in the completed project shall be equal in every respect to that of the samples so submitted and accepted.

E. Samples shall conform to materials, fixtures, equipment, surface textures, colors, etc., as required by drawings and specifications or as requested by the Owner's Representative.

F. Identify sample as to product, color, manufacturer, trade name, lot, style, model, etc., location of use, and contract document reference, as well as the names of the Contractor, supplier, project, and Owner's Representative.

G. Samples shall be 8 inches by 10 inches in size and shall be limited in thickness to a minimum consistent with sample presentation. In lieu thereof, submit the actual full-size item.

H. Samples of value may be returned to the Contractor for use in the project after review, analysis, comparison, and/or testing as may be required by the Owner's Representative.

I. Furnish one 8-inch by 10-inch sample of the finally reviewed materials, colors, or textures to the Owner's Representative for final record. Such material samples shall carry on the back all identification as previously described including, if paint sample, manufacturer, mix, proportion, name of color, building, Contractor, subcontractor, and surfaces to which applied.

1.04 SUBMITTAL REGISTER

Designate in a submittal register/schedule, coordinated with the construction schedule, the date for submission and the date the reviewed shop drawings, product data, and samples will be needed. The submittal register shall be on 8-1/2-inch by 11-inch or 11-inch by 17-inch sheets in a format acceptable to the Owner’s Representative. The submittal register shall include the submittal description, specification section, date to be submitted, date reviewed, and date acceptable submittal is required.

1.05 SUBMITTAL REQUIREMENTS

A. Make submittals promptly in accordance with the submittal register/schedule and in such sequence as to cause no delay in the work. Schedule submission a minimum of 30 calendar days before reviewed submittals will be needed.

B. Submittals shall contain:

1. The date of submission and the dates of any previous submissions.

2. The project title and number.

3. Contract identification.

4. The names of:

a. Contractor.

b. Supplier.

c. Manufacturer.

5. Identification of the product, with the Specification Section number and/or Detail or Standard noted.

6. Field dimensions, clearly identified as such.

7. Relationship to adjacent or critical features of the work or materials.

8. Identification of deviations from contract documents.

9. Identification of revisions on resubmittals.

10. A 5-inch by 5-inch blank space for Engineer's stamps.

11. Contractor's stamp, initialed or signed, shall certify Contractor's review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal that the product meets the requirements of the work and of the contract documents.

1.06 SUBMITTAL FORMAT

A. Each submittal shall have a transmittal form. A sample transmittal form is included at the end of this section. Every page in a submittal shall be numbered in sequence. Each copy of a submittal shall be collated and stapled or bound, as appropriate. Copies not collated will be rejected.

B. Where product data from a manufacturer is submitted, clearly mark which model is proposed, with all pertinent data, capacities, dimensions, clearances, diagrams, controls, connections, anchorage, and supports. Present a sufficient level of detail for assessment of compliance with the contract documents.

C. Each submittal shall be assigned a unique number. Submittals shall be numbered sequentially. The submittal numbers shall be clearly noted on the transmittal. Original submittals shall be assigned a numeric submittal number. Resubmittals shall bear an alphanumeric system which consists of the number assigned to the original submittal for that item followed by a letter of the alphabet to represent that it is a subsequent submittal of the original. For example, if Submittal 25 requires a resubmittal, the first resubmittal will bear the designation "25-A" and the second resubmittal will bear the designation "25-B" and so on.

D. Disorganized submittals that do not meet the requirements above will be returned without review.

1.07 RESUBMITTALS

Resubmittal of submittals will be reviewed and returned in the same review period as for the original submittal. It is considered reasonable that the Contractor shall make a complete and acceptable submittal by the second submission of a submittal item. The Owner’s Representative reserves the right to withhold monies due to the Contractor to cover additional costs of any review beyond the second submittal.

1.08 CONTRACTOR'S JOBSITE DRAWINGS

Provide and maintain on the jobsite one complete set of prints of all drawings which form a part of the contract. Immediately after each portion of the work is installed, indicate all deviations from the original design shown in the drawings either by additional sketches or ink thereon. Upon completion of the job, deliver this record set to the Owner's Representative.

SHOP DRAWING SUBMITTAL NO. _____

SUBMITTAL TRANSMITTAL/ CERTIFICATION FORM

LAS VIRGENES MUNICIPAL WATER DISTRICT
5 MILLION GALLON RESERVOIR PROJECT

Attn: AECOM
John Coffman
1220 Avenida Acaso
Camarillo, CA 93012

From:

Description:

Submittal:

Submittal #(0-999) *Submission (A-Z)* *Section* *Page #* *Paragraph #*

Date: Previous Submission Date: Copies:

Supplier: Contact Name and Phone:

Manufacturer: Contact Name and Phone:

☐ PE Certificate Required
☐ Identification of Revisions
☐ Certification Attached
☐ Identification of Deviations from Contract Documents
☐ Field Dimensions Clearly Identified

Signature_____ _____

Remarks:

Relationship to Critical Features of Work:

Certification Statement: By this submittal, I hereby represent that I have determined and verified all field measurements, field construction, criteria, materials, dimensions, catalog numbers and similar data, and I have checked and coordinated each item with other applicable approved shop drawings and all Contract requirements.

Cc:

END OF SECTION

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SECTION 015100 CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Earthwork: 312300.

B. Trenching, Backfilling, and Compacting: 312316.

C. General Concrete Construction: 030500.

D. Pressure Testing of Piping: 400515.

1.02 CONSTRUCTION WATER

A. The Owner will make available an adequate supply of water for the purpose of initial hydrostatic testing and disinfection of all works under the contract for which such testing and disinfection is required and specified.

B. Water required for any cases of retesting or repeating disinfecting operations, and all water required for construction uses or other purposes shall be provided by the Contractor at his sole expense.

C. Water supply for the purpose of initial hydrostatic testing and disinfection of all works under the contract will be made available to the Contractor through the new domestic water connection near the Westlake Filtration Plant. The Contractor shall provide approved backflow preventers when connecting to Owner's facilities.

D. Sources of water for other construction purposes shall be the Contractor's responsibility. Arrangements for purchase of water from the Owner for delivery at the above mentioned location may be made by the Contractor if he so desires; however, in every instance of water delivery from the Owner's facilities, whether purchased by the Contractor or furnished by the Owner, the Contractor shall bear all costs incurred in connecting to the source of water supply and transporting and handling water beyond the point of connection.

E. Include the cost of construction water in the appropriate bid item to which it is appurtenant. The cost shall include full compensation for furnishing all labor, materials, tools, and equipment and doing all the work necessary to develop a sufficient water supply and furnishing the necessary equipment for applying the water as described in these specifications.

1.03 ELECTRICAL POWER--CONSTRUCTION PHASE

Provide for the purchase of power or provide portable power for the construction of the project where existing outlets are not available. Provide for the extension of utility lines to the point of usage. The cost of power shall be included in the appropriate bid items to which it is appurtenant and shall include full compensation for furnishing all labor, materials, tools, and equipment required to obtain and distribute power for construction purposes.

1.04 DUST CONTROL

Perform dust control operations to prevent construction operations from producing dust in amounts harmful to persons or causing a nuisance to persons living nearby or occupying buildings in the vicinity of the work. Use water or dust preventative to control dust.

1. Construction Operations shall be suspended if winds exceed 25 mph.

2. Water shall be used as dust suppression for construction activities.

3. Haul trucks shall be covered and two feet of freeboard shall be left between the top of the load and the top of the truck bed.

1.05 FIRE DANGER

Minimize fire danger in the vicinity of and adjacent to the construction site. Provide labor and equipment to protect the surrounding private property from fire damage resulting from construction operations.

No smoking is allowed within the job site or site access areas, except at designed areas, as coordinated with and approved by the Owner's Representative.

1.06 CONSTRUCTION STAKING

A. Furnish construction staking as needed to execute the work. Preserve existing monuments, control points, reference points, and other survey points. In case of their loss or destruction, replace them at no additional expense to the Owner. Furnish construction staking prior to initiating work that requires construction staking.

B. Owner has five (5) existing dam monitoring points (monuments) in the project site, as indicated on the drawings. Preserve these points and transfer from them, distances and elevations necessary for the execution of the structural and piping work.

C. In addition, establish the following points:

1. Center of the reservoir tank.

2. Buried pipelines larger than 6 inches: One set of offset line and grade stakes at 25-foot intervals.

3. Centerline stakes of roads at 50-foot intervals.

4. Toes of slopes over 4 feet high with grade stakes at 100-foot intervals.

5. Pipe supports and pipe headwalls.

6. Curbs, gutters, paving, valves and vaults.

7. Submit survey data showing top of reservoir floor forms at 1/4 points. Data shall be submitted prior to floor form.

D. Construction staking shall be furnished by a land surveyor with a valid California license.

1.07 ACCESS ROADS AND PARKING AREAS

A. Obtain access to project site through the existing gate on Torchwood Pl. Keep the existing gate accessible at all times during working hours so that the Owner's vehicles have access to the site parking lot.

B. The Contractor and his employees will be permitted to park their vehicles in the areas designated on the drawings. Parking and staging on public neighborhood streets is prohibited.

1.08 RESTROOM FACILITIES

A. Provide Sanitary Sewer facilities including toilet and washbasin with cold running water. Provide for janitorial service, which shall include weekly cleaning and trash removal.

1.09 SITE ACCESS THROUGH THREE SPRINGS DRIVE AND TORCHWOOD PLACE

A. When travelling to and from the site using Three Springs Drive and Torchwood Place, close windows to reduce noise to the neighboring community.

B. Tie down loose tools, materials, machinery and equipment to avoid spilling or dropping on Three Springs Drive and Torchwood Place.

END OF SECTION

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SECTION 015526 TRAFFIC REGULATION

1.01 DESCRIPTION

This section describes procedures for traffic regulation for access and deliveries via public streets and work onsite.

1.02 STANDARD SPECIFICATIONS

Wherever reference is made to the State Specifications and Plans, such reference shall mean the State of California, Business, Transportation, and Housing Agency, Department of Transportation 2006 edition Standard Specifications and 2006 edition Standard Plans.

1.03 SUBMITTALS

If the Owner or Owner's Representative determines construction work has damaged Three Springs Drive (Triunfo Canyon Road to Torchwood Place), Torchwood Place and roads to and adjacent to the Westlake Filtration Plant, prepare and submit a traffic control plan to the Owner four weeks in advance of the work. The plan shall be prepared by a Traffic Engineer registered in the State of California.

1.04 GENERAL

A. Provide safe and continuous passage for pedestrian and vehicular traffic at all times, on and offsite.

B. Control traffic at those locations indicated and in conformance with the approved traffic control plans and specifications.

C. Furnish, construct, maintain, and remove detours, road closures, traffic signal equipment, lights, signs, barricades, fences, K-rail, flares, solar-powered flashing arrow signs, miscellaneous traffic devices, flagmen, drainage facilities, paving, and such other items and services as are necessary to adequately safeguard the public from hazard and inconvenience. All such work shall comply with the ordinances, directives, and regulations of authorities with jurisdiction over the public roads in which the construction takes place and over which detoured traffic is routed by the Contractor. After devices have been installed, maintain and keep them in good repair and working order until no longer required. Replace such devices that are lost or damaged, to such an extent as to require replacement, regardless of the cause of such loss or damage.

D. Prior to the start of construction operations, provide written notice to the police and fire department in whose jurisdiction the project lies, giving the expected starting date, completion date, and the names and telephone numbers of two responsible persons who may be contacted at any hour in the event of a condition requiring immediate emergency service to remove, install, relocate, and maintain warning devices. In the event these persons do not promptly respond or the authority deems it necessary to call out other

forces to accomplish emergency service, the Contractor will be held responsible for the cost of such emergency service.

E. In the event work must be done in the public right-of-way, coordinate with the City of Westlake Village a minimum of 72 hours in advance. Secure written approval from the City. If any underground utilities, traffic devices, pipes, or conduits are damaged, all costs incurred by the City of Westlake Village in making such repairs, plus 15% for administration costs, shall be paid by the Contractor.

F. Coordinate Contractor activities with the following agencies to not affect scheduled City services as follows: Residential Trash Pick Up (Thursday of each week), Street Sweeping (Fridays), and Westlake Village Transit (Routes 1 through 4)

G. Do not restrict access on Three Springs Drive or Torchwood Place at any time.

1.05 TRAFFIC CONTROL DEVICES AND SIGNS

A. Traffic control devices and temporary striping shall conform to the California Manual of Uniform Traffic Control Devices (California MUTCD). Construction signs shall conform to the State of California Sign Specification Sheets

B. The placement of construction signing, striping, barricades, and other traffic control devices used for handling traffic and public convenience shall conform to the California MUTCD and “Work Area Traffic Control Handbook” (WATCH), 2012. In case of discrepancy, WATCH 2012 takes precedence over the California MUTCD. WATCH is published by Building News, Inc.

C. Signs shall be reflectorized when they are used during hours of darkness. Cones and portable delineators used for night lane closures shall have reflective sleeves. Equip barricades used in the diversion of traffic with flashers if in place during hours of darkness.

D. During the duration of a detour, cover existing signs not in accordance with the traffic control plan. Relocate existing signs that are in force to provide visibility from all relocated traffic lanes.

1.06 TEMPORARY STEEL PLATE BRIDGING, WITH A NONSKID SURFACE

A. When backfilling operations of an excavation in the traveled way, whether transverse or longitudinal, cannot be properly completed within a workday, provide steel plate bridging with a nonskid surface and shoring to preserve unobstructed traffic flow. In such cases, the following conditions shall apply:

1. Steel plates used for bridging shall extend a minimum of 12 inches beyond the edges of the trench.

2. Install steel plate bridging to operate with minimum noise.

3. Shore the trench to support the bridging and traffic loads.

4. Use temporary paving with cold asphalt concrete to feather the edges of the plates if plate installation by Method 2 is used.

5. Secure bridging against displacement by using adjustable cleats, shims, or other devices.

B. Install steel plate bridging and shoring as follows:

1. Attach approach plate(s) and ending plate (if longitudinal placement) to the roadway by a minimum of two dowels predrilled into the corners of the plate and drilled 2 inches into the pavement. Butt subsequent plates to each other. Compact fine graded asphalt concrete to form ramps, maximum slope 8.5% with a minimum 12-inch taper to cover all edges of the steel plates. When steel plates are removed, backfill the dowel holes in the pavement with either graded fines of asphalt concrete mix or concrete slurry.

C. Maintain the steel plates, shoring, and asphalt concrete ramps.

D. Provide a plan showing how emergency access to the Westlake Filtration Plant and Las Virgenes Reservoir will be maintained at all times.

E. Install no less than the required minimal thickness of steel plate bridging required for a given trench width:

Trench Width (feet)	**Minimum Plate Thickness (inches)**
1	1/2
1 1/2	3/4
2	7/8
3	1
4	1 1/4

F. For spans greater than 4 feet, prepare a structural design by a registered civil engineer and submit to the Owner's Representative for review.

G. Design steel plate bridging for HS20-44 truck loading per Caltrans Bridge Design Specifications Manual. Maintain on the steel plate a nonskid surface having a minimum coefficient of friction equivalent to 0.35 as determined by California Test Method No. 342.

H. Use a “Rough Road” sign (W8-8) with black lettering on an orange background in advanced of steel plate bridging. This is to be used along with any other required construction signing.

1.07 VEHICULAR TRAFFIC CONTROL

A. Unless otherwise shown in the drawings or allowed by the City within whose jurisdiction the work is being performed, limit construction activities to 7 a.m. to 4 p.m. Monday through Friday. Return roadways and sidewalks to unrestricted vehicle and pedestrian usage when construction is not underway.

B. Restrict equipment and material deliveries to the hours of 8:30 a.m. to 2:30 p.m. to avoid school bus pickup and drop off times.

C. Make equipment and material deliveries to the jobsite only during the hours of 7:00 am to 4:00 pm for the following activities:

1. Days when concrete is poured for floor, roof and tank shotcrete construction (columns, walls, pedestals, pipe supports and headwalls are excluded from this timeframe and should be delivered during 8:30 a.m. and 2:30 p.m.)

2. Days when asphalt and road base are placed for road construction

D. If deliveries are made without pre-approval from the Owner outside of the hours of 8:30 a.m. to 2:30 p.m., the Owner will deduct an amount of $1,000 from the Contractor's pay request, per occurrence.

E. Provide 72 hours written notice via email to the following agencies when concrete is poured for floor, roof and tank shotcrete construction and days where asphalt and road base are placed for road construction (all phases of paving). The Owner's Representative will provide contact information during construction.

- Los Angeles County Sheriffs and Fire Department
- Las Virgenes Municipal Water District
- City of Westlake Village Public Works Department
- City of Westlake Village Trash and Street Sweeping Services
- City of Westlake Village Bus Services
- Las Virgenes School District
- Resident Engineer
- Courtesy copy to the Construction Manager

F. Truck operations in and out of construction and staging areas shall be controlled by flagmen at all times. Construction site access gate shall remain open during construction hours.

G. Provide digital signs with messaging in each direction on Three Springs Drive 72 hours in advance of floor and roof concrete placement and days when asphalt and base are placed for paving operations. The digital sign, message, and location shall be pre-

approved by the City of Westlake Village and Las Virgenes Municipal Water District in writing. The Contractor shall secure this approval. The digital signs shall be removed the day following completion of each of these activities.

H. Do not allow parking or staging on public neighborhood streets and utilize the existing onsite parking made available to minimize impacts to residents.

I. Do not allow diesel truck engine braking of employee and delivery vehicles on Three Springs Road and Torchwood Place to minimize noise impacts to residents.

1.08 PEDESTRIAN TRAFFIC CONTROL

A. Maintain and delineate a minimum of one 4-foot-wide pedestrian walkway along the paved portions of the Westlake Filtration Plant perimeter road.

B. Erect a fence or provide other means of securement to preclude unauthorized entry to any excavation during all non-working hours on a 24-hour basis including weekends and holidays. Said fence shall be a minimum of 7 feet high around the entire excavation, consisting of a minimum 9-gauge chain-link type fence fabric and shall be sturdy enough to prohibit toppling by children or adults. There shall be no openings under the wire large enough for any child to crawl through. Lock any gates if no adult is in attendance. Place warning signs spaced on 50-foot centers on the outside of the fence with the statement "DEEP HOLE DANGER."

1.09 ACCESS TO ADJACENT PROPERTIES

A. Maintain reasonable access from public streets to adjacent properties at all times during construction. Prior to restricting normal access from public streets to adjacent properties, notify each property owner or responsible person, informing him/her of the nature of the access restriction, the approximate duration of the restriction, and the best alternate access route for that particular property.

END OF SECTION

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SECTION 015721 STORM WATER RUNOFF CONTROL FOR SITES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section describes work necessary by the Contractor to allow the Owner to comply with the California State Water Resources Control Board (SWRCB) Construction Activities Storm Water General Permit No. 2009-0009-DWQ (NPDES No. CAS000002) for discharges of storm water associated with construction activities for specific construction sites. Specifically, this includes the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP). The work shall reflect the Contractor's experience, resources, and capabilities in determining and meeting the requirements of the General Permit.

B. Disposal of construction water from operations such as groundwater dewatering and water used for backfilling trenches for pipelines is not part of the work under this section. Refer to Sections 312300 and 312316 for permit requirements for those discharges. Storm Water Runoff from the reservoir site shall be treated and then temporarily diverted to the existing onsite storm drain system and treated until acceptance of the project. Runoff to the existing open reservoir during Construction is not allowed until acceptance of the project by the owner.

1.02 RELATED WORK DESCRIBED ELSEWHERE

A. Coordination of Work and Permits: 011100.

B. Submittals: 013300.

C. Earthwork: 312300.

D. Trenching, Backfilling, and Compacting: 312316.

E. Disinfection of Piping and Structures: 331300.

F. Pressure Testing of Piping: 400515.

1.03 SUBMITTALS

A. Submit the SWPPP in electronic format following the procedure described for shop drawings in Section 013300.

B. Prepare and submit a hazardous materials business plan prior to equipment use on the site. The approved plan shall be followed for project construction. The plan shall include:

1. Specific bermed equipment maintenance and refueling areas.

2. Bermed and lined hazardous material storage areas on site that are covered during the rainy season.

3. Hazardous material spill cleanup equipment on site (e.g., sorbent pads, shovels, and bags to place contaminated soil in).

4. Workers trained in location and use of cleanup equipment.

1.04 SUMMARY OF PROCEDURE FOR SITES

A. Perform the risk determination per Section VIII of the General Permit No. 2009-0009-DWQ and the Division of Water Quality Fact Sheet Part II, “Rationale”; Section J, “Risk Determination”; paragraph 1, “Traditional Projects.”

B. For Risk Level 1 requirements, follow the requirements of Attachment C:

1. Good site management housekeeping.
2. Non-storm water management.
3. Erosion control.
4. Sediment controls.
5. Runoff and runoff controls.
6. Inspection, maintenance, and repair.

C. For Risk Level 2 requirements, follow the requirements of Attachment D:

1. Good site management housekeeping.
2. Non-storm water management.
3. Erosion control.
4. Sediment controls.
5. Runoff and runoff controls.
6. Inspection, maintenance, and repair.
7. Rain event action plan.

D. For Risk Level 3 requirements, follow the requirements of Attachment E:

1. Good site management housekeeping.
2. Non-storm water management.
3. Erosion control.
4. Sediment controls.
5. Runoff and runoff controls.
6. Inspection, maintenance, and repair.
7. Rain event action plan.

1.05 GENERAL CONSTRUCTION ACTIVITY STORM WATER PERMIT

A. Prepare and submit the SWPPP to the Owner for inclusion in the PRDs. For information regarding preparation of the SWPPP, see www.waterboards.ca.gov. The Owner will submit permit registration documents (PRDs) along with appurtenant fee, under the Construction Activities Storm Water General Permit (2009-0009-DWQ).

B. No work on the project site shall commence prior to the Owner submitting the PRDs. Allow no less than seven days after submitting the SWPPP to the Owner for receipt of notice from the Owner that the PRDs have been filed.

C. The qualified SWPPP developer and qualified SWPPP practitioners responsible for creating, revising, overseeing, and implementing the SWPPP shall attend a State Water Board-sponsored or -approved qualified SWPPP developer and qualified SWPPP practitioner training course.

D. The SWPPP shall be appropriate for the type and complexity of the project and shall be developed and implemented to address project-specific conditions. The project SWPPP shall identify specific BMPs needed to address all possible generated pollutants.

E. Read and be familiar with the requirements contained in the General Permit necessary to develop an SWPPP. Attention is directed to the publication entitled *Construction General Permit Fact Sheet (2009-0009-DWQ)* which has been prepared by the state and should assist the Contractor in the development of the SWPPP. Copies of the Fact Sheet may be purchased by writing the SWRCB, Division of Water Quality, 1001 I Street, Sacramento, CA 95814, telephone 916-341-5455, www.waterbooks.ca.gov. In addition, see the California Storm Water Quality Association Storm Water *Best Management Practice Handbook 2003*, www.cabmphanbdbooks.com.

F. Compliance with the requirements contained in the General Permit may require the use of erosion and sedimentation control procedures outside the limits of immediate construction activity.

1.06 NOTICE OF INTENT (NOI)

The General Permit requires the Owner to file an NOI with the SWRCB. A copy of the NOI shall be included in the SWPPP. The Owner will file the NOI with the SWRCB and provide a copy to the Contractor for inclusion in the SWPPP.

1.07 EROSION CONTROL PROTOCOL

A. Prior to start of any work, prepare an SWPPP for construction in compliance with the SWRCB's Construction Activities Storm Water General Permit No. 2009-0009-DWQ. The General Permit became effective on July 1, 2010 and superseded order No. 99-008-DWQ. This plan shall be designed for no less than a 10-year, eight-hour duration storm event. Where possible, erosion control measures shall be installed prior to work beginning. Erosion and sediment control features shall be utilized during and

immediately after grading to minimize impacts associated with erosion and off-site siltation of adjacent reservoir.

B. Prior to construction-related discharges, construct energy dissipation measures at groundwater dewatering discharge points to prevent erosion.

C. Construct sedimentation basins for dewatering discharge points to prevent excess downstream sedimentation. These basins shall be constructed prior to dewatering and regularly maintained during construction, including after storm events, to remain in good working order.

D. Construct straw bale/filter fabric barriers, backed by wire fencing for strength, around spoil piles to contain sediment from runoff. Install these barriers prior to any stockpiling during the rainy season and immediately after stockpiling during the dry season and shall be regularly maintained, including during major rainfall events, until the stockpiles are completely removed.

E. After construction, place erosion control matting on disturbed slopes greater than 5:1 (20%), over seeding and mulching.

F. Construct straw bale or filter fabric barriers at the base of disturbed slopes, for a minimum of two months following slope completion (or until the end of the rainy season, whichever is longer), to reduce short-term erosion impacts prior to plant growth.

G. Construct water bars, filter fabric fencing, or rice wattles at 50-foot (15-meter) intervals on slopes greater than 5:1 (20%).

1.08 HAZARDS AND HAZARDOUS MATERIALS

A. The project-specific SWPPP shall be prepared in compliance with the Statewide Construction Activities Storm Water General Permit No. 2009-0009-DWQ to prevent adverse impacts to nearby reservoir associated with construction-related incidental spills. This plan shall include a description of BMPs, spill prevention measures, spill containment equipment, and monitoring requirements.

B. The following pollution prevention measures shall be followed in association with pipeline construction:

1. If rain occurs during or within three days after concrete is placed for any structures, spread and secure plastic sheets or tarps over the concrete in such a manner to prevent rain from coming in contact with the concrete.

2. Wash out concrete trucks in a designated area where the material cannot run off into the open reservoir, storm drain, or percolate into the groundwater. This area shall be specified on all applicable construction plans and be in place before any concrete is poured.

3. Upon entering the site and regularly thereafter, inspect and maintain equipment prior to working in or immediately adjacent to reservoir. Repair any leaks or hoses/fittings in poor condition before the equipment begins work.

4. Runoff from construction operations shall be discharged to the onsite sanitary sewer.

PART 2 - MATERIALS

Not used.

PART 3 - EXECUTION

3.01 GENERAL

A. Develop and submit the SWPPP as required by the SWRCB Fact Sheet and the General Permit for acceptance by the Owner prior to commencement of construction activities.

B. Comply with the conditions identified in the General Permit that apply to the work under this contract.

C. The Contractor's personnel and subcontractors shall comply with the SWPPP.

D. Keep the SWPPP on site during construction activity. Make available upon request of a representative of the RWQCB and/or other regulatory agency.

E. Amend the SWPPP whenever there is a change in construction or operations which may affect the discharge of significant quantities of pollutants to surface waters, groundwaters, or a municipal storm sewer system.

3.02 STORM WATER POLLUTION PREVENTION PLAN

The SWPPP shall provide a description of potential sources which are likely to add significant quantities of pollutants to storm water discharges or which may result in nonstorm water discharges from the construction site. A description of the items required to be included in the SWPPP is included in the General Permit.

3.03 IMPLEMENTATION FOR SITE PROJECTS

A. The SWPPP shall be implemented at the appropriate level to protect water quality at all times throughout the life of the project. The SWPPP shall remain on the site during construction activities, commencing with the initial mobilization and ending with the termination of coverage under the General Permit. The discharger shall make the SWPPP available at the construction site during working hours while construction is occurring and shall be made available upon request by a state or municipal inspector. When the original SWPPP is retained by a crew member in a construction vehicle and is not currently at the construction site, current copies of the BMPs and map/drawing shall

be left with the field crew and the original SWPPP shall be made available via a request by radio or telephone. Once construction activities are complete, until stabilization is achieved, the SWPPP shall be available from the SWPPP contact listed in the PRDs.

B. Comply with Part II, Section I of the Division of Water Quality Fact Sheet regarding sampling, monitoring, reporting, and recordkeeping and Section XVI of the General Permit. Comply with the monitoring and reporting requirements for the previously established risk level.

3.04 DUTY TO COMPLY

A. Comply with the conditions identified in the General Permit and the SWPPP. Nonadherence with the conditions specified in the General Permit may constitute a violation of the Clean Water Act and the Porter-Cologne Water Quality Control Act and may be grounds for enforcement action by the RWQCB.

B. Take all reasonable steps to minimize or prevent any discharge in violation of the General Permit.

3.05 COMPLIANCE CERTIFICATION

A. An officer or other authorized representative of the Contractor shall certify in writing to the Owner annually and at the completion of construction, if it occurs before the next annual report, that construction activity is and has been in compliance or has been modified to comply with the requirements of the General Permit and the SWPPP.

B. If compliance with any of the General Permit and SWPPP requirements cannot be certified, notify the Owner immediately. The notification shall identify the type of noncompliance, describe the actions necessary to achieve compliance, and include a time schedule when compliance will be achieved. Submit each noncompliance notification to the Owner within 15 days of identification of the event.

END OF SECTION

SECTION 017410 CLEANING DURING CONSTRUCTION AND FINAL CLEANING

1.01 GENERAL

A. This section includes cleaning during construction and final cleaning on completion of the work.

B. At all times maintain areas covered by the contract and adjacent properties and public access roads free from accumulations of waste, debris, and rubbish caused by construction operations.

C. Conduct cleaning and disposal operations to comply with local ordinances and antipollution laws. Do not burn or bury rubbish or waste materials on project site. Do not dispose of volatile wastes, such as mineral spirits, oil, or paint thinner, in storm or sanitary drains. Do not dispose of wastes into streams, waterways, or the open reservoir.

D. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

1.02 CLEANING DURING CONSTRUCTION

A. During execution of work, clean site, adjacent properties, and public access roads and dispose of waste materials, debris, and rubbish to assure that buildings, grounds, and public properties are maintained free from accumulations of waste materials and rubbish.

B. Wet down dry materials and rubbish to lay dust and prevent blowing dust.

C. Provide containers for collection and disposal of waste materials, debris, and rubbish.

D. Cover or wet excavated material leaving and arriving at the site to prevent blowing dust. Clean the public access roads to the site of any material falling from the haul trucks.

E. Sweeping streets at the completion of each day’s work as follows:

1. Las Virgenes Westlake Filtration Plans, surrounding roads and access driveway.

2. Torchwood Place.

3. Three Springs Drive, from Torchwood Place to Triunfo Canyon Road.

1.03 SITE CLEANING PRIOR TO LANDSCAPING

Remove concrete, concrete wash, stucco splatter, gunite overspray, and all other wastes and debris prior to final grading and landscaping.

1.04 FINAL CLEANING

A. At the completion of work and immediately prior to final inspection, clean the entire project site as follows.

B. Clean, sweep, wash, and polish all work and equipment including finishes.

C. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces; polish surfaces.

D. Repair, patch, and touch up marred surfaces to match adjacent surfaces.

E. Broom clean paved surfaces; rake clean landscaped areas.

F. Remove from the site temporary structures and materials, equipment, and appurtenances not required as a part of, or appurtenant to, the completed work.

END OF SECTION

SECTION 019310 OPERATION AND MAINTENANCE MANUALS

1.01 GENERAL

This section describes the requirements for preparation and submittal of operation and maintenance manuals.

1.02 SUBMITTALS

A. Submit six copies of all manufacturer's operation and maintenance manuals and data pertinent to equipment supplied for the project. Prepare and organize the material in three-ring binders with divider tabs and labels. Include a table of contents. Include a CD of all catalog data in PDF format and all drawings in both PDF and CADD formats. All PDF files shall be formatted to allow word search.

Equipment requiring operation and maintenance manual shall include, but not be limited to:

- Valves
- Actuators
- Motor operators
- Backflow preventers
- Couplings
- Instruments
- Gauges
- PLC
- UPS
- SCADA components
- Motor Starters
- Switchgear/breakers
- Safety Climb in Reservoir

B. Submittals shall include:

1. List of equipment furnished for project with name, address, and telephone number of each vendor.
2. List of serial numbers of equipment furnished.
3. A copy of shop drawings for mechanical, electrical, and instrument equipment in final form.
4. Manufacturer's operation and maintenance instructions and parts lists.

5. Tabulation of motor nameplate horsepower, nameplate current, field-measured current, overload relay setting, and catalog number for polyphase motors.

6. List of fuses, lamps, seals, and other expendable equipment and devices. Specify size, type, and ordering description. List name, address, e-mail address, website address, fax number, and telephone number of vendor.

1.03 EQUIPMENT DATA SHEETS

Provide six sets of equipment data sheets, bound in three-ring binders, summarizing the equipment manufacturer's maintenance instructions and recommendations. A blank data sheet and a sample data sheet are attached.

Preventive Maintenance and Operating Requirement Sheets

Preventive Maintenance Program	Equipment Record Number	
EQUIPMENT DESCRIPTION	ELECTRICAL OR MECHANICAL DATA	
Name:	Size:	
Serial No.:	Model:	
Vendor:		
Vendor Address:	Type:	
	Mfr.:	
Vendor Rep:	Voltage:	Amps:
Phone:	Phase:	rpm:
Maintenance Work to be Done		Frequency*
OPERATING REQUIREMENTS AND REFERENCE		

*D - Daily; W - Weekly; B - Biweekly; M - Monthly; Q - Quarterly;
S - Semiannually; A - Annually.

SAMPLE

Preventive Maintenance and Operating Requirement Sheets

Preventive Maintenance Program	Equipment Record Number	
EQUIPMENT DESCRIPTION	ELECTRICAL OR MECHANICAL DATA	
Name: Influent Pump No. 1 Tag No.: P01-1	Size: 15 hp	
Serial No.: 123456ABC Vendor: ABC Pump Co.	Model: 140T Frame Serial No. 987654ZY Class F Insulation W/Space Heater	
Vendor Address: 1111 Pump Circle Newport Beach, CA 92663	Type: Mfr.: DEF Motors, Inc.	
Vendor Rep: XYZ Equipment, Inc.	Voltage: 460	Amps: 20
Phone: 714/752-0505	Phase: 3	rpm: 1,800
Maintenance Work to be Done		Frequency*
1. Operate all valves and check such things as a) bearing temperature, b) changes in running sound, c) suction and discharge gauge readings, d) pump discharge rate, and e) general condition of the drive equipment.		D
2. Check packing.		D
3. Checking pumping unit for any dust, dirt, or debris.		W
(Continued on attached sheet)		
OPERATING REQUIREMENTS AND REFERENCE		
For manufacturer's instructions regarding installation, operation, maintenance, and trouble shooting of this equipment, see Volume ____, Section _____.		

*D - Daily; W - Weekly; B - Biweekly; M - Monthly; Q - Quarterly;
S - Semiannually; A - Annually.

SAMPLE

Preventive Maintenance and Operating Requirement Sheets

Preventive Maintenance Program	Equipment Record Number	
EQUIPMENT DESCRIPTION	ELECTRICAL OR MECHANICAL DATA	
Name:	Size:	
Serial No.:	Model:	
Vendor:		
Vendor Address:	Type:	
	Mfr.:	
Vendor Rep:	Voltage:	Amps:
Phone:	Phase:	rpm:
Maintenance Work to be Done		Frequency*
4. Lubricate bearing frame and motor bearings (consult manufacturer's instructions for type of grease or oil).		Q
5. Disassemble and change or repair the following: a) impeller, b) shafts, c) shaft sleeve, d) rotary seals, and e) sleeve bearings.		A
OPERATING REQUIREMENTS AND REFERENCE		

*D - Daily; W - Weekly; B - Biweekly; M - Monthly; Q - Quarterly;
S - Semiannually; A - Annually.

END OF SECTION

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SECTION 020120 PROTECTING EXISTING UNDERGROUND UTILITIES

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and procedures for protecting existing underground utilities.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Connections to Existing Buried Pipelines: 020130.

B. Trenching, Backfilling, and Compacting: 312316.

C. Subsurface Utility Locating (Potholing): 023219.

PART 2 - MATERIALS

2.01 REPLACEMENT IN KIND

Except as indicated below or as specifically authorized by the Owner's Representative, reconstruct utilities with new material of the same size, type, and quality as that removed.

PART 3 - EXECUTION

3.01 GENERAL

A. Replace in kind street improvements, such as curbs and gutters, barricades, traffic islands, signalization, fences, signs, etc., that are cut, removed, damaged, or otherwise disturbed by the construction.

B. Where utilities are parallel to or cross the construction, but do not conflict with the permanent work to be constructed, follow the procedures given below. Notify the utility owner 48 hours in advance of the crossing construction and coordinate the construction schedule with the utility owner's requirements. For utility crossings not shown in the drawings, refer to the General Provisions and the instructions of the Owner's Representative for guidance.

C. Determine the true location and depth of utilities and service connections which may be affected by or affect the work. Determine the type, material, and condition of these utilities. In order to provide sufficient lead-time to resolve unforeseen conflicts, order materials and take appropriate measures to ensure that there is no delay in work.

3.02 PROCEDURES

A. Protect in Place: Protect utilities in place, unless abandoned, and maintain the utility in service, unless otherwise specified in the drawings or in the specifications.

B. Cut and Plug Ends: Cut abandoned utility lines and plug the ends. Plug storm drains and sewers with an 8-inch wall of brick and mortar. Cap waterlines with a cast-iron cap or install a 3-foot-long concrete plug. Dispose of the cut pipe as unsuitable material.

C. Remove and Reconstruct: Where so indicated in the drawings or as required by the Owner's Representative, remove the utility and, after passage, reconstruct it with new materials. Provide temporary service for the disconnected utility.

3.03 COMPACTION

A. Utilities Protected in Place: Backfill and compact under and around the utility so that no voids are left. Compact to the level of compaction specified in Section 312316.

B. Utilities Reconstructed: Prior to replacement of the utility, backfill the trench and compact to an elevation 1 foot above the top of the ends of the utility. Excavate a cross trench of the proper width for the utility and lay, backfill, and compact.

C. Alternative Construction--Sand-Cement Slurry: Sand-cement slurry consisting of one sack (94 pounds) of portland cement per cubic yard of sand and sufficient moisture for workability may be substituted for other backfill materials to aid in reducing compaction difficulties. Submit specific methods and procedures for the review of the Owner's Representative prior to construction.

3.04 THRUST BLOCKS ON WATERLINES

A. The Contractor's attention is called to thrust blocks which may have been installed for waterlines throughout the project whose thrust is in the direction of the new excavation and, therefore, may be affected by the construction. These waterlines are owned and operated by the Owner. Protect thrust blocks in place or shore to resist the thrust by a means approved by the Owner and reconstruct. If the thrust blocks are exposed or rendered to be ineffective in the opinion of the Owner's Representative, reconstruct them to bear against firm unexcavated or backfill material.

B. Provide firm support by backfilling that portion of the trench for a distance of 2 feet on each side of the thrust block to be reconstructed from the pipe bedding to the pavement subgrade, with either:

1. Sand-cement slurry (94 pounds of cement per cubic yard).

2. The native material compacted to a relative compaction of 95%.

C. Then excavate the backfill material for construction of the thrust block.

D. Test compaction of the backfill material before pouring any concrete thrust block. Use 2,500 pounds per square inch strength concrete per Section 030500 for reconstruction.

3.05 ADJACENT PARALLEL UTILITIES

A. The Contractor's attention is called to the following utilities:

Size and Description	Station	
	From	To
6” Water, 4” Irrigation, 6” Drain, and 8” Water	±19+00	±22 +91

B. The position of these utilities between the above stations is just outside the new construction. Protect these utilities from any disturbances and repair the pipelines and associated vaults and appurtenances if they are damaged in any way.

END OF SECTION

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SECTION 020130 CONNECTIONS TO EXISTING BURIED PIPELINES

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and installation of hot-tap connections to existing buried steel pipelines.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Protecting Existing Underground Utilities: 020120.

B. Painting and Coating: 099000.

C. Polyethylene Sheet Encasement: 099754.

D. Fusion-Bonded Epoxy Linings and Coatings: 099761.

E. Manual, Check, and Process Valves: 400520.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit manufacturer's catalog data for tapping sleeves. Show coatings.

C. Submit shop drawing for design and fabrication of steel outlet connections to existing steel pipes.

PART 2 - MATERIALS

2.01 TAPPING SLEEVES FOR STEEL PIPES

A. Tapping sleeves shall comply with AWWA C223 and shall be Type 304 or 316 Stainless Steel.

B. Pressure rating shall be at least 200 psi for piping 12 inches and smaller and at least 150 psi for piping 14 through 24 inches.

2.02 TAPPING GATE VALVES

Provide tapping gate valves per Section 400520.

PART 3 - EXECUTION

3.01 VERIFICATION OF PIPE OUTSIDE DIAMETER PRIOR TO INSTALLATION

Excavate the points of connection prior to submittal of shop drawings. Verify outside diameter prior to ordering materials.

3.02 WRAPPING OR COATING TAPPING VALVE

After installation, wrap the tapping valve with cold-applied wax tape per Section 099752 and polyethylene sheet wrap per Section 099754.

END OF SECTION

SECTION 023219 SUBSURFACE UTILITY LOCATING (POTHOLING)

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and procedures for performing pothole operations to locate existing underground utilities.

1.02 SUBMITTALS

A. Submit request for pre-marking of pothole locations at least five calendar days prior to the commencement of field activities.

B. Submit a traffic control/protection plan at least seven calendar days prior to the commencement of field activities.

C. Submit proposed method of potholing, including description of equipment to be used, and schedule for potholing for approval at least seven calendar days prior to the commencement of field activities. Obtain Owner's approval of pothole locations prior to commencement of field activities.

D. Submit field logs to the Owner within two working days after the completion of pothole excavations in each area. Include dates of potholing operations and any additional discovered information or pertinent data. Include for each pothole excavation field log:

1. Pothole number.

2. Date of pothole.

3. Depths to top and bottom of utility (measured from existing grade over utility at pothole).

4. Surveyed locations of potholed utility (including northing and eastings).

5. Miscellaneous Contractor's notes.

E. Submit temporary steel cap and/or steel plate bridging shop drawings at least seven calendar days prior to the commencement of field activities.

F. Submit sand-cement slurry mix design at least seven calendar days prior to the commencement of field activities.

G. Submit asphalt concrete mix design at least seven calendar days prior to the commencement of field activities.

1.03 PROCEDURES

A. Subsurface utility-locating (potholing) services shall conform to CI/ASCE 38-02. For the purpose of this scope, “locate” means to obtain the horizontal and vertical position of the utility line by excavating a circular test hole or narrow trench (where approved of and/or requested by the Owner). Construct test holes using vacuum excavation or comparable nondestructive equipment in a manner that will cause no damage to the utility.

B. Subsurface utility locating shall consist of test hole excavations at locations indicated on the pothole plans as approved by the Owner. Narrow trench excavations (slot potholes) may be required at locations approved by the Owner or to locate multiple parallel utilities.

1.04 TIME OF COMPLETION/SCHEDULE

The Contractor shall diligently prosecute the work to completion before the expiration of 15 working days immediately following the date of the project kick-off meeting.

1.05 STANDARD SPECIFICATIONS

Wherever reference is made to the Public Works Specifications such reference shall mean the technical requirements of Standard Specifications for Public Works Construction (SSPWC), 2012 edition.

PART 2 - MATERIALS

2.01 SAND-CEMENT SLURRY BACKFILL AT TEST HOLES AND AT EXPLORATORY TRENCHES

Sand-cement slurry backfill shall consist of two sacks of Type I or II portland cement added per cubic yard of imported sand and sufficient water for workability.

2.02 ASPHALT CONCRETE PAVEMENT REPAIR AT EXPLORATORY TRENCHES AND AT TEST HOLES

A. Asphalt concrete paving shall conform to III-C2-AR-4000 as listed in Section 400-4 of the Public Works Specifications.

B. Asphalt shall be Performance Grade PG 64-10 per Section 92 in the State Specifications. Asphalt content in the pavement shall be 5.5% to 6.0%.

C. Areas to be paved shall receive prime coat. Prime coat shall be medium curing (MC-70) in accordance with Section 203-2 of the Public Works Specifications.

D. Aggregate shall be in accordance with Section 400-1 of the Public Works Specifications.

E. Paving thickness shall match existing plus 1 inch.

PART 3 - EXECUTION

3.01 POTHOLING OPERATIONS

A. Backfill and repair test hole excavations immediately after obtaining the measurement data. Backfill and repair trench excavations requiring use of temporary steel plate bridging within four working days. Promptly provide notice to the Owner for scheduling field survey activities. Advise Owner of number of pothole excavations completed and number remaining.

B. Underground Service Alert Requirements: Comply with Underground Service Alert requirements for notification prior to excavation. Contact Underground Service Alert at 1-800-642-2444 (or dial 811) no less than two and no more than ten days prior to the start of exploratory excavation. Verify whether or not a representative of each utility or agency will be present during excavation, and coordinate with said individual(s). Take any precautions required by the utility owner.

C. Conduct potholing operations in a manner that minimizes the damage potential to existing underground utilities in order to ensure that the existing facilities will remain in operation without interruption.

D. Collect and record field data. Coordinate and cooperate with and facilitate field data collection by Owner's surveyor. Pothole excavations shall sufficiently expose subsurface utilities to allow Contractor and Owner's surveyor to easily determine and measure the following data:

1. Elevation at top and bottom of utility.

2. Elevation of existing grade over utility at pothole.

3. Coordinates at surface.

4. Outside diameter of utility or width of duct banks.

5. Utility material and condition.

E. Location and Depiction of Existing Utilities: Pothole maps for subsurface utility locating shall be present and utilized during potholing activities. The plans shall be compared to utility/agency paint markings following Underground Service Alert notification. If discrepancies are found between the plans and paint markings, promptly notify the Owner prior to commencement of any excavation

3.02 TRAFFIC CONTROL

Furnish, install, maintain, and remove necessary traffic signs, barricades, lights, signals, cones, pavement markings, and other traffic control devices. Perform traffic control in accordance with Work Area Traffic Control Handbook (WATCH) promulgated by the

Southern California Chapter, APWA, 2012 and OSHA Regulations for Construction Projects.

3.03 EXCAVATION

A. Protect utilities or underground structures from damage during potholing. Immediately report any damaged utilities to the affected utility's owner and the Owner. Repair immediately any damaged utilities in accordance with the respective utility owner's requirements. Neatly cut and remove existing pavement. Excavate test holes in such a manner as to prevent any damage to wrappings, coatings, or other protective coverings, utilizing vacuum excavation or hand digging.

B. Methods: Backhoe excavation is not permitted except for trench excavations**.** Use the following methods for pothole excavations:

1. Hand Digging: Hand digging is the method of excavating a pothole by manual means with hand-held, non-mechanical equipment such as a shovel.

2. Vacuum Excavation: Vacuum excavation shall consist of air or water pressure to break up the soil and a vacuum device to collect the spoil. Determine if air or water vacuum excavation shall be used depending upon specific site and environmental characteristics. Soil type such as heavy clay may require water vacuum excavation. Utilize air vacuum excavators if mud from water vacuum excavators cannot be disposed properly. Use air vacuum excavators if damage to utilities, such as cutting through cables, will occur with the use of water vacuum excavators.

a. Air: Air vacuum excavators shall utilize a high velocity air stream to penetrate, expand, and break up the soil. Remove the loosened particles of soil and rock from the excavation through the use of a vacuum.

b. Water: Water vacuum excavation systems shall excavate the pothole using high-pressure water to reduce and loosen the soil. Remove the wet soil and mud slurry to a spoil tank using a vacuum.

C. Size of Test Hole Excavation: Maximum test hole size shall be 8 inches in diameter at surface, unless indicated otherwise by Owner.

D. Size of Exploratory Trench Excavation: Trench width and length shall be as approved by the Owner. Trench depth shall be as required to accurately locate subsurface utilities.

3.04 TEMPORARY STEEL PLATE BRIDGING, WITH A NONSKID SURFACE

A. Provide steel plate bridging with a nonskid surface and shoring to preserve unobstructed traffic flow. In such cases, the following conditions shall apply:

1. Steel plates used for bridging shall extend a minimum of 12 inches beyond the edges of the trench.

2. Install steel plate bridging to operate with minimum noise.

3. Shore the trench to support the bridging and traffic loads.

4. Use temporary paving with cold asphalt concrete to feather the edges of the plates if plate installation by Method 2 is used.

5. Secure bridging against displacement by using adjustable cleats, shims, or other devices.

B. Install steel plate bridging and shoring using the following method:

Attach approach plate(s) and ending plate (if longitudinal placement) to the roadway by a minimum of two dowels predrilled into the corners of the plate and drilled 2 inches into the pavement. Butt subsequent plates to each other. Compact fine graded asphalt concrete to form ramps, maximum slope 8.5% with a minimum 12-inch taper to cover all edges of the steel plates. When steel plates are removed, backfill the dowel holes in the pavement with either graded fines of asphalt concrete mix or concrete slurry.

C. Maintain the steel plates, shoring, and asphalt concrete ramps.

D. Unless specified, use of steel plate bridging at any given location shall not exceed four consecutive working days in any given week. Cover backfilling of excavation with a minimum of 3 inches of temporary layer of cold mix asphalt concrete.

E. The following table shows the required minimal thickness of steel plate bridging required for a given trench width:

Trench Width (feet)	**Minimum Plate Thickness (inches)**
1	1/2
1 1/2	3/4

F. The Contractor may use standard steel plate with known coefficient of friction equal or exceeding 0.35.

G. Use a “Rough Road” sign (W8-8) with black lettering on an orange background in advanced of steel plate bridging. This is to be used along with any other required construction signing.

3.05 POTHOLE REPAIR

A. After excavating a test hole or trench, provide and install a temporary steel cap (over test hole) or temporary steel plate bridging (over trench) to facilitate data gathering by Owner’s surveyor.

B. Following data gathering, remove temporary steel caps and/or steel plate bridging, and backfill excavation with approved material as follows:

1. Test Hole Excavations: Sand-cement slurry backfill per Part 2 of this section. Bring to grade with asphalt cement pavement per Part 2 of this section. Match existing pavement thickness plus 1 inch.

2. Exploratory Trenches: Backfill per Part 2 of this section. Match existing pavement thickness plus 1 inch.

C. The finished surface of the repair shall be of like material and constructed to the same finished grade as the adjacent pavement. The finished surface shall be such that it does not allow water to pond. There shall be no discernable difference in surface level at the joint between the existing pavement and the completed repair.

3.06 DISPOSAL OF CUTTINGS

Dispose of cuttings off-site.

END OF SECTION

SECTION 030500 GENERAL CONCRETE CONSTRUCTION

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, installation, and testing of formwork, reinforcing steel, joints, concrete, and finishing and curing for general concrete construction.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Leakage Testing of Hydraulic Structures: 030510.

B. Painting and Coating: 099000.

C. Concrete Curbs, Gutters, and Sidewalks: 321613.

D. Prestressed Circular Concrete Tanks: 331620.

E. Wall Pipes, Seep Rings, and Penetrations: 400762.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with the General Provisions and Section 013300.

B. Prepare concrete and mortar mix designs and laboratory 7-day and 28-day compressive tests, or submit test reports of 7- and 28-day compressive tests of the mix where the same mix has been used on two previous projects. Submit mix design in writing for review by the Owner at least 15 days before placing of any concrete.

C. Submit manufacturer's catalog data and descriptive literature for form ties, spreaders, corner formers, form coatings and curing compound, bond breakers, joint sealant, backing rod, joint filler, control joints, expansion joint dowels, epoxy bonding compound, floor hardener, color additive, and epoxy anchor adhesive.

D. Submit mill test certificates identifying chemical and physical analyses of each load of reinforcing steel delivered. If mill test reports are unavailable and the quantity of steel for a structure exceeds 5 tons, provide a laboratory test to prove conformance with the specified ASTM standard.

E. Submit reinforcing bending lists and placing drawings for all reinforcing. Placing drawings shall indicate all openings (mechanical, electrical, equipment, and architectural) including additional reinforcing at openings and corner bar arrangements at intersecting beams, walls, and footings indicated in the typical detail and structural drawings. Placing drawings shall be coordinated with the concrete placing schedule. Each bending list and placing drawing submitted shall be complete for each major element of a structure (grade slabs, footings, walls, deck, floor, or roof slabs) including dowels and corner bars. Furnishing such lists shall not be construed that the lists will be reviewed for accuracy. The Contractor shall be wholly and completely responsible for

the accuracy of the lists and for furnishing and placing reinforcing steel in accordance with the details shown in the drawings and as specified. Placing drawings shall be prepared by the Contractor and shall not incorporate photocopies of the contract drawings.

F. Submit calculations and drawings for structural design of any proposed variations to the contract drawings. Calculations and drawings shall be signed by a civil or structural engineer, registered in the State of California.

G. Submit six copies of a report from a testing laboratory verifying that aggregate material contains less than 1% asbestos by weight or volume, conforms to the specified gradations or characteristics, and is innocuous for alkaline reactivity as determined by Appendix X-1 of ASTM C33.

1.04 SHRINKAGE TESTS

A. Perform drying shrinkage tests for the trial batch specified in the paragraph in Part 2 entitled "Trial Batch and Laboratory Tests."

B. Drying shrinkage specimens shall be 4-inch by 4-inch by 11-inch prisms with an effective gauge length of 10 inches. Fabricate, cure, dry, and measure specimens in accordance with ASTM C157 modified as follows:

1. Remove specimens from molds at an age of 23 hours ±1 hour after trial batching, place immediately in water at 70°F ±3°F for at least 30 minutes, measure within 30 minutes thereafter to determine original length, then submerge in saturated lime water at 73°F ±3°F. At age seven days, make measurement to determine expansion, expressed as a percentage of original length. This length at age seven days shall be the base length for drying shrinkage calculations (zero days' drying age).

2. Then, store specimens immediately in a humidity-controlled room maintained at 73°F ±3°F and 50% ±4% relative humidity for the remainder of the test. Make and report measurements to determine shrinkage expressed as percentage of base length separately for 7, 14, 21, and 28 days of drying after 7 days of moist curing.

C. Compute the drying shrinkage deformation of each specimen as the difference between the base length (at zero days' drying age) and the length after drying at each test age. Compute the average drying shrinkage deformation of the specimens to the nearest 0.0001 inch at each test age. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, disregard the results obtained from that specimen. Report results of the shrinkage test to the nearest 0.001% of shrinkage. Take compression test specimens in each case from the same concrete used for preparing drying shrinkage specimens. These tests shall be considered a part of the normal compression tests for the project. Allowable shrinkage limitations shall be as specified in Part 2.

PART 2 - MATERIALS

2.01 NON-DOMESTIC CEMENT AND ADDITIVES

A. The use of cement and additives in concrete which originate outside of the United States of America may be permitted only after review of a written request to use such materials. The request to use nondomestic materials shall include a chemical analysis that indicates the material meets the project specifications. Certifications that state the nondomestic materials meet the project requirements will not be accepted.

B. Test reports for concrete materials shall be current to within three months of inclusion into the project and shall be identifiable to the materials supplied.

2.02 FORMWORK

A. Design forms according to ACI 347.

B. Class I Forms: Use steel forms, ply form, or smooth-surface plywood 3/4-inch minimum thickness for straight surfaces and 1/2-inch minimum thickness for curved surfaces.

C. Class II Forms: Use plywood in good condition, metal, or smooth-planed boards free from large or loose knots with tongue and groove or ship lap joints.

D. Class II forms may be used for exterior concrete surfaces that are 1 foot or more below finished grade. Use Class I forms for all other surfaces.

E. Coat forms with form release agent.

2.03 BOND BREAKER

Bond breaker shall be a nonstaining type which will provide a positive bond prevention, such as Williams Tilt-Up Compound, as manufactured by Williams Distributors, Inc., Seattle, Washington; Silcoseal 77, as manufactured by SCA Construction Supply Division, Superior Concrete Accessories, Franklin Park, Illinois; or equal.

2.04 FORM RELEASE AGENT

A. Form release agent shall effectively prevent absorption of moisture and prevent bond with the concrete. Agent shall be nonstaining and nontoxic after 30 days.

B. For steel forms, release agent shall prevent discoloration of the concrete due to rust.

2.05 REINFORCING STEEL

A. Reinforcement shall conform to ASTM A615 or A706, Grade 60.

B. Fabricate reinforcing in accordance with the current edition of the Manual of Standard Practice, published by the Concrete Reinforcing Steel Institute. Bend reinforcing steel cold.

C. Deliver reinforcing steel to the site bundled and with identifying tags.

2.06 WELDED WIRE REINFORCEMENT

Welded wire reinforcement shall conform to ASTM A185.

2.07 TIE WIRE

Tie wire shall be 16 gauge minimum, black, soft annealed.

2.08 BAR SUPPORTS

Bar supports in beams and slabs exposed to view after form stripping shall be galvanized and plastic coated. Use concrete supports for reinforcing in concrete placed on grade.

2.09 BAR COUPLERS

Reinforcing steel bar splicing couplers shall be a mechanical type as manufactured by Dayton Barsplice Inc. or equal. Use couplers that do not reduce tensile or ultimate strength of bars.

2.10 JOINT SEALANT FOR CONCRETE STRUCTURES

A. Joint sealant shall be a multipart, gray, nonstaining, nonsagging, gun grade polyurethane sealant, which cures at ambient temperature to a firm, flexible, resilient, tear-resistant rubber. Sealant shall comply with ASTM C920, Type M, Grade P, Class 25 for horizontal joints and Grade NS, Class 25 for vertical joints and be recommended by the manufacturer for continuous immersion in water.

Characteristic or Parameter	Technical Requirements
Pot life	1 to 3 hours
Hardness	35 Shore A, ±5, ASTM D2240
Elongation	650%, ASTM D412
Tensile strength	200 psi, ASTM D412
Peel strength on concrete	No adhesion loss at 25 pounds
Temperature service range	40°F to 167°F
Immersion in water	Continuous

B. Sealant shall be Tremco Vulkem 227 or Sikaflex-2CNS (for Grade NS, Class 25), Sikaflex-2CSL of Sika Corporation or Vulkem 245 (for Type M, Grade P, Class 25), or equal. Troweling of sealants into joints will not be permitted.

2.11 BACKING ROD FOR EXPANSION JOINTS

Backing rod shall be an extruded closed-cell polyethylene foam rod, such as Minicel backer rod, manufactured by Industrial Systems Department, Plastic Products Group of

Hercules, Inc., Middletown, Delaware; Ethafoam SB, as manufactured by Dow Chemical Company, Midland, Michigan; or equal. The rod shall be 1/4 inch larger in diameter than the joint width. Where possible, provide full-length sections for the joint; minimize splices. Apply backup rod and bond breaker tape in expansion joints.

2.12 BOND BREAKER TAPE

Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape that will adhere to the premolded joint material or concrete surface. The tape shall be the same width as the joint. The tape shall be compatible with the sealant.

2.13 PREFORMED CONTROL JOINT

Preformed control joint shall be a one-piece, flexible, PVC joint former, such as Kold-Seal Zip-Per Strip KSF-150-50-50, manufactured by Vinylex Corp., Knoxville, Tennessee, or a one-piece steel strip with preformed groove, such as Keyed Kold Retained Kap, manufactured by Burke Concrete Accessories, Inc., San Mateo, California, or equal. Provide the preformed control joint material in full-length unspliced pieces.

2.14 PREMOLDED JOINT FILLER

Joint filler shall be preformed, non-extruded type constructed of closed-cell neoprene conforming to ASTM D1752, Type I, as manufactured by W. R. Grace Company of Cambridge, Massachusetts; W. R. Meadows, Inc., Elgin, Illinois; or equal or bituminous-type preformed expansion joint filler conforming to ASTM D994.

2.15 STEEL EXPANSION JOINT DOWELS

A. Steel expansion joint dowels shall conform to one of the following:

1. Steel bar dowels with a 12-mil-thick epoxy coating. Steel bar dowels shall conform to ASTM A36 or ASTM 615, plain rounds, Grade 40. Epoxy coating shall be in conformance with ASTM A775.

2. Stainless steel bar dowels conforming to ASTM A276, Type 302.

B. Exposed portion of expansion joint dowels shall be thoroughly greased prior to casting of adjoining wall or slab.

2.16 CEMENT

A. Use domestic Portland cement that conforms to ASTM C150, Type I, II, or III. Use Type III cement for high early strength concrete only for special locations and only when reviewed in advance by the Owner's Representative. Use Type I cement for tremie concrete.

B. Use only one brand of cement in any individual structure. Use no cement that has become damaged, partially set, lumpy, or caked. Reject the entire contents of the sack or container that contains such cement. Use no salvaged or reclaimed cement.

C. Maximum tricalcium aluminate shall not exceed 8%. The maximum percent alkalies shall not exceed 0.6%.

2.17 AGGREGATES

A. Aggregates shall be natural rock, sand, or crushed natural rock, shall comply with ASTM C33, and shall contain less than 1% asbestos by weight or volume. Aggregates shall be free from any substances that will react with the cement alkalies, as determined by Appendix X-1 of ASTM C33.

B. Special Testing Requirements for Aggregate Alkali-Silica Reaction: Both fine and coarse aggregates shall be taken from sources known to produce non-reactive aggregate. As part of the concrete mix design submittal, provide test reports performed within the last 12 months, both for fine and coarse aggregate, showing aggregate is not reactive to alkali, per Appendix X-1 of ASTM C33. In addition, sample and test aggregate used in the first 100 cubic yards supplied under this contract, utilizing the accelerated mortar bar test, ASTM C1260. The sampling of aggregate will be witnessed by the owner’s representative. Notify the owner’s representative 24 hours in advance of the selection of samples. All testing shall be done by a qualified, certified, independent testing laboratory.

2.18 WATER AND ICE

Use water and ice that is clean and free from objectionable quantities of organic matter, alkali, salts, and other impurities that might reduce the strength, durability, or otherwise adversely affect the quality of the concrete. Water shall not contain more than 500 mg/L of chlorides or more than 500 mg/L of sulfate.

2.19 COLOR ADDITIVE FOR EXTERIOR ELECTRICAL DUCT ENCASEMENT

For exterior electrical duct concrete encasements, use a color additive for identification purposes: brick red "Colorfull" as manufactured by Owl Manufacturing Company, Arcadia, California; coral red "Chromix C-22" as manufactured by L. M. Scofield Company, Los Angeles, California; or equal. Add the color additive while the concrete is being mixed using the quantity per cubic yard of concrete recommended by the manufacturer for the class of concrete indicated.

2.20 CONCRETE ADMIXTURES

A. Class A concrete shall contain an air-entraining admixture conforming to ASTM C260. Admixtures shall be Master Builders MB-AE 90, Sika AER, or equal.

B. Class A concrete shall contain a water-reducing admixture conforming to ASTM C494, Type A or D. It shall be compatible with the air-entraining admixtures. The amount of

admixture added to the concrete shall be in accordance with the manufacturer's recommendations. Admixture shall be Master Builders Pozzolith polymer-type normal setting, Plastocrete 161 or Plastiment, Sika Chemical Corporation, or equal.

C. Do not use any admixture that contains chlorides or other corrosive elements in any concrete. Admixtures shall be nontoxic after 30 days.

2.21 GROUT

A. Nonshrink grout shall conform to ASTM C1107 and to these specifications. Use a nongas-liberating type, cement base, premixed product requiring only the addition of water for the required consistency. Grout shall be UPCON High Flow, Master Flow 928, or equal. Components shall be inorganic.

B. Ordinary type grout (dry pack) shall consist of one part portland cement to two parts sand (100% passing a No. 8 sieve). Add sufficient water to form a damp formable consistency.

C. Expansive Grout: Premixed, cementitious mixture with a minimum 28-day strength of 3,500 psi. Provide air-entraining admixture as recommended by the manufacturer.

D. Epoxy Grout:

1. Mix the two components of epoxy bonding compound in compliance with the manufacturer's instructions.

2. Use sand that is oven dry and meets the following gradation requirements for epoxy grout:

Sieve Size	**No. 8**	**No. 50**	**No. 100**
% Passing	100	30 ±15	5 ±5

2.22 GROUT BEDDING FOR HORIZONTAL JOINTS

The grout placed on horizontal construction joints shall be a mixture of cement, sand, and water in the same proportions and strength used in the overplaced concrete with coarse aggregate omitted.

2.23 REPAIR MORTAR

A. Mortar used for repair of concrete voids shall be made of the same materials as used for concrete, except that the coarse aggregate shall be omitted or the mortar shall consist of not more than one part cement to two and one-half parts sand by damp loose volume. The quantity of mixing water shall be no more than necessary for handling and placing.

B. Materials for repair of major defects or cracks shall be in accordance with “Repair of Defects and Cracks” specified in Part 3.

2.24 BONDING COMPOUND

A. Epoxy bonding compound shall be Sikadur 32 Hi-Mod, Sika Chemical Corporation, Lyndhurst, New Jersey; Concresive by BASF; Euco Epoxy 452 by Euclid Chemical Company; or equal.

B. Nonepoxy bonding compound shall be Weldcrete by Larsen Products Corp., Link by Sta-Dry Manufacturing Corp., Euco Weld by Euclid Chemical Co., or equivalent. The compound shall be rewettable for up to two weeks.

2.25 CONCRETE MIX DESIGN

A. Conform to ASTM C94, except as modified by these specifications.

B. Air content as determined by ASTM C231 shall be 4% ±1%.

C. Maximum water-cement ratio for Class A concrete = 0.45 by weight.

D. Use classes of concrete as described in the following table:

Class	**Type of Work**	**28-Day Compressive Strength (in psi)**	**Minimum Cement Content (in lbs per C.Y.)**
A	Concrete for all structures and concrete not otherwise specified. Concrete fill at structure foundations, cradle, supports across pipe trenches, and reinforced pipe encasement.	4,000	564
B	Pavement	3,000	500
C	Floor grout and miscellaneous unreinforced concrete.	2,500	450

E. Measure slump in accordance with ASTM C143. Slump shall be as follows:

Slab on grade or heavy sections wider (in plan view) than 3 feet	3 inches maximum
Footings, walls, suspended slabs, beams, and columns	4 inches maximum

Proportion and produce the concrete to have a maximum slump as shown. A tolerance of up to 1 inch above the indicated maximum shall be allowed for individual batches

provided the average for all batches or the most recent 10 batches tested, whichever is fewer, does not exceed the maximum limit. Concrete of lower than usual slump may be used provided it is properly placed and consolidated.

F. Aggregate size shall be 3/4 inch maximum for slabs and sections 8 inches thick and less. Aggregate size shall be 1 inch maximum for slabs and sections greater than 8 inches and less than 17 inches. Aggregate size shall be 1 1/2 inches maximum for all larger slabs and sections. Aggregate size for floor grout shall be maximum 3/8 inch.

G. Combined aggregate grading shall be as shown in the following table:

Sieve Sizes	Maximum Aggregate Size		
	1 1/2"	1"	3/4"
	Percent Passing		
2"	100	---	---
1 1/2"	90 - 100	100	---
1"	50 - 86	90 - 100	100
3/4"	45 - 75	55 - 100	90 - 100
3/8"	38 - 55	45 - 75	60 - 80
No. 4	30 - 45	35 - 60	40 - 60
No. 8	23 - 38	27 - 45	30 - 45
No. 16	17 - 33	20 - 35	20 - 35
No. 30	10 - 22	12 - 25	13 - 23
No. 50	4 - 10	5 - 15	5 - 15
No. 100	1 - 3	1 - 5	0 - 5
No. 200	0 - 2	0 - 2	0 - 2

H. Mix design for pumped concrete shall produce a plastic and workable mix. The percentage of sand in the mix shall be based on the void content of the coarse aggregate.

2.26 TRIAL BATCH AND LABORATORY TESTS

A. Before placing any concrete, a testing laboratory designated by the Contractor shall prepare a trial batch of Class A concrete, based on the preliminary concrete mixes submitted. Concrete shall conform to the requirements of this section. Prepare the trial batch using the aggregates, cement, and admixture proposed for the project. The cost of laboratory trial batch tests will be borne by the Contractor. Perform trial batch testing at no additional cost to the Owner.

2.27 SHRINKAGE LIMITATION

A. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-day drying age or at 28-day drying age, shall be 0.036% or 0.042%, respectively. Use a mix design for construction that has first met the trial batch shrinkage requirements. Shrinkage limitations apply only to Class A concrete.

B. If the trial batch specimens do not meet the shrinkage requirements, revise the mix design and/or materials and retest.

2.28 SLURRY CEMENT BACKFILL

A. Slurry cement backfill shall consist of a fluid, workable mixture of aggregate, cement, and water.

B. Aggregate shall be either:

1. Material selected from excavation, imported material, or a combination thereof, free from organic matter and other deleterious materials and meeting the following gradation:

Sieve Sieves	Percentage Passing
1 1/2 inches	100
1 inch	80 to 100
3/4 inch	60 to 100
3/8 inch	50 to 100
No. 4	40 to 80
No. 100	10 to 40

2. Commercial quality concrete sand.

C. Proportion the aggregate, cement, and water by either weight or volume. Include at least 188 pounds of cement per cubic yard produced. The water content shall be sufficient to produce a fluid, workable mix that will flow and can be pumped without segregation of the aggregate while being placed.

D. Thoroughly machine-mix the materials for the slurry cement backfill in pugmill, rotary drum, or other mixer. Continue the mixing until the cement and water are thoroughly dispersed throughout the material. Place slurry cement backfill within one hour after mixing.

2.29 CURING COMPOUND

A. Curing compound shall conform to ASTM C309.

B. Curing compound shall be compatible with required finishes and coatings and shall meet the State of California Clean Air Quality Standards which limit the quantity of volatile organic compounds to 350 grams per liter.

2.30 MATS, PAPER, AND SHEETING FOR CURING

A. Burlap mats shall conform to AASHTO M182.

B. Sisal-kraft paper and polyethylene sheets shall conform to ASTM C171.

PART 3 - EXECUTION

3.01 FORM TOLERANCES

A. Failure of the forms to produce the specified concrete surface and surface tolerance shall be grounds for rejection of the concrete work. Rejected work shall be repaired or replaced at no additional cost to the Owner.

B. The following table indicates tolerances or allowable variations from dimensions or positions of structural concrete work:

	Maximum Tolerance (inch)
Sleeves and inserts	+1/4 -1/4
Projected ends of anchors	+1/4 -0.0
Anchor bolt setting	+1/4 -1/4
Finished concrete, all locations	+1/4 -1/4 in 10 feet
	Max ±1-inch in total length

The planes or axis from which the above tolerances are to be measured shall be as follows:

Sleeves and inserts:	Centerline of sleeve or insert.
Projected ends of anchors:	Plane perpendicular to the end of the anchor as located in the drawings.
Anchor bolt setting:	Centerline of anchor bolt.
Finish concrete:	The concrete surface as defined in the drawings.

Where equipment is to be installed, comply with manufacturer's tolerances if more restrictive than above.

3.02 FORM SURFACE PREPARATION

A. Clean form surfaces to be in contact with concrete of foreign material prior to installation.

B. Coat form surfaces in contact with concrete with a release agent prior to form installation.

3.03 FORM REUSE

Reuse only forms that provide a uniform surface texture on exposed concrete surfaces. Apply light sanding or other surface treatment between uses for uniform texture. Plug unused tie rod holes with corks, shave flush, and sand the concrete surface side. Do not patch forms other than filling tie rod holes, except in the case of Class II forms. Do not use metal patching discs on Class I forms.

3.04 REMOVAL OF FORMS

A. Forms and shoring for elevated structural slabs or beams shall remain in place until the concrete has reached a compressive strength equal to the specified 28-day compressive strength as determined by test cylinders. Do not remove supports and reshore. The following table indicates the minimum allowable time after the last cast concrete is placed before forms, shoring, or wall bracing may be removed:

Sides of footings and encasements	24 hours
Walls, vertical sides of beams, girders, columns, and similar members not supporting loads	48 hours
Slabs, beams, and girders	10 days (forms only)
Shoring for slabs, beams, and girders	Until concrete strength reaches specified 28-day strength
Wall bracing	Until top or roof slab concrete reaches specified 28-day strength

B. Do not remove forms from concrete that has been placed with outside air temperature below 50°F without first determining if the concrete has properly set without regard for time. Do not apply heavy loading on green concrete. Immediately after forms are removed, the surface of the concrete shall be carefully examined and any irregularities in the surface shall be repaired and finished as specified.

3.05 FORMED OPENINGS

Openings shall be of sufficient size to permit final alignment of pipes or other items without deflection or offsets of any kind. Allow space for packing where items pass through the wall to ensure watertightness. Provide openings with continuous keyways and water stops. Provide a slight flare to facilitate grouting and the escape of entrained

air during grouting. Provide formed openings with reinforcement as indicated in the typical structural details. Reinforcing shall be at least 2 inches clear from the opening surfaces and encased items.

3.06 EMBEDDED ITEMS

Set anchor bolts and other embedded items accurately and hold securely in position until the concrete is placed and set. Check all special castings, channels, or other metal parts that are to be embedded in the concrete prior to and again after concreting. Check nailing blocks, plugs, and strips necessary for the attachment of trim, finish, and similar work prior to concreting.

3.07 BEVELED EDGES (CHAMFER)

Form 3/4-inch beveled edges on exposed concrete edges and corners, beam soffit corners, and where indicated in the drawings. Reentrant corners in concrete members shall not have fillets, unless otherwise shown in the drawings. The top edges of slabs, walkways, beams, and walls may be beveled with an edging trowel in lieu of using chamfer strips.

3.08 CONSTRUCTION JOINTS

A. Provide construction joints where shown in the drawings.

B. After a concrete placement pour has been completed to the construction joint and the concrete has hardened, thoroughly clean the entire surface of the joint of surface laitance, loose or defective concrete, and foreign material. Expose clean aggregate by sandblasting and thoroughly cleaning the surface of construction joints before placing the new concrete. Cover horizontal construction joints with grout bedding. Spread uniformly and work thoroughly into all irregularities of the surface. The consistency of the mortar shall be suitable for placing and working and shall be placed immediately prior to placing new concrete.

C. In case of emergency, place additional construction joints. (An interval of 45 minutes constitutes cause for an emergency construction joint.)

3.09 TIME BETWEEN POURS

At least two hours shall elapse after depositing concrete in the columns or walls before depositing in beams, girders, or slabs supported thereon. Place beams, girders, brackets, column capitals, and haunches monolithically as part of the floor or roof system, unless otherwise indicated in the drawings.

3.10 INSTALLATION OF PREMOLDED JOINT FILLER

Install in joint accurately as shown. Attach to concrete with a bonding agent recommended by the joint sealant and joint filler manufacturer for compatibility.

3.11 INSTALLATION OF JOINT SEALANTS

A. Immediately before installing the joint sealant, clean the joint cavity by sandblasting or power wire brushing. Install bond breaker tape per manufacturer's instructions.

B. After the joints have been prepared as described above, apply the joint sealant. Apply the primer, if required, and joint sealant only with the equipment and methods recommended by the joint sealant manufacturer. Application criteria for the sealant materials, such as temperature and moisture requirements and primer cure time, shall be in accordance with the recommendations of the sealant manufacturer.

C. Apply masking tape along the edges of the exposed surface of the exposed joints. Trowel the joints smooth with a tuck pointing tool wiped with a solvent recommended by the sealant manufacturer.

D. After the sealant has been applied, remove the masking tape and any sealant spillage.

3.12 PLACING REINFORCEMENT

A. Place reinforcing steel in accordance with the current edition of Recommended Practice for Placing Reinforcing Bars, published by the Concrete Reinforcing Steel Institute.

B. Place reinforcing in accordance with the following, unless otherwise indicated:

1. Reinforcement indicated in the drawings is continuous through the structure to the farthest extent possible. Terminate bars and hooks 2 inches clear from faces of concrete.

2. Splices may be used to provide continuity due to bar length limitations. Minimum length of bars spliced for this reason is 30 feet. Splicing of reinforcement that is detailed to be continuous in the drawings is not permitted.

C. Reinforcing steel, before being positioned and just prior to placing concrete, shall be free from loose mill and rust scale and from any coatings that may destroy or reduce the bond. Clean reinforcing steel by sandblasting or wire brushing and remove mortar, oil, or dirt to remove materials that may reduce the bond.

D. Do not straighten or rebend reinforcing steel in the field. Do not use reinforcing with bends not shown in the drawings.

E. Position reinforcing steel in accordance with the drawings and secure by using annealed wire ties or clips at intersections and support by concrete or metal supports, spacers, or metal hangers. Do not place metal clips or supports in contact with the forms. Bend tie wires away from the forms to provide the specified concrete coverage. Bars, in addition to those shown in the drawings, which may be found necessary or desirable by the Contractor for the purpose of securing reinforcement in position shall be provided by the Contractor at his own expense.

F. Place reinforcement a minimum of 2 inches clear of any metal pipe or fittings.

G. Secure reinforcing dowels in place prior to placing concrete. Do not press dowels into the concrete after the concrete has been placed.

H. Roll wire mesh used for reinforcement flat before placing concrete. Support and tie wire mesh to prevent movement during concrete placement.

I. Position dowels for masonry walls to occur at reinforced block cells.

3.13 SITE-MIXED CONCRETE

Conform to ACI 304.

3.14 READY-MIXED CONCRETE

Conform to ASTM C94.

3.15 PLACING CONCRETE

Conform to ACI 304.

3.16 PUMPING CONCRETE

Conform to ACI 304.2R-91.

3.17 WEATHER REQUIREMENTS

A. Conform to ACI 305 for placing during hot weather.

B. Conform to ACI 306 for placing during cold weather.

3.18 BACKFILL AGAINST WALLS

A. Do not place backfill against walls until the concrete has obtained a compressive strength equal to the specified 28-day compressive strength. Where backfill is to be placed on both sides of the wall, place the backfill uniformly on both sides.

B. Do not backfill the walls of structures that are laterally restrained or supported by suspended slabs or slabs on grade until the slab is poured and the concrete has reached the specified compressive strength.

3.19 PLACING SLURRY CEMENT BACKFILL

Place slurry cement backfill in a uniform manner that will prevent voids in, or segregation of, the backfill. Remove foreign material that falls into the excavation or trench. Do not commence backfilling over or place any material over the slurry cement backfill until at least four hours after placing the slurry cement backfill, except that when

concrete sand is used for the aggregate and the in-place material is free draining, backfilling may commence as soon as the surface water is gone.

3.20 CONCRETE FINISHES

A. Complete concrete surfaces in accordance with the following schedule:

Finish Designation	Area Applied
F-3	Beams, columns, and walls of structures or buildings exposed to view. Underside of formed floors or slabs.
F-4	Exterior and interior surfaces to be coated.
S-4	Slabs and floors of structures.
E-1	Exposed edges. EXCEPTION: edges normally covered with earth.
E-2	Top of walls, beams, and similar unformed surfaces.

B. Finish F-1: Repair defective concrete, fill depressions deeper than 1/2 inch, and fill tie holes.

Finish F-3: Repair defective concrete, fill tie holes, remove fins, fill depressions 1/4 inch or deeper, fill depressions and airholes with mortar. Dampen surfaces and then spread a slurry consisting of one part cement and one and one-half parts sand by damp loose volume, over the surface with clean burlap pads or sponge rubber floats. Remove any surplus by scraping and then rubbing with clean burlap.

Finish F-4: Repair defective concrete, remove fins, fill depressions 1/16 inch or deeper, fill tie holes, remove mortar spatter, and remove bulges higher than 1/16 inch.

Finish S-4: Steel trowel finish without local depressions or high points and apply a light hair-broom finish. Do not use stiff bristle brooms or brushes. Leave hair-broom lines parallel to the direction of slab drainage.

Finish E-1: Provide chamfer or beveled edges.

Finish E-2: Strike smooth and float to an F-3 or F-4 finish.

3.21 CURING CONCRETE

A. Conform to ACI 308.

B. Water cure with burlap mats unless optional curing methods are permitted.

C. Do not use curing compound on surfaces that are to be coated in accordance with Section 099000.

D. It is the responsibility of the Contractor to select the appropriate curing method in response to climatical and/or site conditions occurring at the time of concrete placement. Take appropriate measures as described in ACI 305 and 306 for protecting and curing concrete during hot and cold weather.

3.22 REPAIR OF DEFECTS AND CRACKS

A. Do not repair defects until concrete has been evaluated by the Owner's Representative.

B. Surface Defects:

1. Repair surface defects that are smaller than 1 foot across in any direction and are less than 1/2 inch in depth.

2. Repair by removing the honeycombed and other defective concrete down to sound concrete, cut or grind edges perpendicular to the surface and at least 3/8 inch deep, abrasive clean and thoroughly dampen the surface, work into the surface an epoxy bonding agent, and fill the hole with one part cement to one part fine sand. Match the finish on the adjacent concrete, and cure as specified.

C. Severe Defects:

1. Repair severe defects that are larger than surface defects but do not appear to affect the structural integrity of the structure.

2. Repair by removing the honeycombed and other defective concrete down to sound concrete, make edges of the repair area perpendicular to the surface, as required above, sandblast the sound concrete surface, coat the exposed surfaces with epoxy bonding compound, place nonshrink grout, match the finish on the adjacent concrete, and cure as specified.

D. Repair minor cracks in concrete structures that are wider than 1/10 inch by cutting out a square edged and uniformly aligned joint 3/8 inch wide by 3/4 inch deep, preparing exposed surfaces of the joint, priming the joint, and applying polyurethane joint sealant.

E. If the cracks are major or affect the hydraulic capacity or function of the element, the Owner's Representative may require the concrete to be repaired by epoxy injection.

F. Major Defects and Cracks: If the defects affect the structural integrity of the structure or if patching does not satisfactorily restore quality and appearance to the surface, the Owner’s Representative may require the concrete to be removed and replaced, complete.

3.23 ALUMINUM SURFACES IN CONTACT WITH CONCRETE

Coat aluminum surfaces in contact with concrete per Section 099000, System No. 54.

3.24 CONCRETE TESTS

A. Concrete quality testing will be performed on the concrete by the Owner as follows:

1. Frequency of Sampling: Cast four concrete test cylinders from each 50 cubic yards, or fraction thereof, of each class of concrete placed in any one day. Sampling and curing of cylinders shall conform to ASTM C31.

2. Strength Testing: Test cylinders in accordance with ASTM C39. Test one cylinder at 7 days for information; test two cylinders at 28 days for acceptance; and hold one cylinder for verification. Strength acceptance will be based on the average of the strengths of the two cylinders tested at 28 days. If one cylinder of a 28-day test manifests evidence of improper sampling, molding, or testing, other than low strength, discard it and use the fourth cylinder for the test result.

3. Determine concrete slump by ASTM C143 with each strength test sampling and as required to establish consistency.

4. Determine air content of the concrete using ASTM C231 to verify the percentage of air in the concrete immediately prior to depositing in forms.

5. The average value of concrete strength tests shall be equal to or greater than the specified 28-day strength. No test shall be less than 90% of the specified 28-day strength.

6. If the 28-day strength tests fail to meet the specified minimum compressive strength, the concrete will be assumed to be defective and one set of three cores from each area may be taken as selected by the Owner and in accordance with ASTM C42. If the average compressive strength of the set of three concrete cores fails to equal 85% of the specified minimum compressive strength or if any single core is less than 75% of the minimum compressive strength, the concrete will be considered defective. The Owner may require additional coring, nondestructive load testing, or repair of defective concrete. Costs of coring, testing of cores, load testing, and required repairing pertaining thereto shall be paid by the Contractor at no extra cost to the Owner.

B. To facilitate concrete sampling and testing, the Contractor shall:

1. Furnish labor to assist the Owner in obtaining and handling samples at the project site.

2. Advise the Owner in advance of concrete placing operations to allow for scheduling and completion of quality testing.

3. Provide and maintain facilities for safe storage and proper curing of concrete test specimens on the project site, as required by ASTM C31.

END OF SECTION

SECTION 030510 LEAKAGE TESTING OF HYDRAULIC STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes the method of testing concrete hydraulic structures for leakage.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Concrete Construction: 030500.

B. Precast Circular Concrete Manhole: 034210.

C. Precast Concrete Vaults: 034220.

D. Prestressed Circular Concrete Tank: 331620.

PART 2 - MATERIALS

Provide water, piping, and equipment to test concrete structures for leakage.

PART 3 - EXECUTION

3.01 GENERAL

A. Hydrostatically test reinforced concrete structures which will contain water to determine that they conform to “Leakage Test Procedure” herein and are free of detectable leaks. Do not hydrostatically test walls which are to be restrained or laterally supported by slabs until slab concrete has obtained the specified compressive strength.

B. Prior to testing, clean exposed surfaces by thoroughly hosing and removing surface laitance and loose matter from walls and slabs. Remove wash water and debris from the structures by means other than washing through plant piping.

C. Conduct testing before backfill is placed against walls and after concrete has attained the specified compressive strength, the concrete has cured, and joint sealants have set and cured a minimum of 14 days.

3.02 LEAKAGE TEST PROCEDURE

A. Fill hydraulic structures to be subjected to leakage tests with water to the maximum operating liquid level line. Filling shall not exceed 8 feet of water depth per 24-hour period. Filling shall be at a uniform rate over a 24-hour period with continuous monitoring. For structures with adjacent bays, fill all bays simultaneously. Empty

adjacent bays alternately. Repair any running leaks which appear during filling before continuing.

B. After the structure has been kept full for 48 hours, it will be assumed for the purposes of the test that the absorption of moisture by the concrete in the structure is complete. Close all valves and gates to the structure and measure the change in water surface each day for a five-day period.

C. During the test period, examine exposed portions of the structure, and mark visible leaks or damp spots. Repair visible leaks or damp spots after dewatering. If the drop in water surface in a 24-hour period exceeds 1/20 of 1% of the normal volume of liquid contained in the structure, the leakage shall be considered excessive. Repair leaks and damp spots that still exist three days after filling.

D. The determination of surface moisture evaporation of open structures shall be aided with a 24-inch-deep, white-colored, watertight container with not less than 10 square feet of surface area exposure. Position container to experience environmental conditions similar to the structure being tested. Subtract the water loss due to evaporation from the measured water loss in the structure to determine the water loss due to leakage.

E. If the leakage is excessive, drain the structure, repair leaks and damp spots, and refill the structure and again test for leakage. Continue this process until the drop in water surface in a 24-hour period meets the test requirements.

F. Inspect the manholes of the underdrain system for evidence of leaks in floor slabs. If leakage is indicated, locate and repair.

G. Repair visible leaks and damp spots whether leakage exceeds the allowable leakage or not.

H. Make repairs and additional filling and testing (including the cost of water) at no additional cost to the Owner.

3.03 REPAIR METHODS

Methods for repairing concrete not passing the leakage test shall be as described in Section 030500.

END OF SECTION

SECTION 034210 PRECAST CIRCULAR CONCRETE MANHOLES

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes design, materials, testing, and installation of precast circular concrete manholes.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Concrete Construction: 030500.

B. Trenching, Backfilling, and Compacting: 312316.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit manufacturer's catalog data on precast concrete manholes, frames, joint sealing compound and covers. Show dimensions and materials of construction by ASTM reference and grade. Show lettering on manhole covers.

PART 2 - MATERIALS

2.01 PRECAST CIRCULAR CONCRETE MANHOLES

A. Precast circular manhole shall be similar to APWA Std. 201-2, with a FRP grated sump (2’x2’x2’) in the base in lieu of a channel.

B. Precast circular concrete manhole sections shall comply with ASTM C478.

C. Precast top section shall be an eccentric cone.

D. Design joints using a butyl rubber sealant per ASTM C990.

2.02 CONCRETE

A. Cement for manholes shall conform to ASTM C150, Type I or II.

B. Concrete used in pouring the manhole base shall be Class A per Section 030500.

2.03 STEPS OR RUNGS

Cast manholes with steps (ladder rungs). Steps (ladder rungs) shall be 1/2-inch minimum diameter steel reinforced bar with a polypropylene plastic covering (per ASTM D4101),

or as otherwise shown on the drawings. Minimum clear length of rungs shall be 14 inches. Space rungs vertically at 12 inches on center, set between 5 and 6 inches from the face of the concrete, and align with each other in a straight vertical line (both parallel and perpendicular to ladder rungs). Steps shall be Lane International P-14938 or equal.

2.04 MANHOLE FRAMES AND COVERS

A. Manhole frames and covers shall be made of cast iron conforming to ASTM A48, Class 30. Castings shall be smooth, clean, and free from blisters, blowholes, and shrinkage. Frames and covers shall be designed for H20-44 traffic loads. The cover shall seat firmly into the frame without rocking.

B. Grind or otherwise finish each cover so that it will fit in its frame without rocking. Frames and covers shall be match marked in sets before shipping to the site.

C. Before leaving the foundry, clean castings and subject them to a hammer inspection.

D. Provide 2-inch lettering on lid reading “AMMONIA INJECTION” or as approved by Owner.

2.05 SEALING COMPOUND AND MORTAR

Butyl rubber sealing compound shall comply with ASTM C990. Mortar shall comply with ASTM C387, Type S, or use grout complying with Section 030500.

PART 3 - EXECUTION

3.01 MANHOLE BASE

A. Excavate for the manhole and install a crushed rock base, 12 inches thick, per Section 312316. Crushed rock base material shall extend 1 foot beyond the outside edge of the concrete manhole base. Compact to 90% relative density.

B. Form and pour concrete bases as one monolithic pour.

3.02 INSTALLING MANHOLES

A. Set each precast concrete manhole unit plumb on a bed of sealant or mortar to make a watertight joint at least 1/2 inch thick with the concrete base or with the preceding unit. Point the inside joint and wipe off the excess sealant or mortar. Secure the manhole frame to the grade ring with grout and cement mortar fillet. Backfill, compact, and replace pavement.

B. Assemble units so that the cover conforms to the elevation determined by the manhole location as follows:

1. In Paved Areas: Top of cover shall be flush with the paving surface.

2. In Shoulder Areas: Top of cover shall be flush with existing surface where it is in traveled way of shoulder and 0.1 foot above existing surface where outside limits of traveled way but not in the existing roadside ditch.

3. In Roadside Ditch or Unpaved Open Areas: Top of cover shall be 18 inches above the ground surface.

3.03 SEALING AND GROUTING OF MANHOLE SECTIONS

Clean ends of precast sections of foreign materials. Place two wraps of butyl rubber sealing compound around the groove of the lower section Set next section in place. Fill remaining interior and exterior joint cavity completely with mortar of the proper consistency. Trowel interior and exterior surfaces smooth on tongue-and-groove joints. Wipe off any excess grout from the interior and exterior of the joints. Prevent mortar from drying out by applying curing compound or comparable method. Chip out and replace cracked or defective mortar. Completed manhole shall be rigid and watertight.

3.04 LEAKAGE TESTING OF MANHOLES

Test manholes for leakage along with the pipe.

3.05 BACKFILL AROUND MANHOLES

Backfill and compact around the manholes using native material, per Section 312316 and the pipe specification.

END OF SECTION

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SECTION 034220 PRECAST CONCRETE VAULTS

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, design, and installation of precast concrete vaults and structures.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Concrete Construction: 030500

B. Ladders: 055100.

C. Grating, Cover Plates, and Access Hatches: 055300.

D. Earthwork: 312300.

E. Gravel and Crushed Rock Base for Structures: 312323.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit manufacturer's catalog data on precast concrete items. Show dimensions of vaults and thicknesses of walls, floors, and top slabs. Show reinforcing wire and steel. Show materials of construction by ASTM reference and grade.

C. Submit manufacturer's design calculations and certification signed and sealed by a professional engineer registered in the State of California that vault design and construction comply with the specified design load conditions and the referenced ASTM specifications (e.g., ASTM C857 and C858).

D. Submit concrete mix design, compressive test reports, and testing laboratory reports for aggregate in accordance with Section 030500, General Concrete Construction.

PART 2 - MATERIALS

2.01 MANUFACTURERS

Precast concrete vaults shall be manufactured by Brooks Products Inc., Utility Vault Company, Jensen Precast, or equal.

2.02 PRECAST CONCRETE VAULTS

A. Precast concrete vaults shall comply with ASTM C858 except as modified herein.

B. Design loads shall be in accordance with ASTM C857, except as modified herein. Traffic loads, unless otherwise stated, shall conform to Load Designation A-16 per Table 1. Soil lateral loads shall be as determined by ASTM C857 or loadings specified in the

project soils report, whichever is greater. Alternate design by the strength design method shall include a load factor of 1.7 times the lateral earth or hydrostatic pressures.

C. Include the following load conditions in the design:

1. Vault roof removed while structure is backfilled to grade and subject to live and dead loads.

2. Vault roof in place and walls subject to simultaneous vertical and horizontal application of all live, impact, and dead loads. Include the case of an A-16 designated load placed directly above the wall.

D. Design shall also comply with the following restrictions:

1. The maximum reinforcement ratio allowed is one-half the reinforcement ratio that would produce a balanced strain condition.

2. Earth pressure shall be converted to a horizontal pressure using a coefficient of earth pressure at rest of 0.5 and not a coefficient of active earth pressure.

3. Include a live load surcharge of 2 feet of soil in the design of the walls.

E. Design all vaults to receive the specified traffic loading.

F. Precast vault construction shall be in the form of monolithic walls or horizontal wall sections; do not use panel walls.

G. Minimum wall thickness shall be 6 inches. Design knockout wall panels to accommodate loading pressures defined above.

H. Design vault roof with removable and resealable panels for equipment access.

I. Floor slab shall be precast concrete as shown in the drawings. Calculations for the floor slab design shall be included in the vault design submittal.

J. Design joints using a butyl rubber sealant per ASTM C990.

2.03 SEALANTS AND MORTAR

Butyl rubber sealing compound shall comply with ASTM C990. Mortar shall comply with ASTM C387, Type S or use grout complying with Section 030500 .

2.04 LADDERS

Provide FRP ladders per Section 055100.

2.05 ACCESS HATCHES

A. Provide parkway rated access hatches, HS-20, per Section 055300.

2.06 DRAIN COVERS

Provide FRP drain covers.

2.07 CEMENT

Cement shall be ASTM C150, Type II.

2.08 ADMIXTURES

Provide concrete admixtures as specified in Section 030500.

2.09 CRUSHED ROCK BASE

Crushed rock base material shall comply with Section 312323.

PART 3 - EXECUTION

3.01 VAULT BASE

A. Excavate for the vault and install a crushed rock base, 6 inches thick.

B. Crushed rock base material shall extend 1 foot beyond the outside edge of the concrete vault base. Compact to 90% relative density.

3.02 SEALING AND GROUTING

Fill joints between precast sections with either a butyl rubber sealing compound or mortar.

3.03 INSTALLING VAULTS

A. Subsequent to placing the base, set each precast concrete vault section plumb on a bed of sealant or cement mortar at least 1/2-inch thick to make a watertight joint with the concrete base and with the preceding unit. Point the inside joint and wipe off the excess mortar or sealant.

B. Install hatches as specified on the drawings.

C. Install hatch drainpipe as specified on the drawings.

3.04 BACKFILL AROUND VAULTS

Backfill and compact around the vaults using fill as specified in Section 312300. Compact to 90% relative compaction.

END OF SECTION

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SECTION 050520 BOLTS, WASHERS, ANCHORS, AND EYEBOLTS

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes materials and installation of anchor bolts, connecting bolts, washers, drilled anchors, epoxy anchors, screw anchors, eyebolts, and stainless steel fasteners.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Miscellaneous Structural Steel and Aluminum: 051210.

B. Ladders: 055100.

C. General Piping Requirements: 400500.

D. Pipe Hangers and Supports: 400764.

1.03 DESIGN CRITERIA

Structural Connections: AISC Specification for Structural Steel Buildings (March 9, 2005), except connection details are shown in the contract drawings.

1.04 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit manufacturer's catalog data and ICC reports for bolts, washers, and concrete anchors. Show dimensions and reference materials of construction by ASTM designation and grade.

PART 2 - MATERIALS

2.01 ANCHOR BOLTS

Steel anchor bolts shall conform to ASTM A307, Grade A, B, or C.

2.02 CONNECTION BOLTS

A. Steel connection bolts shall conform to ASTM A307. Connection type shall be per the AISC handbook.

B. Provide galvanized bolts where shown in drawings. Galvanizing of bolts, nuts, and washers shall be in accordance with ASTM F2329.

2.03 STAINLESS STEEL BOLTS

Stainless steel bolts shall be ASTM A193, Grade B8 or ASTM F593. Nuts shall be ASTM A194, Grade 8M or ASTM F594. Use ASTM A194 nuts with ASTM A193 bolts; use ASTM F594 nuts with ASTM F593 bolts. Provide washer for each nut and bolthead. Washers shall be of the same material as the nuts.

2.04 LUBRICANT FOR STAINLESS STEEL BOLTS AND NUTS

Lubricant shall be chloride free and shall be RAMCO TG-50, Anti-Seize by RAMCO, Specialty Lubricants Corporation Husky™ Lube O'Seal, or equal.

2.05 HARDENED STEEL WASHERS

Washers for American Standard beams and channels shall be square or rectangular, tapered in thickness, smooth, hot-dipped galvanized, and conforming to ASTM F436.

2.06 DRILLED ANCHORS

A. Unless otherwise indicated in the drawings, drilled anchors shall be Type 316 stainless steel wedge anchors as manufactured by ITW Ramset/Redhead, Kwik Bolt TZ by Hilti, or equal.

2.07 EPOXY ANCHORS

A. Epoxy anchors in concrete shall be Type 316 stainless steel threaded rod adhesive anchors. Adhesive shall be Rawl Power-Fast, Hilti HIT RE 500-SD, Simpson SET-XP, or equal.

2.08 EMBEDDED EYEBOLTS

Eyebolts shall be of the welded-eye or forged type, Type 316 stainless steel.

PART 3 - EXECUTION

3.01 STORAGE OF MATERIALS

Store material, either plain or fabricated, above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

3.02 GALVANIZING

Zinc coating for bolts, anchor bolts, and threaded parts shall be in accordance with ASTM F2329.

3.03 INSTALLING CONNECTION BOLTS

A. Use steel bolts to connect structural steel members. Use stainless steel bolts to connect structural aluminum members.

B. Install washers per AISC Specification for ASD.

C. Bolt holes in structural members shall be 1/16 inch in diameter larger than bolt size. Measure cast-in-place bolt locations in the field before drilling companion holes in structural steel beam or assembly.

D. Drive bolts accurately into the holes without damaging the thread. Protect boltheads from damage during driving. Boltheads and nuts or washers shall rest squarely against the metal. Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with a plane normal to the bolt axis, provide beveled washers to give full bearing to the head or nut. Where self-locking nuts are not furnished, bolt threads shall be upset to prevent the nuts from backing off.

E. Bolts shall be of the length that will extend entirely through but not more than 1/4 inch beyond the nuts. Draw boltheads and nuts tight against the work. Tap boltheads with a hammer while the nut is being tightened.

3.04 INSTALLING ANCHOR BOLTS

A. Preset bolts and anchors by the use of templates. For mechanical equipment (pumps, compressors, and blowers), do not use concrete anchors set in holes drilled in the concrete after the concrete is placed.

B. For static items, use drilled anchors with ICC report data.

C. After anchor bolts have been embedded, protect projecting threads by applying grease and having the nuts installed until the time of installation of the equipment or metalwork.

D. Minimum depth of embedment of drilled mechanical anchors shall be as recommended by the manufacturer, but no less than that shown in the drawings.

E. Prepare holes for anchors in accordance with the anchor manufacturer’s recommendations prior to installation.

3.05 INSTALLATION OF STAINLESS STEEL BOLTS AND NUTS

Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

END OF SECTION

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SECTION 051210 MISCELLANEOUS STRUCTURAL STEEL AND ALUMINUM

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes materials, fabrication, and installation of structural steel, structural aluminum, stainless steel plate and members, steel tubing, aluminum tubing, and aluminum sheet.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Concrete Construction: 030500.

B. Bolts, Washers, Anchors, and Eyebolts: 050520.

C. Ladders: 055100.

D. Handrails and Safety Chains: 055200.

E. Access Hatches: 055300.

F. Painting and Coating: 099000.

1.03 DESIGN CRITERIA

Structural Connections and Framing: AISC Specification for Structural Steel Buildings (March 9, 2005), except connection details which are shown in the contract drawings.

1.04 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit placing or erection drawings that indicate locations of fabricated items. Reproductions of contract documents will not be accepted for this purpose.

PART 2 - MATERIALS

2.01 STRUCTURAL STEEL

Material for all-purpose bolted or welded construction shall conform to the following:

A. ASTM A992: W shapes (rolled wide flange shapes).

B. ASTM A36 or A572, Grade 50: S, M, HP, and channels.

C. ASTM A36: Angles and plates.

2.02 BOLTS AND WASHERS

See Section 050520.

2.03 STEEL PIPE COLUMNS

Conform to ASTM A53, Grade B.

2.04 HOLLOW STRUCTURAL STEEL (HSS) AND STAINLESS STEEL TUBING

A. Steel: Conform to ASTM A500, Grade B.

B. Stainless Steel: Conform to ASTM A554, Grade MT-316L.

2.05 STAINLESS STEEL PLATE AND MEMBERS

Except where otherwise specified, stainless steel plate shall be Type 316, ASTM A240. Stainless steel pipe shall conform to ASTM A312, Grade TP316. Wrought stainless steel fittings shall conform to ASTM A403, Class WP316.

2.06 ALUMINUM SHEET

Aluminum sheet shall conform to ASTM B209, Alloy 3003, H 14 temper.

2.07 STRUCTURAL ALUMINUM

Aluminum structural members shall conform to ASTM B308, Alloy 6061-T6. Aluminum bars and rods shall conform to ASTM B221, Alloy 6061-T6.

2.08 ALUMINUM TUBING

Aluminum seamless pipe and tubing shall conform to ASTM B241, Alloy 6061-T6. Wall thickness shall be Schedule 80, per ANSI H35.2, unless otherwise shown in the drawings.

2.09 WELDING ELECTRODES

A. Welding electrodes for structural steel shall conform to AWS A5.5. Use electrodes in the E-70 series.

B. Welding electrodes for aluminum shall be ER4043 filler metal.

C. Welding electrodes for stainless steel shall conform to AWS A5.4. Use electrodes as follows:

Stainless Steel Material	**Welding Electrode Material**
Type 304	E 308
Type 304L	E 347
Type 316	E 316
Type 316L	E 318

PART 3 - EXECUTION

3.01 STORAGE OF MATERIALS

Store structural material, either plain or fabricated, above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

3.02 FABRICATION AND ERECTION

A. Fabricate miscellaneous metal items to straight lines and true curves. Drilling and punching shall not leave burrs or deformations. Continuously weld permanent connections along the entire area of contact. Exposed work shall have a smooth finish with welds ground smooth. Joints shall have a close fit with corner joints coped or mitered and shall be in true alignment. Unless specifically indicated in the drawings, there shall be no bends, twists, or open joints in any finished member nor any projecting edges or corners at intersections. Conceal fastenings wherever possible. Built-up parts shall be free of warp. Exposed ends and edges of metal shall be slightly rounded.

B. Clean the surfaces of metalwork to be in contact with concrete of rust, dirt, grease, and other foreign substances before placing concrete.

C. Set embedded metalwork accurately in position when concrete is placed and support rigidly to prevent displacement or undue vibration during or after the placement of concrete. Unless otherwise specified, where metalwork is to be installed in recesses in formed concrete, said recesses shall be made, metalwork installed, and recesses filled with dry-pack mortar in conformance with Section 030500.

3.03 GALVANIZING FOR STEEL PLATES, PIPE, AND TUBING

Zinc coating shall be in accordance with ASTM A123.

3.04 WELDING

A. Perform welding on steel by the SMAW process. Welding shall conform to the AWS D1.1-2008, except as modified in AISC Section J2.

B. Perform welding on aluminum by the gas metal arc (MIG) or gas tungsten arc (TIG) process. Welding shall conform to the AWS D1.2-2003.

C. Perform welding on stainless steel by the TIG process. All welds shall be full penetration and smooth unless otherwise indicated in the drawings. Provide inert gas on the inside of pipe during welding to reduce oxidation.

D. Provide a minimum of two passes for metal in excess of 5/16-inch thickness.

E. Produce weld uniform in width and size throughout its length with each layer of weldment smooth; free of slag, cracks, pinholes, and undercuttings; and completely

fused to the adjacent weld beads and base metal. Avoid irregular surface, nonuniform bead pattern, and high crown. Form fillet welds of the indicated size of uniform height and fully penetrating. Accomplish repair, chipping, and grinding of welds in manner that will not gouge, groove, or reduce the base metal thickness.

3.05 BOLTING

See Section 050520.

3.06 CONTROL OF FLAME CUTTING

Do not use a gas-cutting torch in the field for correcting fabrication errors on any member in structural framing. Use a gas-cutting torch only on minor members when the member is not under stress.

3.07 REPAIR OF GALVANIZED SURFACES

Repair or replace metal with damaged galvanized surfaces at no additional cost to the Owner. Repair galvanized surfaces per Section 099000, System No. 55.

3.08 CORROSION PROTECTION OF ALUMINUM SURFACES

A. Coat aluminum surfaces to be embedded or which will be in contact with concrete or masonry, per Section 099000, System No. 54 before installation. Allow the coating to dry before the aluminum is placed in contact with the concrete.

B. Where aluminum surfaces come in contact with dissimilar metals, except stainless steel, keep the dissimilar metallic surfaces from direct contact by use of neoprene gaskets or washers.

3.09 PAINTING AND COATING OF STRUCTURAL STEEL

Coat nongalvanized structural steel surfaces per Section 099000, System No. 15. Apply prime coat in the shop prior to shipping to the site. Apply intermediate and finish coats after erection, except surfaces that will be inaccessible for coating after erection or assembly shall be finish coated prior to erection or assembly. Color of finish coat shall be as selected by Owner. Faying surfaces of connections that are not specified to be slip critical may be primed and need not be further painted.

END OF SECTION

SECTION 055100 LADDERS

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes materials, fabrication, and installation of ladders.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Concrete Construction: 030500.

B. Bolts, Washers, Anchors, and Eyebolts: 050520.

C. Handrails and Safety Chains: 055200.

D. Painting and Coating: 099000.

1.03 DESIGN CRITERIA

Handrails, Walkways, Ladders, and Personnel Platforms: OSHA and State Safety Standards.

1.04 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit drawings of stairs, ladders, and stair nosings. Show dimensions and reference materials of construction by ASTM designation and grade.

PART 2 - MATERIALS

2.01 VERTICAL LADDERS

A. INTERNAL VERTICAL LADDERS

Fabricate internal (inside 5MG tank) ladders as shown in the drawings. Ladders shall be Type 316 stainless steel. Minimum diameter of rungs shall be 3/4 inch. The distance between rungs, cleats, and steps shall not exceed 12 inches and shall be uniform throughout the length of the ladder. The minimum clear length of rungs or cleats shall be 16 inches. Apply nonskid coating per manufacturer's recommendations.

B. EXTERNAL VERTICAL LADDERS

Fabricate external (outside 5MG tank) ladders as shown in the drawings. Ladders shall be aluminum. Minimum diameter of rungs shall be 3/4 inch. The distance between rungs, cleats, and steps shall not exceed 12 inches and shall be uniform throughout the

length of the ladder. The minimum clear length of rungs or cleats shall be 16 inches. Apply nonskid coating per manufacturer's recommendations.

2.02 SAFETY CLIMB FOR VERTICAL LADDERS

A. Equip the ladders with a ladder-centered notched safety climbing tube of ASTM A276, Type 316 stainless steel.

B. Provide a Saf-T-Pivot dismount post removable extension kit for each ladder that is equipped with a Saf-T-Climb.

C. Provide a Ladder Up Safety Post by Bilco or equal for ladders at hatches.

D. Provide post, storage brackets, and box mounted inside hatch for the safety pivot dismount post removable extension kit, which extends above the roof hatch. Provide five sets of safety belts and sleeves. Provide ladder-up safety posts for ladders without safety climbs. Posts shall be of the same material as the ladder.

2.03 SECURITY COVERS FOR LADDERS

Provide 6-foot-high security covers at bottom of exterior tank ladders. Equip covers with hinges on one side and locking clasp on the other side. Covers shall be 1/8-inch-thick aluminum as manufactured by Carbis Inc., Core Terminal Products, or equal.

2.04 WELDING ELECTRODES

A. See Section 051210.

PART 3 - EXECUTION

3.01 STORAGE OF MATERIALS

Store structural material, either plain or fabricated, above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

3.02 INSTALLING LADDERS

Mount ladders to provide clearance in back of ladder so that the distance from the centerline of rungs, cleats, or steps to the nearest permanent object in back of the ladder shall be not less than 7 inches.

3.03 INSTALLING ANCHOR BOLTS

See Section 050520.

END OF SECTION

SECTION 055200 HANDRAILS AND SAFETY CHAINS

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes materials, fabrication, and installation of aluminum handrail and safety chains.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Concrete Construction: 030500.

B. Painting and Coating: 099000.

1.03 DESIGN CRITERIA

Handrails, Walkways, Ladders, Personnel Platforms: OSHA.

1.04 SUBMITTALS

A. Submit shop drawings in accordance with the General Section 013300.

B. Submit drawings of handrail and safety chains. Show dimensions and reference materials of construction by ASTM designation and grade. Show design criteria.

C. Submit placing or erection drawings that indicate locations of handrail and safety chains. Reproductions of contract documents will not be accepted for this purpose.

PART 2 - MATERIALS

2.01 STEEL HANDRAILS

Conform to ASTM A53. Steel handrails shall be standard weight (Schedule 40), 1-1/2-inch steel pipe, hot-dipped galvanized.

2.02 ALUMINUM HANDRAILS

Construct aluminum handrails of clear anodized aluminum pipe conforming to ASTM B429, Alloy 6063-T6. Handrail shall be CV Pipe Rail by Craneveyor, Wesrail as manufactured by Moultrie Manufacturing Co., or equal.

2.03 STAINLESS STEEL HANDRAILS

Construct stainless steel handrail of ASTM A554, Grade MT-316 or 316L round tubing as manufactured by J. G. Braun or equal. Outside diameter shall be 1 ½ inches.

2.04 GALVANIZED STEEL HANDRAIL SAFETY CHAINS

Handrail safety chains shall be galvanized steel. Chains shall be straight link style, 3/16 inch in diameter, with at least 12 links per foot and with snaphooks at each end. Snaphooks shall be galvanized boat type.

2.05 WELDING ELECTRODES

A. Welding electrodes for structural steel shall conform to AWS A5.5. Use electrodes in the E-70 series.

B. Welding electrode for aluminum shall be ER4043 filler metal.

C. Welding electrodes for stainless steel shall conform to AWS 5.4. Use Electrodes E308 for Type 304 stainless steel and E316 for Type 316 stainless steel.

PART 3 - EXECUTION

3.01 STORAGE OF MATERIALS

Store material above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

3.02 FABRICATION AND ERECTION

A. Clean the surfaces of metalwork to be in contact with concrete of rust, dirt, grease, and other foreign substances before placing concrete.

B. Set embedded metalwork accurately in position when concrete is placed and support it rigidly to prevent displacement or undue vibration during or after the placement of concrete. Unless otherwise specified, where metalwork is to be installed in recesses in formed concrete, said recesses shall be made, metalwork installed, and recesses filled with dry-pack mortar in conformance with Section 030500.

3.03 WELDING

A. Perform welding on steel by the SMAW process. Welding shall conform to the AWS D1.1-2006, except as modified in AISC Section J2.

B. Perform welding on aluminum by the gas metal arc (MIG) or gas tungsten arc (TIG) process. Welding shall conform to the AWS D1.2-2003.

C. Perform welding on stainless steel by the gas tungsten arc (TIG) process. Welds shall be full penetration and smooth. Provide inert gas on the inside of pipe during welding to reduce oxidation.

D. Provide a minimum of two passes for metal in excess of 5/16-inch thickness.

E. Produce weld uniform in width and size throughout its length with each layer of weldment smooth; free of slag, cracks, pinholes, and undercuttings; and completely fused to the adjacent weld beads and base metal. Avoid irregular surface, nonuniform bead pattern, and high crown. Form fillet welds of the indicated size of uniform height and fully penetrating. Accomplish repair, chipping, and grinding of welds in manner that will not gouge, groove, or reduce the base metal thickness.

3.04 INSTALLING HANDRAILS

Provide handrail components to complete the installation for the various types of handrail.

3.05 INSTALLING SAFETY CHAINS

Provide two chains 4 inches longer than the access opening for each opening. Mount the top chain 3 feet 6 inches above the floor, and mount the lower chain 2 feet above the floor.

3.06 REPAIR OF GALVANIZED SURFACES

Repair damaged galvanized surfaces by coating per Section 099000, System No. 55.

3.07 CORROSION PROTECTION FOR ALUMINUM SURFACES

A. Coat aluminum surfaces to be embedded or which will be in contact with concrete or masonry per Section 099000, System No. 54 before installation. Allow the coating to dry before the aluminum is placed in contact with the concrete.

B. Where aluminum surfaces come in contact with dissimilar metals, keep the dissimilar metallic surfaces from direct contact by use of neoprene gaskets or washers.

3.08 CORROSION PROTECTION OF STEEL HANDRAIL POSTS EMBEDDED IN CONCRETE

Coat steel handrail posts to be embedded in concrete per Section 099000, System No. 7. Apply coating from the bottom of the post to 1 inch above concrete embedment.

END OF SECTION

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SECTION 055300 ACCESS HATCHES

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes materials, fabrication, and installation of steel and aluminum grating, cover and floor plates, and access hatches.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Concrete Construction: 030500.

B. Painting and Coating: 099000.

1.03 DESIGN CRITERIA

A. Grating, Floor Plates, and Miscellaneous Cover Plates: Design live load of 200 psf, maximum deflection of 1/240 of span.

B. Access Hatches: AASHTO H20S loading.

1.04 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit drawings of grating, cover plates, and access hatches. Show dimensions and reference materials of construction by ASTM designation and grade. Show design criteria.

PART 2 - MATERIALS

2.01 DESIGN OF GRATING, FLOOR PLATES, AND MISCELLANEOUS COVER PLATES

A. Grating, floor plates, and miscellaneous cover plates shall be as detailed in the drawings or, if not detailed, shall be designed per subsection on “Design Criteria” in Part 1. No single piece of grating, floor plate, or miscellaneous cover plate shall weigh more than 80 pounds. Length of individual pieces shall not exceed one and one-half times the width, unless limited by the installation.

B. Field measure grating and cover plates for proper cutouts and size.

C. Grating shall be completely banded. For pipe and conduits (including electrical conduit) larger than 1 inch in diameter penetrating grating, cut and band grating..

2.02 STAINLESS STEEL PLATE AND MEMBERS

Except where otherwise specified, stainless steel plate and members shall be Type 304.

2.03 ALUMINUM SHEET

Aluminum sheet shall conform to ASTM B209, Alloy 3003, H 14 temper.

2.04 ALUMINUM ACCESS HATCHES

A. Access hatches shall be U.S.F. Fabrications, Inc., Type THD aluminum Bilco Type JD of the size and configuration shown in the drawings. Aluminum doors shall be anodized. Latch and lifting mechanism assemblies, hold-open arms and guides, and brackets, hinges, pins, and fasteners shall be Type 316 stainless steel. Hatches shall be designed to be opened and closed by one person.

B. Locking and Latching Devices:

1. Recessed hasp covered by a hinged lid flush with the exterior surface.

2.05 WELDING ELECTRODES

A. Welding electrodes for structural steel shall conform to AWS A5.5. Use electrodes in the E-70 series.

B. Welding electrode for aluminum shall be ER4043 filler metal.

C. Welding electrodes for stainless steel shall conform to AWS A5.4. Use electrodes as follows:

Stainless Steel Material	**Welding Electrode Material**
Type 304	E 308
Type 304L	E 347
Type 316	E 316
Type 316L	E 318

PART 3 - EXECUTION

3.01 STORAGE OF MATERIALS

Store structural material, either plain or fabricated, above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

3.02 INSTALLATION AND ERECTION

A. Clean the surfaces of metalwork to be in contact with concrete of rust, dirt, grease, and other foreign substances before placing concrete.

3.03 WELDING

A. Perform welding on aluminum by the gas metal arc (MIG) or gas tungsten arc (TIG) process. Welding shall conform to AWS D1.2-2003.

B. Perform welding on stainless steel by the gas tungsten arc (TIG) process. Welds shall be full penetration and smooth. Provide inert gas on the inside of pipe during welding to reduce oxidation.

C. Provide a minimum of two passes for metal in excess of 5/16-inch thickness.

D. Produce weld uniform in width and size throughout its length with each layer of weldment smooth; free of slag, cracks, pinholes, and undercuttings; and completely fused to the adjacent weld beads and base metal. Avoid irregular surface, nonuniform bead pattern, and high crown. Form fillet welds of the indicated size of uniform height and fully penetrating. Accomplish repair, chipping, and grinding of welds in manner that will not gouge, groove, or reduce the base metal thickness.

3.04 CORROSION PROTECTION OF ALUMINUM SURFACES

A. Coat aluminum surfaces to be embedded or which will be in contact with concrete or masonry per Section 099000, System No. 54 before installation. Allow the coating to dry before the aluminum is placed in contact with the concrete.

B. Where aluminum surfaces come in contact with dissimilar metals, keep the dissimilar metallic surfaces from direct contact by use of neoprene gaskets or washers.

END OF SECTION

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SECTION 066720 BAFFLES

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes design, materials, fabrication, and installation of fabric-reinforced Hypalon baffles.

1.02 RELATED WORK SPECIFIED ELSEWHERE

General Concrete Construction: 030500.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with the Section 013300.

B. Submit manufacturer's catalog data and descriptive literature. Show lining thickness.

C. Submit shop drawings showing baffle sheet layout with proposed size, number, and position of factory-fabricated sheets and indicating the location of all field joints. Shop drawings shall also show complete details and/or methods for anchoring the lining, making field joints, seals at structures, etc.

D. Submit fabric-reinforced Hypalon manufacturer’s 10 year warranty of installation and materials.

E. Provide fabric-reinforced Hypalon manufacturer’s certification of baffle installer and other qualifications including references for previous similar installations years of service.

PART 2 - MATERIALS

2.01 CHLOROSULFONATED POLYETHYLENE (HYPALON)

A. The membrane lining material shall be fabric-reinforced Hypalon designed and manufactured specifically for the purpose of this work and shall have been satisfactorily demonstrated by prior use to be suitable and durable for such purposes. The manufacturer shall have produced and have in service in similar applications for a period of not less than one year at least 500,000 square feet of fabric-reinforced industrial grade Hypalon material utilizing the same scrim specified for use under these specifications. Baffles shall be manufactured by Layfield, Envirocan, Lange, Burke, or equal.

B. Manufacture Hypalon utilized for encapsulation of the scrim from a composition of which Hypalon Type 45 synthetic rubber resin is the sole elastomer. Do not use zinc

compounds of any kind, including zinc oxide, zinc stearate, and zinc dusting agents. Do not use dusting agents of any kind on the finished product.

C. Scrim used in the membrane shall be 10 x 10 or 6 x 6 1,000d polyester that permits strikethrough of the Hypalon through the fabric to facilitate adhesion between the plies of Hypalon. Trim selvage edges prior to applying the Hypalon coating.

D. The composite membrane material shall consist of a bonded, fabric-reinforced Hypalon rubber sheeting. It shall be uniform in color, thickness, size, and surface texture. The fabric shall be totally encapsulated between plies of Hypalon and shall not extend closer than 1/8 inch or further than 3/4 inch to the edge of the Hypalon coating either side of the fabric. Do not provide exposed fabric along longitudinal edges of roll stock and indications of delamination. The composite material shall be a flexible, durable, watertight product free of pinholes, blisters, holes, and contaminants and shall not delaminate in a water environment.

E. The composite membrane material shall be fabric-reinforced Hypalon consisting of one ply of scrim and two plies of Hypalon.

Property	Specification	Test Method
Tensile strength, psi, min.	1,000 min	ASTM D412
Elongation, at break % min.	250 min	ASTM D412
Water absorption, (max. wt. gain), % - 7 days at 70°F	7.0	ASTM D471
Low temperature, cold bend, 1/8-inch mandrel for 4 hours, °F	-25 no cracks	ASTM D2136
Ozone Resistance (3 ppm at 30% strain at 104°F, 72 hours)	No cracks visible under 7 times magnification	ASTM D1149
Heat Aging (14 days at 212°F)		
Tensile strength, psi, min.	1,500	ASTM D412
Elongation, % min.	150	
Thickness	0.030 and not less than 0.029	ASTM D751
Breaking strength, lbs, min.	200	ASTM D751 Grad Method
Tongue tear, lbs, min.	70	ASTM D413
Ply adhesion, machine method 180-degree peel, lbs/2-inch width, min.	8	ASTM D413 Method A

F. Baffle material and accessories shall be NSF 61 approved for potable water use.

G. The fabricator shall be an experienced firm customarily engaged in factory-fabricating individual widths of fabric-reinforced Hypalon roll stock into large sheets. Factory seams shall have a minimum of 1-1/2-inch scrim-to-scrim overlap when made by the solvent seaming method and 5/8-inch scrim-to-scrim overlap when made by the heat-welded method.

H. Provide each factory-fabricated sheet with prominent, unique, indelible identifying markings indicating proper direction of unrolling and/or unfolding to facilitate layout and positioning in the field. Individually package each factory-fabricated sheet in a heavy cardboard or wooden crate fully enclosed and protected to prevent damage to it during shipment, prominently identified in the same fashion as the sheet within, and showing the date of shipment. Until installed, store factory-fabricated sheets in their original unopened crates; if outdoors, store on pallet and protect from the direct rays of the sun under a light-colored, heat-reflective opaque cover in a manner that provides a free-flowing airspace between the crate and cover.

2.02 DESIGN OF WEIRS AND BAFFLES

A. Design baffles so that the horizontal deflection due to wave action shall not exceed L/100 where L is the length between support points in inches.

B. Provide slotted mounting holes to provide for vertical adjustment of at least 3/4 inch. Provide butt plates at joints.

2.03 ATTACHMENT BOLTS, NUTS, AND WASHERS

Attach weirs and baffles with Type 316 stainless steel bolts and nuts. Fasteners shall comply with ASTM A193, Grade B8M or ASTM F593, Type 316 Nuts shall be ASTM A194, Grade 8M or ASTM F594, Type 316. Use ASTM A194 nuts with ASTM A193 bolts; use ASTM F594 nuts with ASTM F593 bolts. Provide washer for each nut and bolt head. Washers shall be of the same material as the nuts.

2.04 CAULKING AND JOINT SEALANTS

See Section 030500.

2.05 WARRANTY

A. Provide an installation warranty of one (1) year. Any defects due to installation workmanship shall be satisfactory repair without cost to the Owner.

B. Provide a manufacturer’s material weathering warranty of at least ten (10) years.

PART 3 - EXECUTION

3.01 PACKING AND SHIPPING

Comply with AWWA F102, Section 6.2.

3.02 INSPECTION

After delivery to the site, check baffles for cracks, holes, and other defects. Replace any item not satisfactory.

3.03 INSTALLATION

Install baffles as indicated on the drawings and in accordance with the fabric-reinforced Hypalon manufacturer's guidelines. Installation shall be conducted by an installer with five (5) years of similar experience and/or certified by the fabric-reinforced Hypalon manufacturer.

3.04 SEAM STRENGTH

Factory and field seams (joints) shall, after 12 days, have a seam strength of 170 pounds when tested in accordance with ASTM D751, Grab Method (using 4-inch-wide specimens having a length of 10 inches plus the seam width). The distance between the jaws of the testing apparatus at the start of the test shall be 8 inches plus the seam width and shall have sufficient strength in peel that they fail by delamination from the scrim rather than in the plane of the seam.

END OF SECTION

SECTION 071119 VAPOR BARRIER DAMPPROOFING MEMBRANE

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and installation of polyethylene film vapor barrier dampproofing membrane for the perimeter drain.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Concrete Construction: 030500.

B. Earthwork: 312300.

1.03 SUBMITTALS

A. Submit shop drawings and samples in accordance with the Section 013300.

B. Submit manufacturer's catalog data, descriptive literature, and samples of the vapor barrier material, tape, and adhesive.

PART 2 - MATERIALS

2.01 VAPOR BARRIER MATERIAL

A. Polyethylene sheeting, minimum 6 mils thick, conforming to ASTM D4397.

B. Sheets shall be as wide as practicable for application that will result in the least number of laps.

2.02 ADHESIVE

Trowel consistency adhesive as recommended by the membrane manufacturer.

2.03 TAPE

Tape for the sealing of laps and joints shall be a pressure-sensitive adhesive tape as recommended by the manufacturer of the vapor barrier material. Tape shall be a minimum of 3 inches wide.

PART 3 - EXECUTION

3.01 GENERAL

Install beneath the tank concrete slab on grade.

3.02 INSTALLATION

Lay vapor barrier sheets directly over the compacted subgrade just before concrete is poured. Carefully install to avoid puncture or tear. Patch punctures and tears occurring during subsequent operations. Lap edges not less than 4 inches and lap end joints not less than 6 inches, with all laps continuously sealed with tape. Carry barrier over any pipes laid on the fill and seal in waterproof manner to any pipes or conduits which penetrate the fill. Turn up membrane a minimum of 2 inches at the edges and secure to exterior wall foundations or footings with adhesive. Do not place stakes through vapor barrier membranes for screeding of concrete slabs.

END OF SECTION

SECTION 099000 PAINTING AND COATING

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and application of painting and coating systems for the following surfaces:

A. Submerged metal.

B. Exposed metal.

C. Buried metal.

D. Concrete and masonry.

E. PVC and FRP.

F. Metal in contact with concrete.

G. Fusion-bonded epoxy coated steel.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Cold-Applied Wax Tape Coating: 099752.

B. Fusion-Bonded Epoxy Linings and Coatings: 099761.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit manufacturer’s data sheets showing the following information:

1. Percent solids by volume.

2. Minimum and maximum recommended dry-film thickness per coat for prime, intermediate, and finish coats.

3. Recommended surface preparation.

4. Recommended thinners.

5. Statement verifying that the specified prime coat is recommended by the manufacturer for use with the specified intermediate and finish coats.

6. Application instructions including recommended equipment and temperature limitations.

7. Curing requirements and instructions.

C. Submit color swatches.

D. Submit certificate identifying the type and gradation of abrasives used for surface preparation.

E. Submit material safety data sheets for each coating.

PART 2 - MATERIALS

2.01 PAINTING AND COATING SYSTEMS

The following index lists the various painting and coating systems by service and generic type:

PAINT COATINGS SYSTEM INDEX

No.	**Title**	**Generic Coating**
Submerged Metal Coating Systems		
7.	Submerged Metal, Potable or Nonpotable Water	Epoxy
Exposed Metal Coating Systems		
11.	Exposed Metal, Corrosive Environment	Epoxy (four-coat system)
15.	Exposed Metal, Atmospheric Weathering or Water Condensation Environment	Acrylic
18.	Exposed Metal, Organic Zinc Primer for Shop Coating and Field Touch-Up	Organic zinc
R.	Temporary Rust Inhibitor	Epoxy
Buried Metal Coating Systems		
21.	Buried Metal	Epoxy
24.	Buried Metal	Corrosion-resisting grease
PVC, CPVC, and FRP Coating Systems		
41.	PVC	Polyurethane
Coating Systems for Nonferrous Metals		
54.	Aluminum Insulation from Concrete and Carbon Steel	Epoxy
Coating System for Fusion Epoxy-Coated Steel Surfaces		
66.	Fusion Epoxy-Coated Steel, Color Coding	Epoxy

These systems are specified in detail in the following paragraphs. For each coating, the required surface preparation, prime coat, intermediate coat (if required), topcoat, and coating thicknesses are described. Mil thicknesses shown are minimum dry-film thicknesses. Provide system No. R to all bare steel pipe for rust prevention during shipping.

2.02 SUBMERGED OR POTENTIALLY SUBMERGED METAL COATING SYSTEMS

System No. 7--Submerged Metal, Potable or Nonpotable Water:

Type: Epoxy.

Service Conditions: For use with structures, valves, piping, or equipment immersed in potable or nonpotable water.

Surface Preparation: SSPC SP-10.

Coating System: Apply the manufacturer's recommended number of coats to attain the specified minimum dry-film coating thickness. Products: Devoe Bar-Rust 233H, Tnemec 100, Scotchkote 323, Tnemec N140, Sherwin-Williams Tank Clad HS B62-80, Scotchkote 306, PPG AQUAPON® LT NSF Low Temperature Epoxy Coatings 95-172, Carboline Carboguard 891, PPG Amercoat 395FD, Carboline Plasite 7133 or 9133, Keysite 740, or equal; 30 mils total. Color of topcoat: white, unless otherwise noted. Each coat shall be different color than the one preceding it.

2.03 EXPOSED METAL COATING SYSTEMS

A. System No. 11--Exposed Metal, Corrosive Environment:

Type: Polyamide cured epoxy intermediate and finish coats with inorganic zinc prime coat.

Service Conditions: For use with metal structures or pipes subjected to water condensation or splashing; salt spray; chemical fumes such as hydrogen sulfide; and chemical contact.

Surface Preparation: SSPC SP-10.

Prime Coat: Two-component inorganic zinc pigmented coating recommended by the manufacturer to be coated with polyamide epoxy paint finish coating. Minimum zinc content shall be 12 pounds per gallon. Apply to a thickness of 3 mils. Products: Tnemec 90E-92, Devoe Catha-Coat 304 or 304V, International Interzinc 180HS, PPG Dimetcote 9HS, Carboline Carbozinc 11HS, Sherwin-Williams Zinc-Clad II Plus, PPG METALHIDE® 28 Inorganic Zinc-Rich Primer 97-672, or equal.

Intermediate Coat: Apply to a thickness of 4 mils. Products: Tnemec N69; Devoe Devran 224HS; International Interguard 760HS; PPG Amercoat 385; Carboline 888,

890, or 893; Sherwin-Williams Macropoxy 646 B58-600; PPG PITT-GUARD® Direct-to-Rust Epoxy Mastic Coating 97-145 series; or equal.

Finish Coats: Apply two coats to a thickness of 4 mils each. Products: Tnemec N69, Devoe Devran 224HS or 231, International Interguard 760HS, PPG Amercoat 385, Carboline 890, Sherwin-Williams Macropoxy 646 B58-600, PPG PITT-GUARD® Direct-to-Rust Epoxy Mastic Coating 97-145 series, or equal.

B. System No. 15--Exposed Metal, Atmospheric Weathering or Water Condensation Environment:

Type: One component acrylic enamel having a minimum volume solids content of 35% with an inorganic zinc primer.

Service Conditions: For use on interior and exterior metal and piping subject to sunlight, weathering, humidity, or water condensation.

Surface Preparation: SSPC SP-10.

Prime Coat: Sherwin-Williams Zinc Clad II Plus primer, Devoe Inorganic Zinc 304V, Carboline Carbozinc 11HS, Tnemec 90E-92, or equal applied to a minimum dry-film thickness of 3 mils.

Finish Coats: Two or more coats of Sherwin-Williams Sher-Cryl B66–300, Devoe Devflex 659, Carboline 3359 or 3359DTM, Tnemec Series 28 or 29, or equal. Apply sufficient coats to provide a total minimum dry-film thickness of 8 mils. Thickness of any individual coat shall not exceed 4 mils.

C. System No. 18--Organic Zinc Primer for Shop Coating and Field Touch-Up:

Type: Organic zinc primer having a minimum zinc content of 14 pounds per gallon.

Service Conditions: For use as a shop-applied primer or field touch-up primer over inorganic zinc prime coatings on exposed metal.

Surface Preparation: SSPC SP-10.

Coating: Coating shall be of the two- or three-component converted epoxy, epoxy phenolic, or urethane type. Products: Tnemec 90-97, International Interzinc 308, PPG Amercoat 68HS, Devoe 313, Carboline 859, Sherwin-Williams Zinc-Clad III HS, PPG DURETHANE™ MCZ 97-679, or equal; applied to a minimum dry-film thickness of 3 mils. Organic zinc primer shall be manufactured by the prime coat manufacturer.

2.04 BURIED METAL COATING SYSTEMS

System No. 21--Buried Metal:

Type: High solids epoxy or phenolic epoxy having a minimum volume solids of 80% (ASTM D2697).

Service Conditions: Buried metal, such as valves, flanges, bolts, nuts, structural steel, and fittings.

Surface Preparation: SSPC SP-10.

Coating System: Apply three or more coats of PPG Amerlock 400 or 400VOC, Tnemec 104HS or 80, Devoe Bar-Rust 233H, Carboline 890LT, Sherwin-Williams Tank Clad HS B62-80 series, or equal; 30 mils total. Maximum thickness of an individual coating shall not exceed the manufacturer's recommendation.

2.05 SYSTEM NO. 24--BURIED METAL:

Type: Corrosion-resisting grease.

Service Conditions: Buried metal, such as bolts, bolt threads, tie rods, and nuts.

Surface Preparation: SSPC SP-3 or SP-6.

Coating: NO-OX-ID GG-2 as manufactured by Sanchem, Inc. Apply to a minimum thickness of 1/4 inch.

2.06 PVC AND FRP COATING SYSTEM

System No. 41--PVC:

Type: Epoxy primer with a minimum volume solids of 54% and a pigmented polyurethane enamel having a minimum volume solids of 52%.

Service Conditions: PVC.

Surface Preparation: SSPC SP-1. Then lightly abrade the surface with medium-grain sandpaper.

Prime Coat: One coat of Tnemec Series N69 Epoxoline, International 7510, PPG Amercoat 385, Devoe Devran 224HS, Sherwin-Williams Macropoxy 646 B58 series, Carboline 888 or 890, PPG PITT-GUARD® Direct-to-Rust Epoxy Mastic Coating 97-145 series, or equal. Apply to a minimum dry-film thickness of 4 mils.

Finish Coat: One coat of Tnemec Series 1075, International Interthane 990HS, PPG Amercoat 450HS, Devoe Devran 379, Sherwin-Williams Hi-Solids Polyurethane B65-300 series, PPG PITTHANE® Ultra Gloss Urethane Enamel 95-812 series, or equal. Apply to a minimum dry-film thickness of 3 mils.

2.07 COATING SYSTEMS FOR NONFERROUS METALS

System No. 54--Aluminum Insulation from Concrete and Carbon Steel:

Type: High solids epoxy or phenolic epoxy having a minimum volume solids of 80% (ASTM D2697).

Service Conditions: Coat areas of aluminum grating, stairs, structural members or aluminum fabrications, in contact with concrete or carbon steel with this system.

Surface Preparation: Solvent or steam cleaning per SSPC SP-1; do not use alkali cleaning. Then dust blast.

Coating System: Apply three or more coats of PPG Amerlock 400 or 400VOC, Tnemec Series 135, Devoe Bar-Rust 233H, Sherwin-Williams Macropoxy B58-600, PPG PITT-GUARD® Direct-to-Rust Epoxy Mastic Coating 97-145 series, or equal; 30 mils total. Maximum thickness of an individual coating shall not exceed the manufacturer's recommendation.

2.08 COATING SYSTEMS FOR FUSION EPOXY-COATED STEEL SURFACES

System No. 66--Fusion Epoxy-Coated Steel, Color Coding:

Type: Epoxy having a minimum volume solids content of 60%.

Application: Color coding of pipe or steel surfaces already coated with fusion bonded epoxy.

Surface Preparation: SSPC SP-1. Then sweep blast the epoxy surface per SP-7 to provide a 2- to 3-mil profile in the fusion-bonded epoxy substrate.

Prime Coat: None.

Finish Coat: One coat of Carboline 890, Tnemec 104, International Interguard 760HS, PPG Amercoat 385, Devoe Devran 224HS, Sherwin-Williams Macropoxy 646 B58-600 series, PPG PITT-GUARD® Direct-to-Rust Epoxy Mastic Coating 97-145 series, or equal. Apply to a minimum dry-film thickness of 5 mils.

2.09 TEMPORARY RUST INHIBITOR FOR STEEL SURFACES

Provide a thin layer of epoxy primer to prevent rust during shipping.

2.10 ABRASIVES FOR SURFACE PREPARATION

A. Abrasives used for preparation of ferrous (excluding stainless steel) surfaces shall be one of the following:

1. 16 to 30 or 16 to 40 mesh silica sand or mineral grit.

2. 20 to 40 mesh garnet.

3. Crushed iron slag, 100% retained on No. 80 mesh.

4. SAE Grade G-40 or G-50 iron or steel grit.

B. In the above gradations, 100% of the material shall pass through the first stated sieve size and 100% shall be retained on the second stated sieve size.

2.11 ORGANIC ZINC PRIMER FOR FIELD TOUCH-UP AND SHOP COATING

Where shop-applied inorganic zinc primers cannot be used because of volatile organic compound (VOC) regulations, the organic zinc primer described in System No. 18 may be substituted for the specified inorganic zinc primers.

PART 3 - EXECUTION

3.01 WEATHER CONDITIONS

A. Do not paint in the rain, wind, snow, mist, and fog or when steel or metal surface temperatures are less than 5°F above the dew point.

B. Do not apply paint when the relative humidity is above 85%. Do not paint when temperature of metal to be painted is above 120°F.

C. Do not apply alkyd, inorganic zinc, silicone aluminum, or silicone acrylic paints if air or surface temperature is below 40°F or expected to be below 40°F within 24 hours. Edit paragraph below to match the coatings used in your project.

D. Do not apply epoxy, acrylic latex, and polyurethane paints on an exterior or interior surface if air or surface temperature is below 60°F or expected to drop below 60°F in 24 hours.

3.02 SURFACE PREPARATION PROCEDURES

A. Remove oil and grease from metal surfaces in accordance with SSPC SP-1. Use clean cloths and cleaning solvents and wipe dry with clean cloths. Do not leave a film or greasy residue on the cleaned surfaces before abrasive blasting.

B. Remove weld spatter and weld slag from metal surfaces and grind smoothly rough welds, beads, peaked corners, and sharp edges including erection lugs in accordance with SSPC SP-2 and SSPC SP-3. Grind 0.020 inch (minimum) off the weld caps on pipe weld seams. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.

C. Do not abrasive blast or prepare more surface area in one day than can be coated in one day; prepare surfaces and apply coatings the same day. Remove sharp edges, burrs, and weld spatter.

D. For carbon steel, do not touch the surface between the time of abrasive blasting and the time the coating is applied. Apply coatings within two hours of blasting or before any rust bloom forms.

E. Surface preparation shall conform with the SSPC specifications as follows:

Solvent Cleaning	SP-1
Hand Tool Cleaning	SP-2
Power Tool Cleaning	SP-3
White Metal Blast Cleaning	SP-5
Commercial Blast Cleaning	SP-6
Brush-Off Blast Cleaning	SP-7
Pickling	SP-8
Near-White Blast Cleaning	SP-10
Power Tool Cleaning to Bare Metal	SP-11
Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating	SP-12
Surface Preparation of Concrete	SP-13

F. Wherever the words “solvent cleaning,” “hand tool cleaning,” “wire brushing,” or “blast cleaning” or similar words are used in these specifications or in paint manufacturer’s specifications, they shall be understood to refer to the applicable SSPC (Society for Protective Coatings), surface preparation specifications listed above.

G. For carbon steel surfaces, after abrasive blast cleaning, the height of the surface profile shall be 2 to 3 mils. Verify the surface profile by measuring with an impresser tape acceptable to the Owner’s Representative. Perform a minimum of one test per 100 square feet of surface area. Testing shall be witnessed by the Owner’s Representative. The impresser tape used in the test shall be permanently marked with the date, time, and locations where the test was made. Test results shall be promptly presented to the Owner’s Representative.

H. Do not apply any part of a coating system before the Owner’s Representative has reviewed the surface preparation. If coating has been applied without this review, if directed by the Owner’s Representative, remove the applied coating by abrasive blasting and reapply the coat in accordance with this specification.

3.03 ABRASIVE BLAST CLEANING

A. Use dry abrasive blast cleaning for metal surfaces. Do not use abrasives in automatic equipment that have become contaminated. When shop or field blast cleaning with handheld nozzles, do not recycle or reuse blast particles.

B. After abrasive blast cleaning and prior to application of coating, dry clean surfaces to be coated by dusting, sweeping, and vacuuming to remove residue from blasting. Apply the specified primer or touch-up coating within the period of an eight-hour working day. Do not apply coating over damp or moist surfaces. Reclean prior to application of primer or touch-up coating any blast cleaned surface not coated within said eight-hour period.

C. Keep the area of the work in a clean condition and do not permit blasting particles to accumulate and constitute a nuisance or hazard.

D. During abrasive blast cleaning, prevent damage to adjacent coatings. Schedule blast cleaning and coating such that dust, dirt, blast particles, old coatings, rust, mill scale, etc., will not damage or fall upon wet or newly coated surfaces.

3.04 PROCEDURES FOR ITEMS HAVING SHOP-APPLIED PRIME COATS

A. After application of primer to surfaces, allow coating to cure for a minimum of two hours before handling to minimize damage.

B. When loading for shipment to the project site, use spacers and other protective devices to separate items to prevent damaging the shop-primed surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the shop-primed surfaces after separation. Use padded chains or ribbon binders to secure the loaded items and minimize damage to the shop-primed surfaces.

C. Cover shop-primed items 100% with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.

D. Handle shop-primed items with care during unloading, installation, and erection operations to minimize damage. Do not place or store shop-primed items on the ground or on top of other work unless ground or work is covered with a protective covering or tarpaulin. Place shop-primed items above the ground upon platforms, skids, or other supports.

3.05 FIELD TOUCH-UP OF SHOP-APPLIED PRIME COATS

A. Remove oil and grease surface contaminants on metal surfaces in accordance with SSPC SP-1. Use clean rags wetted with a degreasing solution, rinse with clean water, and wipe dry.

B. Remove dust, dirt, salts, moisture, chalking primers, or other surface contaminants that will affect the adhesion or durability of the coating system. Use a high-pressure water blaster or scrub surfaces with a broom or brush wetted with a solution of trisodium phosphate, detergent, and water. Before applying intermediate or finish coats to inorganic zinc primers, remove any soluble zinc salts that have formed by means of scrubbing with a stiff bristle brush. Rinse scrubbed surfaces with clean water.

C. Remove loose or peeling primer and other surface contaminants not easily removed by the previous cleaning methods in accordance with SSPC SP-7. Take care that remaining

primers are not damaged by the blast cleaning operation. Remaining primers shall be firmly bonded to the steel surfaces with blast cleaned edges feathered.

D. Remove rust, scaling, or primer damaged by welding or during shipment, storage, and erection in accordance with SSPC SP-10. Take care that remaining primers are not damaged by the blast cleaning operation. Areas smaller than 1 square inch may be prepared per SSPC SP-11. Remaining primers shall be firmly bonded to the steel surfaces with cleaned edges feathered.

E. Use repair procedures on damaged primer that protects adjacent primer. Blast cleaning may require the use of lower air pressure, smaller nozzles, and abrasive particle sizes, short blast nozzle distance from surface, shielding, and/or masking.

F. After abrasive blast cleaning of damaged and defective areas, remove dust, blast particles, and other debris by dusting, sweeping, and vacuuming; then apply the specified touch-up coating.

G. Surfaces that are shop primed with inorganic zinc primers shall receive a field touch-up of organic zinc primer per System No. 18 to cover scratches or abraded areas.

H. Other surfaces that are shop primed shall receive a field touch-up of the same primer used in the original prime coat.

3.06 PAINTING SYSTEMS

A. All materials of a specified painting system, including primer, intermediate, and finish coats, shall be produced by the same manufacturer. Thinners, cleaners, driers, and other additives shall be as recommended by the paint manufacturer for the particular coating system.

B. Deliver paints to the jobsite in the original, unopened containers.

3.07 PAINT STORAGE AND MIXING

A. Store and mix materials only in areas designated for that purpose by the Owner's Representative. The area shall be well-ventilated, with precautionary measures taken to prevent fire hazards. Post "No Smoking" signs. Storage and mixing areas shall be clean and free of rags, waste, and scrapings. Tightly close containers after each use. Store paint at an ambient temperature from 50°F to 100°F.

B. Prepare multiple-component coatings using all of the contents of the container for each component as packaged by the paint manufacturer. Do not use partial batches. Do not use multiple-component coatings that have been mixed beyond their pot life. Provide small quantity kits for touch-up painting and for painting other small areas. Mix only the components specified and furnished by the paint manufacturer. Do not intermix additional components for reasons of color or otherwise, even within the same generic type of coating.

3.08 PROCEDURES FOR THE APPLICATION OF COATINGS

A. Conform to the requirements of SSPC PA-1. Follow the recommendations of the coating manufacturer including the selection of spray equipment, brushes, rollers, cleaners, thinners, mixing, drying time, temperature and humidity of application, and safety precautions.

B. Stir, strain, and keep coating materials at a uniform consistency during application. Power mix components. For multiple component materials, premix each component before combining. Apply each coating evenly, free of brush marks, sags, runs, and other evidence of poor workmanship. Use a different shade or tint on succeeding coating applications to indicate coverage where possible. Finished surfaces shall be free from defects or blemishes.

C. Do not use thinners unless recommended by the coating manufacturer. If thinning is allowed, do not exceed the maximum allowable amount of thinner per gallon of coating material. Stir coating materials at all times when adding thinner. Do not flood the coating material surface with thinner prior to mixing. Do not reduce coating materials more than is absolutely necessary to obtain the proper application characteristics and to obtain the specified dry-film thicknesses.

D. Remove dust, blast particles, and other debris from blast cleaned surfaces by dusting, sweeping, and vacuuming. Allow ventilator fans to clean airborne dust to provide good visibility of working area prior to coating applications. Remove dust from coated surfaces by dusting, sweeping, and vacuuming prior to applying succeeding coats.

E. Apply coating systems to the specified minimum dry-film thicknesses as determined per SSPC PA-2.

F. Apply primer immediately after blast cleaning and before any surface rusting occurs, or any dust, dirt, or any foreign matter has accumulated. Reclean surfaces by blast cleaning that have surface colored or become moist prior to coating application.

G. Apply a brush coat of primer on welds, sharp edges, nuts, bolts, and irregular surfaces prior to the application of the primer and finish coat. Apply the brush coat prior to and in conjunction with the spray coat application. Apply the spray coat over the brush coat.

H. Before applying subsequent coats, allow the primer and intermediate coats to dry for the minimum curing time recommended by the manufacturer. In no case shall the time between coats exceed the manufacturer’s recommendation.

I. Each coat shall cover the surface of the preceding coat completely, and there shall be a visually perceptible difference in applied shade or tint of colors.

J. Applied coating systems shall be cured at 75°F or higher for 48 hours. If temperature is lower than 75°F, curing time shall be in accordance with printed recommendations of the manufacturer, unless otherwise allowed by the Owner’s Representative.

K. Assembled parts shall be disassembled sufficiently before painting or coating to ensure complete coverage by the required coating.

3.09 SURFACES NOT TO BE COATED

Do not paint the following surfaces unless otherwise noted in the drawings or in other specification sections. Protect during the painting of adjacent areas:

A. Concrete walkways.

B. Mortar-coated pipe and fittings.

C. Stainless steel.

D. Metal letters.

E. Glass.

F. Fencing.

G. Electrical fixtures except for factory coatings.

H. Nameplates.

I. Buried pipe, unless specifically required in the piping specifications.

J. Fiberglass items, unless specifically required in the FRP specifications.

K. Aluminum handrail, stairs, and grating.

3.10 PROTECTION OF SURFACES NOT TO BE PAINTED

Remove, mask, or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect working parts of mechanical and electrical equipment from damage during surface preparation and painting process. Mask openings in motors to prevent paint and other materials from entering the motors.

3.11 SURFACES TO BE COATED

The exact coating to be applied in any location is not designated by the descriptive phrases in the coating system titles such as “corrosive environment,” “buried metal,” or “submerged metal.” Coat surfaces with the specific coating systems as described below. All paint colors must be approved by the Owner.

Piping Designation	Color of Finish Coat
Water Tank	To Be Determined
Filtered Water Inlet and Outlet (FWI & FWO)	Tan
Domestic Water	Tan
Drains and Overflow	Tan
Air Lines	Tan
Ammonia Conduit	Orange
Electrical/Communication Conduits	White

A. Coat exterior tank walls and tank roof with Owner approved color. Color options are: (1) Sherwin-Williams 6172 Hardware or TNEMEC Hardware #F156A6752, (2) TNEMEC #124GN Canvas Green, and (3) TNEMEC #132GN Camouflage.

B. Coat submerged piping per System No. 7.

C. Coat valves as described in the various valve specifications or if not noted the same as the adjacent piping. Aboveground valves, or valves in vaults and structures, shall match the color of the connecting piping.

D. Coat aluminum surfaces in contact with concrete per System No. 54.

E. Coat buried flanges, nuts and bolts, valves, flexible pipe couplings, exposed rebar in thrust blocks, and valve boxes per System No. 21 unless otherwise specified in the particular specifications for the above items.

F. Coat aboveground structural steel or structural steel located in vaults and structures similar to adjacent pipe unless otherwise noted.

3.12 DRY-FILM THICKNESS TESTING

A. Measure coating thickness specified for carbon steel surfaces with a magnetic-type dry-film thickness gauge in accordance with SSPC PA-2. Provide certification that the gauge has been calibrated by a certified laboratory within the past six months. Provide dry-film thickness gauge as manufactured by Mikrotest or Elcometer.

B. Test the finish coat of metal surfaces (except zinc primer and galvanizing) for holidays and discontinuities with an electrical holiday detector, low-voltage, wet-sponge type. Provide measuring equipment. Provide certification that the gauge has been calibrated by a certified laboratory within the past six months. Provide detector as manufactured by Tinker and Rasor or K-D Bird Dog.

C. Check each coat for the correct dry-film thickness. Do not measure within eight hours after application of the coating.

D. For metal surfaces, make five separate spot measurements (average of three readings) spaced evenly over each 100 square feet of area (or fraction thereof) to be measured. Make three readings for each spot measurement of either the substrate or the paint. Move the probe or detector a distance of 1 to 3 inches for each new gauge reading. Discard any unusually high or low reading that cannot be repeated consistently. Take the average (mean) of the three readings as the spot measurement. The average of five spot measurements for each such 100-square-foot area shall not be less than the specified thickness. No single spot measurement in any 100-square-foot area shall be less than 80%, nor more than 120%, of the specified thickness. One of three readings which are averaged to produce each spot measurement may underrun by a greater amount as defined by SSPC PA-2.

E. Perform tests in the presence of the Owner's Representative.

3.13 REPAIR OF IMPROPERLY COATED SURFACES

If the item has an improper finish color or insufficient film thickness, clean and topcoat the surface with the specified paint material to obtain the specified color and coverage. Sandblast or power-sand visible areas of chipped, peeled, or abraded paint, feathering the edges. Then prime and finish coat in accordance with the specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

3.14 CLEANING

A. During the progress of the work, remove discarded materials, rubbish, cans, and rags at the end of each day's work.

B. Thoroughly clean brushes and other application equipment at the end of each period of use and when changing to another paint or color.

C. Upon completion of painting work, remove masking tape, tarps, and other protective materials, using care not to damage finished surfaces.

END OF SECTION

SECTION 099752 COLD-APPLIED WAX TAPE COATING

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and application of a three-part, cold-applied wax tape coating system for buried piping per NACE RP0375-2006, Section 4 except as modified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

Polyethylene Sheet Encasement: 099754.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with the Section 013300.

B. Submit manufacturer's catalog data sheets and application instructions.

PART 2 - MATERIALS

2.01 PRIMER

A. Primer shall be a blend of petrolatums, plasticizers, and corrosion inhibitors having a paste-like consistency. The primer shall comply with NACE RP0375-2006 and shall have the following properties:

1. Pour Point: 100°F to 110°F.

2. Flash Point: 350°F.

3. Coverage: 1 gallon per 100 square feet.

B. Primer shall be Trenton Wax Tape Primer, Denso Paste Primer, or equal.

2.02 WAX TAPE

A. Wax tape shall consist of a synthetic-fiber felt, saturated with a blend of microcrystalline wax, petrolatums, plasticizers, and corrosion inhibitors, forming a tape coating that is easily formable over irregular surfaces. The tape shall comply with NACE RP0375-2006 and shall have the following properties:

1. Saturant Pour Point: 115°F to 120°F.

2. Thickness: 50 to 70 mils.

3. Tape Width: 6 inches.

B. Wax tapes used for pipe soil-to-air transitions shall be UV light stable so as not to degrade in the presence of sunlight.

C. Wax tape shall be Trenton No. 1 Wax Tape, Denso "Densyl Tape," or equal.

2.03 PLASTIC WRAPPER

A. Wrapper shall be a polyvinylidene chloride plastic with three 50-gauge plies wound together as a single sheet. The wrapper shall have the following properties:

1. Color: Clear.

2. Thickness: 1.5 mils.

3. Tape Width: 6 inches.

B. Plastic wrapper shall be Trenton Poly-Ply, Denso Tape PVC Self-Adhesive, or equal.

2.04 POLYETHYLENE SHEET COATING

See Section 099754.

PART 3 - EXECUTION

3.01 WAX TAPE COATING APPLICATION

A. Surfaces shall be clean and free of dirt, grease, water, and other foreign material prior to the application of the primer and wax tape.

B. Apply primer by hand or brush to fitting surfaces. Work the primer into crevices and completely cover exposed metal surfaces.

C. Apply the wax tape immediately after the primer application. Work the tape into the crevices around fittings. Apply the wax tape by pressing and molding the tape into conformity with the surface so that it does not bridge over irregular surfaces configurations. Begin wrapping approximately 3 inches behind the area to be wrapped. If starting at a straight edge, wrap the tape spirally around the pipe while touching the end edge before starting the angle to begin the spiral. If the previous roll is headed in a downward direction, tuck the next roll under the previous roll. Stretch each roll tight as wrapping continues to avoid air bubbles.

D. Wrap the wax tape spirally around the pipe and across the fitting. Use a minimum overlap of 50% of the tape width. Apply tape to flanges, mechanical and restrained joint bolts, nuts and glands, and grooved-end couplings to 6 inches beyond each side of the item.

E. Work the tape into the crevices and contours of irregularly shaped surfaces and smooth out so that there is a continuous protective layer with no voids or spaces under the tape.

F. After application, seal the overlap seams of the tape by hand by tapering and pressing the seam, attempting to create a continuous surface. There shall be no air pockets underneath the tape. The tape shall have direct intimate contact with the pipe surface.

G. On vertical sections of the piping, such as at pipe-to-soil transitions, wrap the pipe starting from the bottom and proceeding upward so that downward flowing water and backfill do not catch in a seam.

H. Overwrap the completed wax tape installation with the plastic wrapping material. Wrap spirally around the pipe and across the fitting. Use a minimum overlap of 55% of the tape width and apply two layers or applications of overwrap. Secure plastic wrapper to pipe with adhesive tape.

3.02 APPLICATION OF POLYETHYLENE SHEET COATING TO BURIED PIPING

Wrap completed wax tape coating system with polyethylene film per Section 099754 and secure around the adjacent pipe circumference with adhesive tape.

3.03 HANDLING AND INSTALLING WAX-TAPE COATED PIPE

A. Handle pipe in a manner to minimize damage to the coating. Equipment used for the handling of coated pipe shall be designed and constructed to avoid damaging the protective coating system. Inspect supported areas of the pipe prior to installation. Repair damaged areas before installation.

B. The pipeline trench shall be free of rocks, foreign matter, and projections that could damage the coating system.

END OF SECTION

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SECTION 099754 POLYETHYLENE SHEET ENCASEMENT

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and installation of a polyethylene sheet encasement for buried pipe, fittings, and valves, in accordance to AWWA C105, except as modified herein. PVC pipe, concrete pipe and steel pipe with mortar coating do not require encasement except as incidental to the encasement of fittings and valves.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Cold-Applied Wax Tape Coating: 099752.

B. Trenching, Backfilling, and Compacting: 312316.

C. General Piping Requirements: 400500.

D. Flexible Pipe Couplings and Expansion Joints: 400722.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit manufacturer's catalog literature and product data sheets describing the physical, chemical, and electrical properties of the encasement material.

PART 2 - MATERIALS

2.01 POLYETHYLENE WRAP

A. The encasement shall consist of low-density polyethylene wrap of at least 8-mil thickness conforming to AWWA C105.

2.02 PLASTIC ADHESIVE TAPE

A. Tape shall consist of polyolefin backing and adhesive which bonds to common pipeline coatings including polyethylene.

B. Minimum Width: 2 inches.

C. Products: Canusa Wrapid Tape; Tapecoat 35; Polyken 934; AA Thread Seal Tape, Inc.; or equal.

PART 3 - EXECUTION

3.01 APPLICATION OF MOLDABLE MASTIC FILLER TO IRREGULAR ADJACENT SURFACES

When the adjacent joints are bell-and-spigot or mechanical joints and any associated welding specifications do not require an external full fillet weld, apply a moldable mastic filler (per Section 400500) at the step-down area prior to the application of the sheet encasement and tape.

3.02 APPLYING SHEET COATING TO BURIED PIPING AND FITTINGS

A. Apply wrapping per AWWA C105 as modified herein.

B. Apply a double wrapping.

C. Install the polyethylene to completely encase the pipe and fittings to provide a watertight corrosion barrier. Continuously secure overlaps and ends of sheet and tube with polyethylene tape. Make circumferential seams with two complete wraps, with no exposed edges. Tape longitudinal seams and longitudinal overlaps, extending tape beyond and beneath circumferential seams.

D. Wrap bell-spigot interfaces, restrained joint components, and other irregular surfaces with wax tape or moldable sealant prior to placing polyethylene encasement.

E. Minimize voids beneath polyethylene. Place circumferential or spiral wraps of polyethylene tape at 2-foot intervals along the barrel of the pipe to minimize the space between the pipe and the polyethylene.

F. Overlap adjoining polyethylene tube coatings a minimum of 1 foot and wrap prior to placing concrete anchors, collars, supports, or thrust blocks. Hand wrap the polyethylene sheet, apply two complete wraps with no exposed edges to provide a watertight corrosion barrier, and secure in place with 2-inch-wide plastic adhesive tape.

3.03 APPLYING SHEET COATING TO BURIED VALVES

A. Wrap flanges and other irregular surfaces with wax tape or moldable sealant. Press tightly into place leaving no voids underneath and a smooth surface under coating for polyethylene sheet.

B. Wrap with a flat sheet of polyethylene. Place the sheet under the valve and the flanges or joints with the connecting pipe and fold in half. Extend the sheet to the valve stem and secure the sheet in place with 2-inch-wide plastic adhesive tape. Apply a second layer and secure with tape. Make two complete wraps, with no exposed edges, to provide a watertight corrosion barrier. Secure the sheets with tape around the valve stem below the operating nut and around the barrel of the connecting pipe to prevent the entrance of water and soil. Place concrete anchor and support blocks after the wrap has been installed.

3.04 APPLYING SHEET COATING TO BURIED FLEXIBLE PIPE COUPLINGS

A. Wrap irregular surfaces with wax tape or moldable sealant. Press tightly into place leaving no voids underneath and a smooth surface under coating for polyethylene sheet.

B. Apply two layers or wraps around the coupling. Overlap the adjoining pipe or fitting a minimum of 1 foot and secure in place with tape. Provide sufficient slack in polyethylene to allow backfill to be placed around fitting without tearing polyethylene. Apply tape around the entire circumference of the overlapped section on the adjoining pipe or fitting in two complete wraps, with no exposed edges, to provide a watertight corrosion barrier.

3.05 REPAIR OF POLYETHYLENE MATERIAL

Repair polyethylene material that is damaged during installation. Use polyethylene sheet, place over damaged or torn area, and secure in place with 2-inch-wide plastic adhesive tape.

3.06 APPLYING SHEET COATING TO EXISTING BURIED PIPING

When connecting polyethylene-encased pipe or fittings to existing pipe, expose existing pipe, thoroughly clean the surface, and securely tape the end of the polyethylene to the existing as specified above. When the existing pipe is polyethylene encased, wrap new polyethylene encasement over the existing, with overlap of at least 2 feet. Tape securely as specified above.

3.07 BACKFILL FOR POLYETHYLENE-WRAPPED PIPE, VALVES, AND FITTINGS

Place sand backfill within 1 foot of the pipe, valves, and fittings wrapped with polyethylene encasement per Section 312316.

3.08 INSTALLATION AND REPAIR OF POLYETHYLENE AT SERVICE TAPS

A. Wrap two or three layers of polyethylene adhesive tape completely around the pipe to cover the area where the tapping machine and chain will be mounted.

B. Mount the tapping machine on the pipe area covered by the polyethylene tape. Then make the tap and install the corporation stop directly through the tape and polyethylene.

C. After making the direct service connection, inspect the entire circumferential area for damage and make repairs.

D. To minimize the possibility of dissimilar metal corrosion at service connections, wrap the corporation stop a minimum clear distance of 3 feet of copper service pipes with polyethylene or dielectric tape.

END OF SECTION

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SECTION 099761 FUSION-BONDED EPOXY LININGS AND COATINGS

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, application, and testing of one-part, fusion-bonded, heat-cured, thermosetting, 100% solids epoxy linings and coatings on steel and cast-iron equipment, such as valves, flexible pipe couplings, and steel pipe.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Painting and Coating: 099000.

B. Flexible Pipe Couplings and Expansion Joints: 400722.

C. General Piping Requirements: 400500.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit manufacturer's catalog literature and product data sheets, describing the physical and chemical properties of the epoxy coating. Describe application and curing procedure.

C. Submit coating application test records for measuring coating thickness and holiday detection for each item or pipe section and fitting. Describe repair procedures used.

PART 2 - MATERIALS

2.01 PIPING AND EQUIPMENT SURFACES

A. Provide equipment that is free of salts, oil, and grease to the coating applicator.

B. Provide bare pipe that is free of salts, oil, and grease to the coating applicator.

2.02 SHOP-APPLIED EPOXY LINING AND COATING

Lining and coating shall be 100% solids, thermosetting, fusion-bonded, dry powder epoxy resin: Scotchkote 134 or 206N or equal. Epoxy lining and coating shall meet or exceed the following requirements:

Hardness (minimum)	Barcol 17 (ASTM D2583) Rockwell 50 ("M" scale)
Abrasion resistance (maximum value)	1,000 cycles: 0.05 gram removed
	5,000 cycles: 0.115 gram removed
	ASTM D1044, Tabor CS 17 wheel, 1,000-gram weight
Adhesion (minimum)	3,000 psi (Elcometer)
Tensile strength	7,300 psi (ASTM D2370)
Penetration	0 mil (ASTM G17)
Adhesion overlap shear, 1/8-inch steel panel, 0.010 glue line	4,300 psi, ASTM D1002
Impact (minimum value)	100 inch-pounds (Gardner 5/8-inch diameter tup)

2.03 FIELD-APPLIED EPOXY COATING FOR PATCHING

Use a minimum 80% solids liquid epoxy resin. Product: Scotchkote 306 or 323 or equal.

2.04 PAINTING AND COATING OF GROOVED-END AND FLEXIBLE PIPE COUPLINGS

Line and coat couplings the same as the pipe. Color shall match the color of the pipe fusion epoxy coating.

PART 3 - EXECUTION

3.01 SHOP APPLICATION OF FUSION-BONDED EPOXY LINING AND COATING--GENERAL

A. Grind surface irregularities, welds, and weld spatter smooth before applying the epoxy. The allowable grind area shall not exceed 0.25 square foot per location, and the maximum total grind area shall not exceed 1 square foot per item or piece of equipment. Do not use any item, pipe, or piece of equipment in which these requirements cannot be met.

B. Remove surface imperfections, such as slivers, scales, burrs, weld spatter, and gouges. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.

C. Uniformly preheat the pipe, item, or piece of equipment prior to blast cleaning to remove moisture from the surface. The preheat shall be sufficient to ensure that the surface temperature is at least 5°F above the dew point temperature during blast cleaning and inspection.

D. Sandblast surfaces per SSPC SP-5. Protect beveled pipe ends from the abrasive blast cleaning.

E. After cleaning and surface preparation, test the surface for residual chloride concentration. If the residual chloride concentration exceeds 5 $\mu g/cm^2$, then apply a phosphoric acid wash to the surface after sandblasting. The average temperature, measured at three different locations, shall be 80°F to 130°F during the acid wash procedure. The acid wash shall be a 5% by weight phosphoric acid solution. The duration in which the acid is in contact with the surface shall be determined by using the average temperature as tabulated below:

Surface Temperature (°F)	**Contact Time (seconds)**
80	52
85	45
90	36
95	33
100	28
105	24
110	21
130	10

After the acid wash has been completed, remove the acid with demineralized water having a maximum conductivity of 5 micromhos/cm at a minimum nozzle pressure of 2,500 psi.

F. Apply lining and coating by the electrostatic spray or fluidized bed process. Minimum thickness of lining or coating shall be 15 mils. Heat and cure per the epoxy manufacturer's recommendations. The heat source shall not leave a residue or contaminant on the metal surface. Do not allow oxidation of surfaces to occur prior to coating. Do not permit surfaces to flash rust before coating.

3.02 SHOP APPLICATION OF FUSION-BONDED EPOXY LINING AND COATING TO PIPE--ADDITIONAL REQUIREMENTS

A. Apply lining and coating per AWWA C213 except as modified herein.

B. Grind 0.020 inch (minimum) off the weld caps on the pipe weld seams before beginning the surface preparation and heating of the pipe.

3.03 SHOP APPLICATION OF FUSION-BONDED EPOXY LINING AND COATING TO JOINT AREAS OF DUCTILE-IRON AND CAST-IRON FITTINGS--ADDITIONAL REQUIREMENTS

Limit the protective coating thickness in the joints of ductile-iron and cast-iron fittings to maintain a leak-proof joint. However, the coating thickness in the joint area shall not be less than 4 mils.

3.04 QUALITY OF LINING AND COATING APPLICATIONS

The cured lining or coating shall be smooth and glossy, with no graininess or roughness. The lining or coating shall have no blisters, cracks, bubbles, underfilm voids, mechanical damage, discontinuities, or holidays.

3.05 FACTORY TESTING OF COATING--GENERAL

A. Test linings and coatings with a low-voltage wet sponge holiday detector. Test pipe linings and coatings per AWWA C213, Section 5.3.3. If the number of holidays or pinholes is fewer than one per 20 square feet of coating surface, repair the holidays and pinholes by applying the coating manufacturer's recommended patching compound to each holiday or pinhole and retest. If the number of pinholes and holidays exceeds one per 20 square feet of coating surface, remove the entire lining or coating and recoat the item or pipe.

B. Measure the coating thickness at three locations on each item or piece of equipment or pipe section using a coating thickness gauge calibrated at least once per eight-hour shift. Record each measured thickness value. Where individual measured thickness values are less than the specified minimum thickness, measure the coating thickness at three additional points around the defective area. The average of these measurements shall exceed the specified minimum thickness value, and no individual thickness value shall be more than 2 mils below or 3 mils above the specified minimum value. If a section of the pipe, item, or piece of equipment does not meet these criteria, remove the entire lining or coating and recoat the entire item or piece of equipment.

3.06 FACTORY INSPECTION OF LINING AND COATING OF PIPE--ADDITIONAL REQUIREMENTS

Check for coating defects on the weld seam centerlines. There shall be no porous blisters, craters, or pimples lying along the peak of the weld crown.

3.07 SHIPPING, STORAGE, AND HANDLING

A. When loading piping, fittings, couplings, or other coated items for shipment to the project site, use spacers and other protective devices to separate pipes or other coated items to prevent damaging the coated surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the coated surfaces after separation. Use padded chains or ribbon binders to secure the loaded pipe or other coated items and minimize damage.

B. Do not load or unload pipe, fittings, couplings, or other coated items by inserting forklift tines or lifting chains inside the pipe or item. Use nonmetallic slings, padded chains, or padded forklift tines to lift pipe or other coated items.

C. Cover piping or other coated items 100% with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.

D. Provide stulls, braces, and supports for piping during shipping and storage such that out-of-roundness or deflection does not exceed 0.5% of the pipe diameter.

E. Handle piping and other coated items with care during the unloading, installation, and erection operations to minimize damage. Do not place or store pipe or other coated items on the ground or on top of other work unless ground or work is covered with a protective covering or tarpaulin. Place pipe or other coated items above the ground upon platforms, skids, or other supports.

F. Store piping or other coated items at the site on pallets to prevent direct contact with ground or floor. Cover pipe or coated items during storage with protective coverings or tarpaulins to prevent deposition of rainwater, salt air, dirt, dust, and other contaminants.

G. Do not allow piping or other coated items to contact metal, concrete, or other surfaces during storage, handling, or installation and erection at the site that could damage or scratch the coating.

3.08 FIELD REPAIRS

Patch scratches and damaged areas incurred while installing fusion-bonded epoxy coated items with a two-component, 80% solids (minimum), liquid epoxy resin. Wire brush or sandblast the damaged areas per SSPC SP-10. Lightly abrade or sandblast the coating or lining on the sides of the damaged area before applying the liquid epoxy coating. Apply an epoxy coating to defective linings and coatings to areas smaller than 20 square inches. Patched areas shall overlap the parent or base coating a minimum of 0.5 inch. If a defective area exceeds 20 square inches, remove the entire lining and coating and recoat the entire item or piece of equipment. Apply the liquid epoxy coating to a minimum dry-film thickness of 15 mils.

END OF SECTION

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SECTION 260500 GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, installation, and testing of the electrical system.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. One-Year Guarantee: General Conditions and Supplement.

B. Permits and Licenses: General Conditions and Supplement.

C. Construction Facilities and Temporary Controls: 015100.

1.03 REGULATORY AGENCIES AND STANDARDS

See General Conditions and Supplement.

1.04 QUALITY CONTROL

Materials, appliances, equipment, and devices shall conform to the applicable Underwriters' Laboratories, Inc. (UL) standards. The label of, or listing by, UL is required for all electrical equipment where applicable.

1.05 UTILITY COMPANY REQUIREMENTS

There are no utility company coordinate requirements in this project.

1.06 ELECTRICAL SERVICE CHANGES

A. These specifications and drawings delineate interfacing with existing system.

B. Prior to connecting to the existing system, make certain that every item is thoroughly prepared. Do the actual work at an off-peak time, or overtime, as arranged with the Owner or as hereinafter specified. Once the work is started, vigorously prosecute it to completion to keep downtime to a minimum.

C. Prepare a work procedure for all work-interrupting service to the Owner's equipment. Include a step-by-step procedure that will be followed in the performance of this work and the time involved in each step. Submit this procedure to the Owner's Representative for review two weeks in advance of the performance of the work.

1.07 POWER FOR CONSTRUCTION

Provide for or purchase power for construction in accordance with Section 015100.

1.08 SUBMITTALS

A. Submit shop drawings in accordance with General Conditions and Supplement.

B. Where catalog cuts are included, all items shown in such catalog cuts not pertinent to this project shall be crossed out. Where catalog lists manufacturer's standard options, those options not to be included shall be crossed out and those options to be provided shall be clearly highlighted.

PART 2 - MATERIALS

2.01 GENERAL

A. Similar materials and equipment shall be the product of a single manufacturer.

B. Provide only products which are new, undamaged, and in the original cartons or containers.

C. Materials and equipment shall be the standard products of manufacturers regularly engaged in the production of such material and shall be the manufacturer's current design.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The drawings indicate connections for typical equipment only. If the equipment furnished is different from what is shown, provide the modifications necessary for a safe and properly operating installation in accordance with the equipment manufacturer's recommendations.

B. The drawings diagrammatically indicate the desired location and arrangement of conduit runs, equipment, and other items. Field-determine exact location based on physical size and arrangement of equipment, finished elevations, and obstructions.

C. Work or equipment not indicated or specified which is necessary for the complete and proper operation of the electrical systems shall be accomplished without additional cost to the Owner.

D. Accomplish work required to pierce any waterproofing after the part piercing the waterproofing has been set in place. Seal and make watertight the openings made for this purpose.

E. Install equipment and material piercing firewalls and fire-resistant or fire-stopped walls, partitions, ceilings, and floors in a manner so the rating remains equivalent.

F. Seal weathertight equipment or components exposed to the weather.

G. Protect equipment outlets and conduit openings with factory-made plugs or caps whenever work is not in progress at that point.

3.02 REMOVAL OR RELOCATION OF MATERIALS AND EQUIPMENT

Repair affected surfaces to conform to the type, quality, and finish of the surrounding surface.

3.03 NAMEPLATES

A. Mark each individual panelboard, disconnect switch, timer, and relay. Contactor to identify each item with its respective service or function.

B. Provide a nameplate inside the door of each panelboard listing its designation, voltage, and feeder circuit number.

C. Provide a nameplate on each transformer listing its designation, voltage, feeder number, and load served.

D. Provide nameplates with engraved lettering not less than 1/4 inch high. Use black-on-white laminated plastic, attached with rivets or sheet metal screws. Do not use embossed plastic adhesive tape.

END OF SECTION

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SECTION 260519 WIRES AND CABLES

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes materials and installation of wires and cables rated 600 volts and below.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Electrical Requirements: 260500.

B. Grounding and Bonding: 260526.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 260500.

B. Submit material list for each conductor type. Indicate insulation material, conductor material, voltage rating, manufacturer and other data pertinent to the specific cable, such as shielding, number of pairs, and applicable standards.

PART 2 - MATERIALS

2.01 LOW-VOLTAGE BUILDING WIRE

A. Conductor material shall be copper.

B. Low-voltage building wire for use at 600 volts or less shall be 600-volt insulated, Type XHHW or THWN, and rated for continuous operation at 75°C.

C. No. 12 AWG minimum conductor size for power.

D. No. 14 AWG minimum conductor size for control circuits.

E. Conductors for receptacle circuits shall be solid. All other conductors shall be stranded.

2.02 TWISTED-SHIELDED CABLE

A. Cables shall be two No. 18 AWG stranded tinned-copper conductors individually insulated with fully color-coded PVC rated at 300 volts minimum; insulated conductors twisted together and shielded with a spiral-wound metal foil tape overlapped for 100% shielding. Outer jacket shall be PVC.

2.03 FIBER OPTIC CABLE

See relevant section.

2.04 GROUNDING CONDUCTORS--BARE COPPER

Refer to Section 260526 for bare copper grounding conductors.

2.05 CONDUCTOR TAGS

Provide individual or sleeved, nonmetallic, snap-on type; Grafoplast, Phoenix Contact, Thomas & Betts sleeve markers, or self-extinguishing heat-shrink adhesive-type markers. Brady, Thomas & Betts, or equal.

2.06 PLASTIC ADHESIVES

Plastic adhesives for color coding shall be 7-mil minimum thickness, flame-retardant, weather resistant tape, resisting abrasion, UV rays, moisture, alkalies, solvents, and acids. Adhesives shall meet the requirements of the UL 510 and CSA C22.2.

PART 3 - EXECUTION

3.01 LOW-VOLTAGE BUILDING WIRE INSTALLATION

A. Install wiring and cable in conduit and terminate unless otherwise noted.

B. To reduce pulling tension in long runs, coat cables with pulling compound recommended by the cable manufacturer before being pulled into conduits.

C. Remove debris and moisture from the conduits, boxes, and cabinets prior to cable installation.

D. Group conductors in panelboards, cabinets, pull boxes, and switchboard wireways; tie with plastic ties; and fan out to terminals.

3.02 IDENTIFICATION

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	**208/120 Volts**	**480/277 Volts**
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green

B. Phase conductors No. 10 AWG and smaller and neutral/ground conductors No. 6 and smaller shall have factory color coding with solid color insulation. Do not use onsite coloring of ends of conductors or apply colored plastic adhesives in lieu of factory color coding. Larger conductors may have onsite application of colored plastic adhesives at ends of conductors and at each splice.

C. Control wires shall have colored insulation. Separate color codes for each wire shall be provided in each conduit that has up to seven wires. Conduits with more than seven wires shall have at least seven types of colored insulation.

D. Tagging of Conductors: Tag control wires and instrument cables in panels, pull boxes, wireways, and at control device. Tag control wires and instrument cables with same wire numbers as on the shop drawing submittals. Tag power wires in pull boxes and wireways where there is more than one circuit. Tag power conductors with motor control center or panelboard number and circuit numbers.

3.03 LOW-VOLTAGE WIRE SPLICES

A. Solid Conductors: Use 3M "Scotchlok," Ideal "Super Nut," Buchanan B-Cap, or equal. Conductors shall not perform splices in underground handholes or pull boxes.

B. Stranded Conductors No. 8 and Larger: Use T & B "Locktite" connectors, Burndy Versitaps and heavy-duty connectors, O.Z. solderless connectors, or equal.

C. Stranded Conductors No. 10 and Smaller: Use crimp connectors with tools by same manufacturer and/or UL listed for connectors of all stranded conductors.

3.04 LOW-VOLTAGE WIRE TERMINATIONS

A. Terminate wires and cables at each end.

B. Provide ring tongue, nylon- or vinyl-insulated copper crimp terminals for termination on screw-type terminals, except for light switches and receptacles. Utilize installation tools recommended by the crimp manufacturer.

C. Terminal lugs shall be UL listed and of the copper compression type, electro-tin plated. Provide color-coded system on terminal and die sets to provide the correct number and location of crimps. Permanent die index number shall be embossed on completed crimp for inspection purposes.

D. Tighten screws to the value recommended by the manufacturer.

E. Wiring terminals in the remote generator control panel and medium-voltage switchgear shall be as specified in the respective specification sections.

3.05 FIELD TESTING

A. Perform insulation resistance test on all circuits and feeders with No. 10 size conductors and larger. Utilize a 1,000-volt d-c megohmmeter for 600-volt insulated conductors.

B. Test each complete circuit prior to energizing. Insulation resistance between conductors and between each conductor and ground shall not be less than 25 megohms. Repair or replace wires or cables in circuits that do not pass this test and repeat the test.

C. Evaluate ohmic values by comparison with conductors of same length and type.

D. Perform Continuity test by ohmmeter method to ensure proper cable connections.

E. Inspect shielded cables for proper shield grounding, proper terminations, and proper circuit identifications.

F. Inspect control cables for proper termination and proper circuit identification.

END OF SECTION

SECTION 260526 GROUNDING AND BONDING

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, testing, and installation of electrical grounding.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Electrical Requirements: 260500.

B. Wires and Cables: 260519.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 260500.

B. Submit material list for all grounding materials and equipment. Indicate size, material, and manufacturer.

C. Submit test results. Indicate overall resistance to ground and resistance of each electrode.

PART 2 - MATERIALS

2.01 CONDUCTORS

Conductors shall be low-voltage building-wire type as specified in Section 260519.

2.02 GROUND WELL

Install a ground well as detailed in the drawings. Grounding rod shall be 10-ft long copper clad steel, ¾" diameter.

PART 3 - EXECUTION

3.01 EQUIPMENT GROUNDING

A. Ground raceways and noncurrent carrying parts of electrical equipment in accordance with NEC Article 250. Use the metallic conduit system for equipment and enclosure grounding. Grounding through the conduit system shall be in excess of ground conductors.

B. Circuits shall carry one ground conductor for equipment grounding.

END OF SECTION

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SECTION 260534 CONDUITS, BOXES, AND FITTINGS

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes material, installation, and testing for conduit, boxes, and fittings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Electrical Requirements: 260500.

B. Grounding and Bonding: 260526.

C. Trenching, Backfilling, and Compacting: 312316.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 260500.

B. Submit product data for the following:

1. Conduit and fittings for each type specified.

2. Boxes.

1.04 QUALITY CONTROL

A. NEMA Compliance: Comply with NEMA standards pertaining to conduits and components.

B. UL Compliance and Labeling: Comply with requirements of UL standards pertaining to electrical conduits and components. Provide conduits and components listed and labeled by UL.

PART 2 - MATERIALS

2.01 PVC-COATED RIGID STEEL CONDUIT AND FITTINGS

A. Conduit:

1. All conduits, prior to coating, shall conform to NEMA C80.1 and UL 6. Conduits shall be hot-dipped galvanized inside and out with hot galvanized threads.

2. Both interior and exterior of the conduit shall be coated with an epoxy acrylic primer of approximately 0.5-mil thickness.

3. The exterior coating shall be applied by dipping in liquid plastisol or other equal method that will produce a finished product conforming to NEMA 5-19-1986.

4. The thickness of the PVC coating shall be a minimum of 40 mils the full length of the conduit except the threads.

5. The bond between the PVC coating and the conduit surface shall be greater than the tensile strength of the plastic.

6. Apply a chemically cured urethane coating of a thickness of 2 mils to the interior of conduit.

7. The conduit shall be bendable without damage to the PVC or urethane coatings.

8. Threads shall have an added protection of a 2-mil clear urethane coating.

B. Fittings:

1. Coat fittings similar to the conduits.

2. Provide a loose coupling with each length of conduit. A PVC coating shall be bonded to the outer surface of the coupling, and a PVC sleeve equal to the outside diameter of the uncoated conduit shall extend beyond both ends of the coupling approximately one pipe diameter or 2 inches whichever is smaller. The wall thickness of the sleeve shall be the same as the plastic coating on the pipe.

3. The PVC coating on the coupling shall be ribbed to enhance installation.

4. Hubs shall have PVC sleeves equal to those on the couplings.

5. Screws on Form 8 fittings shall be of stainless steel with encapsulated plastic heads.

6. Size U bolts and RA clamps to fit conduit, and encapsulate the nuts in plastic.

7. Fittings shall otherwise be same as specified for rigid steel.

8. Elbows or bends exceeding 45 degrees shall be PVC coated and shall be of the same dimensions as specified for rigid steel long-radius elbows.

9. Conduit bodies, where applicable, shall be Form 8 with a tongue-in-groove (V-seal) gasket to effectively seal out corrosive elements.

C. Conduits and fittings shall conform to NEMA RN-1 and shall be manufactured by Robroy, Perma-coat, KorKap, Ocal or equal.

2.02 RIGID NONMETALLIC CONDUIT (PVC) AND FITTINGS

A. Conduit: PVC Schedule 80, 90°C rise rating. Conforming to NEMA TC-2 Type EC-80 and UL-651.

B. Long-Radius Elbows (90 Degrees): Rigid PVC-coated conduit or PVC Schedule 80 conduit of the same dimension as specified for steel conduit.

C. Couplings, Adapters, Bell Ends, Expansion Couplings, Elbows, and Turns of 30 Degrees: Factory made to NEMA TC-2 and TC-3.

D. Joint Cement: As recommended by manufacturer as suitable for the climate, furnished with instructions to achieve watertight joints.

E. Manufacturers: Carlon, Condux, or equal.

2.03 LIQUIDTIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

A. Conduit: Steel, UL-360 listed, PVC jacketed.

B. Fittings:

1. Conform to ANSI C33.84, UL listed for use with the conduit.

2. In sizes 1-1/4 inches and less UL listed for grounding.

3. Made of steel or malleable iron, zinc plated, 105°C insulated throat, grounding and bonding lug.

2.04 CONDUIT BODIES

A. Provide types, shapes, and sizes to suit individual applications. Provide matching gasketed covers, secured with at least two captive corrosion-resistant screws.

B. Bodies connecting to rigid conduit shall be of the same material and material coating as the conduit, with metal threaded hubs. Provide with threaded covers or gasketed covers secured with at least two corrosion-resistant captive screws.

2.05 CONDUIT SUPPORTS

A. Supports, hangers, preformed channels, and clamps shall be Type 304 stainless steel, or PVC-coated steel. Bolts and nuts shall be Type 304 stainless steel.

2.06 DEVICE BOXES

PVC-coated steel, with metal threaded hubs. Provide with gasketed covers secured with at least two corrosion-resistant capture screws.

2.07 PULL BOXES

A. Pull Boxes shall be subsurface enclosure that have a bottom and is used with underground conduits, into which personnel can reach but do not enter, for the purpose of installing, operating, or maintaining equipment, cabling, or both. Use pull boxes with 24-inch by 36-inch minimum inside dimensions.

B. Provide pull boxes, for pulling conductors, as indicated indicated.

C. Pull Boxes: Precast concrete, closed bottom with sump and hot-dipped galvanized steel traffic-rated covers, designed to AASHTO HS20-44 loading. Provide with pulling irons.

D. Cover Holddowns: Stainless steel, penta-head, flush with cover, bolts.

E. Sump: Cast in bottom of pull boxes with cover and discharge pipe.

F. Pull boxes shall have identification on covers pertaining to type of service or as indicated in the drawings.

G. Manufacturer: Brooks Products, Associated Concrete Products, or equal.

2.08 CONDUIT SEALANT

A. Moisture Barrier Types: Sealant shall be a nontoxic, nonshrink, nonhardening, putty-type hand-applied material providing an effective barrier under submerged conditions.

B. Fire-Retardant Types: Fire stop material shall be a reusable, nontoxic, asbestos-free, expanding, putty-type material with a three-hour rating in accordance with UL-35L4.

2.09 WARNING TAPE

Tape shall be 6-inch-wide detectable warning tape with red protective polyethylene jacket resistant to alkalies, acids, and other destructive elements. The polyethylene tape shall be continuously imprinted "CAUTION--ELECTRICAL CONDUIT BELOW" unless otherwise indicated or directed by the Owner's Representative.

PART 3 - EXECUTION

3.01 CONDUIT USAGE SCHEDULE

Install the following types of conduits and fittings in locations listed, unless otherwise noted in the drawings. Definitions and requirements of NEC apply unless specifically modified below.

A. Exposed:

1. Material: PVC-coated rigid steel conduit, long radius elbows.

2. Minimum Size: 3/4 inch.

B. Above Grade in Pipe

1. Material: Rigid nonmetallic conduit.

2. Minimum Size: 1 inch.

C. Underground:

1. Material: Rigid nonmetallic conduit.

2. Minimum Size: 3/4 inch.

D. Conduit Stub-Ups:

1. Provide PVC-coated rigid steel conduit long-radius elbows for stub-ups which connect to underground rigid PVC conduit. Extensions from elbows above grade shall be PVC-coated rigid steel for a minimum of 6 inches above grade.

E. Final Connections to Vibrating Equipment, or Instruments:

1. Material: Liquid-tight flexible conduit.

2. Minimum Size: 1/2 inch.

3. Length of liquid-tight flexible conduit shall be 5 feet or less, unless field conditions require longer lengths.

3.02 CONDUIT INSTALLATION, GENERAL

A. Install above grade conduits exposed.

B. Run exposed conduits parallel and perpendicular to surface or exposed structural members and follow surface contours as much as practicable to provide a neat appearance.

C. Make right-angle bends in conduit runs with long-radius elbows or conduits bent to radii not less than those specified for long-radius elbows.

D. Make bends and offsets so that the inside diameter of conduit is not effectively reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.

E. Cap all conduits immediately after installation to prevent entrance of foreign matter.

F. Do not use diagonal runs except when specifically noted in the drawings.

G. Route exposed conduit to preserve headroom, access space, and work space.

H. Use manufacturer's recommended installation tools.

I. Conduit Terminations:

1. Terminate conduits with locknuts and bushings except where threaded hubs are specified.

2. Install conduits squarely to the box and provide one locknut outside the box and one locknut and bushing inside the box.

3. Install locknuts with dished side against the box.

4. When terminating in threaded hubs, screw the conduit or fitting tight into the hub so that the end bears against the fire protection shoulder.

5. When chase nipples are used, install conduits and coupling square to the box and tighten the chase nipple leaving no exposed threads.

J. Install exposed, parallel, or banked conduits together. Make bends in parallel or banked runs from the same centerline so that the bends are parallel. Factory elbows may be used in banked runs only where they can be installed parallel.

K. Conduit runs are shown schematically. Supports, pull boxes, junction boxes, conduit bodies, and other ancillary equipment are not shown in drawings. Provide as required by NEC. Provide additional boxes to permit pulling of wires without damage to the conductors or insulation.

3.03 REQUIREMENTS FOR RIGID NONMETALLIC (PVC) CONDUIT

A. Comply with the installation provisions of NEMA TC2, except as modified below.

B. Make cuts with a fine tooth handsaw. For sizes 2 inches and larger, use a miter box or similar saw guide to assure a square cut.

C. Use factory-made couplings for joining conduit.

D. Cementing and joining operation shall not exceed 20 seconds. Do not disturb joint for 5 minutes, longer (up to 10 minutes) at lower temperatures. Make joints watertight. Joining procedure shall conform with detailed procedures of ASTM D 2855.

E. Install expansion fittings. Expansion fittings are required when the conduit is left exposed in trenches for a period of time during which the conduit's temperature can vary more than 2 degrees. Install expansion fittings near the fixed end of the run and 100 feet on center.

3.04 CONDUIT SEALING

A. Seal conduit entries with silicone sealant as follows:

1. Conduits exiting buildings.

2. Conduits entering cable trenches or underground pull boxes.

3.05 GROUNDING

A. Provide grounding in accordance with Section 260526.

B. Use grounding bushings for all conduits carrying a grounding conductor.

3.06 CONDUITS UNDERGROUND

Use PVC conduits where conduit is installed underground in locations other than under concrete slab. Provide 24-inch minimum cover. Provide 3-inch minimum fine sand below conduits as specified in Section 312316. Maintain a 12-inch minimum separation between conduit and other systems. Pitch conduit to drain away from buildings. Provide sand-cement slurry extending 3 inches on top and sides of ducts. Slurry shall be as specified in Section 312316 with a red color additive. Provide warning tape 12 inches above slurry.

3.07 CONDUIT AND EQUIPMENT SUPPORTS

Support conduit at intervals and at locations as required by the NEC. Do not use perforated strap or plumbers tape for conduit supports.

3.08 DAMAGED CONDUIT

A. Repair or replace conduit damaged during or after installation.

B. Replace crushed or clogged conduit or any conduit whose inner surface is damaged or not smooth.

C. Repair cuts, nicks, or abrasions in the zinc coating of galvanized conduit with galvanizing repair stick, Enterprise Galvanizing "Galvabra" or equal.

D. Repair cuts, nicks, or abrasions in the PVC coating of PVC-coated conduit with the manufacturer's recommended PVC material and build up surface thickness to match the factory coating thickness and color.

3.09 ADJUSTING AND CLEANING

Upon completion of installation of conduits and boxes, inspect interiors of conduits and boxes; clear all blockages; and remove burrs, dirt, and construction debris.

END OF SECTION

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SECTION 262419 LOW-VOLTAGE MOTOR CONTROL

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes modifying an existing motor control center.

1.02 RELATED WORK SPECIFIED ELSEWHERE

General Electrical Requirements: 260500.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with the Section 260500.

B. Submit manufacturer's descriptive and technical literature.

PART 2 - MATERIALS

2.01 EXISTING MOTOR CONTROL CENTER MODIFICATIONS

A. Existing motor control center is a Westinghouse Series 2100. See nameplate information in Figures 1 and 2 below

Figure 1

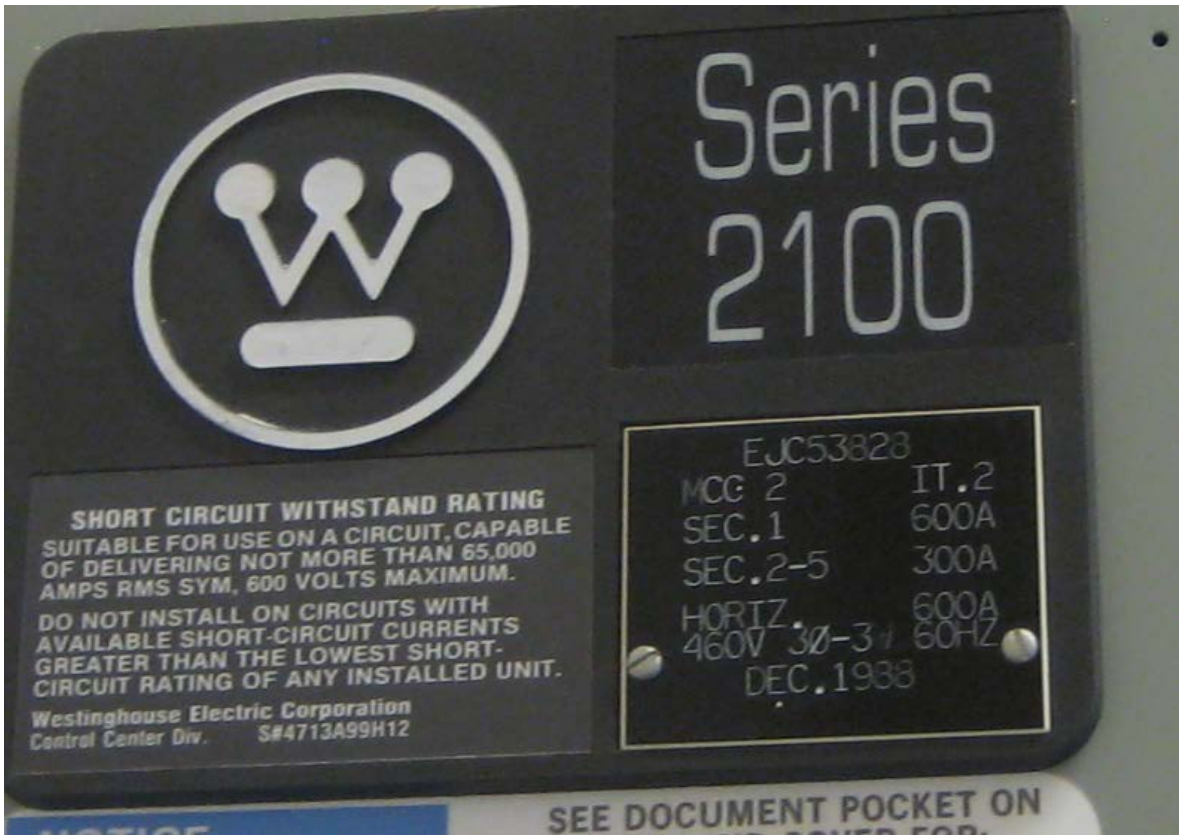

Figure 2

B. Install and connect two 25 Amp, three-pole feeder circuit breakers in spare compartment of existing MCC-B shown in Figure 3, with interior of compartment depicted in Figure 4. Figure 4 is referenced as View B in drawing E-02.

C. Circuit breakers shall be molded case type, have 65 kA interrupting capacity, similar to existing breakers shown in Figure 5. Provide all necessary accessories including new cover door with factory made openings for the breakers, handles for operation with cover door closed, nameplates, etc., similar to that shown in Figure 6.

D. One of these breakers shall feed irrigation pump via feeder P004 shown in the drawings. The second breaker shall be spare. Nameplates to read: “IRRIG. PUMP” and “SPARE” respectively.

Figure 3

Figure 4

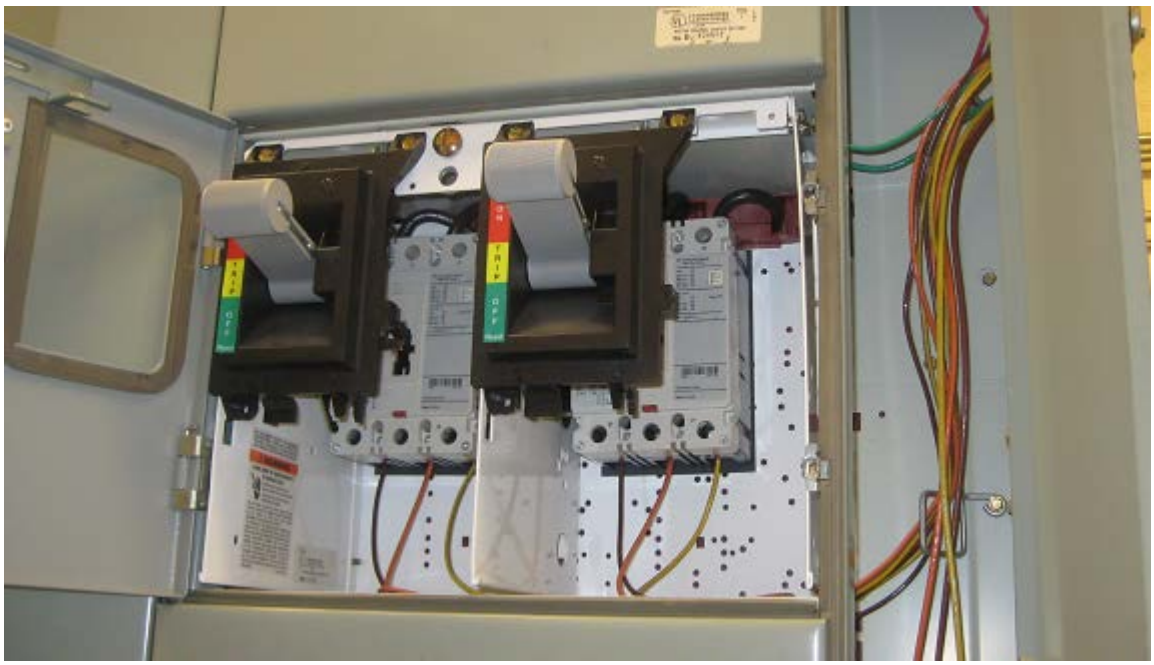

Figure 5

Figure 6

PART 3 - EXECUTION

3.01 INSTALLATION

Make modifications per manufacturer's recommendations. Westinghouse is now owned by Eaton Corporation.

3.02 FIELD TESTS

A. Operate each breaker and verify that all phases of each load are disconnected.

END OF SECTION

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SECTION 262726 WIRING DEVICES

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes materials and installation of a lighting switch and a manual motor starter.

1.02 RELATED WORK SPECIFIED ELSEWHERE

General Electrical Requirements: 260500.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with the General Conditions.

B. Submit material list for each type of wiring device and cover plate. Indicate type, ratings, material, color, and manufacturer.

1.04 REFERENCES

A. NEMA WD 1, General Purpose Wiring Devices.

B. NEMA WD 6, Wiring Device Configurations.

PART 2 - MATERIALS

2.01 GENERAL

Provide wiring devices that are listed by Underwriters' Laboratories, Inc.

2.02 LIGHTING SWITCH & COVER PLATE

Switch shall be 120/277-volt ac. Provide toggle--type switch. Cover plate shall be individually gasketed, polycarbonate lift-cover type.

2.03 MANUAL MOTOR STARTERS

A. Provide number of poles and size of thermal overload heaters for the motor being controlled. Provide NEMA 4X enclosure.

B. Starters shall have provisions for padlocking in the off position, shall be marked “Suitable as Motor Disconnect,” and shall be UL listed.

C. Starters shall be the heavy-duty type with toggle button operation. Arrow Hart Type LL, Allen-Bradley Bulletin 609, Cutler-Hammer MS/B100, or equal.

PART 3 - EXECUTION

3.01 GROUNDING

Provide a bonding jumper between the grounded outlet box and the receptacle ground terminal.

3.02 FIELD TESTING

Test operation of each switch.

END OF SECTION

SECTION 264213 CATHODIC PROTECTION AND JOINT BONDING

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, testing, and installation of cathodic protection equipment including thermite weld materials for buried piping, wiring, joint bond cables, anode backfill, test stations, reference cells, valves, and flange insulation kits.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Painting and Coating: 099000.

B. Cold-Applied Wax Tape Coating: 099752.

C. Trenching, Backfilling, and Compacting: 312316.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit manufacturer's catalog data on anodes, wire and cables, anode backfill material, test stations, reference cells, thermite welds, flange insulation kits, dielectric unions, and other equipment.

C. Submit manufacturer's catalog data on thermite weld packages for each pipeline material.

1.04 MANUFACTURERS

Anodes, wire, and anode backfill material shall be systems as designed by Farwest Corrosion Control; Matcor, Inc.; Harco; or equal.

PART 2 - MATERIALS

2.01 THERMITE WELD MATERIALS

A. Thermite weld shall be "Cadweld" by Erico Products, "Thermoweld" by Continental Industries Inc., "Pin Brazing" by BAC, or equal.

B. Thermite-weld caps shall be high-density polyethylene plastic, 10 mils (minimum) thick, as manufactured by Royston Laboratories or equal. Cap shall have a 100% solids mastic-filled dome and a tunnel portion to contain the lead wire from the thermite weld connection. Use Roybond 747 primer or equal. Weld caps shall be Royston Handy Cap 2 or equal.

2.02 SILVER BRAZING ALLOY

Silver brazing alloy shall have a minimum silver content of 15% as determined by ASTM E56-1990.

2.03 CATHODIC PROTECTION TEST STATIONS

A. Flush-Mounted Type: Test station shall consist of a glass-filled polycarbonate-urethane-coated body suitable for installation in asphalt. Design to withstand H-20 traffic loads. Station shall be watertight. Provide a five-lead terminal board. Provide locking lid. Terminal studs and nuts shall be nickel-plated brass. Test station shall be Cott Manufacturing Co. "Flush Fink" or equal.

B. Post-Mounted Test Stations: Connect wires by means of solderless lugs to a five-lead terminal board. Terminal studs and nuts shall be nickel-plated brass. Test station shall be Cott Manufacturing Co., "Big Fink," Robroy Industries, or equal.

C. Anode test stations shall be modified Capron plastic, not smaller than 6 inches by 8 inches by 4 inches with stainless steel lockable latches. Circuit board shall be clear Lexan. Enclosures shall be white, NEMA 3, raintight; manufactured by Cott Manufacturing Co., Robroy, or equal.

D. Provide a Holloway Type RS 0.01-ohm shunt in each test station. Shunts shall be as manufactured by Agra Engineering, M. C. Miller Company, Cott Manufacturing Co., or equal.

E. Test station wiring shall be No. 10 AWG, single conductor, stranded copper, with 600-volt THWN insulation.

2.04 DIELECTRIC SEALANT

Unbacked elastomeric tape 0.125-inch thick, "Moldable Sealant" by Tapecoat Co., "Tac-Tape" by Royston Laboratories, with manufacturer's primer.

2.05 JOINT BONDING WIRES

Joint bonding wires shall be No. 2 AWG single-conductor, stranded copper, with 600-volt TW insulation.

2.06 FLEXIBLE PIPE COUPLING BONDS

A. Flexible pipe coupling bonds shall be copper straps 1/16 inch thick by 1 1/4 inches wide and shall have an electrical resistance equivalent to a 1/0 stranded copper wire. Each strap shall have five holes punched in it at the locations for thermite welding the strap to the pipe, coupling follower rings, and coupling middle ring or sleeve. The bonding strap shall allow a total of 1-inch expansion or contraction of the pipe joint.

B. Connect the bonding strap to the pipe and coupling by thermite welds (five places) using a 15-gram cartridge as manufactured by Cadweld, Thermoweld, or equal.

2.07 FLANGE INSULATION KITS

A. Flange insulation kits shall consist of insulating gasket, an insulating stud sleeve for each bolt, insulating washers for each bolt, and a steel washer between each insulating washer and the nut. The sleeves shall be one piece, integral with the insulating washer. Provide double sleeve and washer sets for each bolt.

B. Gasket material shall be phenolic, 1/8 inch thick. The flange insulating gasket shall be full diameter (full face) of the flange with a nitrile O-ring on each side of the gasket. Dielectric strength shall be not less than 500 volts per mil and a compressive strength of not less than 24,000 psi.

C. Insulating flange bolt sleeves shall be spiral-wrapped mylar having a minimum dielectric strength of 4,000 volts per mil.

D. Insulating flange bolt washers shall be high-strength phenolic a minimum thickness of 1/8 inch. Dielectric strength shall be not less than 500 volts per mil and a compressive strength of not less than 25,000 psi.

E. Steel flange bolt washers for placement over the insulating washers shall be a minimum thickness of 1/8 inch and be zinc plated or stainless steel.

F. Flange insulation kits shall be as manufactured by Advance Product Systems, PSI, Central Plastics Company, or equal.

2.08 POLYURETHANE SEALANT

Polyurethane sealant shall be PRC 270 or equal.

2.09 MONOLITHIC INSULATING JOINT

A. Insulating joints shall be a monolithic design, with butt-welded ends, manufactured for dielectric separation of welded steel pipe. The pressure and temperature rating of the insulating joint shall match the pipeline in which it is installed. Dielectric properties measured across the insulating joint in air shall be 5-mohm minimum resistance with 3,000-volt minimum voltage breakdown.

PART 3 - EXECUTION

3.01 INSTALLING FLANGE INSULATION KITS

A. Overdrill bolt holes by 1/8 inch to accommodate insulating sleeves of flange insulation kits if carbon steel (ASTM A307) or stainless steel (ASTM A193, Grades B8 or B8M) bolts or studs are used.

B. Bolts or studs 1/8 inch smaller than the standard bolt or stud size per AWWA C207, Table 2, or AWWA C115, Table 2, may be used if high strength (ASTM A193, Grade B7) bolts or studs are used with AWWA Class B, D, or E steel flanges or AWWA C115 ductile-iron flanges. Overdrilling of the bolt holes is not required in such case. Do not use high strength bolts (e.g., ASTM A193, Grade B7) with cast gray iron flanges.

C. Install flange insulation kits per NACE SP0286. Prevent moisture, soil, or other foreign matter from contacting any portion of the insulating joint prior to its being sealed. If moisture, soil, or other foreign matter contacts any portion of the insulating joint, disassemble the entire joint, clean with a solvent, and dry prior to reassembly. Follow the manufacturer's recommendations regarding the torquing pattern of the bolts and the amount of torque to be used when installing the flange insulation kit.

3.02 INSTALLING POLYURETHANE SEALANT FOR FLANGE INSULATION KITS IN PIPING 24 INCHES AND LARGER

Apply sealant into the gap between the two flanges inside the pipe. Apply sufficient sealant to fill the gap to the thickness of the pipe lining; trowel to provide a smooth and even layer between the two pieces of pipe.

3.03 COATING FLEXIBLE PIPE COUPLING BONDS

Prime coat with vinyl butyral acid wash. Alternatively, solvent clean or steam clean copper surfaces per SSPC SP-1; do not use alkali cleaning. Then dust blast per Section 099000. Then coat the copper straps used to bond the flexible pipe couplings in accordance with Section 099000, System No. 21.

3.04 LINING AND COATING INSULATING FLANGES

A. After testing, wrap buried insulating flanges, including bolts, nuts, and washers, and adjacent surfaces of the pipe or valve with wax tape coating per Section 099752.

B. Line the interior of the piping per Section 099000, System No. 7 for a distance of two pipe diameters in each direction away from the insulating flange. At an insulated valve flange, line interior of the piping for a distance of two pipe diameters away from the valve.

3.05 BURIED JOINT BONDING

A. Bond buried joints on ductile-iron pipe and steel pipe not having welded joints or bonding rods. Provide two bonding wires spaced 90 degrees apart across each joint. Connect the bonding wires to the pipes by means of thermite welds. Apply thermite weld caps over the completed thermite welds.

B. Weld wire directly to pipe or coupling as shown in drawings. Use weld materials of type and size recommended by the manufacturer for the type and size of wire and pipe being used. Welds to underground dielectric coated steel pipe shall be primed with an

elastomer resin-based primer and then covered with a mastic-filled plastic cap following the manufacturer's instructions.

3.06 INSTALLATION OF CATHODIC TEST STATIONS

A. Install flush-mounted type with the top flush with the ground or pavement.

B. Install post-mounted type on a 3-inch high-density ultraviolet stabilized polyethylene conduit.

C. Coil the wire in slack loops to compensate for settlement near the cell and near the cathodic test station.

3.07 TESTING JOINT BONDING WIRES FOR CONTINUITY

A. Perform electrical tests to demonstrate that all joint bonding wires or rods have been properly installed. The purpose of the test is to locate improperly attached bonding wires or rods after backfilling and compacting have been completed. Perform testing using one of the following methods:

1. Conduct tests by the "Null" method, using an impressed audio frequency current to detect electrical points of discharge. Product: Tinker and Rasor Model PD Detector and Null Method. Locate poorly attached joint bonding wires or rods by noting a disturbance in null.

2. Conduct tests by means of a d-c voltage gradient survey. Product: Solomon Corrosion Consulting Services (SCCS) Pty, Ltd. Model PCS 2000. Provide a d-c current to the pipeline. Use two probes at grade level to detect changes in resistance to earth at points of electrical discharge.

B. Excavate pipe joints identified as having defective bonding wires or straps and repair the defective items.

3.08 INSTALLING DUAL-SIDED UTILITY MARKERS

Install one marker at each cathodic protection test station.

END OF SECTION

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SECTION 311100 CLEARING, STRIPPING, AND GRUBBING

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes the work included in clearing, stripping, grubbing, and preparing the project site for construction operations.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Protecting Existing Underground Utilities: 020120.

B. Earthwork: 312300.

C. Trenching, Backfilling, and Compacting: 312316.

D. Landscape Planting: 329010.

1.03 CLEARING

A. Locate existing bench marks and dam monitoring control points prior to clearing and tie out the northing, easting and elevation using the project vertical and horizontal control. Submit information to the owner's representative prior to commencing work with clearing. Said work shall be performed by a surveyor registered in the State of California. If bench marks or dam monitoring points are damaged, reset said benchmarks or monitoring points. Secure approval of reset bench marks and or monitoring points per the Division of Dam Safety and County of Los Angeles Survey Department.

B. Remove and dispose of trees, snags, stumps, shrubs, brush, limbs, sticks, branches, and other vegetative growth. Remove rocks, tiles, and lumps of concrete. Remove all evidence of their presence from the surface. Remove and dispose of trash piles, rubbish, and designated fencing. Protect structures and piping above and below ground, trees, shrubs, and vegetative growth and fencing which are not designated for removal.

1.04 STRIPPING

A. Remove and dispose of organic sod, grass and grass roots, and other objectionable material remaining after clearing from the areas designated to be stripped.

B. Retain topsoil material onsite for dressing backfill areas before planting.

1.05 GRUBBING

After clearing and stripping, remove and dispose of wood or root matter, including stumps, logs, trunks, roots, or root systems greater than 1 inch in diameter or thickness to a depth of 12 inches below the ground surface.

1.06 SITE PREPARATION

All tree root balls and structures and improvements such as wells, vaults, pipelines, abandoned utilities, etc., planned to be removed shall be removed or treated in accordance with the standard specifications. Depressions or voids left from clearing and grubbing and demolition of existing structures shall be filled with compacted fill as specified herein.

PART 2 - MATERIALS

2.01 TREES AND SHRUBBERY

Existing trees, shrubbery, and other vegetative material may not be shown in the drawings. Inspect the site as to the nature, location, size, and extent of vegetative material to be removed or preserved, as specified herein. Preservation of Trees, Shrubs, and Other Plant Material

A. Save and protect plant materials (trees, shrubbery, and plants) beyond the limits of clearing and grubbing from damage resulting from the work. No filling, excavating, trenching, or stockpiling of materials will be permitted within the drip line of these plant materials. The drip line is defined as a circle drawn by extending a line vertically to the ground from the outermost branches of a plant or group of plants. To prevent soil compaction within the drip line area, no equipment will be permitted within this area.

B. Cut and remove tree branches where necessary for construction. Remove branches other than those required for a balanced appearance of any tree. Treat cuts with a tree sealant.

PART 3 - EXECUTION

3.01 CLEARING, STRIPPING, AND GRUBBING AREAS AND LIMITS

A. Clear, strip, and grub excavation and embankment areas associated with new structures, slabs, walks, and roadways.

B. Clear and strip stockpile areas.

C. Limits of clearing, stripping, and grubbing:

1. Excavation, Excluding Trenches: 5 feet beyond tops of cut slopes.
2. Trench excavation for piping and electrical conduits: 5 feet from edge of trench.
3. Earth Fill: 5 feet beyond toe of permanent fill as indicated in the drawings.
4. Structures: 5 feet beyond footings.
5. Streets, Roadways, and Parking Areas: 5 feet beyond paving or 5 feet beyond related cut and fill.
6. Landscaped Areas: 2 feet beyond areas designated to receive landscaping.

3.02 DISPOSAL OF CLEARING AND GRUBBING DEBRIS

Do not burn combustible materials. Remove cleared and grubbed material from the worksite and dispose.

3.03 DISPOSAL OF STRIPPED MATERIAL

Remove stripped material and legally dispose offsite, except topsoil.

END OF SECTION

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SECTION 312300 EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, testing, installation of earthwork for excavations, fills, and embankments for roadways, structures, sites and accessory items such as filter fabric, and vapor barrier.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Protecting Existing Underground Utilities: 020120.

B. General Concrete Construction: 030500.

C. Leakage Testing of Hydraulic Structures: 030510.

D. Clearing, Stripping, and Grubbing: 311100.

E. Blasting: 312310.

F. Trenching, Backfilling, and Compacting: 312316.

G. Gravel and Crushed Rock Base for Structures: 312323.

H. Filter Fabric: 313219.

I. Riprap for Channels, Structures, and Embankments: 313716.

J. Drainage and Plumbing Piping: 402350.

K. Storm Water Runoff Control for Sites

1.03 SUBMITTALS

A. Provide submittals in accordance with Section 013300.

B. Submit excavation and shoring drawings for worker protection in accordance with the General Provisions.

C. Submit six copies of a report from a testing laboratory verifying that the material contains less than 1% asbestos by weight or volume and conforms to the gradation specified.

D. Submit dewatering plan including disposition of groundwater.

E. Submit manufacturer's catalog data and a sample of filter fabric. Submit manufacturer's installation instructions and details for filter fabric.

1.04 TESTING FOR COMPACTION

A. The Owner’s Representative will test for compaction and relative density as described below.

B. Determine the density of soil in place by the sand cone method, ASTM D1556 or by nuclear methods, ASTM D6938. Additional sand cones and densities will be required if the backfill material is visually variable.

C. Determine laboratory moisture-density relations of soils per ASTM D1557. If nuclear methods are used for in-place density determination, the compaction test results for maximum dry density and optimum water content shall be adjusted in accordance with ASTM D4718. This will be required for determination of percent relative compaction and moisture variation from optimum.

D. Determine the relative density of cohesionless soils per ASTM D4253 and D4254.

E. Sample materials per ASTM D75.

F. "Relative compaction" is the ratio, expressed as a percentage, of the inplace dry density to the laboratory maximum dry density.

G. Compaction shall be deemed to comply with the specifications when no test falls below the specified relative compaction. The Contractor shall pay the costs of any retesting of work not conforming to the specifications.

1.05 DISPOSAL OF EXCESS MATERIALS

Excess site excavated material shall be placed on-site in the dry storage area identified in the drawings. Waste and deleterious materials shall be disposed of offsite by the Contractor at his expense. No prearranged disposal site or related permits have been determined or secured by the Owner.

1.06 MATERIAL AVAILABILITY

Obtain backfill material from excavated materials or imported granular material as designated in the drawings.

1.07 NOISE ORDINANCE

Comply with the City of Westlake Village noise ordinance.

PART 2 - MATERIALS

2.01 STRUCTURAL FILL

Structural fill is material that is to be placed beneath structures to the limits indicated in the drawings. Material shall be excavated material that is free from organic matter, roots, debris, and rocks larger than 3 inches in the greatest dimension.

2.02 TYPE 1 STRUCTURAL BACKFILL

A. Structural backfill is material that is to be placed adjacent to and around piping and structures.

B. Material shall be free from deleterious material and shall have the following gradation:

Sieve Size	Percent Passing By Weight
1 1/2 inches	100
3/4 inch	80 to 90
3/8 inch	60 to 75
No. 4	50 to 65
No. 40	25 to 40
No. 100	20 to 35
No. 200	0 to 15

C. Excavated onsite material may be used for Type 1 structural backfill provided it conforms to the above specifications for structural backfill material.

2.03 FILL

Fill material is material that is to be placed in locations that are not to be constructed as structural fill or structural backfill. Fill material shall be native material.

2.04 SAND, INCLUDING IMPORTED SAND FOR PIPE ZONE AND PIPE BASE IN PIPE TRENCHES

A. Granular material free from clay balls, organic matter, and other deleterious substances and conforming to the following gradations:

Sieve Size	Percent Passing By Weight
3/8 inch	100
No. 4	75 to 100
No. 30	12 to 50
No. 100	5 to 20
No. 200	0 to 10

B. Sand shall have a coefficient of permeability greater than 0.014 cm/s measured in accordance with ASTM D2434 or a minimum sand equivalent of 30 per ASTM D2419.

2.05 CONCRETE SLURRY FILL

Refer to Section 030500 for slurry cement backfill to be used for “Slurry Cement Backfill” below the water storage tank.

2.06 WATER FOR COMPACTION

Water shall be free of organic materials and shall have a pH of 7.0 to 9.0, a maximum chloride concentration of 500 mg/L, and a maximum sulfate concentration of 500 mg/L. Provide all water needed for earthwork. Provide temporary piping and valves to convey water from the source to the point of use. See Section 015100.

2.07 AGGREGATE BASE FOR HYDRAULIC STRUCTURES

A. Aggregate base shall be free from clay balls, organic matter, and other deleterious substances and shall conform to the following gradation:

Sieve Size	Percent Passing By Weight
1 inch	100
3/4 inch	90 to 100
No. 4	35 to 55
No. 30	10 to 30
No. 200	0 to 9

B. The coarse aggregate (material retained by the No. 4 sieve) shall consist of material of which at least 25% by mass shall be fractured or crushed particles as determined per California Test Method No. 205.

C. Aggregate base material shall meet the following requirements:

Parameter	Minimum Value	Test Standard
Durability index	40	California Test Method No. 229
Resistance (R value)	80	California Test Method No. 301
Sand equivalent	25	California Test Method No. 217

2.08 PERMEABLE DRAIN MATERIAL

Use Class 2 permeable material per Caltrans' Standard Specifications, Section 68.

2.09 FILTER FABRIC

A. Filter fabric shall be manufactured from polyester, nylon, or polypropylene material; shall be of nonwoven construction; and shall meet the following requirements:

1. Grab tensile strength (ASTM D5034): 100 lbs minimum for a 1-inch grip.

2. Apparent opening size per ASTM D4751: 0.21M.

B. Filter fabric shall be as specified in Section 313219.

2.10 DRAINPIPE

Underdrain or back of wall drainpipe shall be PVC as specified in Section 402350, 4-inch-diameter perforated and solid pipe, Schedule 80 polyvinyl chloride (PVC) conforming to the requirements of ASTM D1785. Perforated sections of pipe shall have two rows of 3/8-inch-diameter holes 60 degrees apart spaced at 6 inches on center. Fittings for drainpipe shall be Schedule 80 Type II PVC solvent weld type conforming to ASTM D2467.

2.11 WEST SADDLE DAM PIPE SUPPORTS

The following gradations apply to work for the pipe supports at the west Saddle Dam and headwalls:

A Materials

A.1 General: The compacted embankment and riprap materials shall conform to the requirements specified herein. Material incorporated into the dam embankments and determined by the District's Representative to be in violation of specification requirements shall be removed from the embankment. Blending of materials for purposes of modifying the materials to meet specified gradation requirements will not be permitted on the dam embankments, and such blending, if done, shall be performed at the site of excavation or in stockpiles away from the dam embankments except that raking of oversize rocks from Zones 4 and 5 will be permitted on the embankments.

A.2 Zone 1: Material for Zone 1 shall be blended and moisture conditioned clays and clayey sands obtained from Borrow Area F. The material shall contain at least 70 percent by weight passing the No. 4 U. S. Standard Sieve, and at least 40 percent by weight passing the No. 200 U.S. Standard Sieve.

A-3 Zone 2: Material for Zone 2 shall consist of hard, sound and durable particles, to be furnished by the Contractor, and shall meet the following gradation limits after compaction in the dam embankments:

Screen or U.S. Standard Sieve Size	Percent by Weight Passing
3/8 inch	100
No. 4	70-100
No. 16	30-70
No. 80	10-30
No. 200	0-10

A.4 Zone 3: Material for Zone 3 shall consist of hard, sound and durable particles, and shall meet the following gradation limits after compaction in the dam embankments:

Screen or U.S. Standard Sieve Size	Percent by Weight Passing
4 inches	100
1-1/2 inches	50-100
¾ inch	30-60
3/8 inch	15-35
No. 4	0-10
No. 200	0-5

A.5 Zone 4: Material for Zone 4 shall be obtained from excavations in Borrow Areas 2 and 3 and excavation for the dam foundations and appurtenant works. Borrow Areas 2 and 3 are stratified with materials of varying fracturing and hardness characteristics, therefore material having varying gradations will be produced from different strata unless special excavation or processing techniques are used. It is not the intent of these specifications to require special excavation techniques or processing of Zone 4 materials; however, materials having the characteristics listed below shall be selected for use to construct this zone. Zone 4 is intended to be a random Zone composed of the finer grained less hard and durable particles from the approved borrow sources and, notwithstanding the Contractor's option to place coarser graded materials in this zone, sufficient quantities of hard durable material meeting the gradation requirements for Zone 5 and riprap shall be reserved. The classification of materials permitted in Zone 4 is made for purposes of placement and compaction only and not for payment purposes.

In addition to the requirements below for Zone 4 materials the Contractor shall strip sufficient material from the borrow areas, maintain the surfaces of borrow areas free of fines, or blend the materials during the excavation process so that the percentage of material passing the No. 200 U. S. Standard Sieve does not exceed 25 percent for Zone 4 Class A, 10 percent for Zone 4 Class B, and 8 percent for Zone 4 Class C.

Zone 4--Class A: Material shall have a maximum particle size of 10 inches, and shall have not more than 60 percent by weight passing the No. 4 U. S. Standard Sieve after compaction.

Zone 4--Class B: Material shall have a maximum particle size of 16 inches and shall have not more than 40 percent by weight passing the No. 4 U. S. Standard Sieve after compaction.

Zone 4--Class C: Materials shall have a maximum particle size of 24 inches and shall have not more than 20 percent by weight passing the No. 4 U. S. Standard Sieve after compaction.

A.6 Zone 5: Material for Zone 5 shall consist of Rock selected by the Con- tractor from excavation in Borrow Areas 2 and 3 and from excavation for the dam foundations and appurtenant works. In order to minimize special excavation and selection of materials, two classifications will be permitted in Zone 5. These two classifications of materials for Zone 5 are made for the purposes of placement and compaction only and not for payment purposes. The material shall meet one of the following gradational requirements after compaction in the embankment.

Zone 5 – Class A

Screen or U.S. Standard Sieve Size	Percent by Weight Passing
12 inches	100
3 inches	50-90
No. 4	030
No. 200	0-5

Zone 5 – Class B

24 inches	100-10-70
3 inches	0-20
No 4	0-5
No. 200	

A.7 Riprap: Material for riprap shall be hard, durable rock selected by the Contractor from excavation in Borrow Areas 2 and 3 and from excavation for the dam foundations and appurtenant works. The rock shall have a maximum size of 36 inches in the least dimension, shall contain at least 50 percent by weight larger than 9 inches in the least dimension, and shall contain not more than 5 percent by weight sand and rock dust.

A.8 Aggregate Base: Material for aggregate base shall consist of hard, durable particles, and shall meet the following gradation limits after placement in the embankments:

Screen or U.S. Standard Sieve Size	Percent by Weight Passing
2 inches	100
1-1/2 inches	90-100
¾ inch	50-85
No. 4	25-45
No. 30	10-25
No. 200	2-9

A.9 Rockfill: Rockfill material shall meet the requirements for riprap.

PART 3 - EXECUTION

3.01 TEMPORARY EXCAVATIONS

A. Temporary slopes, excavations, and shoring shall conform to California Occupational Safety and Health Administration regulations and any other local ordinances and building codes, as applicable. Design, furnish, and maintain the support of temporary excavations for worker safety. Continuously monitor the temporary slopes and support and remove or stabilize any loose or unstable soil/rock masses.

B. For dry excavations, unshored, temporary slopes in hard, unfractured, volcanic bedrock shall not be constructed steeper than 0.25h:1v. Stockpiled material or equipment shall not be placed closer than 5 feet from a temporary slope crest. Dewatering and erosion protection, such as controlled runoff drainage, shall be provided. Furnish, install, and maintain appropriate slope netting to protect workers from rock fragments that may originate from the planned cut-slopes.

3.02 GROUNDWATER AND DEWATERING

A. Provide and operate equipment adequate to keep excavations and trenches free of water. Remove water during period when concrete is being deposited, when pipe is being laid, and during the placing of backfill. Avoid settlement or damage to adjacent property. Dispose of surface water runoff to the existing onsite sanitary sewer system and to prevent damage to adjacent property and in accordance with regulatory agency requirements. When dewatering open excavations, dewater from outside the structural limits and from a point below the bottom of the excavation. Obtain and comply with discharge permit from agencies with jurisdiction outlined in Section 011100.

B. If groundwater seepage or perched water is encountered during grading, then measures to dewater the excavation shall be implemented to maintain a dry excavation. Care shall be taken to minimize the disturbance of the excavation bottom. Surface water shall be directed away from excavations, and shall be removed from excavations prior to placement of fill materials or concrete. No surface water will be allowed to be discharged into the open water reservoir.

C. Before implementing a dewatering system, a dewatering test program shall be conducted to evaluate the feasibility and efficiency of the proposed dewatering system. Obtain permits in accordance with National Pollutant Discharge Elimination System (NPDES) regulations and local permit requirements.

3.03 SITE GRADING

Perform earthwork to the lines and grades shown in the drawings. Shape, trim, and finish slopes of channels to conform to the lines, grades, and cross sections as shown. Remove exposed roots and loose rocks exceeding 3 inches in diameter. Round tops of banks to circular curves of not less than a 6-foot radius. Neatly and smoothly trim rounded surfaces. Do not overexcavate and backfill to achieve the proper grade.

3.04 EXCAVATION

A. Excavations shall have sloping, sheeting, shoring, and bracing conforming with 29CFR1926 Subpart P-Excavations, CAL/OSHA requirements, and the General Conditions.

B. Excavation is unclassified. Perform excavation regardless of the type, nature, or condition of the material encountered to accomplish the construction. Coordinate excavation with Section 312310, Blasting. Do not operate excavation equipment within 5 feet of existing structures or newly completed construction. Excavate with hand tools in these areas.

C. After the required excavation has been completed, the Owner will observe the exposed subgrade to determine the need for any additional excavation. It is the intent that additional excavation is to be conducted in all areas within the influence of the structure where unacceptable subgrade materials exist at the exposed subgrade. Overexcavation shall include the removal of all such unacceptable material that exists directly beneath the structure or within a zone outside and below the structure defined by a line sloping at 1-horizontal to 1-vertical from 1 foot outside the edge of the footing. Refill the overexcavated areas with structural backfill material.

D. The Contractor will not receive any additional payment for refill material used for his convenience.

3.05 LIMITS OF FOUNDATION EXCAVATION

Excavate to the depths and widths needed to accomplish the construction. Allow for forms, working space, structural backfill, and site grading. Do not excavate for footings, slabs, or conduits below elevations indicated. Unless unacceptable material is encountered and overexcavation is authorized in writing by the Owner, backfill overexcavations with compacted structural backfill material, except for under the tank. Refer to the drawings for concrete and slurry backfill under the tank. Correct cuts below grade by benching adjoining areas and creating a smooth transition. The Contractor shall bear all costs for correcting unauthorized overexcavated areas.

3.06 PREPARATION OF FOUNDATION SUBGRADE – GENERAL

A. The finished subgrade shall be within a tolerance of ±0.08 of a foot of the grade and cross section indicated, shall be smooth and free from irregularities, and shall be at the specified relative compaction. The subgrade shall extend over the full width and extend 1 foot beyond the edge of the foundations.

B. Compact the top 6 inches of the subgrade to 95% relative compaction. Recompaction will not be required if rock is exposed at final subgrade.

C. Remove soft material encountered and replace with structural backfill. Fill holes and depressions to the required line, grade, and cross sections with structural backfill.

D. If rock is encountered at final grade, overexcavate to a depth of 6 inches and place structural backfill to establish final grade.

E. Prior to backfilling, the excavation bottom will be observed by the Owner's Representative. If unsuitable materials are present at that level, additional overexcavation may be required. Lean concrete or concrete slurry shall be placed as backfill beneath the tank and extending up from the excavated rock surface in cut areas. 4,000 psi concrete shall be placed beneath the tank and extending up from the excavated rock surface in areas to receive fill.

3.07 PREPARATION OF SUBGRADE FOR TANKS

A. Excavation for the tank subgrade shall be carried down to bedrock at least 12 inches below the tank bottom slab. Exposed rock shall not extend more than two inches into the Permeable Drain Material (PDM). Exposed rock more than two inches below PDM shall be filled with Concrete Slurry Fill (CSF) to within two inches of the PDM or 14 inches below the tank slab.

B. Bedrock exposed more than 14 inches below the tank slab shall be overlaid with CSF to the base of the PDM.

C. Prior to placing CSF, all loose exposed rock shall be removed by sweeping or air vacuum.

D. Placement of CSF shall not exceed 24 inches in one lift. Allow to set 24 hours between lifts of CSF.

E. Rock excavation to the base of PDM shall extend 6 feet beyond the edge of tank slab.

F. Place 12 inches PDM over rock/CSF in two layers and compact to 95% relative density.

3.08 PREPARATION FOR PLACING FILL OR BACKFILL

A. After excavation of existing material or removal of unacceptable material at the exposed subgrade, scarify the final subgrade surface to a depth of 6 inches and compact to 90% relative compaction.

B. Remove foreign materials and trash from the excavation before placing any fill material. Obtain the specified compressive strength and finish of concrete work per Sections 030500 before backfilling.

3.09 GRADING AND SUBGRADE PREPARATION IN PAVEMENT AREAS

Where pavements will be constructed on aggregate base, scarify the subgrade soils to a depth of 12 inches below the pavement section (aggregate base layer) or existing ground surface, whichever is deeper, moisture condition the soils to within 2 percent of optimum moisture content, and compact the scarified subgrade soils to at least 95 percent relative compaction. The scarified and recompaction work should extend laterally at least 3 feet beyond the pavement limits.

3.10 PLACING AND COMPACTING FILL AND STRUCTURAL FILL

A. Place in maximum 8-inch lifts and compact each lift to 95% relative compaction.

B. Where fill is to be constructed on slopes steeper than 5:1 and at the toes of excavations, the fill shall be keyed and benched into firm native materials. Benches shall be sloped at least 2% into the slope and shall be of a width at least equal to the height of fill lift.

C. All fill materials excluding fill placed in the disposal fill and visual-concealment berm shall be moisture-conditioned to within 2 percent of optimum moisture content prior to and during compaction. Water shall be added to the fill when the moisture content of the fill material is below that sufficient to achieve the recommended compaction. While water is being added, the soil shall be bladed and mixed to provide uniform moisture content throughout the material. When the moisture content of the fill material is excessive, the fill shall be aerated by blading or other methods.

D. All tank-pad backfill materials shall be compacted to a minimum of 95 percent relative compaction of the maximum dry density determined from ASTM D1557. Fill materials placed in the eastern fill disposal area shall be compacted using at least four passes of a heavy vibratory roller such as a and fill material placed in the visual-concealment berm fill area shall be compacted using five passes of a heavy vibratory roller. A heavy vibratory roller is one meeting the minimum compaction effort of a Case 602 or IR-FD 100 sheep’s foot roller

E. Backfill within 5 feet of below grade walls (measured horizontally) shall be compacted with lightweight, hand-operated compaction equipment to minimize the potential for large compaction stresses.

F. Compaction testing will be performed by the Owner's Representative during grading and fill placement of the tank-pad backfill material. Measurements of in situ or field moisture content and relative compaction shall be evaluated using either ASTM D2922 (nuclear gauge) and/or ASTM D1556 (sand cone method). Grading in the eastern disposal fill area and the western visual-concealment berm area will be monitored, to confirm compliance with recommendations, but compaction tests will not be required in those areas.

3.11 PLACING AND COMPACTING STRUCTURAL BACKFILL

A. Place structural backfill material around piping, structures, channels, and other areas, including authorized overexcavation areas, to the lines and grades shown or specified. Do not exceed loose lifts of 8 inches. Fill materials placed as backfill in the tank pad shall be spread evenly and thoroughly blade-mixed during spreading to provide relative uniformity of material within each layer. Soft or yielding materials shall be removed and replaced with properly compacted fill material prior to placing the next layer.

B. Limits of Structural Backfill: Limits of structural backfill, except as specified above for tank subgrade, shall be 1.0 feet from edge of footing and shall extend at a 1:1 slope to the final excavation depth.

C. Compact each lift to 95% relative compaction, unless otherwise shown in the drawings. Stop structural backfill at least 6 inches below finished grade in all areas where topsoil is to be placed.

D. Backfill around concrete structures as specified in Section 030500.

E. Do not operate earthmoving equipment within 5 feet of walls of concrete structures. Place and compact backfill adjacent to concrete walls with hand-operated tampers or other equipment that will not damage the structure.

3.12 DISPOSAL FILL

A disposal fill site has been designated to the east of the proposed tank site. Excavated rock materials shall be placed in that area. Perform the following:

1. Cut a continuous, equipment-width key, 8-foot wide into bedrock at the toe of the fill. That keyway shall be constructed level/horizontal with the base of the key entirely on bedrock materials.

2. Place the disposal fill on horizontal benches cut into the bedrock as the fill is placed.

3. Place the disposal fill in lifts of 18 inches or less and densified by several passes of a vibratory roller.

3.13 VISUAL-CONCEALMENT BERM FILL

A. A visual-concealment berm fill site is shown on the drawings to the west of the proposed tank site. Perform the following:

1. Cut a continuous, equipment-width key, 8-foot wide into bedrock at the toe of the fill. That keyway shall be constructed level/horizontal with the base of the key entirely on bedrock materials.

2. Coarse-grained materials should be limited to 6-inches in maximum diameter and the materials shall be blended with fine-grained materials to produce a fill with no more than 20 percent passing the 200 sieve.

3. The disposal fill shall be placed on horizontal benches cut into the bedrock as the fill is placed.

4. If the gradation and composition of the fill used to construct the visual screening berm will allow for evaluating relative compaction in accordance with ASTM D1557, the fill shall be placed in horizontal lifts of no more than 12 inches in thickness, moisture conditioned to within 2 percent of optimum, and mechanically compacted to at least 85 percent relative compaction. However, if evaluation of relative compaction of the embankment fill is not practical using traditional methods, the disposal fill shall be placed as specified above and densified by at least five passes of a heavy vibratory roller meeting the minimum effort of a self-propelled Case 602 or IR-FD 100 sheep's foot roller

3.14 USE OF ONSITE MATERIALS AS FILL

Material derived from the tank excavation may be placed in the proposed visual-concealment berm west of the tank, as long as those materials contain or are mixed with sufficient fines, are free of organics, and do not contain oversize rock (that is over 6 inches in diameter), trash, debris, corrosive, or other unsuitable materials.

3.15 FILL IN TANK PAD

The concrete fill shall extend up from the excavated rock surface to the base of the tank drainage system and shall extend laterally at least 6 feet beyond the perimeter of the tank. Fill materials used to backfill the overexcavated area of the tank pad and outside the limits of the concrete fill shall consist of Class II Base material, compacted to at least 95 percent relative compaction.

3.16 DRAINAGE SYSTEM AND MATERIALS

Drainage material used for subsurface drains or behind retaining walls shall conform to Section 68-1.025, "Class 2 Permeable Material" of the Caltrans (2002), Standard Specifications. Drainage materials in contact with earth materials shall be protected with nonwoven filter fabric satisfying requirements for underdrains per Section 88-1.03 of the Caltrans (2002), Standard Specifications.

3.17 MOISTURE CONTROL

During the compacting operations, maintain optimum practicable moisture content required for compaction purposes in each lift of the material. Maintain uniform moisture content throughout the lift. Insofar as practicable, add water to the material at the site of excavation. Supplement by sprinkling the material. At the time of compaction, the water content of the material shall be at optimum water content or within 2 percentage points above optimum. Aerate material containing excessive moisture by blading, discing, or harrowing to hasten the drying process.

3.18 PLACING AND COMPACTING AGGREGATE BASE FOR HYDRAULIC STRUCTURES

Place the aggregate base in 6- to 8-inch lifts and compact to 95% relative compaction.

3.19 VAPOR BARRIER INSTALLATION

Place vapor barrier as specified in Section 071119.

3.20 PLACING AND COMPACTING STRUCTURAL BACKFILL FOR PIPE SUPPORTS AND HEADWALLS AT WEST SADDLE DAM

Backfill and compact concrete pipe supports per Note 4 on Sheet CD-08.

END OF SECTION

SECTION 312310 BLASTING

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes blasting procedures for excavation.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Earthwork: 312300.

B. Trenching, Backfilling, and Compacting: 312316.

1.03 PERMITS AND SAFETY ORDERS

A. Prior to any blasting, obtain the blasting permits required by Las Virgenes Municipal Water District and any applicable agency having jurisdiction. Notify the fire district, local fire department, and utilities in the general blast area per the contacts listed on the drawings. The Los Angeles County Sheriff's Department requires prior notification of any blasting work. The assigned USA Dig Alert construction project notification number, date, and blast area location are required on the permit application from the Sheriff's Department. Submit a copy of permits required to the Owner's Representative prior to drilling for blasting.

B. Comply with the requirements specified in the General Industry Safety Orders of the California Division of Industrial Safety.

C. Comply with the City of Westlake Village noise ordinance.

D. If the amount of explosives to be transported exceeds 1,000 pounds, secure a permit from the California Highway Patrol.

E. Store, handle, and use explosives as provided in the Federal OSHA of 1970 and the Construction Safety Act of 1969, as amended; Safe Explosives Act, Title XI, Subtitle C of Public Law 107-296, Interim Final Rule; and Organized Crime Control Act of 1970, Title XI, Public Law 91-452, Approved October 15, 1970, as amended; and CAL/OSHA, Division of Mining and Tunneling rules.

F. Ensure that deliveries of explosives to worksites comply with rules and regulations issued by the Department of Transportation (DOT) and the Transportation Security Administration (TSA) for commercial transportation of explosives pursuant to the mandates of the USA Patriot Act of 2001. Under TSA rules, commercial drivers with hazardous materials endorsement shall undergo a personal background records check, training, and testing.

G. Comply with applicable provisions of OSHA of 1970, 29 U.S.C., Section 651 et seq., including safety and health regulations for construction.

H. Blasting and Explosives:

1. U.S. Code of Federal Regulations (CFR):

a. CFR 27, U.S. Department of Justice, Alcohol, Tobacco, and Firearms (ATF), Explosives Division, 27 CFR Part 555, Implementation of the Safe Explosives Act, Title XI, Subtitle C of Public Law 107-296, Interim Final Rule.

b. Organized Crime Control Act of 1970, Title XI, Public Law 91-452, Approved October 15, 1970, as amended.

c. CFR 49, Parts 100-177 (DOT RSPA), 301-399 (DOT FHA).

d. Federal OSHA Act of 1970, as amended.

e. Construction Safety Act of 1969, as amended.

2. State Agencies:

a. California Code of Regulations (CCR):

(1) Title 8, Chapter 4, Subchapter 20, Tunnel Safety Orders.

(2) Title 8, General Industry Safety Orders, Subchapter 7, Group 18, Explosives and Pyrotechnics.

3. Nonregulating Industry Support Organizations:

a. Vibration Subcommittee of the International Society of Explosive Engineers (ISEE), blast monitoring equipment operation standards (1999 or later version if available).

b. Institute of Makers of Explosives (IME) Safety Library Publications (SLPs).

1.04 SUBMITTALS

A. Administrative

1. Blasting Licenses and Permits:

a. Copy of Cal/OSHA Blasting Licenses with Construction and Non-electric initiation system endorsements for all proposed blasters-in-charge.

b. Copies of all blasting permits required by Los Angeles County.

c. Copy of Blasting Contractor’s federal ATF License.

2. Conceptual Blasting Plan. Submit at least 30 days prior to start of blasting:

a. General blasting methods that are expected to be used for rock excavation.

b. Description of blasting techniques as well as techniques to control noise,

blasting vibrations, air-overpressures, and fly rock. Include detailed specifications of blasting mats and how they will be safely placed to cover all blasts as required Part 3.01.D.

c. Procedures to monitor blast-induced vibrations and air-overpressures at adjacent foundation areas, existing or previously completed structures, and other existing facilities.

d. Name and qualifications of the person(s) responsible for monitoring and reporting blast vibrations.

e. Detailed description of clearing, guarding and warning signals that will be applied to assure that no persons or visible wildlife will be in areas where any harm could be caused by blasting operations.

f. Provide a general sequence and schedule of planned blasting work including lift heights, the general sequence of drilling, blasting, and excavating.

g. Include details of a test blast using no more than 60% of the maximum expected charge-per-delay.

3. Blasting Safety Plan

a. A complete description of the clearing and guarding procedures that will be employed to ensure personnel, staff, visitors, and all other persons are at safe locations during blasting. This information shall include details regarding visible warning signs or flags, audible warning signals, method of determining blast area zones, access blocking methods, guard placement and guard release procedures, primary initiation method, and the system by which the blaster-in-charge will communicate with site security guards.

b. Detailed description of how explosives will be safely transported and used at the various work sites. Plans shall explain how day-storage boxes and explosive transport vehicles will satisfy all applicable regulations. This plan shall also indicate how explosives will be inventoried, secured and guarded to prevent theft or unauthorized use of explosives. The plan shall provide 24-hour security and/or the use of motion-detector and alarmed double wire fencing security measures around the stored explosives.

c. Include Material Safety Data Sheets (MSDS) and specific details about hazard communication programs for employees.

d. Equipment that will be used to monitor the approach of lightning storms and in the event of such, evacuation and site safety security plans.

e. Contingency plans for handling of misfires caused by cut-offs or other causes.

f. Fire prevention plan details, including smoking policies, procedures and limitations for work involving any open flames or sparks, description and location of all fire-fighting equipment, and fire-fighting and evacuation plans.

Also include plans for removing weeds or dried brush adjacent to blast areas.

g. Initial and ongoing blasting and fire safety training programs.

h. Description of the personal protective equipment that will be used by the Contractor's personnel, including but not limited to, safety glasses, hard-toe footwear, hard hats and gloves.

i. Obtain copies of all applicable codes, regulations and ordinances, keep a copy in project files at all times, and provide Owner's Representative with a copy. The Contractor's Safety Representative shall ensure that ongoing blasting work complies with all applicable regulations.

4. Qualifications:

a. Submit names of all proposed Blasters-in-Charge and include experience summaries documenting they have a minimum of 10 years of construction blasting experience at projects with similar blasting conditions. Include references for each proposed Blaster-in-Charge from representatives of at least three owners at projects of a similar nature.

b. Submit qualifications of proposed Blasting Consultant in conformance with relevant codes and this specification.

c. Submit qualifications of proposed Property Condition Survey Professional in conformance with relevant codes and this specification.

5. At least 20 days before surveys are done, submit name and qualifications of the independent Professional or firm proposed to conduct pre-blast condition survey(s), including a list of references.

6. Blast Monitoring Equipment – Details of instrumentation to be used to monitor vibrations and air-overpressure levels complete with performance specifications and user's manuals supplied by the manufacturer. Also submit copies of calibration certificates from the equipment maker certifying that microphones, geophones and all recording equipment has been calibrated within 12 months of the time it will be used.

7. Submit three copies of all pre-blasting reports including photographs and video in DVD format to Owner's Representative at least 10 calendar days before any blasting occurs. The surveys shall be repeated at the conclusion of blasting, and three copies of the post-blasting reports shall be delivered to Owner's Representative seven calendar days after completion of all basting activities.

B. Individual Blasting Plans and Records:

1. Submit Individual Shot Plans at least 48 hours prior to the proposed time of each blast. The review of blasting plans by the Engineer shall not relieve the Contractor of responsibility to assure that all work is done safely and without damage to adjacent structures. Blasting will not be permitted within 20' as measured

horizontally from the top of existing saddle dam as shown on the approved drawings. Plans shall include:

a. Plans showing number, location, diameter, depth, inclination of drill holes.

b. Plans showing amount, type and distribution of explosive per hole; and type and quantity of stemming used to confine all blast charges.

c. Pounds of explosive per square foot for wall-control blasting.

d. Powder factor (lb/yd^3) for production blasting.

e. Delay timing pattern showing initiation hookup and firing times for all separate charges.

f. Maximum charge-per-delay, distance to nearest structures of concern, including scaled distances and calculations of maximum expected peak particle velocity.

g. Scaled drawings showing the location of the blast with respect to structures of concern and final slopes, lines, and grades.

h. Location of seismographs that will be deployed to monitor blast-induced ground motion and air-overpressure

i. A description of blast covering and ground wetting methods.

j. Proposed date and time of blast.

2. Blast Monitoring Records: Submit the following within 24 hours after all blasts:

a. A copy of the instrument-software generated blast monitoring report at each instrument location that includes measured peak particle velocity in inches per second, peak air-overpressure in linear-scale decibels and vibration and air-overpressure event plots, date and time of event recording, and date the instrument was last calibrated.

b. Scaled map showing the locations of all blast monitoring instruments.

3. Blast Reports: Submit the following within 24 hours after all blasts:

a. Submit blast report showing actual charge delay timing details showing surface and in-hole firing times of all initiators, summaries of all explosives and initiators used, maximum charge-per-delay, hole diameters, spacing, depths, burden, and hole charging and stemming configuration of typical holes. Also include all information required by State of California Cal/OSHA regulations.

C. Approval by Owner's Representative of the Conceptual Blasting Plan and Individual Shot Plans proposed by Contractor will only be with respect to the basic principles and methods that Contractor intends to employ. Approval by Owner's Representative does not relieve Contractor of sole responsibility and liability for the safety of persons and

property.

1.05 QUALITY CONTROL

A. All Blasters-in-charge shall be properly licensed and have a minimum of ten years of construction blasting experience at projects with similar scope and complexity.

B. Retain the services of an experienced blasting consultant with at least 10 years' experience in developing and overseeing successful close-in blasting work for similar construction projects. All blasting plans, test blasting plans and revisions shall be prepared by or reviewed by and covered with a signed review letter by the blasting consultant. The blasting consultant will not be required to sign the individual blast plans provided they are signed by an on-site licensed blaster. The Blasting Consultant must not be an employee of any Contractors or associated companies of Contractors involved in the work.

C. The independent professional performing the pre-blast condition surveys shall have at least 5 years of documented experience in performing surveys of structures at dams and other heavy civil structures. The survey professional must also be a completely independent third party who is not be an employee of the Contractor, associated companies, or any suppliers to the work.

D. Images of all blasts shall be recorded with a digital video camera. If the camera is within the zone that may be affected by the blast, as defined by the Blaster-in- Charge, the camera must be started before the blast area is cleared and run without being attended by personnel. Copies of blast video files shall be submitted to the Engineer within 24 hours and before any subsequent blasting work occurs.

1.06 BLASTING SAFETY AND EXPLOSIVES SECURITY

A. Comply with all applicable federal, state and local regulations.

B. Protect the safety of all persons and wildlife; and protect all property during blasting operations.

C. Explosives Security: The responsible CONTRACTOR holding the ATF license for this work shall ensure the security of explosive materials at all times when explosive materials are used or kept on the project site and the CONTRACTOR shall ensure that:

1. All persons that handle explosive materials, have control over them, or access to them, must not be prohibited persons, as defined in Section 555.11 of 27 CFR (ATF Rules).

2. All blasting work and explosive handling activities are done under the direct supervision of a properly licensed Blaster-in-Charge.

3. When explosives are delivered to the work sites, they must not be unloaded from delivery vehicles until a responsible blaster-in-charge has signed the delivery paperwork and assumes full authority and responsibility for the security of the

explosive materials. Unused explosive materials must be similarly signed over to a properly licensed driver with a Commercial Drivers' License with a Hazmat endorsement before explosive materials are loaded onto a fully-DOT-compliant vehicle for removal from the site.

4. The CONTRACTOR shall maintain copies of ATF Employee Possessor questionnaire forms (OMB No. 1140-0072) or documentation of ATF clearance on the CONTRACTOR's ATF license for all employees who will possess, handle or have access or control over explosives for this work as defined in 27 CFR Part

5. This documentation must be available upon request by the appropriate authorities or LVMWD'S Representative. CONTRACTOR and subcontractor employees, without submitted evidence of satisfactory ATF clearance, must not handle, control or have access to explosive materials.

1.07 EXPLOSIVE STORAGE

A. No explosives shall be stored overnight on site.

1.08 PRE-BLAST CONDITION SURVEY

A. Prior to any blasting, perform a pre-blast survey of the conditions of the Las Virgenes Saddle Dam, Westlake Filtration Plant, and addresses designated below:

2500 Sandycreek Drive, Westlake Village, CA
2502 Sandycreek Drive, Westlake Village, CA
2503 Sandycreek Drive, Westlake Village, CA
2506 Sandycreek Drive, Westlake Village, CA
2511 Sandycreek Drive, Westlake Village, CA
2514 Sandycreek Drive, Westlake Village, CA
2521 Sandycreek Drive, Westlake Village, CA
2529 Sandycreek Drive, Westlake Village, CA
2535 Sandycreek Drive, Westlake Village, CA
2538 Sandycreek Drive, Westlake Village, CA
2543 Sandycreek Drive, Westlake Village, CA
2550 Sandycreek Drive, Westlake Village, CA
2210 Three Springs Drive, Westlake Village, CA
2236 Three Springs Drive, Westlake Village, CA
2238 Three Springs Drive, Westlake Village, CA
2252 Three Springs Drive, Westlake Village, CA
2260 Three Springs Drive, Westlake Village, CA
2404 Three Springs Drive, Westlake Village, CA
2412 Three Springs Drive, Westlake Village, CA
2420 Three Springs Drive, Westlake Village, CA
2452 Three Springs Drive, Westlake Village, CA
2504 Three Springs Drive, Westlake Village, CA
2516 Three Springs Drive, Westlake Village, CA
2528 Three Springs Drive, Westlake Village, CA
2604 Three Springs Drive, Westlake Village, CA
2608 Three Springs Drive, Westlake Village, CA
2616 Three Springs Drive, Westlake Village, CA
2626 Three Springs Drive, Westlake Village, CA
2636 Three Springs Drive, Westlake Village, CA
2640 Three Springs Drive, Westlake Village, CA
2804 Three Springs Drive, Westlake Village, CA
2812 Three Springs Drive, Westlake Village, CA
2818 Three Springs Drive, Westlake Village, CA
2820 Three Springs Drive, Westlake Village, CA
2824 Three Springs Drive, Westlake Village, CA
2830 Three Springs Drive, Westlake Village, CA
2840 Three Springs Drive, Westlake Village, CA
2846 Three Springs Drive, Westlake Village, CA
2854 Three Springs Drive, Westlake Village, CA
32609 Torchwood Place, Westlake Village, CA
32612 Torchwood Place, Westlake Village, CA
32620 Torchwood Place, Westlake Village, CA
32628 Torchwood Place, Westlake Village, CA
32638 Torchwood Place, Westlake Village, CA

B. Survey the interior and exterior conditions of all residential structures in the above list. If owner's refuse surveys, provide copies of certified-mail letters documenting attempts to provide the survey by a third-party professional survey company.

C. Type-written reports shall include a description of the interior and exterior condition of the various structures examined. Descriptions shall include the locations of any cracks, damage, or other existing defects and shall include information needed to identify and describe the defect, if any, and to evaluate the effects of construction operations on the defect.

D. Reports shall include hard copy color photographs sized at least 4 x 6 inches, printed in glossy format on paper designed for color photo images. If digital cameras are used, resolution of images shall be 5 megapixels or greater. Photos must be taken of all cracks and other damaged, weathered or otherwise deteriorated structural conditions. If necessary, macro lenses and flash illumination shall be used to ensure defects are shown clearly in the photographs. Photos shall contain an accurate date stamp.

E. Structure condition surveys shall be repeated at facilities or properties where damage concerns have been expressed. Details of any observed changes to surveyed structures and documenting photos shall be reported and submitted as required. All reports shall be type written.

1.09 SEQUENCING, SCHEDULING AND NOTIFICATION

A. Provide notification to LVMWD's representative at least 24 hours in advance of each blast.

1.10 GEOTECHNICAL REPORT

A. A geotechnical report for the project, prepared by Fugro Consultants, Inc., is available at the Las Virgenes Municipal Water District office. The report is dated June 2013 and titled:

Geotechnical Study
1,235-ft Backbone Improvements Project
5 MG Tank and Pipeline Project
Westlake Reservoir
Westlake Village, California

1.11 DEFINITIONS

1. Air-overpressure – absolute value of increases or reductions to atmospheric pressure measured with a 2-Hz flat-response microphone and expressed in decibels or psi.

2. Blaster-in-Charge or Blasting Supervisor - The single designated and licensed person with complete responsibility and total authority over all decisions involving safe handling, use and on-site security of explosives.

3. Charge-per-Delay - For vibration control, any charges firing within any 8-millisecond time period are considered to have a cumulative effect on vibration and air-overpressure effects. Therefore, the maximum charge-per-delay (W) is the sum of the weight of all charges firing within any 8-millisecond time period. For example, if two 100-lb. Charges fire at 100 ms and one 115-lb charge fires at 105

ms, the maximum charge per delay would be 315 lbs.

4. Controlled Blasting – Excavation of rock using explosives, wherein the blast is carefully designed and controlled to provide a distribution of charge and confining stemming that will excavate the rock to the required limits but minimize overbreak, control rock movement, and assure that intensities of blast-induced vibration and air-overpressure do not exceed regulated or specified limits.

5. Delay-Decked-Charge – Multiple charges with differing firing times placed within a single blasthole that are separated by inert stemming material.

6. Line Drilling - A method of overbreak control in which a series of very closely spaced holes is drilled at the perimeter of the excavation. These holes are not loaded with explosives.

7. Occupied Building - Structure on or off construction limits that is occupied by humans or livestock.

8. Over-excavation – Excavation beyond the neat lines shown on the Drawings.

9. Peak Particle Velocity - Peak Particle Velocity (PPV): The maximum of the three ground vibration velocities measured in the vertical, longitudinal and transverse directions. PPV measurement units are expressed in inches per second (ips).

10. Pre-splitting - A drilling and blasting technique wherein small diameter holes are drilled on close-spacing along the neat excavation lines. The charges are small in diameter, specially prepared for pre-splitting, and are detonated ahead of the main production charges. This technique requires free relief of the perimeter and may require advance excavation of the production area to provide that relief.

11. Primary Initiation - The method used to initiate a blast(s) from a remote and safe location. Primary initiation systems use shock-tubes or electrical current to convey firing energy from the point of initiation to blast locations.

12. Production Holes - Blast holes in the main body of the rock mass being removed by drilling and blasting.

13. Prohibited Persons - Persons prohibited from handling or possessing explosive materials as defined by the seven categories described in Section 555.11 of 27 CFR (ATF Rules).

14. Scaled Distance: A calculated value describing relative vibration energy based on distance and charge-per-delay. For ground vibration control and prediction purposes, Scaled Distance (Ds) is obtained by dividing the distance of concern (D) by the square root of the charge-per-delay (W); so Ds = D/W1/2 or when a minimum defined scaled distance is defined to limit charge weight, W = (D/Ds)2. For example, if a blast is designed to meet a minimum scaled distance of 60, the maximum charge-per-delay for a blast located 600 feet from the structure of concern would be (600/60)2, or 100 pounds.

15. Seismograph – An instrument used to record the intensity and frequency of ground vibrations measured with three mutually perpendicular geophones and a linear-scale microphone that measures air-overpressure.

PART 2 - MATERIALS

2.01 MATERIALS AND EQUIPMENT

A. ALLOWABLE EXPLOSIVE MATERIALS AND INITIATORS

1. Only fixed cartridge explosives shall be used for blasting. Use of flowable explosives including ANFO or bulk emulsion is prohibited.
2. Only non-electric initiation systems shall be used for blasting.
3. Use of cap and fuse is prohibited.

PART 3 - EXECUTION

3.01 BLASTING

A. All explosive charges shall be stemmed with clean washed angular crushed stone sized from 3/8 to 3/4 inches. The amount of stemming shall be at least 25-charge-diameters. For instance, if charge diameter is 2 inches, minimum stemming is 50 inches or 4.2 feet.

B. The diameter of explosive charges shall not exceed 2.0 inches.

C. The minimum confining burden on all explosive charges with exposure to open rock or ground surfaces shall be at least 25-charge-diameters.

D. All blasts shall be covered with woven steel cable or steel-cable and rubber-tire blasting mats. Woven polypropylene or similar weed-barrier fabric, covered with at least 6 inches of soil or sand shall be placed over blast areas to protect initiators before mats are placed. Mats shall be overlapped at least 3 feet and shall completely cover the blast area and extend at least three feet beyond the blast area in all directions. If any flyrock or blasted material is thrown more than 10 feet or half the distance to the nearest structure, whichever is less, blasting shall be suspended until Owner’s Representative has approved the Contractor's revised blasting plan showing revisions to the procedure adequate to reduce the flyrock.

E. Before blasts are covered, all loose soils above the blast and located within10 feet of the blast shall be thoroughly wetted with water to suppress airborne dust. Sand or soils placed over weed-barrier fabric shall be similarly wetted before placing blast mats.

F. The depth of blasted rock benches, excluding 2-feet of sub-drilling, shall not exceed 15 feet.

G. Perform blasting Monday through Friday only between the hours of 9:00 a.m. and 4:00 p.m. only.

H. The Peak Particle Velocity (PPV) limits shall not exceed:

1. 2.0 in/s at Dam Embankments.
2. 5.0 in/s at ground above buried utilities.
3. 0.5 in/s at residential structures.
4. 2.0 in/s at LVMWD Buildings and Facilities

I. The maximum charge-per-delay for all blasts shall not exceed 100 pounds.

J. Scaled distance to nearest residential property shall be 65 or greater.

K. Scaled distance to the LVMWD Facilities Building shall be 21 or greater.

L. Intensity of air-overpressure at any off-site structures shall not exceed 133 decibels (0.01295 psi).

M. The diameter of holes drilled in rock for blasting shall not exceed 3.0 inches.

N. If specified vibration limits are exceeded, blasting operations shall cease immediately and a revised blasting plan shall be submitted to Owner's Representative. Blasting shall not resume until a revised blasting plan has been reviewed by the Engineer and the Owner's Representative has expressed in writing the conditions that will be applied to further blasting work.

O. After a blast has been fired, the Blaster-in-Charge shall inspect the area to determine that all charges have fired as planned and that no hazards exist in the blast area before the all clear signal is sounded and workers and others are allowed to return to the area.

P. The majority of excavation on the project shall be done by blasting.

Q. Notify residents within 200' of construction site of the blasting schedule by mail, street signs and the homeowner's association.

R. Provide temporary barriers to separate noise generating equipment from adjacent residences if needed to meet noise thresholds.

3.02 BLAST MONITORING

A. The Contractor shall provide a minimum of six seismographs for monitoring peak ground vibration and air-overpressure at any given time during blasting. The equipment and its use shall conform fully to the standards developed by the Vibration Section of the International Society of Explosive Engineers (ISEE). Monitor ground motion and air-overpressure on the saddle dam crest at the junction with the abutment closest to the blast. Each monitoring device shall have been calibrated within the one year prior to mobilization.

B. Provide continuous blast monitoring at the following locations for blasting south and north of the saddle dam.

1. South of Saddle Dam: Northern and Southern Saddle Dam abutments, Westlake Filtration Plant (northwest exterior), 32609 Torchwood Place, 2210 Three Spring Drive, 2514 / 2506 Sandycreek Drive (one combined location).

2. North of Saddle Dam: Northern and Southern Saddle Dam abutments, Westlake Filtration Plant (northwest exterior), 2820 Three Springs Drive, 32609 Torchwood Place, 2608 / 2604 Three Springs Drive (one combined location).

C. Minimum trigger levels for monitoring shall be 0.05 in/s for ground motion and 120 dB for air-overpressure. Trigger level may be adjusted to higher levels if authorized by Owner's Representative.

3.03 TEST BLAST

A. At the start of blasting, perform at least two test blasts to establish that rock movement is adequately controlled and intensities of specified ground motion and air-overpressure are in conformance with specified levels. The scaled distance to the nearest residential property for the test blasts must be 75 or greater.

3.04 REPAIR OF DAMAGE

A. When blasting operations damage offsite properties, or a portion of the work, or material surrounding or supporting the work, promptly repair or replace damaged items to the condition that existed prior to the damage, to the satisfaction of Owner’s Representative.

3.05 SUSPENSION OF BLASTING

A. Blasting operations may be suspended by Owner’s Representative for any of the following reasons:

1. Contractor's safety precautions are inadequate.
2. Ground motion vibration levels exceed specified limits of maximum particle velocity or maximum particle displacement.
3. Air-overpressure levels exceed specified limits.
4. Existing structural conditions are aggravated or adjacent improvements are damaged as a result of blasting.
5. Blasting endangers the stability or causes damage to rock outside the prescribed limits of excavation.
6. The results of the blasting, in the opinion of Owner’s Representative, are not satisfactory.

B. Blasting operations shall not resume until Owner’s Representative has approved the Contractor's revised blasting plan providing modifications to correct the conditions that resulted in the suspension.

3.06 REMOVAL OF FRACTURED ROCK

Upon completion of blasting to the lines and grades of the tank pad, back cut slope, and pipeline trenches, removed fractured rocks to provide safe working conditions.

3.07 TOLERANCE

Blasting tolerance for 1:1 slopes shall be 2’ or less. Blasting tolerances for all other work shall be 0.1’.

END OF SECTION

SECTION 312316 TRENCHING, BACKFILLING, AND COMPACTING

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, testing, and installation for pipeline and conduits trench excavation, backfilling, and compacting.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Protecting Existing Underground Utilities: 020120.

B. General Concrete Construction: 030500.

C. Cathodic Protection and Joint Bonding: 264213.

D. Clearing, Stripping, and Grubbing: 311100.

E. Earthwork: 312300.

F. Blasting: 312310.

G. Gravel and Crushed Rock Base for Structures: 312323.

H. Asphalt Concrete Paving: 321216.

I. Concrete Curbs, Gutters, and Sidewalks: 321613.

J. Pressure Testing of Piping: 400515.

1.03 SUBMITTALS

A. Submit six copies of a report from a testing laboratory verifying that material contains less than 1% asbestos by weight or volume and conforms to the specified gradations or characteristics for pea gravel, granular material, imported sand, rock refill for foundation stabilization, and water.

B. Submit method(s) of compaction including removal sequence of shoring where used.

1.04 TESTING FOR COMPACTION

A. The Owner will test for compaction as described below.

B. Determine the density of soil in place by the sand cone method, ASTM D1556 or by nuclear methods, ASTM D6938. Compaction tests will be performed for each lift or layer. If nuclear methods are used for in-place density determination, verify the accuracy with one sand cone and one maximum laboratory dry density, for every five nuclear tests taken if the backfill material is processed fill or visually consistent. More sand cones and densities will be required if the backfill material is visually variable. The minimum depth for the sand cone test hole shall be 12 inches. The minimum size shall be 8 inches, and size 16/30 or 10/20 silica sand shall be used.

C. Determine laboratory moisture-density relations of soils by ASTM D1557. If nuclear methods are used for in-place density determination, the compaction test results for maximum dry density and optimum water content shall be adjusted in accordance with ASTM D4718. This will be required for determination of percent relative compaction and moisture variation from optimum.

D. Determine the relative density of cohesionless soils by ASTM D4253 and D4254.

E. Sample backfill materials per ASTM D75.

F. "Relative compaction" is the ratio, expressed as a percentage, of the in-place dry density to the laboratory maximum dry density.

G. Compaction shall be deemed to comply with the specifications when no test falls below the specified relative compaction. The Contractor shall pay the costs for any retesting or additional testing of work not conforming to the specifications.

H. Where compaction tests indicate a failure to meet the specified compaction, the Owner will take additional tests every 25 feet in each direction until the extent of the failing area is identified. Rework the entire failed area until the specified compaction has been achieved.

1.05 PAVEMENT ZONE

The pavement zone includes the asphalt concrete and aggregate base pavement section placed over the trench backfill.

1.06 STREET ZONE

The street zone is the top 30 inches of the trench immediately below the pavement zone in paved areas. Where the depth of cover over the pipe does not permit the full specified thickness of the street zone, construct a thinner street zone, extending from the top of the pipe zone to the bottom of the pavement zone.

1.07 TRENCH ZONE

The trench zone includes the portion of the trench from the top of the pipe zone to the bottom of the street zone in paved areas or to the existing surface in unpaved areas. If the resulting trench zone is less than 24 inches thick, the street zone shall extend to the top of the pipe zone and there shall be no separate trench zone.

1.08 PIPE ZONE

The pipe zone shall include the full width of trench from the bottom of the pipe or conduit to a horizontal level above the top of the pipe, as specified below. Where multiple pipes or conduits are placed in the same trench, the pipe zone shall extend from the bottom of the lowest pipe to a horizontal level above the top of the highest or topmost pipe. Thickness of pipe zone above the highest top of pipe shall be as follows

unless otherwise shown in the drawings or otherwise described in the specifications for the particular type of pipe installed.

Pipe Diameter	Thickness of Pipe Zone Above Top of Pipe
6 inches or smaller	6 inches
8 inches and larger	10 inches

1.09 PIPE BASE OR BEDDING

The pipe base or bedding shall be defined as a layer of material immediately below the bottom of the pipe or conduit and extending over the full trench width in which the pipe is bedded. Thickness of pipe base shall be 6 inches unless otherwise shown in the drawings or otherwise described in the specifications for the particular type of pipe installed.

PART 2 - MATERIALS

2.01 GRANULAR MATERIAL FOR BACKFILL--STREET AND TRENCH ZONES

Granular material or granular soil for backfill used above the pipe zone shall be lean bank-run or pit-run gravel, or native soil. The maximum particle size shall be 3 inches. A maximum of 50% shall pass a No. 200 sieve.

2.02 NATIVE EARTH BACKFILL--STREET AND TRENCH ZONES

A. Native earth backfill used above the pipe zone shall be excavated fine-grained materials free from roots, debris, rocks larger than 3 inches, asbestos, organic matter, clods, clay balls, broken pavement, and other deleterious materials. Less than 50% shall pass a No. 200 sieve. At least 40% shall pass a No. 4 sieve. The coarser materials shall be well distributed throughout the finer material.

2.03 PIPE ZONE MATERIAL

A. Pipe zone materials are herein defined as those select earth materials used as pipeline bedding and shading, and as structure bedding. Pipe zone materials should consist of clean sand with a minimum Sand Equivalent (SE) of 30. The pipe zone materials shall extend from at least 6 inches below the pipe to 12 inches above the crown.

B. Pipe zone materials shall be properly and mechanically compacted in order to achieve a minimum of 90 percent relative compaction as determined by standard test method ASTM D1557. Backfill shall be placed in loose lifts no greater than 6-inches thick and mechanically compacted. Gravel, if used for pipe zone backfill, shall be placed in 6-inch lifts and mechanically densified/vibrated. If gravel is used, provide a filter fabric over the pipe zone, fully encapsulating the gravel zone.

C. The trench width shall be sufficient to allow compaction equipment to operate between the pipe springline and trench wall. The trench shall be a least 2 feet wider than the pipe on each side to allow for shoring installation and compaction of the backfill. Jetting or flooding of pipe-zone materials shall not be allowed.

2.04 TRENCH BACKFILL MATERIALS

A. Trench backfill materials are herein defined as those materials placed above the pipe zone. The native volcanic rock that will be excavated from the site should be suitable as trench backfill, as long as those materials are screened to remove particles, blocky materials, or lumps, larger than 3 inches in largest dimension. The trench backfill material shall contain no more than 15 percent material larger than 2 inches and the larger-size materials shall not be placed in concentrated pockets.

B. Trench backfill shall be spread in loose lifts not to exceed 6 inches in thickness, moisture-conditioned to within 2 percent of optimum moisture content for coarse-grained soils and between optimum moisture and 2 percent above optimum moisture content for fine-grained soils, and then compacted to 90 percent of the maximum dry density as determined from ASTM D1557. The upper 1 foot of the subgrade beneath paved areas shall be compacted to 95 percent of the maximum dry density ASTM D1557.

2.05 PERMEABLE MATERIAL FOR UNDERDRAINS--PIPE ZONE AND PIPE BASE

A. Permeable material shall consist of hard, durable, clean sand, gravel, or crushed stone and shall be free of asbestos, organic material, clay balls, or other deleterious substances. Gradation shall be:

Sieve Size	Percent Passing By Weight
3/4 inch	100
1/2 inch	95 to 100
3/8 inch	70 to 100
No. 4	0 to 55
No. 8	0 to 10
No. 200	0 to 3

B. Durability Index shall be at least 40 per California Test Method No. 229.

2.06 SAND-CEMENT SLURRY BACKFILL--PIPE ZONE

Sand-cement slurry backfill shall consist of one sack (94 pounds) of Type I or II portland cement added per cubic yard of imported sand and sufficient water for workability.

2.07 CONCRETE FOR PIPE ENCASEMENT AND THRUST BLOCKS

A. Concrete for unreinforced pipe encasement and thrust blocks shall be Class C per Section 030500, unless otherwise shown in the drawings.

B. Provide thrust blocks at fittings in pipe having rubber gasket bell-and-spigot or unrestrained mechanical joints. Do not provide thrust blocks for steel pipe having welded, flanged, or butt-strap joints unless detailed in the drawings or required in the detailed piping specification.

C. See the details in the drawings for thrust block sizes. Install thrust blocks based on the test pressures given in Section 400515. Size thrust blocks in accordance with the following table:

Pipe Test Pressure (psi)	**Use Thrust Block Sizing for**
0 to 25	25 psi
26 to 50	50 psi
51 to 100	100 psi
101 to 150	150 psi
151 to 200	200 psi

D. Dimensions of thrust blocks for pipes smaller than 6 inches shall be the same as the dimensions shown for 6-inch pipe, unless specific dimensions are shown in the drawings.

2.08 WATER FOR COMPACTION

See Section 312300. Water shall be free of organic materials injurious to the pipe coatings.

PART 3 - EXECUTION

3.01 SLOPING, SHEETING, SHORING, AND BRACING OF TRENCHES

Trenches shall have sloping, sheeting, shoring, and bracing conforming with 29CFR1926, Subpart P--Excavations, CAL/OSHA requirements, and the General Conditions.

3.02 SIDEWALK, PAVEMENT, AND CURB REMOVAL

Cut bituminous and concrete pavements regardless of the thickness and curbs and sidewalks prior to excavation of the trenches with a pavement saw or pavement cutter. Width of the pavement cut shall be at least equal to the required width of the trench at

ground surface. Haul pavement and concrete materials from the site. Do not use for trench backfill.

3.03 TRENCH EXCAVATION

A. Excavate the trench to the lines and grades shown in the drawings with allowance for pipe thickness, sheeting and shoring if used, and for pipe base or special bedding. If the trench is excavated below the required grade, refill any part of the trench excavated below the grade at no additional cost to the Owner with ¾ crushed rock. Place the refilling material over the full width of trench in compacted layers not exceeding 8 inches deep to the established grade with allowance for the pipe base or special bedding.

B. Trench widths in the pipe zone shall be as shown in the drawings. If no details are shown, maximum width shall be 18 inches greater than the pipe outside diameter. Comply with 29CFR Part 1926 Subpart P--Excavations. Trench width at the top of the trench will not be limited except where width of excavation would undercut adjacent structures and footings. In such case, width of trench shall be such that there is at least 2 feet between the top edge of the trench and the structure or footing.

C. Construct trenches in rock by removing rock to a minimum of 6 inches below bottom of pipe and backfilling with imported sand.

3.04 TRENCH EXCAVATION IN BACKFILL AND EMBANKMENT AREAS

A. Construct and compact the embankment to an elevation of 1-foot minimum over the top of the largest pipe or conduit to be installed.

B. Excavate trench in the compacted backfill or embankment.

3.05 LOCATION OF EXCAVATED MATERIAL

A. During trench excavation, place the excavated material only within the working area. Do not obstruct any roadways or streets. Do not place trench spoil over pipe, buried utilities, manholes, or vaults. Conform to federal, state, and local codes governing the safe loading of trenches with excavated material.

B. Locate trench spoil piles at least 10 feet from the tops of the slopes of trenches. Do not operate cranes and other equipment on the same side of the trench as the spoil piles.

3.06 LENGTH OF OPEN TRENCH

Limit the length of open trench to the amount of pipe installed in one working day. Complete backfilling and temporary or first layer paving not more than 100 feet in the rear of pipe laying.

3.07 DEWATERING

Provide and maintain means and devices to remove and dispose of water entering the trench excavation during the time the trench is being prepared for the pipe laying, during the laying of the pipe, and until the backfill at the pipe zone has been completed. These provisions shall apply during both working and nonworking hours, including lunchtime, evenings, weekends, and holidays. Dispose of surface water runoff to the existing onsite sanitary sewer system and to prevent damage to adjacent property and in accordance with regulatory agency requirements. No surface water will be allowed to be discharged into the open water reservoir. Do not drain trench water through the pipeline under construction. Do not drain trench water to the open reservoir.

3.08 ADDITIONAL TRENCH EXCAVATION

A. After the required excavation has been completed, the Owner will inspect the exposed subgrade to determine the need for any additional excavation. It is the intent that additional excavation be conducted in all areas within the influence of the pipeline where unacceptable materials exist at the exposed subgrade. Overexcavation shall include the removal of all such unacceptable material that exist directly beneath the pipeline to a width 18 inches greater than the pipe outside diameter and to the depth required.

B. Place filter fabric on the bottom of the trench and up the sides a sufficient height to retain rock refill material. Backfill the trench to subgrade of pipe base with rock refill material for foundation stabilization. Place the foundation stabilization material over the full width of the trench and compact in layers not exceeding 8 inches deep to the required grade. Foundation stabilization work shall be executed in accordance with a change order.

C. Rock refill used by the Contractor for his convenience will not be cause for any additional payment.

3.09 INSTALLING BURIED PIPING

A. Grade the bottom of the trench to the line and grade to which the pipe is to be laid, with allowance for pipe thickness. Remove hard spots that would prevent a uniform thickness of bedding. Place the specified thickness of pipe base material over the full width of trench. Grade the top of the pipe base ahead of the pipe laying to provide firm, continuous, uniform support along the full length of pipe, and compact to the relative compaction specified herein. Before laying each section of the pipe, check the grade and correct any irregularities.

B. Excavate bell holes at each joint to permit proper assembly and inspection of the entire joint. Fill the area excavated for the joints with the bedding material specified or indicated in the drawings for use in the pipe zone. If no bedding material is specified or indicated, use imported sand.

C. Inspect each pipe and fitting before lowering the buried pipe or fitting into the trench. Inspect the interior and exterior protective coatings. Patch damaged areas in the field

with material recommended by the protective coating manufacturer. Clean ends of pipe thoroughly. Remove foreign matter and dirt from inside of pipe and keep clean during and after installation.

D. Handle pipe in such a manner as to avoid damage to the pipe. Do not drop or dump pipe into trenches under any circumstances.

E. When installing pipe, do not deviate more than 1 inch from line or 1/4 inch from grade. Measure elevation at the pipe invert.

F. After pipe has been bedded, place pipe zone material simultaneously on both sides of the pipe, in maximum 8-inch lifts, keeping the level of backfill the same on each side. If no pipe zone material is specified or indicated, use imported sand. Carefully place the material around the pipe so that the pipe barrel is completely supported and no voids or uncompacted areas are left beneath the pipe. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling.

G. Compact each lift to the relative compaction specified herein.

H. Push the backfill material carefully onto the backfill previously placed in the pipe zone. If no backfill material is otherwise specified or indicated, use granular material for backfill. Do not permit free-fall of the material until at least 2 feet of cover is provided over the top of the pipe. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe. Do not operate heavy equipment or a sheepsfoot wheel mounted on a backhoe over the pipe until at least 3 feet or one-half of the internal diameter, whichever is greater, of backfill has been placed and compacted over the pipe.

I. When the pipe laying is not in progress, including the noon hours, close the open ends of pipe. Do not allow trench water, animals, or foreign material to enter the pipe.

J. Keep the trench dry until the pipe laying and jointing are completed.

3.10 BACKFILL COMPACTION

A. Unless otherwise shown in the drawings or otherwise described in the specifications for the particular type of pipe installed, relative compaction in pipe trenches shall be as follows:

1. Pipe Zone: 90% relative compaction.

2. Backfill in Trench Zone Not Beneath Paving: 90% relative compaction. Compact backfill within embankment above the pipe zone to the same relative compaction as the adjacent embankment as specified in Section 312300.

3. Backfill in Trench Zone to Street Zone in Paved Areas: 90% relative compaction.

4. Backfill in Street Zone in Paved Areas: 95% relative compaction.

5. Rock Refill for Foundation Stabilization: 80% relative density.

6. Refill for Overexcavation: 80% relative density.

B. Compact trench backfill to the specified relative compaction. Compact by using mechanical compaction or hand tamping. Do not use high-impact hammer-type equipment except where the pipe manufacturer warrants in writing that such use will not damage the pipe.

C. Compact material placed within 12 inches of the outer surface of the pipe by hand tamping only.

D. Do not use any axle-driven or tractor-drawn compaction equipment within 5 feet of building walls, foundations, and other structures.

3.11 MATERIAL REPLACEMENT

Remove and replace any trenching and backfilling material that does not meet the specifications, at the Contractor's expense.

3.12 PLACING SAND-CEMENT SLURRY BACKFILL

Place sand-cement slurry backfill in a uniform manner that will prevent voids in or segregation of the material. Remove foreign material that falls into the excavation or trench. Do not commence backfilling over or place any material over the slurry cement backfill until at least four hours after placing the sand-cement slurry.

END OF SECTION

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SECTION 312323 GRAVEL AND CRUSHED ROCK BASE FOR STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION

This includes materials, testing, and installation of gravel and crushed rock bases for structures such as manholes and vaults.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Concrete: 030500.

B. Earthwork: 312300

C. Trenching, Backfilling and Compacting: 312316

1.03 SUBMITTALS

Submit six copies of a report from a testing laboratory verifying that material contains less than 1% asbestos by weight or volume and conforms to the specified gradations or characteristics.

1.04 TESTING FOR COMPACTION

A. The Owner will test for compaction or relative density as described below.

B. Determine the density of gravel and rock in place by the sand cone method, ASTM D1556 or D2167.

C. Determine the relative density of gravel and rock per ASTM D4253 and D4254.

D. Sample backfill materials per ASTM D75.

E. Compaction shall be deemed to comply with the specifications when no test falls below the specified relative compaction. The Contractor shall pay the costs of retesting work not conforming to the specifications.

PART 2 - MATERIALS

2.01 CRUSHED ROCK AND GRAVEL

A. Crushed rock base and gravel are defined as natural or crushed rock, free from organic matter and containing less than 1asbestos by weight or volume, and meeting the following gradation:

Sieve Size	Percent Passing By Weight
1 1/2 inches	100
3/4 inch	90 to 100
No. 4	35 to 55
No. 30	10 to 30
No. 200	0 to 5

B. Durability Index shall be at least 40 per ASTM D3744 California Test Method No. 229.

2.02 CRUSHED ROCK

Crushed rock base shall conform to ASTM C33, coarse aggregate, size number 57. Durability Index shall be at least 40 per ASTM D3744.

PART 3 - EXECUTION

3.01 PLACEMENT OF CRUSHED ROCK OR GRAVEL

A. Place crushed rock or gravel base beneath structures where shown in the drawings, 6 inches thick unless otherwise indicated. Excavate below the required grade for the bottom of the structure and refill with crushed rock or gravel as specified above. The rock base shall extend a minimum of 12 inches beyond the structure base, floor slab, or footing.

B. Compact base as follows unless otherwise indicated:

1. Lower Lift: 80% relative density.

2. Upper Lifts: 85% relative density.

C. Place base material in maximum lifts of 6 inches.

END OF SECTION

SECTION 313219 FILTER FABRIC

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and installation of filter fabric and its maintenance.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Clearing, Stripping, and Grubbing: 311100.

B. Earthwork: 312300.

C. Trenching, Backfilling, and Compacting: 312316.

D. Riprap for Channels, Structures, and Embankments: 313716.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit manufacturer's catalog data and a sample of the filter fabric.

C. Submit manufacturer's recommended installation instructions and details.

D. Submit mill certificate or affidavit signed by a legally authorized official from the company manufacturing the fabric. The mill certificate or affidavit shall attest that the fabric meets the chemical, physical, and manufacturing requirements stated in this specification.

1.04 GEOTEXTILE INSTALLATION AND RIPRAP APPLICATION INSTRUCTION AND TRAINING

Conduct a geotextile installation and test riprap fill performance demonstration/training session at the site prior to foundation preparation, geotextile installation, and riprap installation. That training session shall include participation by the geotextile manufacturer’s representative, and it shall prequalify the placement and installation personnel, demonstrate the proper foundation preparation and installation methods used, and ensure that the riprap application methods will not damage the geotextile during installation.

Establish geotextile installation procedures. Determine the maximum heights from which the soil, sand, and riprap can be dropped without damaging the geotextile.

PART 2 - MATERIALS

2.01 MANUFACTURERS

Filter fabric shall be manufactured by Haines Geocomponents or equal.

2.02 FILTER FABRIC

A. Filter fabric shall be a pervious sheet of woven or nonwoven plastic yarn. Filter fabric protecting drainage materials in contact with earth materials shall be non-woven type satisfying requirements for underdrains per Section 88-1.03 of Caltrans (2002), standard Specifications.

B. The plastic yarn shall meet the physical requirements specified in AASHTO M288.

C. Geotextiles shall meet the properties specified in AASHTO M288 as follows:

Service	Requirements
Subsurface drainage	Table 2
Stabilization	Table 4
Permanent erosion control	Table 5
Paving fabric	Table 7

D. Minimum physical requirements for drainage geotextile:

Table 1
Minimum Physical Requirements for Drainage Geotextile

Property	Units	Acceptable Values	Specification
Grab Strength	Pounds	Class 2	AASHTO M288, Table 1
Seam Strength	Pounds	Class 2	AASHTO M288, Table 1
Puncture	Pounds	55	ASTM D4833
Trapezoid Tear	Pounds	55	ASTM D4533
Apparent Opening Size	U.S. Sieve	No. 40	ASTM D4751
Permittivity	Sec –1	0.5	ASTM D4491
Ultraviolet Degradation	Percent	50 at 500 hours	ASTM D4355

E. Manufacture the fabric into a width not less than 6 feet.

F. Filter fabric shall not act as a wicking agent.

2.03 SECURING PINS

Securing pins shall be 3/16-inch-diameter steel, pointed at one end, and fabricated with a head to retain a steel washer having an outside diameter of no less than 1.5 inches. The lengths of the pins shall be no less than 12 inches.

PART 3 - EXECUTION

3.01 SHIPMENT, STORAGE, AND HANDLING

A. Protect the fabric from direct sunlight, ultraviolet rays, temperatures greater than 140°F, mud, dirt, dust, and debris at all times during shipment and storage. To the extent possible, wrap the fabric in a heavy-duty protective covering.

B. Store fabric on clean, dry surfaces, free of foreign substances such as grease, oil, paint, epoxy, cement, or any other substances which would have a deleterious effect on the fabric. When stored in outside areas, keep fabric 1-foot minimum above ground level. Keep the fabric in its protective covering until it is ready for installation. Cover opened rolls by a waterproof cover. Do not use hooks, tongs, or other sharp tools or instruments when handling fabric. Fabric may be unloaded or handled in one of the following ways:

1. By placing slings under the rolls.

2. By using a pole inserted through a hollow core, provided the pole extends 1-foot minimum beyond each end of the core and lifting and handling devices are attached to only that portion of the pole located outside the ends of the core.

3. By hand.

3.02 PROTECTION DURING INSTALLATION

Protect the geotextile during installation from clogging, tears, and other damage. Provide ballast (e.g., sand bags) to prevent uplift by wind. Do not leave the geotextile uncovered for more than 10 days after installation.

3.03 SUBGRADE PREPARATION

Prepare the surface to receive fabric to a smooth condition free of sharp objects, obstructions, depressions, debris, and soft or low-density pockets of material.

3.04 PLACEMENT OF GEOTEXTILE IN CHANNELS, SHORELINES, AND TRENCHES

A. Install in accordance with AASHTO M288, Appendices A1 and A3 except as modified below.

B. Place filter fabric in the manner and at the locations shown in the drawings. Do not use fabric with defects, rips, holes, flaws, deterioration, or damage of any nature.

C. Handle and place filter fabric in accordance with the manufacturer's recommendations. Stretch, align, and place the fabric in a wrinkle-free manner.

D. Place fabric with the long dimension perpendicular to the centerline of the trench and lay smooth and free of tension, stress, folds, wrinkles, or creases. Place the strips to provide a minimum width of 12 inches of overlap for each joint.

E. Insert securing pins with washers through both strips of overlapped fabric at not greater than 4-foot intervals along a line through the midpoint of the overlap.

F. Install additional pins regardless of location to prevent any slippage of the filter fabric. Place the fabric so that the upper strip of fabric will overlap the next lower strip. Push each securing pin through the fabric until the washer bears against the fabric and secures it firmly to the foundation.

3.05 SEAMS FOR FILTER FABRIC USED IN CHANNELS, SHORELINES, AND TRENCHES

A. Stitch fabric seams with thread meeting the chemical requirements for plastic yarn or bond by cementing or heat. Stitch fabric with yarn of a contrasting color. The size and composition of the yarn shall be as recommended by the fabric manufacturer. The stitches shall number 5 to 7 per inch of seam. Attach the sheets of filter fabric at the factory or another location to form sections not less than 6 feet wide.

B. Test seams in accordance with method ASTM D1683, using 1-inch-square jaws and 12 inches per minute constant rate of traverse. The strengths shall be not less than 90% of the required tensile strength of the unaged fabric in any principal direction.

3.06 COVERING WITH FILTER ROCK

A. Schedule the work so that the covering of the fabric with the planned thickness of the specified material is accomplished within 10 days after placement of the fabric. Remove and replace all fabric left exposed longer than 10 days.

B. Protect the filter fabric from damage due to the placement of riprap or other materials by limiting the height of drop of the material and by placing a 2-inch cushioning layer of sand on top of the fabric before dumping the material. Before placement of riprap, the Contractor shall demonstrate that the placement technique will prevent damage to the fabric.

3.07 COVERING WITH SOIL OR SAND

Do not cover geotextile prior to inspection by the Owner’s Representative. Place cover soil or sand in a manner that prevents soil or sand from entering the geotextile overlap zone, prevents tensile stress from being mobilized in the geotextile, and prevents wrinkles from folding over onto themselves. On side slopes, place soil or sand backfill from the bottom of the slope upward. Do not drop cover soil or sand onto the geotextile from a height greater than 3 feet. Do not operate equipment directly on top of the geotextile. Use equipment with ground pressures less than 7 psi to place the first lift over the geotextile. Maintain a minimum of 12 inches of soil between full-scale construction equipment and the geotextile. Cover soil or sand material type, compaction, and testing

requirements are described in Section 312316. Equipment placing cover soil shall not stop abruptly, make sharp turns, spin their wheels, or travel at speeds exceeding 5 mph.

3.08 PLACEMENT OF GEOTEXTILE AROUND UNDERDRAIN PIPING

A. Install in accordance with AASHTO M288, Appendices A1 and A2, except as modified below.

B. Wrap the perforated underslab drains with filter fabric. Do not use fabric with defects, rips, holes, flaws, deterioration, or damage of any nature.

C. Handle and place filter fabric in accordance with the manufacturer's recommendations. Stretch, align, and place the fabric in a wrinkle-free manner.

D. Spiral-wrap the perforated underdrain pipes with filter fabric to provide a minimum width of 18 inches of overlap. Install perforated pipe per Section 402350 and the drawings.

E. Cover filter fabric wrapped underdrain pipes with permeable underdrain material and compact per fabric manufacturer and Section 312316.

3.09 INSTALLATION OF GEOTEXTILE FOR PAVING

Install in accordance with AASHTO M288, Appendices A1 and A6.

3.10 REPAIRING DAMAGED FABRIC

A. Protect the fabric at all times during construction from contamination by surface runoff. Remove and replace fabric so contaminated with uncontaminated fabric. Repair any damage to the fabric during its installation or during placement of filter materials or rip rap by the Contractor at his expense.

B. Repair fabric damaged during placing, in other than underdrain piping service, by placing a piece of fabric large enough to cover the torn or punctured area, meet the overlap requirement, and extend a minimum of 12 inches beyond the edge of the damaged area. Repair damaged sections of fabric used in underdrain piping by cutting out the damaged section over the full width of the spiral section and stitching a new fabric section in place for a minimum length of 18 inches.

C. Damage to the fabric and underdrain piping system resulting from the Contractor's vehicles, equipment, or operations shall be repaired by the Contractor at his expense.

D. Maintain a minimum of 6 inches of material between the fabric and all equipment, during spreading and compaction of the covering material. Where embankment material is to be placed on the filter fabric, maintain a minimum of 18 inches of embankment material between the fabric and the equipment. Do not operate or drive equipment or vehicles directly on the filter fabric.

END OF SECTION

SECTION 313716 RIPRAP FOR CHANNELS, STRUCTURES, AND EMBANKMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and installation of riprap for the protection of channels, structures, and embankments.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Earthwork: 312300.

B. Filter Fabric: 313219.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit letter identifying source of stone.

C. Submit analysis from an independent laboratory showing specific gravity, absorption, and durability of stone.

PART 2 - MATERIALS

2.01 STONE FOR RIPRAP

A. Stone for riprap shall be rock excavated onsite during blasting or quarry stone, well graded and angular. Stone shall be of such shape as to form a stable protection for the required section. Do not use flat or elongated shapes unless the thickness of the individual pieces is at least one-third the length. Material shall be clean and free from deleterious impurities including alkali, earth, clay, refuse, and adherent coatings.

B. The individual classes of rocks used in rock slope protection shall conform to the following:

Rock Sizes	Percentage Larger Than*				
	Class				
	8 Tons	**4 Tons**	**2 Tons**	**1 Ton**	**½ Ton**
16 tons	0 to 5				
8 tons	50 to 100	0 to 5			
4 tons	95 to 100	50 to 100	0 to 5		
2 tons		95 to 100	50 to 100	0 to 5	
1 ton			95 to 100	50 to 100	0 to 5
1/2 ton				95 to 100	50 to 100
1/4 ton					95 to 100

Rock Sizes	Percentage Larger Than*					
				Backing		
	1/4 Ton	**Light**	**Facing**	**No. 1**	**No. 2**	**No. 3**
1/2 ton	0 to 5					
1/4 ton	50 to 100	0 to 5				
200 lb	-	50 to 100	0 to 5	0 to 5		
75 lb	95 to 100	-	50 to 100	50 to 100	0 to 5	
25 lb		95 to 100	90 to 100	90 to 100	25 to 75	0 to 5
5 lb					90 to 100	25 to 75
1 lb						90 to 100

*****The amount of material smaller than the smallest size listed for any class of rock slope protection shall not exceed the percentage limit listed determined on a weight basis. Compliance with the percentage limit shown for all other sizes of the individual pieces of any class of rock slope protection shall be determined by the ratio of the number of individual pieces larger than the specified size compared to the total number of individual pieces larger than the smallest size listed for that class.

2.02 QUALITY CONTROL OF STONE

A. Visual evaluation of the excavated rock or quarry, including examination of blast samples and diamond drill core samples and suitable tests and service records, may be used to determine the acceptability of the stone. Notify the Owner in writing of the intended source of stone at least 60 days prior to use.

B. To determine the required quality, provide specific gravity, absorption, and durability tests of stone as follows:

Test	Test Method	Requirement
Apparent Specific Gravity	ASTM C127	2.50 minimum
Absorption	ASTM C127	4.2% maximum
Durability	ASTM D3744	52 minimum

Based on the formula below, absorption may exceed 4.2% if the durability absorption ratio (DAR) is greater than 10. Durability may be less than 52 if DAR is greater than 24.

$$DAR = \frac{\text{Coarse Durability Index}}{\text{\% Absorption} + 1}$$

PART 3 - EXECUTION

3.01 INSTALLATION

Grade areas to a smooth surface. Place riprap on a filter blanket as specified in Section 313219 or, when the blanket is not required, directly on the prepared slope in such a manner as to produce a well-graded mass with the minimum practical percentage of voids. Place the riprap to its full course thickness in one operation and in such a manner as to avoid displacing the underlying material.

END OF SECTION

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SECTION 316820 ROCKFALL DRAPE SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, installation, and testing of rock fall draping and anchors over the vertical 0.25:1 cut slope around the 5MG tank at locations shown on the final plans.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Measurement and Payment: 012000.

B. Earthwork: 311100.

C. Blasting: 312310.

1.03 SUBMITTALS

A. Submit design and calculations of the rock anchor protection system including design of system appurtences. Design shall be prepared by a licensed Civil Engineer and Geologist, both licensed in the State of California.

B. Submit shop drawings in accordance with Section 013300.

C. Submit installation method, sequencing and past projects utilizing the specified drape and anchor system.

PART 2 – MATERIALS

2.01 The system shall be designed to withstand static and dynamic forces generated from rocks sliding from the 0.25:1 cut slope around the tank. The system design shall have been previously used in similar applications and capacities.

2.02 The manufacturer shall be regularly engaged in the design and manufacturing of rock fall protection systems.

2.03 The mesh shall be woven construction, shall be 3 dimensional and diamond shaped with a minimum mesh size of 3.25 inches by 5.5 inches and a depth of 0.43 inches. The ends of each wire shall be formed into a loop and twisted. The loops of the wire mesh shall be fastened together to prevent unraveling of the mesh.

2.04 The wire shall be galvanized high strength alloy steel wire with a minimum tensile strength of 256,000 pounds per square inch and a minimal longitudinal tensile strength load capacity of 10,278 pounds per foot and a tensile strength of 2,810 pounds.

2.05 The wire shall be galvanized with a minimum weight of coating of 0.0256 pounds per square foot. The galvanizing shall be 95% Zinc and 5% Aluminum.

2.06 Net Support Ropes shall have a diameter of 3/4-inch. The wire rope shall be of 6x19 construction (or equivalent), IWRC with a minimum breaking strength of 52,920 pounds.

2.07 Anchors shall be made with 3/4-inch diameter wire rope. The wire rope shall be of 6x19 construction (or equivalent), IWRC with a minimum breaking strength of 52,920 pounds. An eye shall be made in one end using a heavy duty galvanized thimble and stop sleeve.

2.08 Miscellaneous materials used shall be supplied by the vendor of the system and shall be hot dipped galvanized.

2.09 Seam Rope and Fasteners shall be used to fasten the mesh panels to each other. Seam Rope shall be used to lace the mesh to the support rope. Seam rope shall have a minimum diameter of of 5/16” and shall be of 7x7 construction (or equivalent) with a minimum breaking strength of 9,200 pounds.

2.10 Manufacturer shall be Geobrugg or equal.

PART 3 - EXECUTION

3.01 DAMAGE TO DRAPING, WOVEN MESH, WIRE, ROPE AND ANCHORS

Repair damage prior to mesh and anchor installation.

3.02 INSTALLATION

Install in accordance with the manufacturer's recommendations. In case of a conflict between the manufacturer's recommendations and these specifications, these specifications shall prevail.

3.03 ANCHORS

A. Protect the anchor assembly against rust, corrosion, and physical damage prior to completion of grouting of enclosure or encasement in concrete.

B. The diameter of the drilled hole shall be large enough to provide a minimum of 1 inch of grout cover within the bonded length of the anchor.

C. Prior to installing each anchor assembly into the drilled hole, the anchor assembly shall be clean and free of oil, grease, or other extraneous substances, and any damaged material shall be repaired or replaced.

3.04 TESTING

The minimum pullout strength for the anchors shall be 10 tons and shall be verified by the contractor in the field. The testing shall consist of a pullout test incorporating 20% of the total number of anchors. If more than 25% of the tested anchors fail, all anchors shall be tested. Failed anchors shall be replaced by the contractor at no additional cost to the owner. Testing shall be performed against a temporary yoke or load frame. No part of the yoke or load frame shall bear within 3 feet of the anchor.

END OF SECTION

SECTION 321216 ASPHALT CONCRETE PAVING

PART 1 GENERAL

1.01 DESCRIPTION

This section includes materials, testing, and installation of asphalt concrete pavement, for road construction, trench resurfacing and overlay, prime coat, tack coat, and seal coat.

1.02 SUBMITTALS

A. Submit six copies of a report from a testing laboratory verifying that aggregate material contains less than 1% asbestos by weight or volume.

B. Submit test reports for each material to be incorporated into the Work verifying gradation and quality.

C. Submit a plan showing existing striping configuration and type. Plan shall be submitted prior to any pipeline work on said streets at the Westlake Filtration Plant site.

1.03 TESTING FOR COMPACTION

A. The Owner will test for compaction as described below.

B. Determine the density of soil in place by the sand cone method, ASTM D1556 or by nuclear methods, ASTM D6938. Compaction tests will be performed for each lift or layer. If nuclear methods are used for in-place density determination, verify the accuracy with one sand cone and one maximum laboratory dry density, for every five nuclear tests taken if the backfill material is processed fill or visually consistent. More sand cones and densities will be required if the backfill material is visually variable. The minimum depth for the sand cone test hole shall be 12 inches. The minimum size shall be 8 inches, and size 16/30 or 10/20 silica sand shall be used.

C. Determine laboratory moisture-density relations of soils by ASTM D1557. If nuclear methods are used for in-place density determination, the compaction test results for maximum dry density and optimum water content shall be adjusted in accordance with ASTM D4718. This will be required for determination of percent relative compaction and moisture variation from optimum.

D. Determine the relative density of cohesionless soils by ASTM D4253 and D4254.

E. Sample backfill materials per ASTM D75.

F. "Relative compaction" is the ratio, expressed as a percentage, of the in place dry density to the laboratory maximum dry density.

G. Make excavation for compaction tests at the locations and to the depths designated by the Owner's Representative. Backfill and recompact the excavations at completion of testing. When tests indicated that the compaction is less than the specified relative compaction, rework and retest those areas until the specified relative compaction has been obtained.

1.04 STANDARD SPECIFICATIONS

Wherever reference is made to the Public Works Specifications such reference shall mean the Standard Specifications for Public Works Construction (SSPWC), 2006 edition and 2008 Cumulative Supplement or unless noted otherwise.

PART 2 - MATERIALS

2.01 ASPHALT CONCRETE PAVING

Asphalt concrete paving shall conform to PG 64-10 as listed in Section 400-4 of the Public Works Specifications.

2.02 AGGREGATE BASE COURSE

Aggregate base course shall be Crushed Miscellaneous Base as specified in Section 200-2.4 of the Public Works Specifications. Aggregate shall contain less than 1% asbestos by weight or volume.

2.03 PRIME COAT

All areas to be paved shall receive prime coat. Prime coat shall be medium curing (SC-70) in accordance with Section 302-5.3 of the Public Works Specifications.

2.04 TACK COAT

Tack coat shall conform with Section 302-5.4 of the Public Works Specifications and shall be either AR4000, AR8000 paving asphalt or Grade SS-1h emulsified asphalt.

2.05 ASPHALT

Asphalt shall be Performance Grade PG 64-10 per Section 203-6.4 of the Greenbook. Asphalt content in the pavement shall be 5.5% to 6.0%.

2.06 AGGREGATE FOR ASPHALT CONCRETE

Aggregate shall be in accordance with Section 400-1 of the Public Works Specifications. Aggregate shall contain less than 1% asbestos by weight or volume.

2.07 SEAL COAT

Seal coat shall be Type II emulsion-aggregate slurry per Section 203-5 of the Public Works Specifications.

PART 3 - EXECUTION

3.01 PAVEMENT REMOVAL

A. Where work is done within the jurisdiction of the City of Westlake Village, or other jurisdiction, their respective encroachment permit conditions shall govern. Otherwise work shall be as follows:

1. In all existing pavement areas where the surface is removed, broken or damaged by the equipment or in which the ground has caved in or settled due to the installation of the improvements, the surface shall be restored to the original grade by the Contractor.

2. Prior to resurfacing, the existing surfacing shall be removed as specified herein. All broken and jagged edges of the pavement edge shall be sawed straight. Areas to be cut shall be indicated by the Owner and no permanent pavement shall be placed until these edges have been sawed. If during the initial removal of the existing pavement a method of removal was used which disturbed the adjoining pavement, or if during general construction operations the adjacent pavement or base material was disturbed, then this adjoining pavement must also be removed and replaced.

3. Where irregular surfaces are to be surfaced, existing pavement shall be cut parallel to the alignment of the pipe or to the centerline of the roadway, at the discretion of the Owner. Asphalt concrete pavement shall be saw cut to a minimum depth of 2 inches at a point not less than 12 inches outside the limits of excavation or the previous pavement cut (made by pneumatic tools), whichever limits are the greater. Where a trench edge is less than 4 feet from the existing edge of pavement, gutter, or curb, the remaining existing pavement shall be removed and replaced with new pavement.

B. Make arrangements for and dispose of the removed pavement off site.

C. Final pavement saw cuts shall be straight along both sides of trenches, parallel to the pipeline alignment, and provide clean, solid, vertical faces free from loose material. Saw cut and remove damaged or disturbed adjoining pavement. Saw cuts shall be parallel to the pipeline alignment or the roadway centerline or perpendicular to same.

3.02 PAVEMENT REPLACEMENT

A. Place and maintain temporary striping in areas receiving asphalt overlay so that traffic can be returned to normal patterns.

B. The pavement replacement shall be done in kind to the original depth.

3.03 INSTALLATION

Producing, hauling, placing, compacting, and finishing of asphalt concrete shall conform to Section 302-5 of the Public Works Specifications. Apply seal coat to all paving.

3.04 CONNECTIONS WITH EXISTING PAVEMENT

A. Where new paving joins existing paving, grind the existing surfaces 12 inches back from the joint line so that there will be sufficient depth to provide a minimum of 2 inches of asphalt concrete.

B. Dispose of waste material offsite.

C. Tack ground areas prior to placing the asphalt concrete. Meet lines shall be straight and the edges vertical. Paint the edges of meet line cuts with liquid asphalt or emulsified asphalt prior to placing asphalt concrete. After placing the asphalt concrete, seal the meet line by painting with a liquid asphalt or emulsified asphalt and then immediately cover with clean, dry sand.

3.05 PLACING AGGREGATE BASE COURSE

Compact aggregate base course to 95% relative compaction. Install in accordance with Section 301-2 of the Public Works Specifications.

3.06 COMPACTION OF AGGREGATE BASE

Compaction and rolling shall begin at the outer edges of the surfacing and continue toward the center. Apply water uniformly throughout the material to provide moisture for obtaining the specified compaction. Compact each layer to the specified relative compaction before placing the next layer.

3.07 PLACING TACK COAT

Apply tack coat on surfaces to receive finish pavement per Section 302-5.4 of the Public Works Specifications. Apply tack coat to metal or concrete surfaces that will be in contact with the asphalt concrete paving.

3.08 PLACING ASPHALT CONCRETE PAVING

A. Place asphalt overlay to a minimum thickness of 2 inches. Place asphalt pavement for trench restoration to the minimum thicknesses provided in the pavement replacement table above. Install in accordance with Section 302-5 of the Public Works Specifications.

B. Placement of asphalt concrete shall be done by use of an automated asphalt paving machine specifically designed for the placement of asphalt paving. Placement of permanent asphalt concrete with tools or walk behind devices will not be allowed.

C. All manholes, valve boxes and other surface structures shall be brought to new paved grades, as required.

3.09 COMPACTION OF ASPHALT CONCRETE PAVING

Compact until roller marks are eliminated and a density of 92% minimum to 98% maximum has been attained per ASTM D2041.

3.10 APPLYING SEAL COAT

Apply emulsion-aggregate slurry per Section 302-4 of the Public Works Specifications.

3.11 SURFACE TOLERANCE

A. The thickness of asphalt overlay shall not deviate more than 0.04 feet (1/2 inches).

B. After paving has been installed and compacted, spray water over the entire paved area. Correct any areas where water collects and does not drain away.

3.12 PAVEMENT MAINTENANCE

A. Following the certification of completion by the Owner, the Contractor shall maintain the surface of the re-paved, overlayed and new pavement areas for at least the period of the guarantee of the Work.

B. All materials and labor required for the maintenance of paving shall be supplied by the Contractor, and the work shall be done in a manner satisfactory to the Owner.

END OF SECTION

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SECTION 321613 CONCRETE CURBS, GUTTERS, AND SIDEWALKS

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and installation of concrete curbs, gutters, and sidewalks.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Concrete Construction: 030500.

B. Earthwork: 312300.

1.03 SUBMITTAL

Submit a report from a testing laboratory verifying that crushed rock and aggregate material contains less than 1% asbestos by weight or volume and conforms to the specified gradations or characteristics.

1.04 TESTING FOR COMPACTION

A. Determine the density of soil in place by the sand cone method, ASTM D1556 or by nuclear methods, ASTM D6938. Compaction tests will be performed for each lift or layer. If nuclear methods are used for in-place density determination, verify the accuracy with one sand cone and one maximum laboratory dry density for every five nuclear tests taken if the backfill material is processed fill or visually consistent. More sand cones and densities will be required if the backfill material is visually variable. The minimum depth for the sand cone test hole shall be 12 inches. The minimum size shall be 8 inches, and size 16/30 or 10/20 silica sand shall be used.

B. Determine laboratory moisture-density relations of soils by ASTM methods. If nuclear methods are used for in-place density determination, the compaction test results for maximum dry density and optimum water content shall be adjusted in accordance with ASTM D4718. This will be required for determination of percent relative compaction and moisture variation from optimum.

C. Determine the relative density of cohesionless soils by ASTM D4253 and D4254.

D. Sample backfill materials by ASTM D75.

E. "Relative compaction" is the ratio, expressed as a percentage, of the inplace dry density to the laboratory maximum dry density.

F. Compaction shall be deemed to comply with the specifications when no more than one test of any three consecutive tests falls below the specified relative compaction. The one test shall be no more than three percentage points below the specified compaction. The Contractor shall pay the costs of any retesting of work not conforming to the specifications.

1.05 STANDARD SPECIFICATIONS

A. Where requirements for concrete curbs, getters and sidewalks are not covered in the bid documents the technical requirements of the most recent issue of Standard Specifications and Standard Plans for Public Works Construction (Greenbook) shall apply.

PART 2 MATERIALS

2.01 FORMS

A. Forms shall conform to the requirements of Section 030500. Provide stakes and bracing materials to hold forms securely in place.

B. Materials for sidewalk forms shall be 2-inch dressed lumber straight and free from defects, or standard metal forms. Where short-radius forms are required, 1-inch dressed lumber or plywood may be used. Provide stakes and bracing materials to hold forms securely in place.

2.02 EXPANSION JOINT FILLER

Expansion joint filler shall be 1/2 inch thick for curbs and 1/4 inch thick for sidewalks and shall conform to premolded joint filler in Section 030500.

2.03 CONCRETE

Concrete shall be Class A per Section 030500, except that the maximum water-cement ratio for concrete in curbs and gutters shall be 0.55.

2.04 REINFORCING STEEL

Conform to Section 030500.

2.05 CURING COMPOUND

Curing compound shall be as specified in Section 030500.

2.06 EXCAVATION AND BACKFILL

Conform to Section 312300.

PART 3 EXECUTION

3.01 PREPARATION OF SUBGRADE

Excavate and shape subgrade to line, grade, and cross-section. Compact subgrade until the top 12 inches are compacted to 90% relative compaction. Remove all soft material disclosed by compacting and replace with crushed rock base. The finished subgrade shall be within a tolerance of ±0.08 of a foot of the grade and cross-section shown and shall be smooth and free from irregularities at the specified relative compaction. The subgrade shall extend over the full width of the base course.

3.02 SETTING FORMS

A. Conform to Section 030500.

B. Forms on the face of the curb shall not have any horizontal joints within 7 inches of the top of the curb. Brace forms to prevent change of shape of movement in any direction resulting from the weight of the concrete during placement. Construct short-radius curved forms to exact radius. Tops of forms shall not depart from gradeline more than 1/8 inch when checked with a 10-foot straightedge. Alignment of straight sections shall not vary more than 1/8 inch in 10 feet.

3.03 CURB CONSTRUCTION

A. Construct curbs to line and grade shown, and in accordance to the standards cited.

B. Construct ramps in accordance with the details and locations as shown in the drawings.

C. Place preformed asphalt-impregnated expansion joints at intervals not exceeding 45 feet or less than 15 feet, at the beginning and end of curved portions of the curb, at each change in thickness in section, at the end of curbs at buildings and other structures, and at connections to existing curbs.

D. Place contraction joints in the curb at uniform intervals not exceeding 15 feet. Contraction joints shall be of the open-joint type. Construct by inserting a thin, oiled steel sheet vertically in the fresh concrete to force coarse aggregate away from the joint. Insert the steel sheet the full depth of the curb. After initial set has occurred in the concrete and prior to removing the front curb form, remove the steel sheet with a sawing motion. Finish top of curb with a steel trowel and finish edges with a steel edging tool.

E. As soon as the concrete has set sufficiently to support its own weight, remove the front form and finish exposed surfaces. Finish formed face by rubbing with a burlap sack or similar device that will produce a uniformly textured surface, free of form marks, honeycomb, and other defects. Remove and replace defective concrete at the Contractor's expense. Upon completion of the finishing, apply curing compound to exposed surfaces of the curb. Curing shall continue for a minimum of five days.

F. Upon completion of the curing period, but not before seven days have elapsed since pouring the concrete, backfill the curb with earth free from rocks 2 inches and larger and other foreign material. Tamp backfill firmly in place.

G. Finished curb shall present a uniform appearance for both grade and alignment. Remove any section of curb showing abrupt changes in alignment or grade or that is more than 1/4 inch away from its location as staked and construct new curb in its place at no additional cost to the Owner.

END OF SECTION

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SECTION 323112 STEEL CHAIN LINK FENCES AND GATES

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and installation of galvanized steel chain link fence and gates, top and bottom tension wires, top rail and bottom tension wire.

1.02 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit manufacturer's descriptive literature and drawings of fence and gate installation.

PART 2 - MATERIALS

2.01 GALVANIZED CHAIN LINK FABRIC

A. Fabric height shall be 72 inches unless otherwise shown in the drawings.

B. Select optional galvanizing (first option in brackets) or PVC coating (second option in brackets) in paragraphs A, B, C, D, and E.

C. ASTM A392, Class 1; or U.S. Federal Specification RR-F-191/1D, Type I;U.S. Federal Specification RR-F-191/1D, Type IV; or ASTM F668, Class 2; 1.2 ounces per square foot zinc coating, hot-dip galvanized after weaving, 2-inch diamond mesh, 11-gauge steel wire for height under 60 inches, 9 gauge for height 60 inches and over.

D. Modify selvage in paragraph 3 to suit project. Twisted and barbed selvage may not be appropriate in schoolyards, for example.

E. Top selvage shall be knuckled, bottom selvage shall be twisted and barbed.

F. Tie wire shall be same material and gauge as the chain link fabric.

2.02 GALVANIZED POSTS AND BRACES

A. Steel Pipe: ASTM F1083. Galvanize 1.8 ounces per square foot.

B. Use Fed. Std. RR-F-191/3D for galvanized posts and braces; use ASTM F1043 for PVC-coated posts and braces. Post sizes given here are "trade" sizes per ASTM F1043, Table 1 and ASTM F1083, Table 1.

C. Posts and braces shall conform to the requirements of the drawings, except to meet the minimum requirements noted below:

Steel pipe shall conform to ASTM A1011 or A653, cold-formed, electric welded, minimum yield strength of 50,000 psi. Provide posts and braces with Type A galvanized coating in compliance with ASTM F1043 for heavy industrial fence, Group IA pipe or Group II rolled shapes as follows:

1. End, Corner, and Pull Posts: 2.875-inch (outside diameter) steel pipe, 4.64 pounds per linear foot.

2. Line Posts: 2.375-inch (outside diameter) steel pipe, 3.12 pounds per linear foot.

3. Gateposts for up to 6-Foot Leaf Width Gate: 2.875 inches (outside diameter), 4.64 pounds per linear foot.

4. Gatepost for 6- to 13-Foot Leaf width Gate: 4 inches (outside diameter), 6.56 pounds per linear foot.

D. Post Brace Assembly: At gateposts and end posts and at each side of corner and pull posts, place a horizontal compression brace to the next post at midheight of fabric. Truss the two posts together with a diagonal tension rod. Use 1-5/8-inch minimum pipe for the horizontal brace and 3/8-inch (nominal, 5/16-inch true) diameter adjustable diagonal truss rod.

E. Length of Posts into Footing: At line posts for fabric height of less than 72 inches, provide 24 inches. At line posts for fabric height of 72 inches and more, provide 30 inches. At end, corner, and pull posts, provide 6 inches more than at line posts. At gateposts, provide 12 inches more than at line posts. In solid rock, the portion of the depth of footing that is in solid rock may be reduced to one-half of the above lengths.

2.03 GALVANIZED HARDWARE

Comply with U.S. Federal Specification RR-F-191/4D or ASTM F626 and the following:

A. Caps: Weathertight caps on exposed ends of tubular members.

B. Tension Wires: 7-gauge galvanized steel coil spring steel.

C. Tension or Stretcher Bars: One piece, 2 inches less than fabric height, 3/16 inch by 3/4 inch. Provide one bar for each gatepost and end post and two for each corner and pull post.

2.04 GALVANIZED BARBED WIRE

A. Use ASTM A121 for galvanized barbed wire; use ASTM F1665 for PVC-coated barbed wire.

B. Barbed Wire: ASTM A121, Class 3, two twisted 12-1/2-gauge steel wires, 0.80-ounce-per-square-foot zinc coating, 4-point round-shape barbs 5 inches apart.

C. Select optional top tension wire or top rail in paragraph 2. NOTE: See ASTM F626, Section 10, for other types of extension arms that are available.

D. Extension Arms: Post cap and anti-climb 45-degree galvanized steel single extension arm per ASTM F626 for three barbed wires. Top wire: 12 inches above fabric. Provide way for top rail.

2.05 GALVANIZED GATES

A. Provide gates in accordance with ASTM F900, except as modified.

B. Select options in paragraphs E.2 and E.3a. Select optional 90- or 180-degree gate swing.

C. Tubular Perimeter Members: Provide 2-inch pipe, 3.65 pounds per linear foot. Provide intermediate vertical member for width over 8 feet and intermediate horizontal member for width over 10 feet. Assemble frame by welding or with malleable or pressed steel corner fittings, riveted for rigid connection. Provide fabric and barbed wire as for fence. Use stretcher bars at vertical edges and optional at top and bottom edges. Diagonal cross bracing of 3/8-inch (nominal, 5/16-inch true) diameter adjustable truss rods. Form anti-climb extension by extending vertical members 12 inches above fabric. Provide hinged gates to swing through 90 degrees from closed to open.

D. Gate Hardware:

1. Hinges: Provide pressed or forged steel or malleable iron, nonlift-off type, offset for 90-degree opening, one and one-half pairs for each leaf over 6 feet high.

2. Latch: Provide forked type or plunger-bar type for operation from either side, with padlock eye as integral part.

3. Cane Bolt: Provide one 24-inch-long cane bolt at each leaf more than 4 feet 0 inches wide.

2.06 CONCRETE

Five, 94-pound sacks of portland cement per cubic yard. Do not use accelerating admixtures.

PART 3 - EXECUTION

3.01 PREPARATION FOR INSTALLATION

Clear the line of the fence and dispose of resulting material. Grade between post centers, excavate high spots, and fill low spots so bottom of fabric will be between 1 and 2 inches above finished grade.

3.02 INSTALLATION

Install in accordance with ASTM F567, except as modified herein.

3.03 SETTING POSTS

A. Space line posts uniformly at maximum intervals of 10 feet between gateposts and corner posts.

B. Excavate postholes so concrete will be 3 inches below and around metal posts, except that minimum diameter of concrete footing for end, corner, pull, and gateposts is 12 inches. In solid rock, diameters may be reduced to post outside diameter plus 3 inches.

C. Set posts plumb to within 1/4 inch of the post vertical centerline.

D. Fill postholes with concrete to 2 inches above finish grade and crown to slope away from post. In solid rock, emplace posts with a grout of one part portland cement to three parts sand, with sufficient water for workability.

3.04 INSTALLING FABRIC

A. Place fabric on security side of fence. Place tension bands on side opposite fabric side and peen bolt ends or score threads.

B. Tie fabric to line posts and clip tension bar to end, corner, pull, and gateposts at 15-inch intervals. Tie fabric to tension wires or weave tension wires through fabric at 24-inch intervals. Gauge of tie wire equal to gauge of fabric. Tie tension wires to line posts with 6-gauge wire. Twist tie wires two full turns and bend back edges to reduce hazard.

C. Join rolls of fabric by weaving a single strand into ends of the rolls to form a continuous mesh.

END OF SECTION

SECTION 328210 PACKAGED LANDSCAPE IRRIGATION PUMPING STATION

PART 1 - GENERAL

A. DESCRIPTION

This section includes materials, design, and installation of a packaged irrigation pumping station with control system, electrical service connection, hardware, fixture fittings, and appurtenances.

B. RELATED WORK SPECIFIED ELSEWHERE

1. General Concrete Construction: 030500.
2. Fusion-Bonded Epoxy Linings and Coatings: 099761.
3. Landscape Irrigation System: 328420.

C. SUBMITTALS

1. Submit shop drawings in accordance with Section 013300.
2. Submit layout and dimensional drawings for the skid system. Show location of cover plate supports, pumps, piping, valves, conduits, raceways, electrical equipment, pipe and valve supports, and control panels. Show support system for pumps, cover plates, motor starter panels, and other electrical panels. Show number and size of power and control wiring.
3. Submit pump dimensional drawings.
4. Submit manufacturer's catalog data and detail drawings showing all pump parts and describe by material of construction specification (such as AISI, ASTM, SAE, or CDA) and grade or type. Show linings and coatings.
5. Submit pump curves from manufacturer's catalog data on which the specified operating points are marked. Show efficiency and brake horsepower for the selected pump curve. Show NPSH required.
6. Submit manufacturer's reports on hydrostatic tests and performance tests.
7. Submit manufacturer's sample form for reporting the performance test results at least two weeks before the tests. The test form should contain the data presented in the sample form in Section 6 of the ASME PTC 8.2 or ANSI/HI 1.6.

8. Submit manufacturer's certified performance curves for review at least two weeks prior to shipping the units from the factory. Show pump total head, torque, brake horsepower, pump efficiency, and required NPSH. Provide copies of the data recorded during the test and methods of data reduction for determining certified test results.

9. The packaged pumping station manufacturer shall determine and verify quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data and shall review and coordinate each submittal with the requirements of the contract documents.

10. Submit data as a single complete package for pumps and motors, discharge piping, structural support framing, valves and actuators, motor control center components, instrumentation components, and power and instrumentation wiring.

11. Submit complete assembly, foundation, and installation drawings, together with detailed specifications and data covering materials used, parts, devices, and other accessories forming a part of the equipment furnished.

D. DEFINITIONS

Terms shall be as defined in the Hydraulics Institute Standards ANSI/HI 1.1-1.2 for horizontal pumps.

E. DESIGN CRITERIA FOR STRUCTURAL STEEL SKID ASSEMBLY

Structural Connections and Framing: AISC Specification for Structural Steel Buildings (June 1, 1989), except delete the second paragraph of Section A7.1, the last sentence of the first paragraph of Section M5, the last sentence of Section M5.2, and Chapter N in its entirety.

F. MANUFACTURER’S SERVICES

Provide equipment manufacturer’s services at the jobsite for each package pumping station service for the minimum labor days listed below, travel time excluded:

1. One labor day for the package pumping station service to check the installation and advise during start-up, testing, and adjustment of the equipment, including 2 hours to instruct the Owner’s personnel in the overall operation and maintenance of the pumping station system.

PART 2 - MATERIALS

A. MANUFACTURERS

1. The irrigation pumping station unit shall be manufactured and provided by Barrett Engineered Pumps, 1695 National Ave., San Diego, CA 92113, telephone (619) 232-7867; Watertronics, Inc., 555 Industrial Drive, P.O. Box 530, Hartland, Wisconsin 53029-0530, telephone 262/367-5000; or equal.

2. The Contractor shall assign responsibility for the design and factory construction of the packaged water pumping station to a single manufacturer.

B. HYDRAULIC DESIGN REQUIREMENTS

Design to deliver 30 gpm at a discharge pressure of 90 to 100 psi (adjustable). This design flow shall occur in the preferred operating range (POR) as defined in ANSI/HI 9.6.3. Inlet pressure shall be 10 to 80 psi.

C. ELECTRICAL SERVICE

Power supply shall be 480 volts (460 VAC), 3 phase, 60 hertz.

D. PREFABRICATED STEEL BASE

1. Mount pumps and other components of the pumping station assembly on a structural steel skid-type base. The skid structural system shall be free of distortion caused by flexing of the base or system piping. Design the skid with anchors to tank footing.

2. Construct the skid or base using a combination of wide flange members, C-channels, hollow structural steel tubing, and plates complying with ASTM A6, A36, A500, A501, and A992. Weld gussets inside the superstructure, beneath the deck, to provide increased stiffness. Welding on the skid or base shall be completed and stress relieved prior to attaching the pumps and other equipment.

3. Structural steel shall be hot-dipped galvanized. The skid system may be galvanized in separate sections or components and then assembled after the galvanizing.

4. Design structural skid, equipment attachments and supports, pipe and valve supports, skid anchors, cover plate supports, and anchor bolts per UBC requirements.

5. Design and fabricate the skid assembly to support appurtenances and necessary items for a complete pumping station assembly, including pipe supports, grating supports, electrical power wiring and conduits, instrumentation wiring and conduits, instrumentation, and motor control starters.

6. Provide checker or diamond plate covers over and attached to the structural steel skid support system.

E. PUMPS AND MOTORS

1. Pumps:

a. Pumps shall be electric motor driven, horizontal centrifugal with mechanical shaft seal, volute case, and impeller. Pumps shall be cast iron with bronze impellers, with 3,500-rpm horizontal ODP motor.

b. Each pump shall be capable of at least a 5% head increase at normal operating conditions by installing a larger impeller or an impeller of different hydraulic design.

c. Pump curve shall be continuously rising and shall be free of dips and valleys from the design point to the shutoff head. The shutoff head shall be at least 110% of the head that occurs at the design point.

d. The NPSH required shall be at least 5 feet less than the minimum NPSH available at all points on the pump curve up to 120% of the flow at the BEP.

e. Design the pumps and its components to operate continuously over a flow range of 70% to 120% of the flow at the BEP.

f. The shaft seal shall be a self-adjusting mechanical type to prevent leakage and eliminate the need for drain piping. The volute case shall be precision machined from gray cast iron. It shall be possible to rotate the discharge connection to any of four positions. A cast-iron bracket shall maintain alignment between the motor and volute case.

g. The impeller shall be an enclosed type and balanced to a balance quality number of G6.3 or better per ISO 1940/1. Key the impeller to the shaft and lock with a cap screw and washer. Manufacture the motor shaft from steel of reduced length to increase shaft rigidity, extend bearing life, and reduce the overall length of the pump and motor assembly. Protect the motor shaft with a replaceable stainless steel sleeve.

2. Motors:

a. Each pump motor shall be a squirrel-cage induction horizontal solid shaft type. The pump impeller shall be direct mounted and keyed to the motor shaft with a stainless steel protective sleeve. The temperature rise of the motor shall be to NEMA MG-1 Class F insulation.

b. Provide radial and thrust bearings to accommodate the hydraulic thrust of the pump. The motor shall be of proper size to drive the pump at any point on its operation curve without exceeding the service factor nameplate rating.

F. PIPING

Piping shall conform to ASTM A53 Grade B welded or seamless pipe. Size piping such that fluid velocity at the design flow does not exceed 6 fps. Discharge piping shall be Schedule 40 per ASME B36.10 with fusion-bonded epoxy lining and coating per Section 099761. Welding flanges shall be forged steel slip-on or welding neck type. Welding fittings shall be seamless, conforming to ASTM A234, with pressure rating not less than 150 psi.

G. VALVES

1. Drain Valves: Provide drains from any possible low point in the system. The drains shall consist of 1/2-inch brass petcocks. Include the following:

    a. Drain for each pump discharge check valve.
    b. Drain in discharge manifold.
    c. Provide a wash-down 3/4-inch bronze hose bibb downstream of the control valves and upstream of the main station isolation valve.

2. Pump Check Valves: Pump check valve shall be of the silent operating type that begins to close as forward velocity diminishes and fully closed at zero velocity preventing flow reversal. Valve bodies shall be cast iron (ASTM A126C or better) and shall be free from blowholes, sand holes, and other impurities. The valve design shall incorporate a center-guided, spring-loaded poppet, guided at opposite ends and having a short linear stroke that generates a flow area equal to the pipe diameter. Internals shall be machined bronze disc, seat, and stem guide. Size valves to permit full pump capacity to discharge through them without exceeding a pressure drop of 2.5 psi. Valves 4 inches and smaller shall be pressure rated for 250 psi, and 6-inch valves shall be pressure rated to 150 psi.

3. Isolation Valves: Isolation valves shall be butterfly type with 10-position lever for sizes 4 inches and smaller and gear actuators for sizes above 4 inches. Valves shall be rated at 200-psi WOG working pressure. Trim shall include stainless steel stem, bronze- or nickel-coated iron streamlined disc, and full-faced resilient seat designed to eliminate need for flange gaskets.

H. PRESSURE GAUGES

Locate pressure gauges on the discharge manifold for purposes of measuring regulated downstream pressure and on the suction manifold. Pressure gauges shall be Type 304 stainless steel case and bezel construction. Gauges shall be minimum 2 1/2 inches in diameter, liquid filled. Pressure sensing connection shall be 1/2-inch NPT lower gauge connection.

I. ELECTRICAL

1. Main Service Disconnect: Provide a three-pole, main service rated disconnect within a NEMA 3R control enclosure. An externally mounted service disconnect shall not be acceptable. Disconnect shall isolate all power to the control enclosure. The disconnect shall have an operating handle mounted in the enclosure door, mechanically interlocked to prevent entry while disconnect is in the ON position.

2. Motor Fuses, Starters, and Overloads: Each starter shall be protected on each leg by a time delay fuse of the appropriate amperage. Motor starter coils shall be 120-volt operated. Overload relays shall be electronic type, ambient compensating and differential tripping type. Bi-metallic or melting alloy type overloads shall not be permitted. The overload shall protect each power leg and shall be set to the motor's full-load current rating. Further protection shall include sensitivity to current imbalance and single-phase conditions.

3. Control Transformer: A control transformer shall provide 120-volt power to the pumping station controls. The control transformer shall be protected on the primary and secondary sides with appropriately sized fuses. No load other than the pumping station controls shall be supplied by the control transformer.

4. Control Logic: The pump sequence controller shall be an industrial grade PLC with diagnostic LEDs for monitoring of discrete inputs and outputs. Provide at least two additional analog inputs and outputs for monitoring and control purposes. The PLC shall contain two communication ports for monitoring and programming purposes. The PLC shall contain an EEPROM, battery backed RAM, and nonvolatile memory for storage of critical configuration data. The PLC shall be in accordance with Section 405040.

5. Alarms: Controls shall shut down the pumping station in the event of the following alarm conditions. The controls shall attempt to restart the system after alarm shutdown or loss of power to minimize loss of irrigation. After a user-adjustable number of attempts to repressurize the system, the controls will go into hard shut down and remain there until manually reset.

    a. Low discharge pressure cutout. Pressure remains 20 psi below regulated set point for a set time delay.

    b. High discharge pressure cutout. Pressure remains 11 psi above regulated set point for set time delay.

    c. Phase/voltage cutout, high or low voltage, loss of phase or phase reversal.

    d. High pump volute temperature cutout. Pump temperature stays above 120°F for a set time delay.

    e. Starter fail cutout. Output to starter is not met with corresponding running input for set time delay. Indicates overload, phase imbalance, or control fuse.

J. VARIABLE SPEED CONTROL SYSTEM

1. Discharge pressure regulation shall be by the VFD system. Adjustment of regulated downstream pressure shall be accomplished though the control panel operator interface. Hydraulic-type, pilot-controlled pressure-reducing valves are not acceptable.

2. The VFD shall be IGBT based with selectable carrier frequency up to 15 KHz. The VFD shall include terminals for incoming power, motor output power, and control terminals.

3. The VFD shall generate a sine-coded, variable voltage/ frequency, 3-phase output for optimum speed control. The VFD shall incorporate power loss ride-through for a minimum of two seconds. VFD protective features shall include current limit, auto restart, short-circuit protection, electronic motor overload protection, and ground fault protection. The VFD shall have a push-button programming display for easy access to operating parameters. Protect the VFD on the primary side by fuses of the appropriate amperage.

   a. Overload Capacity: 120% rated output current for one minute.

   b. Voltage Fluctuation: +10%, -15%.

   c. Sine wave PWM with full range, automatic torque boost.

   d. Frequency Control Range: 0.1 to 400 hertz.

   e. Frequency Accuracy: Digital, 0.01 hertz; analog, 0.1%.

   f. Motor Overload Protection: Instantaneous overcurrent of 180% of rated output current.

   g. Overvoltage at 820 volts dc if 460-volt input.

   h. Undervoltage: User adjustable.

   i. Momentary Power Loss: Up to two-second ride through.

   j. Electronic ground fault.

   k. LED capacitor charge indicator.

   l. Input phase loss alarm.

   m. Ambient Temperature Range: +14°F to 104°F.

   n. Humidity: 95% noncondensing.

K. INSTRUMENTATION EQUIPMENT

1. Pressure Transducer: A solid-state pressure transducer shall provide a noise free, linear output proportional to discharge pressure. Transducer shall be solid-state, strain-gauge type with integral voltage regulating and output accuracy not less than 0.25%. Construct transducer of stainless steel, rated for the maximum pumping station discharge pressure.

2. Lightning Arrester: The main power supply feeding the pumping station shall be equipped with a 3-phase secondary surge arrester having a breakdown current rating of not less than 80,000 amperes. Duty cycle testing: 2500, 10KA (8x20jus) impulses with less than 10% drift. Sine wave tracking, EMI/RFI noise rejection, and <5ns response time. UL 1449 Category C approvals, second edition. Arrester shall meet IEEE 587.

3. Secondary Control Circuit Fuses: Single-pole secondary distribution fuses with appropriate ratings shall supply power to each pump starter coil circuit and to the control system.

4. Phase Monitor: Protect the incoming power and each motor by a phase loss/low-voltage system dropout relay to de-energize the pumping station control circuit or motor contactor if phase failure, phase reversal, or low-voltage condition occurs. If, after attempted automatic restarts, the phase failure/low-voltage alarm condition remains, the alarm shall be manually reset. Individual motor overloads shall also act as phase monitors for each motor.

L. CONTROL SYSTEM AND DEVICES

1. Mount the pumping station electrical controls in a self-containing NEMA 3R enclosure fabricated from not less than 12-gauge steel. Door gasket seals shall be neoprene sponge, sufficient to protect interior components from weather and dust. Construct the electrical panel door(s) from 12-gauge steel with integral latches.

2. External operating devices shall be dustproof and weatherproof. Mount internal components of the enclosure on a removable back panel. Do not tap mounting screws for components into the enclosure wall.

3. Internal wiring within, and interconnecting between, the panels shall be complete, and no field wiring within the panels shall be required. Wiring troughs and cable raceways shall be self-contained within the enclosure.

4. Do not install pressure gauges, pressure switches, water-activated devices, or waterlines of any sort in any electrical control panel.

5. The control panel shall be designed, built, tested, and UL listed by the pumping station manufacturer. The pumping station discharge pressure shall be regulated to provide surge-free constant pressure as programmed via the control panel operator interface. The control system shall have the following features:

   a. Gradual entry of water from the pump into the discharge manifold to allow for complete purging of air to eliminate pressure surging.

   b. Accept “Call” signal from irrigation controller. When “Call” signal is received, maintain programmed downstream pressure regardless of discharge flow.

c. Up to six, user-adjustable PID control settings to ensure accurate pressure regulation at all flows, programmed pressure, or connected pump combination.

d. Adjustable pressure ramp-up and ramp-down to assure surge-free pressure regulation.

e. After a drop in pressure, gradually increase system pressure over a user-adjustable period of time to eliminate surging.

f. Rate of change of pressure control to anticipate and eliminate rapid pressure changes caused by changing system demand.

g. Provide the following output signals to be monitored by the Tank PLC (PLC-27).

(1) "Fail" and "Pump Running" discrete output signals via relay contacts. Fail shall indicate an alarm condition or loss of power.

(2) 4mA – 20mA analog output indicating discharge pressure.

6. Install corrosion-inhibiting modules in the panel enclosures.

M. SKID WIRING

Skid wiring shall conform to NEC standards. Wiring from control panels to motors shall be in metal-reinforced, watertight, flexible conduit with copper conductors rated not less than 600 volts and of proper size to carry the full load amperage of the motors without exceeding 70% capacity of the conductors. Include a grounding cable sized to NEC requirements in the flexible conduit. There shall be no splices between the motor starters and the motor connection boxes. Wiring to pressure transducer shall be multiconductor, shielded cable suitable for Class II low-voltage controls. Wiring to motor-actuated valves shall be in flexible conduit with TFFN No. 18 gauge copper conductors rated not less than 600 volts.

N. PUMPING STATION ENCLOSURE

Construction shall include a weather-resistant, 14-gauge, all-metal enclosure with welded, lockable lid guides on top and bottom. The front side of the enclosure shall have cooling vents and be easily removable for servicing. Provide the enclosure with twin internally mounted heavy-duty gas-filled lift struts to keep the access door open. All components are to be accessible from top and front sides with the lid completely open. Enclosure is to be suitable for mounting to the pumping station base and shall include openings for suction and discharge piping.

O. ENCLOSURE VENTILATION

For purposes of cooling the pump motor, switchgear, and control logic, place an exhaust fan inside the pump enclosure, mounted to the enclosure. The exhaust fan shall be activated upon pump start and shall run until the pump stops. The fan shall be black die-cast aluminum construction with UL 94 V-0 rated polycarbonate propeller and rated for not less than 240 cfm. Fan motor shall be permanent split-capacitor type with stainless steel ball bearings, Class B insulation, and automatic thermal protection.

PART 3 - EXECUTION

A. FABRICATION AND ERECTION OF STEEL SKID

Fabricate metal items to straight lines and true curves. Drilling and punching shall not leave burrs or deformations. Continuously weld permanent connections along the entire area of contact. Exposed work shall have a smooth finish with welds ground smooth. Joints shall have a close fit with corner joints coped or mitered and shall be in true alignment. There shall be no bends, twists, or open joints in any finished member nor any projecting edges or corners at intersections. Conceal fastenings wherever possible. Built-up parts shall be free of warp. Exposed ends and edges of metal shall be slightly rounded.

B. WELDING OF FABRICATED STEEL SKID COMPONENTS

1. Perform welding on steel by the SMAW process. Welding shall conform to AWS D1.1-2006, except as modified in AISC Section J2.

2. Provide a minimum of two passes for metal in excess of 5/16-inch thickness.

3. Produce weld uniform in width and size throughout its length with each layer of weldment smooth; free of slag, cracks, pinholes, and undercuttings; and completely fused to the adjacent weld beads and base metal. Avoid irregular surface, nonuniform bead pattern, and high crown. Form fillet welds of the indicated size, of uniform height, and fully penetrating. Accomplish repair, chipping, and grinding of welds in manner that will not gouge, groove, or reduce the base metal thickness.

C. FACTORY ASSEMBLY, INSPECTION, AND TESTING

1. Assemble the pumps, piping, skid system, wiring, and controls in the shop and verify that all items fit. Conduct a factory test of the equipment by connecting to a water supply and simulating start-up, shutdown, and alarm modes. Verify that the control responds correctly to the specified start-up and shutdown procedures and alarm modes.

2. Before shipment from the factory, the pumping station shall be inspected and tested to demonstrate proper operation of all components. The Owner's Representative will not witness the tests. The testing shall consist of operation to check the electrical systems and miscellaneous equipment. As a minimum, the inspection shall consist

of inspection of the conduit runs, pipe supports, pump supports, construction of the PLC I/O cabinet and motor control center, and wiring. Defective equipment and materials disclosed by the tests and inspection shall be replaced and the pumping station tested until satisfactory operation can be achieved. Ship the pumping station after satisfactory operation is achieved.

3. Pressure test skid piping and valves to a pressure of 150 psi. Test with valves in both the open and closed positions. Leakage shall be zero.

4. After the assembly is completely shop assembled and tested, the packaged pumping station manufacturer shall match mark field-assembled connections to allow proper field assembly by the Contractor.

D. INSTALLATION

1. Construct and install the irrigation pumping station unit and appurtenances in accordance with the manufacturer’s specifications.

2. The packaged pumping station manufacturer shall furnish a set of installation drawings, wiring diagrams, and instructions for use by the Contractor. The wiring diagrams shall include terminal board numbers for connection of the power supply wiring to the pumping station.

3. The pumping station manufacturer shall assemble the pump baseplates with associated pumps and motors in the shop. After each pump is completely assembled, the pumping station manufacturer shall match mark both sides of each connection as to ensure proper field assembly by the Contractor, if field assembly is required.

4. The packaged pumping station manufacturer's field representative shall install, adjust, and calibrate any equipment that is to be a part of the skid assembly but is shipped separately for field installation.

END OF SECTION

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SECTION 328420 LANDSCAPE IRRIGATION SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, installation, and testing of an automatic landscape irrigation system.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Painting and Coating: 099000.

B. Trenching, Backfilling, and Compacting: 312316.

C. Packaged Landscape Irrigation Pumping Station: 328210.

D. Landscape Planting: 329010.

E. Backflow Preventers and Detector Checks: 331220.

F. Pressure Testing of Piping: 400515.

G. Manual, Check, and Process Valves: 400520.

1.03 DESCRIPTION OF THE SYSTEM

A. Drawings are essentially diagrammatic. Size and location of equipment and fixtures are drawn to scale wherever possible.

B. Provide offsets in piping and changes in equipment locations to conform to structures and to avoid obstructions or conflicts with other work.

C. Do not exceed irrigation head spacing as shown in the drawings.

D. Electrical work shall comply with the NEC.

1.04 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit schedule including coordination of electrical and water connections and the placement of materials and equipment.

C. Submit material list using the following format (double spaced between each item):

Item No.	Description	Manufacturer	Model No.
1.	Pressure supply lines	Lasco	Sch 40 PVC
2.	Non-Pressure supply lines	Lasco	Sch 40 PVC
3.	Sleeves	Lasco	Sch 40 PVC
4.	Shrub Head	Hunter	MPR Rotator 1000
5.	Shrub Head	Hunter	MPR Rotator 2000
6.	Shrub Head	Hunter	MPR Rotator 3000
7.	Remote control valve	Rainbird	ESP – SMT
8.	Gate valve	NIBCO	T-580-70
9.	Master valve	Rainbird	PEB Normally closed

D. Submit shop drawings of fabricated components and installations.

1.05 OPERATION AND MAINTENANCE MANUALS

Provide installation, operation, and maintenance manuals from manufacturers and suppliers. See Section 019310.

1.06 RECORD DRAWINGS

A. Record as-built conditions accurately on one set of diazo reproducible drawings showing all changes in the work constituting departures from the contract drawings including changes in both pressure and nonpressure lines.

B. Dimension from two permanent points of reference (buildings, monuments, sidewalks, curbs, pavements, etc.) the items listed below. Locations shown on record drawings shall be kept day to day as the project is being installed. Dimensions noted in drawings shall be at least 1/8 inch in height.

1. Point of connection.
2. Routing of irrigation pressure lines (dimension maximum 100 feet along routing).
3. Gate valves.
4. Irrigation control valves.
5. Quick coupling valves.
6. Routing of control wires.
7. Other related equipment.

C. Maintain record drawings onsite at all times.

D. Make changes to bond prints in ink (no ballpoint pen).

1.07 CONTROLLER CHARTS

A. Record drawings will be evaluated by the Owner's Representative before charts are prepared.

B. Provide controller chart. Show the area covered by the automatic controller.

C. The chart shall be a reduced drawing of the actual record drawing. In the event the controller sequence is not legible when the drawing is reduced, enlarge it to a readable size.

D. Chart shall be a blackline print with a different color used to show area of coverage for each station.

E. When completed and reviewed by the Owner's Representative, laminate the chart.

F. Mount the chart inside controller enclosure/cabinet using Velcro or equal tape.

G. These charts must be completed and reviewed prior to final observation of the irrigation system.

PART 2 - MATERIALS

2.01 PIPING--GENERAL

A. Pressure supply lines downstream of backflow prevention unit shall be PVC.

B. Nonpressure lines shall be PVC.

2.02 PLASTIC PIPE AND FITTINGS

A. Schedule 80 PVC pipe is longer-lasting than Schedule 40 PVC because of its greater wall thickness and costs only about $0.20 per foot more than the Schedule 40 pipe.

B. PVC Pipe, 3 Inches in Diameter and Smaller: Use Schedule 40, unless indicated otherwise, solvent welded, PVC 1120 pipe complying with ASTM D1785.

C. PVC Pipe, Used for Risers and Swing Joint Assemblies: Use Schedule 80, PVC 1120 pipe conforming to ASTM D1785, with taper pipe threads as specified in ASME B1.20.1. Color pipe used for risers with green pigment or paint.

D. Fittings for PVC Pipe, 3 Inches and Smaller: Use Schedule 40, solvent weld fittings, manufactured from PVC 12454-B compound and complying with ASTM D2466, except threaded fittings. For threaded applications, use only Schedule 80 fittings manufactured from PVC 12454-B compound and complying with ASTM D2464.

E. Connect swing joint and riser assemblies to the irrigation pipeline with a Schedule 80 tee, as described above, that has a female threaded branch.

F. Unions for PVC piping 3 inches and smaller shall have socket-type ends, Viton O-rings, and shall be Schedule 80. Material shall be Type I, Grade 1 PVC, per ASTM D1784.

G. Pipe and fitting joints 3 inches and smaller shall be socket welded except where threaded and flanged joints are required to connect to unions, valves, and equipment. Solvent cement for socket joints shall comply with ASTM D2564. Gaskets for flanged joints shall be fullfaced, 1/8 inch thick, made of ethylene propylene rubber (EPR) having a hardness of 50 to 70 durometer A.

2.03 BRASS PIPE AND FITTINGS

A. Brass pipe shall conform to ASTM B43, threaded ends.

B. Fittings shall be medium brass, screwed, 125-pound class.

2.04 WATER SERVICE – EXISTING FROM TANK SITE

2.05 WYE STRAINERS

Wye strainer shall have a screwed flanged cast-iron bronze body with removable 20- 40- 60- 80- 100-mesh Type 304 or 316 stainless steel monel strainer. Strainer shall have a minimum cold-water working pressure of 150 psi. Equip strainer with brass hose bibb for flushing.

2.06 PRESSURE REGULATORS

Pressure regulator shall have bronze bell housing and no zinc or cast-iron parts. Provide union end or flanged connections. Regulator shall have a minimum operating pressure of 300 psi. Outlet pressure setting: 80 100 psi.

2.07 GATE VALVES 3 INCHES AND SMALLER

Gate valves 3 inches or smaller shall include the following features, unless otherwise noted in the drawings:

1. 150 psi, saturated, steam rated.
2. Bronze body, ASTM B62.
3. Screwed joints.
4. Nonrising stem.
5. Screwed bonnet.
6. Solid disc.
7. Equipped with handwheel.

2.08 QUICK COUPLING VALVES

A. Body of valve shall be red brass with a wall thickness guaranteed to withstand normal working pressure of 150 psi without leakage.

B. Valve shall have 3/4-inch female threads opening at base.

C. Construct valve so it can be operated only with a special connecting device known as a coupler, designed for that purpose. Coupler is inserted into valve and a positive, watertight connection shall be made between coupler and valve. Thread shall be Acme type.

D. Hinge cover shall be red brass with a rubber-like vinyl cover bonded to it in such a manner that it becomes a permanent-type cover, yellow in color.

2.09 CHECK VALVES

A. Check valve shall be PVC brass, Class 150 minimum. Size and type noted in drawings.

B. Install where indicated in drawings.

2.010 AUTOMATIC CONTROLLER, ELECTRICAL

A. Automatic controller shall be fully automatic in operation and shall be capable of operating the number of stations of remote control valves as noted in the drawings.

B. Controller shall be wall installed to a post (per detail) in a watertight enclosure with hinged, locking door panel.

C. Controller shall be programmed for various day, time start, and station watering duration schedules by setting switches and dials. Provide the following features:

1. A minutes operation switch for each station with a positive increment range of 2 to 60 minutes minimum.

2. A repeat switch allowing selected schedules to be repeated after completion of initial watering schedule and allowing repeat operations to be scheduled throughout a 24-hour day.

D. Controller shall have a 120-volt pump starter relay as an integral part.

E. Controller components shall be fused and chassis grounded.

F. Be sure to indicate location of the 120-volt electrical outlet in the drawings.

G. Equip controller with an on and off switch for 120-volt service and electrical outlet, located by wall-mounted unit or inside enclosure as indicated in drawings.

H. Exact location of controller shall be determined in the field by Owner's Representative before installation. Contractor will be responsible for coordinating the electrical service to this location. In the event a conflict prevents this coordination, notify Owner's Representative immediately.

2.011 REMOTE CONTROL VALVES, ELECTRICAL

A. Valve shall be spring-loaded, packless diaphragm activated type with plastic body of a normally closed type and shall be equipped with a flow control.

B. Valve solenoid shall be corrosion-proof and constructed of stainless steel molded in epoxy to form one integral unit and shall be 24-volt ac, 4.5 watts maximum.

C. Valve shall be capable of being operated in field without electricity at controller by a bleeder valve.

2.012 EQUIPMENT ENCLOSURES

Equipment enclosures for pumps per civil engineer drawing CD-10.

2.013 ELECTRICAL WIRING

A. Low Voltage:

1. Connection between the controller and remote control valves shall be made with direct burial AWG-UF type wire, installed in accordance with valve manufacturer's wire chart and specifications.

2. Wiring shall occupy the same trench. Install along the same route as the pressure supply lines wherever possible, and install before main line whenever possible.

3. Where more than one wire is placed in a trench, tape the wiring together at intervals of 10 feet.

4. Make splices using Scotch Lok Unipack waterproof sealing packets, Pen-Tite Connectors, Connector Kings SA102, or equal.

5. Sizing of wire shall be according to manufacturer's recommendations, in no case smaller than No. 14.

B. Electrical enclosures installed outside building shall be NEMA 3.

2.014 IRRIGATION HEADS

A. Irrigation Nozzles on Fixed Risers:

1. Nozzles on fixed risers shall be removable nozzles of full or part circle patterns.

2. Nozzle shall be of plastic material.

3. Nozzles on risers may require shrub adapters.

4. Install risers per construction detail.

5. Nozzles shall be adjustable by means of setscrews.

2.015 PUMPS

A. Show pump model and performance requirements in the drawings.

B. Supply and install pump at location shown in the drawings. Exact location shall be determined in field by Owner's Representative.

C. Connect pump starter to irrigation controller pump switch.

2.016 VALVE BOXES

A. Boxes shall be of type, size, and material as noted in contract drawings.

B. Stencil or engrave identification label in 2-inch-high letters and numbers using epoxy resin base paint of a contrasting color as selected by Owner's Representative. Label per the following:

1. Quick coupling valve boxes shall be round. The cover shall be identified with the letters "QCV."

2. Gate valve boxes shall be 12 inches by 18 inches. The cover shall be identified with letters "GV."

3. Remote control valve boxes shall be 12 inches by 18 inches. The cover shall be identified with the letters "RCV" and the valve number in characters.

4. Splice boxes shall be 12 inches by 18 inches. The cover shall be identified with the letters "SB."

5. Valve boxes for moisture-sensing stations shall be 12 inches by 18 inches. The cover shall be identified with the letters "MSS."

C. Valve boxes for the strainer/pressure-reducing valve assembly shall be sized to fit assembly including working space.

2.017 MISCELLANEOUS EQUIPMENT

A. Provide the following tools:

1. Two wrenches for disassembling and adjusting each type of irrigation head supplied.

2. Two keys for the automatic controller.

3. Two keys for opening valve boxes.

4. Six spray heads, complete with four nozzles for each pattern used.

B. Submit above equipment to Owner at conclusion of project. Before final observation can occur, evidence that Owner has received materials must be shown to Owner's Representative.

PART 3 - EXECUTION

3.01 PRODUCT HANDLING

A. Delivery: Deliver materials in manufacturer's original unopened containers, with each container identified with manufacturer's name, brand, or type.

B. Protection:

1. Protect work and materials under this section from damage during construction and storage. Protect PVC pipe and fittings from sunlight.

2. Beds on which pipe materials are stored shall be the full length of pipe. Do not use pipe that has been damaged or dented.

3. Assume responsibility for damage to existing construction, and restore property to its original condition should damage occur.

3.02 FIELD MEASUREMENTS

Obtain field measurements required for proper and adequate fabrication and installation of the work. Exact measurements are the Contractor's responsibility.

3.03 UTILITIES SERVICES

Make connections to water and electrical services at locations indicated in the drawings.

3.04 PIPE TRENCH CONSTRUCTION

A. Construct a continuous, firm, smooth trench bottom, free of rocks or other hard objects larger than 0.5 inch in size. Where ledge rock, hard pan, or boulders are encountered, undercut and fill the trench bottom with bedding material using sand or compacted fine soils to provide a minimum depth of bed between the pipe and rock of 4 inches. Follow existing utility trenches where possible.

B. Excavate the trench such that the width at any point below the top of the pipe is not greater than necessary to provide adequate room for joining the pipe and compacting the initial backfill. Construct trench widths above the top of the pipe not greater than 2 feet wider than the pipe diameter, except that in unstable soils where sloughing or caving may occur or where required by regulations or local conditions, the sidewalls above the top of the pipe may be sloped.

3.05 PIPE PLACEMENT

A. See ASTM F690, Section 5, for some information on pipe installation procedures.

B. Prior to any backfilling beyond light backfill for shading and prior to connecting to other facilities, allow the pipe to come to within two degrees of the temperature it will reach after complete covering. Install the pipeline to provide protection from hazards imposed by traffic crossing. If the pipe is assembled above ground, lower it into the trench with care to prevent dropping or damaging the pipe or its joints. Avoid dragging or bending which could cause joint stressing, displacement, or pullout.

C. Install the pipe such that deflection in elastomeric seal joints and bending, beyond the manufacturer's recommended maximum amount, does not occur during installation. Avoid bending stresses and at no time block or brace the pipe to hold a bend. Consult the pipe manufacturer for maximum permissible deflection limits and minimum pipe bending radii.

D. At the connection of a buried pipe to a rigid structure such as a stand, compact the foundation and bedding adjoining the structure. A supporting structure beneath the joint and the pipe or a flexible joint also may be used.

E. When the pipe being installed is provided with rubber gasket joints, excavate bell holes in the bedding material to allow for the unobstructed assembly of the joint. Make the bell hole no larger than necessary to accomplish proper joint assembly. When the joint has been made, fill the bell hole with initial backfill material to provide adequate support of the pipe throughout its entire length.

F. Minimum Depth of Cover:

1. Provide minimum cover of 18 inches on pressure supply lines 2 1/2 inches and smaller.

2. Provide minimum cover of 18 inches for control wire.

3. Provide minimum cover of 12 inches for nonpressure lines, unless specified as on surface lines.

4. Provide the minimum depth of cover as specified above over the top of the pipe before the trench is wheel loaded.

5. Provide minimum cover of 36 inches below subgrade for piping and sleeving under paving used for vehicular circulation where possible, unless approved by site inspector due to a hardship on site conditions).

6. Maximum Depth of Cover: Consult the pipe manufacturer for maximum depths of cover.

3.06 PIPELINE CLEARANCES

A. Landscape irrigation pipelines shall have a minimum clearance of 4 inches from each other and 6 inches from other pipelines in the project.

B. Do not install parallel lines directly over one another.

3.07 INSTALLING PVC PIPE 3 INCHES AND SMALLER

A. The 90°F ambient temperature limitation comes from the Chemtrol "Thermoplastic Pipe, Valves, and Fittings" catalog, 1989 edition, page 83. Paragraph 7.5.3 in ASTM D2855 regarding the application of the solvent cement to the joints states, "The surface temperature of the mating surfaces should not exceed 110°F at the time of assembly." Paragraph 7.8 in ASTM D2855 has a schedule of setting times versus temperature, and the maximum set time temperature is 100°F.

B. Do not install PVC pipe when the air temperature is below 40°F or above 90°F. Store loose pipes on racks with a maximum support spacing of 3 feet. Provide shades for pipe stored outdoors until the pipe is filled with water.

C. Store fittings indoors in their original cartons.

D. Store solvent cement indoors or, if outdoors, shade from direct sunlight exposure. Do not use solvent cements that have exceeded the shelf life marked on the storage container.

E. Before installation, check pipe and fittings for cuts, scratches, gouges, buckling, kinking, or splitting on pipe ends. Remove any pipe section containing defects by cutting out the damaged section as a complete cylinder.

F. Do not drag PVC pipe over the ground, drop it onto the ground, or drop objects on it.

G. Prior to solvent welding, remove fittings and couplings from their cartons and expose them to the air for at least one hour to the same temperature conditions as the pipe.

H. Cut pipe ends square and remove all burrs, chips, and filings before joining pipe or fittings. Bevel solvent-welded pipe ends as recommended by the pipe manufacturer.

I. Wipe away loose dirt and moisture from the inside and outside diameters of the pipe end and the inside diameter of the fitting before applying solvent cement. Do not apply solvent cement to wet surfaces.

J. Make up solvent-welded joints per ASTM D2855. Application of cement to both surfaces to be joined and assembly of these surfaces shall produce a continuous bond between them with visual evidence of cement at least flush with the outer end of the fitting bore around the entire circumference.

K. Allow at least eight hours of drying time before moving solvent-welded joints or subjecting the joints to any internal or external loads or pressures.

L. Acceptance criteria for solvent-welded joints shall be as follows:

1. Unfilled Areas in Joint: None permitted.

2. Unbonded Areas in Joint: None permitted.

3. Protrusion of Material into Pipe Bore, Percent of Pipe Wall Thickness: Cement, 50%.

M. Lubricate bolt threads with graphite and oil before installation.

N. Tighten bolts on PVC flanges by tightening the nuts diametrically opposite each other using a torque wrench. Complete tightening shall be accomplished in stages and the final torque values shall be as shown in the following table:

Pipe Size (inches)	**Final Torque (foot-pounds)**
1/2 to 1 1/2	10 to 15
2 to 3	20 to 30

O. Trench bottom shall be continuous, smooth, and free of rocks. See the details in the drawings for trench dimensions, pipe bedding, and backfill.

P. After the pipe has been solvent welded and the joints have set, snake the pipe in the trench per the pipe manufacturer's recommendations in order to allow for thermal expansion and contraction of the pipe.

Q. Do not backfill the pipe trench until the solvent welded joints have set. Support the pipe uniformly and continuously over its entire length on firm, stable soil. Do not use blocking to change pipe grade or to support pipe in the trench.

R. Install buried PVC pipe in accordance with ASTM D2774 and the pipe manufacturer's recommendations. Compact by means of vibratory equipment or by flooding. Apply backfill in layers having a maximum thickness of 8 inches. If water flooding is used, do not add successive layers unless the previous layer is compacted to 90% relative compaction.

3.08 BACKFILLING

A. See ASTM F690, Section 8, for some information on trench backfilling.

B. Initial backfill on lines shall be of a fine granular material with no foreign matter larger than 1/2 inch in size.

C. Backfill for trenching shall be compacted to relative compaction equal to adjacent undisturbed soil and shall conform to adjacent grades without dips, sunken areas, humps, or other irregularities.

D. In proper types of soil, Owner's Representative may accept the use of flooding in lieu of tamping.

E. Do not use truck wheels for compacting soil.

3.09 INSTALLING ELECTRICAL REMOTE CONTROL VALVES

A. Be sure to include detail of the remote control valve installation in the drawings.

B. Install valve in shrub area whenever possible.

C. Install per construction detail.

3.010 INSTALLING QUICK COUPLING VALVES

A. Be sure to detail the quick coupling valves in the drawings.

B. Locate valves within 12 inches of hardscape, unless noted otherwise.

C. Install per construction detail.

3.011 VALVE BOX INSTALLATION

A. Be sure to show valve box locations in drawings.

B. Valves shall be housed in a box as located in contract drawings, except in traffic areas where box shall be concrete with cast-iron lid of a type suitable for traffic installation.

C. Fill area under box with a minimum of 3 cubic feet of pea gravel before box is installed.

D. Identification:

1. Stencil or engrave identification label on each valve box in 2-inch high characters (letters and numbers).

2. Do not label boxes until identification system has been reviewed by the Owner's Representative.

3.012 INSTALLING ELECTRIC VALVE CONTROL WIRING

A. Wherever possible, install wiring in the same trench and along the same route as the main irrigation supply pipeline except in locations where the wire will pass under paving. At those locations, install the wire inside a Schedule 40, PVC 1120 pipe with a minimum 2-inch-diameter sleeve or size as noted in drawings.

B. Tape wiring together at intervals of 5 feet, if not in same trench with pipe, or tape to irrigation pipeline at 10-foot intervals using 1/4-inch-wide fiber-reinforced tape.

C. Use a continuous wire between the controller and valves. Make splices only at the valve box or in a plastic splice box marked "SB." Make an expansion loop of a minimum 18 inches at each wire connection, bend, and/or directional turn.

D. Use color-coded wire or attach permanent markings at each end of the wire to identify it by valve number. The common wire shall be white.

E. Provide a separate wire circuit for each solenoid control valve.

F. Provide one wire, orange in color, from each controller to furthest location in system and other locations as indicated, to be used as needed for future use. Coil last 2 feet of wire and leave in valve box.

3.013 AUTOMATIC CONTROLLER INSTALLATION

A. Locate controller according to drawings and verify location with Owner before installation.

B. Use conduit indicated in drawings for connection of power source to controller. Install valve control wires in a conduit from controller to the bottom of the pipe trench.

C. Mark wire leads on inside of controller box to indicate their use and destination by valve number.

3.014 INSTALLING BACKFLOW PREVENTER ASSEMBLIES

A. Install backflow assemblies where located in the drawings and at minimum height required by local codes.

B. Do not install multiple assemblies on plastic lines. Provide each assembly with its own outlet.

C. Install assemblies according to respective detail drawings or specifications.

D. Assemble pressure supply pipe and fittings using Teflon tape applied to male threads only. Use pipe thread sealant on threaded PVC fittings.

E. Tape pipe or tubing ends closed during installation.

3.015 FLUSHING SYSTEM

A. See ASTM F690, Section 7, for some information on pipe flushing and pressure testing.

B. After irrigation pipelines and risers are in place and connected and prior to installation of irrigation heads, open the control valves and use a full head of water to flush out system.

C. Install irrigation heads only after flushing of the system has been accomplished.

3.016 INSTALLATION OF IRRIGATION HEADS

A. Install irrigation heads as designated in contract drawings.

B. Spacing of heads shall not exceed maximum indicated in drawings. In no case shall the spacing exceed the maximum recommended by manufacturer.

C. Elevate irrigation heads in lawn or turf areas to a minimum of 3 inches above grade. Place heads along curbs, walks, paving, etc., 1/2 inch above finish grade. Lower raised irrigation heads within 10 days after notification by Owner.

3.017 ADJUSTING THE SYSTEM

A. Adjust valves and alignment and coverage of irrigation heads.

B. If it is determined that adjustments in irrigation equipment or nozzle changes will provide proper and more adequate coverage, make such changes or make arrangements with manufacturer to have adjustments made, prior to any planting.

C. These changes or adjustments shall be made without additional cost to the Owner.

D. The entire system shall be operating properly before any planting operations commence.

3.018 OBSERVATIONS AND TESTING

A. Observations: Notify Owner's Representative in advance according to the time indicated for the following observations:

1. Prejob Conference: Seven days.

2. System Layout: 48 hours.

3. Pressure Supply Line Installation and Testing: 48 hours.

4. Coverage Tests: 48 hours.

5. Final Observation: 48 hours.

B. Testing:

1. Hydrostatic Pressure Test: Conduct hydrostatic pressure tests in accordance with Section 400515, except as modified in this section.

    a. Do not allow or cause any of the work of this section to be covered up or enclosed until it has been tested and reviewed by the Owner's Representative.

    b. Fill the line with water for a period of at least 24 hours before hydrostatic testing.

    c. Test pressure for irrigation system piping at 160 psi for a period of twenty four hours.

    d. Complete testing prior to the installation of remote control valves, quick couplers, or other valve assemblies.

    e. Partially backfill pipelines leaving joints exposed and perform initial pressure test. Any leakage from solvent-welded or threaded connections is unacceptable and must be completely repaired.

    f. Perform the final test after completion of backfilling and compaction.

2. Coverage Tests: Conduct irrigation coverage tests under normal operating pressure conditions before any planting is performed. Correct and field adjust irrigation orientation to provide uniform precipitation over the irrigated area. Minimize overspray onto paved surfaces and eliminate overspray on buildings.

3.019 COMPLETION CLEANING

Upon completion of the work, make ground surface level; remove excess materials, rubbish, debris, etc.; and remove construction and installation equipment from premises.

3.020 SYSTEM MAINTENANCE

The irrigation contractor shall maintain the system for a period of 60 days after initial acceptance. The system shall operate on a daily basis during that time period.

END OF SECTION

SECTION 329010 LANDSCAPE PLANTING

PART 1 - GENERAL

1.01. DESCRIPTION

This section includes soil preparation, fine grading, weed control, erosion control, planting, watering, and plant establishment and maintenance.

1.02. SUBMITTALS

A. Submit shop drawings and other items in accordance with Section 013300.

B. Work schedule.

C. An agronomic soils test report will not be required. All soil backfill and soil to be spread over dry rock storage/berm areas will receive imported pre-composted material unless noted otherwise below. Pre-composted material is available from the Rancho Las Virgenes Compost facility. If the contractor chooses another source of or equal, they must submit data for review and approval.

D. Materials list noting product (generic) name and supplier.

E. Submit plant materials list and supplier's name, address, and phone number to Owner's Representative within 30 days of award of contract, giving evidence that Contractor has source for specified plant materials.

F. Guarantees/written certifications.

1.03. GUARANTEE

A. Immediately remove plant material that does not meet the specifications from the site. Replace these and any other plants that are missing with the same variety and size as originally designated in the plant list.

B. Provide a one-year guarantee.

1.04. OBSERVATIONS

A. Request observation by the Owner's Representative at least 48 hours in advance of the time observation is required.

B. Observation will be required for the following parts of the work:

1. Prior to completion of berm rock replacement and soil additive grading.

2. After soil additive.

3. Plant material when delivered to the project site.

4. When shrubs and trees are spotted for planting but before planting pits are excavated.

5. When planting and all other indicated or specified work has been completed.

6. Upon completion of maintenance and plant establishment.

PART 2 - MATERIALS

2.01 AMENDMENTS/FERTILIZERS AND IMPORT SOIL FOR PLANTING AREAS

No fertilizers or pesticides can be placed onsite other than the west side of the visual berm that does not drain to the open water reservoir. For areas that drain to the open reservoir, only clean fill suitable for planting can be used.

2.02 HYDROSEEDING

A. Cellulose fiber mulch shall be Conwed 2000 or equal.

B. Controlled release fertilizer (CRF) shall be resin-coated prills or pellets with an analysis of 16-7-12 (plus iron).

C. For seed mixes, see Plan.

2.03 PLANT MATERIAL

A. Boxed plant materials may be reviewed by Owner's Representative prior to delivery to jobsite. Review, when requested, shall be scheduled by the Contractor.

B. Plant material shall be fresh, vigorous, of normal growth, and free from disease, weeds, insects, insect eggs, or larvae. Plants shall be free from knots, sunscald, injuries, abrasions, or other disfigurements. Container stock shall have grown in containers for at least six months, but not over two years. Tree trunks shall be sturdy and hardened.

C. Plant material shall conform to the State of California Grading Code of Nursery Stock and shall be No. 1 grade.

D. Plant materials shall meet the specifications of federal, state, and county laws requiring inspection for plant diseases and insect infestations. Any inspection certificates required by law shall accompany each shipment invoice or order for stock when such plants arrive at the site. File the certificates of inspection with the Owner.

E. Plants shall be true to name. Tag one plant from each bundle or lot with the name and size of plants in accordance with the standards of practice recommended by the American Association of Nurserymen.

F. Determine the root condition of plants furnished in containers or flats by removal of earth from the roots. The roots of no less than two plants nor more than 2% of each species or variety from each source shall be reviewed by the Owner's Representative. The selection of plants to be reviewed will be made by the Owner's Representative.

G. Plants rendered unsuitable for planting because of this inspection shall be considered as samples, and replacements shall be provided at no additional cost to the Owner. If the sample plants reviewed are found to be defective, the Owner's Representative reserves the right to reject the entire lot or lots of plants. Remove rejected plants from the site immediately.

2.04 GUYING MATERIALS

A. Tree anchors for guying shall be by VIT or equal.

B. Wire shall be solid-core zinc-coated steel, 10 gauge minimum. Wire covering at tree shall be reinforced rubber or plastic two-ply garden hose, 1/2 inch in diameter minimum.

PART 3 - EXECUTION

3.01 LANDSCAPE GRADING

A. Bring planting areas to grade by filling with soil available on site and approved imported compost material. Compost material is available from the Rancho Las Virgenes Compost facility.

B. Final grades for the shrub areas shall be 1 inches below the top of adjoining rock/berm.

3.02 SOIL PREPARATION

A. Do not complete this work until planting is ready to proceed. If 30 calendar days elapse between soil preparation and planting, prepare areas again.

B. Perform rough grading and filter fabric placement prior to adding of any soil amendments.

C. Add the following soil amendments to planting areas at the following rates per 1,000 square feet.

D. Soil preparation area shall be watered with a 0.02% soil drain solution to a depth of 6 inches. Soil shall "cure" (dry out) before planting begins. Follow supplier's recommendations.

E. Prior to planting, rake out area and remove any boulders, rocks, and dirt clods approximately 1 inch in diameter and larger within plant pits.

3.03 HYDROSEEDING

A. Application:

1. Apply the hydrospray in the form of a slurry consisting of cellulose fiber, seed, stabilizer additives, commercial fertilizer, and water. When hydraulically sprayed on the soil surface, the mix shall form a blotter-like ground cover impregnated uniformly with seed and fertilizer and shall allow moisture to percolate to the underlying soil.

2. Prior to hydrospraying, measure the site and stake to identify the areas to be sprayed by each truckload of mix.

B. Hydroseeding:

Dry Hydroseed native mix: Seed mix, refer to plant list on Plan.

C. Equipment:

1. Hydraulic equipment used for the application of the slurry shall be a 1,500-gallon capacity agitator-mixer. This equipment shall have a built-in agitation system and operating capacity sufficient to agitate, suspend, and homogeneously mix a slurry containing not less than 40 pounds of cellulose fiber mulch, plus a combined total of 7 pounds of fertilizer solids for each 100 gallons of water.

2. The slurry distribution hose lines shall be large enough to prevent stoppage and shall be equipped with a set of hydraulic spray nozzles that will provide a continuous nonfluctuating discharge. Mount slurry tank on a traveling unit.

3.04 TREE PLANTING

A. Tree planting pits shall be square with vertical sides.

B. Do not plant trees if the root ball is broken or cracked either before or during the planting process.

C. Tree planting pits shall be a maximum of 6 inches deeper than the root ball and twice the diameter of the root ball.

D. Use prepared soil for backfill and compact before placing the tree in the pit.

E. Composted soil to be used as backfill.

F. Plant trees approximately in the center of the tree planting pits. Scarify sides of root ball.

G. Plant trees with the nursery dirt ring around the trunk 1 inch above finished grade.

H. As soil is backfilled, water with 0.02% solution of soil drain. Backfill mix shall be well drenched at completion of backfill operation. Allow backfill mix to "cure" (dry out) before irrigating, unless plants are stressed due to lack of water it sufficiently to settle as the tree is planted.

I. After the tree is planted, stake the tree or guy as shown in the typical tree staking and guying details in the drawings. Prevent injury to the root ball.

3.05 SHRUB PLANTING

A. Dig shrub planting pits square with vertical sides twice the diameter and 6 inches deeper than the root ball.

B. Use prepared soil for backfill. Place in the bottom of each hole to such a depth that will allow the shrub, when planted, to be at its normal growing depth. Soil to be used as backfill shall be the same as the tree backfill material.

C. Scarify root ball sides before or after shrub is placed in plant pit.

D. Protect the shrubs after planting. Any damage to trees and shrubs due to tamping and other procedures by the Contractor shall be repaired immediately at no expense to the Owner. Protect trees and shrubs from drying out prior to planting.

E. Water and maintain shrubs during the installation and maintenance periods to assure a vigorous and thriving condition.

3.06 MAINTENANCE

A. Maintenance work shall include the following plant establishment work:

1. Maintain the entire project for a minimum period of 365 calendar days, commencing from the time all contract work items have been completed to the satisfaction of the Owner's Representative and evidence of such satisfaction has been received in writing.

2. During this period, keep plants and planted areas well watered and weed-free.

3. Do not apply fertilizers, pesticides, herbicides, or fungicides.

4. Maintain a sufficient number of personnel and adequate equipment to perform the work herein specified from the time any planting is done until the end of the maintenance period.

5. Repair damage to planting areas immediately and throughout the maintenance period.

6. Any planting areas that do not show a prompt establishment of plant material shall be replanted at 10-day intervals.

    a. Depressions caused by vehicles, bicycles, or foot traffic shall be filled and leveled. Replant damaged areas.

    b. Exterminate gophers and moles and repair damage as above.

    c. Wash and maintain in a neat and clean condition.

7. Pinch prune shrubs and trees to encourage new growth and to eliminate rank sucker growth. Remove old flowers and dead foliage and limbs. Do no major pruning without the review of the Owner's Representative.

8. Remove debris and trash from the site weekly.

END OF SECTION

SECTION 330130 LEAKAGE AND INFILTRATION TESTING

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes testing of gravity pipelines, sewers, culverts, drains, and manholes not intended to be pressurized in excess of 5 psi or 12 feet head of water. Leakage test is by internal air pressure or water. Infiltration test is by measurement of rate of flow of water.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Leakage Testing of Hydraulic Structures: 030510.

B. Precast Circular Concrete Manholes: 034210.

C. Precast Concrete Vaults: 034220.

PART 2 - MATERIALS

2.01 TEST PLUGS

Inflatable and expandable type, braced to contain 5 psi over the pipe cross-section area.

2.02 PRESSURE-RELIEF VALVE

Set to limit the internal pipe test pressure to 5 psi.

PART 3 - EXECUTION

3.01 PREPARATION OF THE PIPELINE

A. Prior to testing, flush and clean the pipeline to wet the pipe surface and clean out debris.

B. Plug pipe outlets, including stoppers in laterals, to resist the leakage test pressure.

3.02 LEAKAGE TEST

A. Test for leakage or for infiltration by means of a water test. Test each section of pipe between manholes, or structures. Use the air test where the difference in elevation between the invert of the upper structure and the invert of the lower structure is more than 10 feet.

B. Test each section of pipe subsequent to the last backfill compacting operation.

3.03 WATER TEST

A. Test each section of pipe between two successive structures by closing the lower end of the pipe to be tested and the inlet pipe of the upper structure with plugs or stoppers. Fill the pipe and structure with water to a point 4 feet above the invert of the open pipe in the upper structure or to a height of 10 feet above the invert of the sewer in the lower structure, whichever gives the least hydrostatic pressure on the lower structure.

B. The total leakage shall be the decrease in volume of water in the upper structure. The leakage shall not exceed 0.025 gpm per inch of nominal diameter of pipe per 1,000 feet of pipe being tested.

C. If the leakage is greater than allowed, replace and re-lay until the joints and pipe comply with this test. Complete tests before trench is paved.

3.04 AIR TEST

A. Conduct air tests per the following standards:

Pipe Material	**ASTM Specification**
PVC	F1417, Table 1

B. Test each section of pipe between two successive manholes by plugging pipe outlets with test plugs. Add air slowly until the internal pressure is raised to 4.0 psig. The compressor used to add air to the pipe shall have a blowoff valve set at 5 psig so that the internal pressure in the pipe never exceeds 5 psig. Maintain the internal pressure of 4 psig for at least two minutes to allow the air temperature to stabilize, then disconnect the air supply and allow the pressure to decrease to 3.5 psig. Measure the time in minutes that is required for the internal air pressure to drop from 3.5 psig to 2.5 psig. Compare the results with the values tabulated in the referenced ASTM specifications in paragraph A above.

C. If the pressure drop from 3.5 psig to 2.5 psig occurs in less time than the specified values, overhaul the pipe and, if necessary, replace and re-lay the pipe until the joints and pipe hold satisfactorily under this test.

D. Guard against the sudden expulsion of a poorly installed plug or a plug that is partially deflated.

3.05 TEST FOR INFILTRATION

A. If, in the construction of a section of the sewer between structures, excessive groundwater is encountered, close the end of the pipe at the upper structure sufficiently to prevent the entrance of water. Discontinue pumping groundwater for at least three days. Then test the section for infiltration. The infiltration shall not exceed 0.025 gpm

per inch of diameter per 1,000 feet of main line pipe being tested as measured at the downstream structure. Test period shall be at least eight hours.

B. Where infiltration exceeds the maximum acceptable, immediately uncover the pipe and reduce the infiltration to within the maximum acceptable by replacing, re-laying, or encasing the pipe in concrete.

3.06 CORRECTION OF OBSERVED LEAKS

Even though the infiltration is less than the maximum acceptable, stop any individual leaks that may be observed.

3.07 INSPECTION BY CONTRACTOR FOR DAMAGED OR DEFECTIVE PIPE IN PLACE

A. After completion of backfill, pavement replacement, and air test or infiltration test, inspect the pipe for damage and other defects with the aid of mirrors or by means of closed circuit television (CCTV). Television inspection shall be in accordance with the Standard Specifications for Public Works Construction (SSPWC), Section 500-1.1.5.

B. Schedule the inspection in advance with the Owner's Representative.

C. If the "mirroring" or CCTV inspection indicates any defects, excavate and repair or replace the faulty materials and construction and restore the work and the damage to work of others.

END OF SECTION

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SECTION 331220 BACKFLOW PREVENTERS

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and installation of backflow preventers

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Painting and Coating: 099000.

B. Pressure Testing of Piping: 400515.

C. Manual, Check, and Process Valves: 400520.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300

B. Submit manufacturer's certificate of compliance with AWWA C511 for backflow preventers. Show evidence of compliance with NSF 61.

C. Submit dimensional drawings for each size and type of backflow preventer

D. Submit manufacturer’s catalog data and detail drawings showing backflow preventer parts and describe by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show manufacturer’s recommended maximum operating pressure and maximum recommended flow. Show linings and coatings. Identify each backflow preventer by tag number to which the catalog data and detail sheets pertain. Submit certificate of approval of backflow preventer device by the California Department of Public Health

PART 2 - MATERIALS

2.01 BACKFLOW PREVENTERS

A. Backflow preventers shall be of the reduced pressure type, complying with AWWA C511. Provide two independently operating check valves, an automatic pressure differential relief valve, and test cocks so that a test of each check valve can be made.

B. Backflow preventers shall have check valves of either the poppet or the toggle lever type. Check valves shall have cast-iron (ASTM A126, Class B) body and cover.

C. Differential relief valve shall be bronze (ASTM B61 or B62) with Type 304 or 316 stainless steel trim.

D. Isolation valves shall be provided in accordance with the drawings and applicable specifications.

E. Backflow preventers shall be Watts, Clayton Model RP, Mueller Model FRP-II or 6CM or equal.

2.02 BRONZE COMPONENTS

Bronze in contact with water shall have the following chemical constituents:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

PART 3 - EXECUTION

3.01 PAINTING AND COATING

A. Coat backflow preventers including isolation valves the same as the adjacent piping. If the adjacent piping is not coated, then coat per Section 099000, System No. 15. Apply the specified prime, intermediate and finish coats at the place of manufacture. Do not coat bronze or stainless steel items. Finish coat shall match the color of the adjacent piping.

B. Line backflow preventers 4 inches and larger (including isolation valves) on the interior metal parts, excluding seating areas and bronze and stainless steel pieces per Section 099000, System No. 7.

3.02 SHIPMENT AND STORAGE

A. Identify the equipment with item and serial numbers. Material shipped separately shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number of the equipment for which it is intended. In addition, ship crated equipment with duplicate packing lists, one inside and one on the outside of the shipping container.

B. Pack and ship one copy of the manufacturer's standard installation instructions with the equipment. Provide the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite and before start-up.

C. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Provide closures at the place of pump

manufacture prior to shipping. For studded openings, use all the nuts needed for the intended service to secure closures.

D. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Provide caps or plugs at the place of pump manufacture prior to shipping.

E. Clearly identify lifting points and lifting lugs on the equipment or equipment package. Identify the recommended lifting arrangement on boxed equipment.

3.03 INSTALLATION OF BACKFLOW PREVENTERS

A. Do not use duct tape or plastic for covering the ends of pipe flanges. Use a solid metal cover with rubber gasket to cover flange openings during installation. These metal covers shall remain in place until the piping is connected to the equipment.

B. Do not spring flanges of connecting piping into position. Separately work inlet and outlet piping systems into position to bring the piping flanges into alignment with the matching equipment flanges. Do not move equipment to achieve piping alignment. Do not use electrical heating stress relieving to achieve piping alignment.

C. Line up pipe flange bolt holes with machinery nozzle bolt holes within 1/16 inch maximum offset from the center of the bolt hole to permit insertion of bolts without applying any external force to the piping.

D. Flange face separation shall be within the gasket spacing ±1/16 inch. Use only one gasket per flanged connection.

3.04 FIELD TESTING

Pressure test the backflow preventers along with the connecting piping per Section 400515. There shall be no visible leaks in the backflow preventer assembly, valves, or joints of the interconnecting piping.

END OF SECTION

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SECTION 331300 DISINFECTION OF PIPING AND STRUCTURES

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and procedures for disinfection of water mains by the continuous feed method. Disinfect piping in accordance with AWWA C651, except as modified below.

1.02 RELATED WORK DESCRIBED ELSEWHERE

A. Pressure Testing of Piping: 400515.

B. Prestressed Circular Concrete Tank: 331620.

1.03 SUBMITTALS

A. Provide a chlorination plan noting materials and schedule for Owner’s review.

1.04 JOB CONDITIONS

A. Discharge of chlorinated water into watercourses or surface waters is regulated by the National Pollutant Discharge Elimination System (NPDES). Disposal of the chlorinated disinfection water and the flushing water is the Contractor's responsibility. No water is to be discharged to the open reservoir. Discharge may be coordinated with the Owner and/or the local wastewater utility for discharge to the site sewer along the access road. See Section 331620 regarding tank disinfection and the potential discharge to storm and surface drains.

B. Schedule the rate of flow and locations of discharges in advance to permit review and coordination with Owner and/or the local wastewater utility.

C. Use potable water for chlorination.

D. Submit request for use of water from waterlines of Owner forty-eight (48) hours in advance.

PART 2 - MATERIALS

2.01 LIQUID CHLORINE

Inject with a solution feed chlorinator and a water booster pump. Follow the instructions of the chlorinator manufacturer.

2.02 CALCIUM HYPOCHLORITE (DRY)

Dissolve in water to a known concentration in a drum and pump into the pipeline at a metered rate.

2.03 SODIUM HYPOCHLORITE (SOLUTION)

Further dilute in water to desired concentration and pump into the pipeline at a metered rate.

2.04 CHLORINE RESIDUAL TEST KIT

For measuring chlorine concentration, supply and use a medium range, drop count, DPD drop dilution method kit per AWWA C651, Appendix A.1. Maintain kits in good working order available for immediate test of residuals at point of sampling.

PART 3 - EXECUTION

3.01 CONTINUOUS FEED METHOD FOR PIPELINES

Introduce potable water into the pipeline at a constant measured rate. Feed the chlorine solution into the same water at a measured rate. Proportion the two rates so that the chlorine concentration in the pipeline is maintained at a minimum concentration of 50 mg/L. Check the concentration at points downstream during the filling to ascertain that sufficient chlorine is being added.

3.02 DISINFECTION OF VALVES, BLIND FLANGES, AND APPURTENANCES

During the period that the chlorine solution or slug is in the section of pipeline, open and close valves to obtain a chlorine residual at hydrants and other pipeline appurtenances. Swab exposed faces of valves and blind flanges prior to bolting flanges in place with a 1% sodium hypochlorite solution.

3.03 DISINFECTION OF CONNECTIONS TO EXISTING PIPELINES

Disinfect isolation valves, pipe, and appurtenances per AWWA C651, Section 4.7. Flush with potable water until discolored water, mud, and debris are eliminated. Swab interior of pipe and fittings with a 1% sodium hypochlorite solution. After disinfection, flush with potable water again until water is free of chlorine odor.

3.04 DISINFECTION OF TAPPING SLEEVES

Flush exterior of pipe with potable water after removal of existing coating. Swab exterior of pipe with a 1% sodium hypochlorite solution. Disinfect per AWWA C651, Section 4.8. After completion of tapping, swab interior of pipe, valves, and faces of flanges to be connected to bypass piping with a 1% sodium hypochlorite solution.

3.05 CONFIRMATION OF RESIDUAL IN PIPING

After the chlorine solution applied by the continuous feed method has been retained in the pipeline for 24 hours, confirm that a chlorine residual of 25 mg/L minimum exists along the pipeline by sampling at air valves and other points of access.

3.06 PIPELINE FLUSHING

After confirming the chlorine residual, flush the excess chlorine solution from the pipeline until the chlorine concentration in the water leaving the pipe is within 0.5 mg/L of the replacement water.

3.07 SAMPLING AND BACTERIOLOGIC TESTING

A. There shall be no water in trenches up to the connection for sampling. The sampling piping shall be clean, disinfected, and flushed prior to sampling.

B. Collect two sets of samples per AWWA C651, Section 5.1, deliver to a certified laboratory within six hours of obtaining the samples, and obtain a bacteriologic quality test to demonstrate the absence of coliform organisms in each separate section of the pipeline and in each structure after chlorination and refilling.

3.08 PIPING TEST FACILITY REMOVAL

After satisfactory disinfection, disinfect and replace air valves, restore the pipe coating, and complete the pipeline where temporary disinfection or test facilities were installed.

3.09 PIPING TO BE DISINFECTED

A. Disinfect all piping except:

1. Sewers, reclaimed water, and drainage piping not immediately connected to the reservoir or potable water pipelines.

2. Storm drain piping.

3. Reinforced concrete and vitrified clay pipe.

3.10 DISINFECTION OF STRUCTURES

A. Disinfect reservoir in accordance with AWWA C652, except as otherwise specified herein.

B. Disconnect and bulkhead the outlet pipeline at the valve vault during filling of the reservoir and leak test period. The Owner will provide potable water at no cost to the Contractor for the first disinfection effort. If bacteriological testing shows that the first disinfection effort was not successful, the Contractor will be charged the cost of additional water at the Owner's current rates.

3.11 DISINFECTION OF TANK

A. Disinfect the reservoir after construction is complete and prior to filling of the reservoir for testing or storage of potable water. Disinfect the reservoir again if subsequent test or construction operations contaminate the reservoir.

B. Spray water containing 400-mg/L available chlorine on interior surfaces. Following spray application, disinfection shall comply with AWWA C652, Method 3.

Bacteriological testing shall conform to AWWA C652, Section 4.4. Should tests fail, the disinfection process shall be repeated. Should any disinfected water require discharge to storm and surface drains, the Contractor shall submit a water dechlorination plan for approval prior to discharge. No water shall be discharged to the open reservoir. The plan shall delineate how water shall be dechlorinated and shall be in compliance with applicable regulations of the Regional Water Quality Control Board, the City of Westlake Village, and the County of Los Angeles. Reuse and reclamation of spent water for landscaping or construction purposes is encouraged.

3.12 REPETITION OF PROCEDURE

If the initial chlorination fails to produce required residuals and bacteriologic tests, repeat the chlorination and retesting until satisfactory results are obtained.

3.13 DECHLORINATION

Dechlorinate per AWWA C655. Perform testing of residual chlorine before discharge of water into the environment.

END OF SECTION

SECTION 331620 PRESTRESSED CIRCULAR CONCRETE TANKS

PART 1 – GENERAL

1.01 DESCRIPTION

This section describes materials and construction of AWWA D110, Type I prestressed circular concrete tanks.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Concrete Construction: 030500.

B. Leakage Testing of Hydraulic Structures: 030510.

C. Handrails and Safety Chains: 055200.

D. Baffles: 066720.

E. Painting and Coating: 099000.

F. Earthwork: 312300.

1.03 DESIGN INFORMATION

		Data
1.	Nominal capacity	5 MG
2.	Maximum water depth for overflow at wall Top of overflow pipe	22 feet
3.	Free-board below top of wall to high operating water level	2 feet
4.	Wall height	23 feet
5.	Live load on roof	100 psf
6.	Minimum backfill height (above floor at wall)	1 feet (see drawings) 0.0 feet at test
7.	Equivalent liquid backfill pressure (static--at rest)	0 psf at F.G., 65 x H psf at tank bottom
8.	Equivalent liquid backfill pressure (dynamic) on wall (add to static pressure)	0 psf at F.G.
9.	Downward drag coefficient of backfill on wall	0
10.	Soil bearing capacity (net)	6000 psf
11.	Seismic data	Refer to Fugro West Inc. Geotechnical Study Report, June 2013

1.04 BID-SUBMITTALS RESPONSIVENESS

The following items shall be included in the bid documents:

A. Written statement that the General Contractor and/or the tank constructor has successfully completed at least two circumferentially strand wrapped prestressed Type 1 concrete tanks 3 MG or larger in the last 10 years. The referenced two tanks shall have Type 1 core walls. Experience with tank construction having other than what is indicated in the drawings shall not be considered. All tanks listed for the experience requirements must have been built in the General Contractor's or tank constructor's own name, or one of its divisions.

B. The name and address of the tank constructor, if different than the prime bidder or General Contractor.

C. The name of the General Contractor's proposed superintendent who will be in direct charge of the project for the full duration of the contract and the name, if different, of the proposed subcontractor's superintendent who will be in direct charge of the tank construction.

    1. The proposed tank construction superintendent shall be currently employed by the qualified tank constructor and shall have been the tank construction superintendent on no less than two strand-wrapped prestressed concrete tanks during the last ten years. The tank superintendent shall have been under the direct employment of the tank constructor for both tanks listed and will be required to be on the project site full-time and in responsible charge during all tank concrete construction activities.

D. Descriptive literature of the wrapping, vertical prestressing, and automated shotcrete machinery to be used that meets these specifications. Literature shall include actual printouts or other records of applied wrapping force recordings (as well as force elongation diagrams, if available) taken from projects on which the proposed prestressing equipment and systems have been used.

E. A written statement from the tank prestressor indicating that the prestressor has a minimum of two operable strand-wrapping and automated shotcrete machines meeting these specifications.

1.05 SUBMITTALS AFTER AWARD OF CONTRACT

A. Provide submittals in accordance with Section 013000.

B. Set of tank design calculations and drawings indicating the procedures to be used and the ability of the proposed tank to resist loads specified. The tank design calculations and drawings shall be signed and stamped by a civil or structural engineer registered in the state of California who has at least five years of experience in the design of the type of tank specified. Said engineer must be under the full-time employment of the tank General Contractor or the subcontractor performing the tendon wrapping and stressing operations.

Submit a list of at least three prestressed concrete tanks with Type 1 core walls and in seismic Zone 4, completed in the last five years and stamped and signed by said engineer.

C. Detailed construction drawings shall include:

1. Scaled dimensional drawings.
2. Accessory list with fabrication details.
3. Erection drawings.
4. Catalog cuts and description of standard manufactured items.
5. Location, size, and anchorage of vertical and circumferential prestress reinforcement.
6. Prestress forces including initial, temporary, final, and related losses.

D. Provide documentation relative to concrete tank work as may be specified elsewhere in the construction specifications.

E. Section 1.05.E provides requirements for certifying concrete in compliance with NSF 61. Below please find, for your consideration and use, language used by California Department of Public Health on previous tank projects:

1. Concrete that comes in direct contact with potable water shall include the following:

a. Cement shall be NSF/ANSI 61 certified

b. Admixtures shall be NSF/ANSI 61 certified

c. Aggregates shall be tested and approved by one of the following methods:

- Provide test cylinders using the proposed mix designs for the concrete that come in direct contact with potable and test as a Barrier Material per Chapter 5 of NSF/ANSI 61 – 2005. Concrete shall be tested for all CA Title 22 radionuclides listed in Table 64442.

- Gross Alpha radionuclides testing of the dry aggregates using test procedures acceptable to the California Department of Public Health.

d. Testing shall be conducted by an ANSI or ELAP accredited product certification body for Drinking Water Quality.

2. If NSF/ANSI 61 certified cement and admixtures are not available the following testing procedure shall be required:

a. Provide concrete test cylinders for each mix design that will come in direct contact with potable water to an approved testing laboratory.

b. Concrete specimens shall be soak-tested to verify water quality is in compliance with NSF/ANSI 61-2011 Chapter 5 – Barrier Materials. Concrete specimens shall be tested for the items listed in NSF/ANSI 61 Table 3.1 – Portland and Hydraulic Cements.

c. Testing shall be conducted by an ANSI or ELAP accredited product certification body for Drinking Water Quality.

F. Mill certificates that prestressing strand complies with these specifications.

G. Stress-strain curves and physical properties of the vertical prestressed reinforcing identified specifically for this project.

H. Submittals for admixtures proposed for use in the concrete tank walls.

I. Certificate of compliance with AWWA D110 as modified herein.

J. Submit manufacturer's data sheets showing the percent solids by volume for painting and coating materials supplied.

1. Minimum recommended dry-film thickness per coat for prime, intermediate, and finish coats.
    a. Recommended surface preparation.
    b. Recommended thinners.
2. Statement verifying that the specified prime coat is recommended by the manufacturer for use with the specified intermediate and finish coats.
3. Application instructions including recommended equipment and temperature limitations.
4. Verification from the manufacturer that the product meets current California VOC requirements.
5. Color chips for exterior tank coatings.
6. Painting Subcontractor's Quality Control: The painting subcontractor shall furnish a statement covering experience on similar work. The painting subcontractor shall have a minimum of five years' experience in the application of the specified products to concrete surfaces. Upon request, the painting subcontractor shall furnish a list of references of projects on which similar specified materials were applied.

K. Submit mill test certificates showing the dimensional and physical characteristics of each size, heat, or reel of the prestressing steel.

L. Submit evidence to the Owner's Representative, prior to the preparation of shop drawings and installation of vertical tendons, that the proposed tendon anchorage system meets the requirements of these specifications. Should such anchor systems not meet the

specifications, the Owner's Representative may order anchorage tests to be made. Such testing expenses shall be paid for by Contractor

1.06 BASIS OF DESIGN

A. The prestressed concrete tank shall conform to the dimensions and be equipped with the appurtenances shown in the drawings and shall consist of cast-in-place concrete roof, columns, and floor. The cast-in-place concrete core wall shall be post-tensioned vertically with steel rods and circumferentially with wrapped strand and protected with shotcrete and specified coatings.

B. Roof and Roof Supports

1. Design flat roofs with drop panels in accordance with ACI 350. Roof designs that incorporate post-tensioning, precasting, dome, flat slab without drop panels, or waffle-type structures will not be considered.

2. Concrete roof shall be two-way flat slab poured-in-place reinforced concrete. The roof shall incorporate drop panels and shall be supported by circular spiral-reinforced concrete columns, as indicated in the drawings.

3. The concrete cover over column ties or spiral reinforcing in columns shall be 1.5 inch nominal with a ±1/4-inch construction tolerance.

C. Wall

1. Walls shall be cast-in-place reinforced concrete with vertical post-tensioning. Do not use precast or shotcrete walls.

2. Wall-to-Wall Footing Connection: Support walls by solid neoprene bearing pads allowing free radial movement of the wall relative to the wall footing. Tie the walls circumferentially to the wall footing with seismic cables consisting of hot-dipped galvanized strands encased in closed-cell sponge rubber sleeves permitting a radial free movement of the wall of at least 3/4 inch. Provide a 9-inch by 3/8-inch PVC center bulb water stop connection between wall and wall footing.

3. Wall-to-Roof Connection: Support the flat slab roof by solid neoprene bearing pads allowing free radial movement of the wall relative to the roof or vice versa. Provide an elastomeric sealant between wall and roof as indicated in the drawings.

4. Seismic Forces: Calculate forces and moments resulting from water sloshing and seismic accelerations of roof, wall, and water loads in accordance with AWWA D110, ASCE 7-05 ACI 350.3.

5. Bearing Pads

a. Support tank walls and flat slab roofs around the circumference of the tank by neoprene bearing pads of the size and thickness indicated in the

submitted calculations. Use neoprene sponge-rubber filler pads to seal the tank between the bearing pads.

b. The minimum pad thickness under tank walls shall be 1 inch and under roof slabs 1/2 inch.

c. The minimum total neoprene pad width under tank walls shall be 3 inches and under roof slabs shall be 2 inches.

d. Loads transmitted through neoprene pad areas shall account for all vertical and horizontal forces.

e. Base neoprene pad sections on continuous loading values not to exceed those allowed in the neoprene design manuals.

f. Fill voids remaining between wall and wall footing and between wall and roof, not filled completely with solid neoprene pads, with closed-cell neoprene sponge-rubber pads and soft mastic to ensure a substantially unrestrained free movement of wall and roof.

6. Minimum final circumferential prestressing force for water load at the bottom of the wall shall be:

$$Pcw = 62.5 (R) (H) \quad \text{(lbs/ft of height)}$$

in which:

R = inside radius of wall (feet).

H = maximum overload water height (feet).

This force shall taper uniformly to zero at the top of the maximum overflow water height.

7. Minimum final circumferential prestress for differential temperature and dryness bending (Pctd) at any height on the wall, for aboveground wall conditions (per these specifications), shall be 200 psi over the water load and after deduction of all losses.

8. Minimum Circumferential Backfill Force on Wall (Pcb):

$$Pcb = (h) (p) (R + 0.0833 t) \quad \text{(lbs/ft of height)}$$

in which:

R = inside radius of wall (feet).

h = height of soil above wall-footing (feet).

p = equivalent liquid backfill pressure (lbs/C.F.) under seismic loading.

t = total wall thickness including cover over prestressing wires (inches).

9. When vertical post-tensioning is used in lieu of a continuous metal diaphragm, the minimum "final" vertical compression and the vertical prestressing force (Pvtd) for poured-in-place walls, at any point around the tank wall, shall be no less than the amounts (Pctd) calculated herein. The total vertical post-tensioning (200 psi x Ag at wall) shall be applied prior to the circumferential prestressing.

10. Maximum final stress in circular and vertical prestress steel (fse) shall not be less than the maximum allowable initial stress of 0.75 minimum ultimate strength (±1.5% MUS) less 25,000-psi stress losses.

11. Minimum initial-to-final stress ratio (I.F. ratio) is the value of the not-to-be-exceeded initial steel stress divided by the value of the final steel stress as defined herein.

D. Maximum Compressive Stress in Concrete Walls: The maximum compressive stress in concrete walls, under any combination of load conditions, at any stage during the construction, and without any allowance for stress losses due to creep of steel and concrete or due to elastic deformation or concrete shall not exceed 0.55 f'c.

1. Minimum Total Overall Wall Thickness: The minimum overall wall thickness shall be no less than the value calculated below:

$$t_{overall} = \frac{[(\text{I.F. Ratio}) \times (Pcw + Pctd)] + Pcb}{(0.55 \quad 'c) \times (12)}$$

2. Bottom edge restraint reinforcing for cast-in-place walls prestressed vertically with threadbar tendons shall be reinforced on the inside bottom of the tank wall with No. 5 bars, having a length not less than 40% of the wall height and spaced 18 inches maximum on centers.

E. Wall Footing

1. The circumferential wall footing reinforcing shall have a minimum total cross-sectional area no less than 0.5% of the wall footing section excluding any reinforcement requirements for tension forces due to water loads.

2. Tension forces caused by liquids acting on wall footings shall be taken fully by reinforcing steel in the radial and circumferential direction at steel stresses not

exceeding 18,000 psi. No value shall be given to radial friction resistance effects of soils on footings.

3. Hinged or fixed wall-to-wall footing connections shall not be considered.

4. Radial and circumferential bar sizes shall not exceed 3/4 inch in diameter.

5. Stagger splices in parallel bars to avoid more than one splice at any point around the circumference of the wall footing.

6. Install water stops in radial construction joints in the floor and wall footings and connect and seal to the circumferential water stop connecting the wall-to-wall footing. Circumferential joint water stop between the floor slab and ringwall footing shall be continuous and connected to radial water stop when the footing is cast over the floor slab or circumferentially adjacent.

7. The minimum width of the wall footing shall be 4 feet. The minimum thickness shall be 2'-7".

F. Floor

1. The floor shall be no less than 6.5 inches thick.

2. The cross-sectional area of steel provided for floor reinforcing in each direction shall be no less than 0.5% of the nominal floor cross-sectional area with a maximum bar spacing of 12 inches. Floor thicknesses in excess of 8 inches shall have two mats of reinforcing with the bottom mat being at least 3 inches clear to subgrade.

3. Do not post-tension floor slab.

G. Column Footings

1. Column footings shall be cast above the floor slab. The minimum size of column footings shall be 4 feet by 4 feet.

2. Footing reinforcing steel added to the floor reinforcement shall be evenly spaced and staggered to the normal slab reinforcing.

H. Prestressing System

1. No stressing system will be considered unless it has been successfully used on tanks of similar size and capacity.

2. Vertical wall prestressing tendons shall be 1.25-inch or 1.375-inch-diameter thread bars, with screw nut anchors.

3. Circumferential prestressing of tank walls shall be done with hot-dipped galvanized strand.

4. Circumferential wrapping forces applied on strand shall be continuously electronically monitored and permanently recorded while the steel is being wrapped. Die-drawing of prestress reinforcement will not be permitted.

5. Vertical tendon forces and elongations shall be electronically monitored and permanently recorded from beginning to end of each stressing operation.

6. Do not base tank wall design on wrapping tolerances greater than what the wrapping machinery can continuously meet based upon electronically recorded data taken from previous projects.

7. Do not space wrapped strands in any vertical layer closer than 2.5 strand diameters or less than 3/8-inch clearance between individual strands, whichever offers the greatest clearance between strands.

8. Cover each interior strand layer with shotcrete of 0.375-inch thickness.

9. The minimum cover over the final strand layer shall be 1.5 inches.

10. The horizontal distance between vertical prestressing tendons shall not exceed 50 inches.

11. Do not consider circumferential tank wall systems based on cable- or rod-type tendons involving the circumferential movement of prestressing steel relative to the wall surface. Do not consider systems utilizing strand cables placed inside ducts that are incorporated circumferentially in the core wall or placed manually around the exterior of the core wall.

I. Anchorage for Vertical Posttensioned Tendons

1. Secure posttensioned prestressing at the ends by means of permanent anchoring devices that shall hold the prestressing steel at a force not less than 95% of the guaranteed minimum tensile strength of the prestressing steel.

2. Distribute load from the anchoring devices to the concrete through steel bearing plates.

3. Use fully threaded anchor connections at each end of the vertical prestressing tendon which incorporates a spherical-shaped bearing surface which matches the conical bearing surface in the bearing plate.

4. The contact point of the spherical-shaped vertical prestressing bearing surface to conical hole shall be approximately 1/4 inch to 1/2 inch below the bearing plate surface.

5. Do not use wedge anchors for permanent tendon anchor hardware.

J. Anchor Pockets for Vertical Tendons

1. Form anchor pockets for vertical prestressing tendons with permanently emplaced hot-dipped galvanized cylinders welded securely to the top bearing plate.

2. Seal anchor pockets from moisture and concrete intrusion during concrete activities with wooden plugs and plastic tape.

3. Anchor pockets for vertical prestressing tendons must have provisions to allow flushing of ducts with water during concrete placement.

PART 2 - MATERIALS

2.01 CONCRETE ADMIXTURES

A. Do not use admixtures containing chlorides, fluorides, sulfides, or nitrates in any concrete mix for prestressed concrete tanks.

B. Do not use air-entraining admixtures in concrete mix Class PA.

2.02 CONCRETE MIX DESIGN

A. Conform to Section 030500 except as modified herein.

B. The maximum water-cement ratio for Classes PA and PB concrete shall be 0.42 by weight.

C. Use classes of concrete as described in the following table:

Class	Type of Work	Minimum 28-Day Compressive Strength (in psi)	Minimum Cement Content (lbs/C.Y.)
PA	Prestressed tank walls	4,000	564
PB	Prestressed tank roof slab and columns	4,500	564
PS	Shotcrete	4,500 per ACI 350	1c:3s
A	All other concrete	4,000	Section 030500

D. Slump shall be as follows:

1. Prestressed tank Walls, Roof Slab and Columns: 4 inches maximum.
2. Shotcrete: 5 to 7 inches.
3. Other Concrete: See Section 030500.

2.03 SHOTCRETE

A. Shotcrete shall be composed of portland cement, sand, and water applied as a "wet mix" to the tank walls.

B. Cement shall be in accordance with Section 030500.

C. Do not use admixtures containing chlorides, fluorides, sulfides, or nitrates.

D. Coarse sand shall conform to the following requirements:

Sieve Size	Percent Passing By Weight
3/8 inch	100
No. 4	95 to 100
No. 8	80 to 90
No. 16	50 to 85
No. 30	25 to 60
No. 50	10 to 30
No. 100	2 to 10

1. The fineness modulus shall fall between 2.70 and 3.00 per ASTM C136.

2. Use plaster sand for finish coatings where smooth surfaces are required. Plaster sand shall meet the following gradation:

Sieve Size	Percent Passing By Weight
3/8 inch	100
No. 4	97 to 100
No. 8	90 to 98
No. 16	70 to 85
No. 30	35 to 55
No. 50	15 to 25
No. 100	2 to 8

3. The sand shall have a fineness modulus of no less than 2.40 or more than 2.75.

E. Shotcrete testing shall conform to the cylinder testing requirements of Section 030500.

F. If necessitated by warm weather, up to 50 ounces per cubic yard of a retarder may be added. Retarder shall be Pozzolith 300R or equal.

G. Rebound materials may not be reused.

H. Water shall meet the requirements set out in Section 030500.

I. Fibrous Shotcrete Reinforcement:

1. Shotcrete, unless otherwise specified herein, shall be fibrous reinforced. Such material shall consist of 100% virgin polypropylene non-fibrillated fibers specifically manufactured for use as concrete/shotcrete secondary reinforcement. The required volume of fibers to be added per cubic yard of shotcrete shall be as specified in the subsection on "Prestressing Strands and Seismic Cables" of these specifications.

2. Polypropylene fibers shall provide maximum control of cracking from drying shrinkage and thermal expansion/contraction and added toughness of the shotcrete.

3. The fibers shall be manufactured in accordance with applicable building codes and ASTM C1116, Type III 4.1.3 and ASTM C1116 (Ref. ASTM C1018) Performance Level I5 outlined in Section 21, Note 17. Fibrous concrete reinforcement shall be as manufactured by the Fibermesh Company, Chattanooga, Tennessee, or equal.

4. Acceptable polypropylene fibers shall have the following physical characteristics:

   a. Specific Gravity: 0.91.

   b. Fiber Length: Graded per manufacturer.

2.04 SHOTCRETE PROPORTIONING

A. Each cubic yard of shotcrete mortar as delivered to the site or site mixed shall consist of 0.1% (1.5 pounds per cubic yard) polypropylene fibers with a mix ratio of 3 pounds of moist sand to 1 pound of portland cement. Up to 50 ounces of PRO-KRETE-R or POZZOLITH 300R may be added at the option of shotcrete applicator during warm weather conditions.

B. When night temperatures are expected to drop below 35ºF, high early strength portland cement shall be used in lieu of regular portland cement. Should high early strength portland cement not be available, the mix design shall consist of a moist sand-portland cement mix ratio, by weight, no greater than 2.59.

C. If the batching procedures require smaller volumes of cement and sand be used, the required cement-to-sand ratio shall still be adhered to.

D. Additives other than PRO-KRETE-R or POZZOLITH 300R (such as POZZOLITH 300N or others) shall not be used unless reviewed by the Owner's Representative.

E. If used, the total volumetric air content of the shotcrete before placement shall not exceed 7% ±1%, as determined by ASTM C173 or ASTM C231.

F. Unless otherwise shown in the drawings, shotcrete cylinder strengths at 28 days shall be no less than specified. Higher shotcrete cylinder strengths shall not permit a reduction in the specified cement content. The cement content in the mix designs may be increased should the specified 28-day strength requirement not be met.

G. The polypropylene fibers and admixtures shall be added to the shotcrete at the time it is batched and in the amounts specified. Additives shall be mixed in strict conformance to the manufacturer's instructions and recommendations for uniform and complete distribution. Each certificate of delivery supplied by the shotcrete supplier shall indicate the additive trade name, manufacturer's name, and amount per cubic yard added to each batch of shotcrete.

2.05 PRESTRESSING STRANDS AND SEISMIC CABLES

A. Galvanized seven-wire prestressing strands and seismic cables shall conform with ASTM A416 except as modified:

Nominal strand diameter	3/8 inch
Nominal area after galvanizing	0.089 square inch
Nominal weight/1,000 L.F.	303 pounds
Ultimate tensile strength	21,400 pounds (min)
Yield strength at 1% extension	16,000 pounds (min)
Elongation in 24 inches at fracture	4.5% (min)
Weight of zinc coating	0.85 ounce/square foot (min)
Pitch	12- to 16-strand diameter

Nominal strand diameter	1/2 inch	0.6 inch
Nominal area after galvanizing	0.153 square inch	0.217
Nominal weight/1,000 L.F.	505 pounds	930 pounds
Ultimate tensile strength	38,200 pounds (min)	54,200 pounds (min)
Yield strength at 1% extension	28,500 pounds (min)	40,700 pounds (min)
Elongation in 24 inches at fracture	4.5% (min)	4.5%
Weight of zinc coating	0.85 once/square foot (min)	0.85 ounce/square foot
Pitch	12- to 16-strand diameter	12- to16-strand diameter

B. Store and protect strands from water, rain, moisture, and foreign material prior to use.

2.06 VERTICAL PRESTRESSING BARS

A. Use high-strength threadbars with deformations and screw threads over the entire length of the bars, suitable for mechanical coupling and attachment to anchor assemblies, and anchor nuts with circular ball-shaped face. Anchor nut shall provide a vent for grouting.

B. Bars shall conform with ASTM A722, Type II and shall meet the following requirements:

Item	Unit	Specification*	
Nominal diameter	inches	1.25	1.375
Minimum tensile force	kips (min.)	187	225
Yield force at 0.2% offset	kips (min.)	150	190
Elongation in 20 bar (diameter)	% (min.)	4	4
Nominal cross-sectional area	square inches	1.23	1.48
Nominal bar weight	lbs/ft	4.17	5.04
Minimum ultimate strength	ksi	150	
*Contractor to select value based on design requirements.			

Only threadbars which are stress relieved after the threads are formed will be accepted. Threadbars shall be proof stressed after stress relieving and threading. Threadbars shall have a maximum carbon content of 0.55%.

C. Bar sizes shall be as indicated in the reviewed calculations.

D. Anchorage plates for vertical prestressing bars shall conform with ASTM A36. The anchor plates shall have a hole with a conical shape at the top of the hole to receive shaped anchor nut.

E. Protect bars during shipping and storage.

F. The threadbars and their deformations shall be hot rolled. Threadbars manufactured with quenched and tempered steels will not be accepted.

2.07 TESTING OF PRESTRESSING MATERIAL

A. Prior to stressing operations, the prestressor shall calibrate recording equipment at an approved testing laboratory to the satisfaction of the Engineer.

B. Continuous force readings for either the vertical or the circumferential prestressing operations shall be developed with electronic or the substantial equivalent strain gauge method force sensing transducers which have a maximum nonlinearity error of ±0.5% and a maximum hysteresis error of ±0.25%.

2.08 CIRCUMFERENTIAL PRESTRESSING EQUIPMENT

A. The circumferential stressing system used shall produce a continuously, electronically (or substantially equivalent) monitored permanent stress or force record along the full length of the strand as it is being applied. The stress variation in any strand at any point around the circumference shall not be greater than ±1.5% of the ultimate strength of the steel. In addition to this record, a system which deflects the tensioned prestressing material between the tensioning device and the wall, after it has left the tensioning device, shall provide a similar continuously monitored stress or force record along its full length as it is

being applied to the wall. The recordings shall show that either before or after deflection, the stress variation in the prestressing material at any point around the circumference shall not be greater than ±1.5% of the ultimate strength of the steel.

B. No manually recorded readings will be accepted.

2.09 WATER STOPS

A. Floor Construction Joints: Minimum 3/8-inch by 6-inch water stop with center bulb.

B. Wall-to-Wall Footing Connections: Minimum 3/8-inch by 9-inch water stop with a 3/4-inch-minimum center bulb.

C. Vertical Wall Joints: Minimum 3/8-inch by 6-inch water stop without a center bulb.

D. Construction Joints in Roof: Minimum 3/8-inch by 6-inch water stop with a 3/8-inch-minimum center bulb.

E. Water stops shall meet the requirements specified in Section 030500.

2.10 NEOPRENE BEARING PADS

A. Design neoprene bearing pads considering bearing stress, radial wall movement, and shear deflection.

B. Material for the pads shall conform to ASTM D2000 M2BC414A14C12F17 for 40 durometer neoprene pads, ASTM D2000 M2BC310A14C12F17 for 30 durometer neoprene pads, and M2BC517A14C12F17 for 50 durometer neoprene pads.

2.11 CLOSED-CELL NEOPRENE FILLER PADS

Filler pads shall be soft grade conforming to 2A3 of ASTM D1056.

2.12 SEISMIC CABLE SLEEVES

A. Cable sleeves shall be medium-grade closed-cell neoprene conforming to 2A3 of ASTM D1056 and the following:

Compression deflection	9 to 13 psi
Shore 00 durometer	60 to 80 psf
Density	12 to 28 psf
Water absorption by weight	5%
Temperature range	
Low (flex without cracking)	-30°F
High continuous	150°F
High intermittent	200°F
Compression set (average) 1/2-inch sample compressed 50% for 22 hours at 70°F and 24 hours recovery	15% to 25%
Lineal shrinkage (max.) during heat aging (seven days at 158°F)	5%
Tensile strength	115 psi min.
Elongation	180% min.
Resilience (bayshore-% rebound average 1/2-inch thickness at 72°F)	20% to 40%

B. Material shall be Rubatex R431N or R423N or equal.

2.13 DUCTS FOR VERTICAL TENDONS

A. Duct enclosures for vertical prestressing steel shall be standard 1.25- or 1.375-inch-diameter PVC pipe, Class 160, ASTM D1784, for 1-1/4-inch-diameter tendons, and 1-1/2-inch-diameter PVC pipe, Class 200, ASTM D1784, for 1-3/8-inch-diameter tendons, unless otherwise specified in the drawings.

B. Provide ducts with expandable valves to facilitate the injection of epoxy after prestressing.

2.14 EPOXY GROUT FOR VERTICAL TENDONS

A. Epoxy grout shall be a two-part epoxy system that will completely encase and protect the prestressing steel inside ducting and anchors.

B. Do not use portland cement grout.

2.15 ACCESSORIES

A. Pipe Connections:

1. Show pipe encasements in the drawings.
2. Install and encase piping as indicated in the drawings.
3. Locate piping connections as shown in drawings.

B. Overflow: Circular weir inlet and overflow pipe dimensions as shown in drawings.

C. Ladders:

1. Conform to project, state, and OSHA requirements.

2. Equip the interior ladders with a ladder-centered notched safety climbing tube of ASTM A276, Type 304 stainless steel. Provide storage brackets and box mounted on the handrail for the removable portion of the tube that extends above the roof hatch. Provide three sets of safety belts and sleeves.

3. Construct the interior ladder of AISI Type 316 or 316L stainless steel.

D. Exterior and Interior Ladders: One per Section 055100.

E. Roof Hatches: Roof hatches over interior ladder (total two each) shall be as indicated in the drawings. Hatches shall be aluminum construction with heavy pintle hinges, compression spring operators enclosed in telescopic tubes, positive snap latch with turn handle and exterior padlock hasp, and neoprene seal. Equip each cover with an automatic hold-open and release device and a safety chain mounted at the end opposite the ladder. Hardware shall be Type 304 stainless steel. Curb for Type J scuttle shall be metal type in lieu of capflashing type.

F. Roof Vent: The roof vent shall be as shown in drawings with removeable stainless steel insect screen.

2.16 HANDRAIL

Handrail shall be aluminum and wrap around the exterior ladder landing and two roof hatches. See Section 055200.

2.17 PAINT AND COATINGS

Coat above-grade portions of exterior tank walls and roof slab with Tnemec Series 156 ENVIRO-CRETE or equal. Color will be selected by Owner.

PART 3 - EXECUTION

3.01 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Package prestressing steel against intrusion of chemical, dirt, moisture, or other contaminants from the atmosphere and for the protection of the steel against physical damage and corrosion during shipping and storage.

B. Prestressing steel that has sustained physical damage through rust or otherwise will be rejected.

C. Store materials and prestressing material delivered to the jobsite off the ground and wrap with polyethylene or sisal-kraft paper to prevent any moisture from coming in contact with the materials.

D. Neatly stack reels of strand, prestressing tendons, anchorages, etc.

3.02 CONCRETE FORMWORK

A. Do not form beveled edges (chamfer) at the vertical joints in the exterior wall of the tank.

B. Comply with the following tolerances or allowable deviations for the circular tank exterior wall:

Vertical alignment in total wall height	±1/2 inch
Out-of-round (per 100 feet of diameter)	±1/2 inch
Horizontal gap between prestressing strand and wall surface (in 24 inches)	3/8 inch

Transitions from plus to minus tolerance shall be gradual, even, and smooth.

C. Form ties left in walls shall have water stops and a 1-inch-minimum breakback or cone depth. Do not break snap ties until the concrete has reached the design concrete strength. Do not use tie wires as form ties. Do not use snap ties that are designed so that the ends must be broken off before the forms can be removed. Fully threaded stub bolts may be used in lieu of smooth ties with water stops. Taper ties with plastic or rubber plugs of a proven design may be used.

D. Fill taper form tie holes that extend through the tank wall as follows:

1. Locate large end of taper tie on the "wet" side of the wall.

2. Sandblast or roughen tie rod hole and blow clean prior to filling.

3. After sandblasting and cleaning, drive rubber plug with one end open to the center of the hole. Plug size shall be larger in diameter than the diameter of the hole at the center of the wall.

4. Coat entire annular surface of the hole with epoxy prior to dry-packing of the holes. Apply epoxy in accordance with manufacturer's instructions.

5. Dry-pack each side of hole with cement mortar consisting of one part cement well mixed with one part sand by volume and only sufficient water such that mortar will ball together when molded by slight pressure of the hands. Apply dry pack to the "wet" side of the wall first prior to dry-packing dry side. Pack into the hole with tool.

6. Cure dry-pack surfaces. Coat the "wet" side of the dry pack with epoxy coating.

    a. The wall form design shall allow wall sections to be poured full height without creating horizontal cold joints. Form ties shall be of sufficient strength and number to prevent spreading of the forms during the placement of concrete and shall permit ready removal of the forms without spalling or damaging the concrete.

b. Concrete placement in walls shall be done only through pour openings in the wall forms and may not be poured from the top through the use of "elephant trunks" or tremies. Either erect the complete form on one side of the wall and erect the form on the other side of the wall while the concrete placement is in progress, or remove pour panels from either the inside or outside form assembly before concrete placement starts. The vertical distance between horizontal rows of openings shall not exceed 8 feet with the lowest row of openings being no higher than 2 feet from the bottom of the wall. The minimum pouring opening size shall be 24 inches by 18 inches.

c. Forms may be removed as soon as the concrete has developed sufficient strength to prevent sagging, misalignment, spalling, cracking, or breaking of edges of the concrete. Do not remove wall forms prior to 12 hours after completion of the wall concrete placement.

3.03 CONCRETE JOINTS AND WATER STOPS

A. Concrete joints shall conform to Section 030500 and as specified herein.

B. Splice water stops at intersections between wall, wall footing, roof slab, and floor slab water stops.

C. Bend up horizontal water stops during placing of concrete until the concrete has been brought to the level of the water stop. Then place additional concrete over the water stop and vibrate the concrete.

D. Prior to installation of water stop, provide water stop regular splice and intersection splice samples with each type and size of water stop. Make splices in the presence of the Owner's Representative. Make splice samples by the workers designated to make field splices.

3.04 CONCRETE FINISHES

A. Finishes shall conform to Section 030500 except as modified herein.

B. Roof slab shall receive a steel trowel and light hair broom finish.

C. Shotcrete shall have a natural gun/nozzle finish.

3.05 CONCRETE CURING

A. Cure concrete in accordance with the methods specified herein for the different parts of the work and described in detail in the following paragraphs. These methods are considered to be minimum for curing. The conditions that exist in the field during placement and curing may require additional curing procedures and efforts to ensure proper protection and curing of the concrete. Select and implement the appropriate method commensurate with climatic conditions.

B. Cure floor slab using Method 2 or 3 as specified below.

C. Cure exterior walls using Method 2 or 4 as specified below.

D. Cure roof slab using Method 3 or 4 as specified below.

E. Cure concrete for not less than 14 days after placing in accordance with the following methods:

1. Method 1, Water Spray Method: Tightly close off concrete surfaces to be cured by bulkheads or other means or entirely surround by tight enclosures, and keep the concrete surfaces moist by sprinkling, spraying, or other means.

2. Method 2, Wet-Burlap-Mat Method: Thoroughly wet and cover concrete surfaces to be cured with wet burlap mats as soon as the forms have been stripped or as soon as the concrete has set sufficiently to avoid marring the surface. Keep entire concrete surface and burlap continuously and completely wet during the entire curing period.

3. Method 3, Curing Blanket Method:

    a. Thoroughly wet concrete surfaces to be cured and cover with curing blankets as soon as the concrete has set sufficiently to avoid marring the surface. The curing blankets shall be weighted to maintain close contact with the concrete surface during entire curing period. Should the curing blankets become torn or otherwise ineffective, keep surfaces moist and replace damaged sections. The curing blankets shall consist of one of the following two types:

        i. Sheets of heavy waterproof sisal-kraft paper laid with the edges butted together and with the joints between strips sealed with 2-inch-wide strips of sealing tape or with the edges lapped not less than 3 inches and fastened together with waterproof cement to form continuous watertight joints; or

        ii. Sheets of clean polyethylene, having a minimum thickness of 4 mils, laid with edges butted together and with the joints between sheets sealed with 1-inch-wide strips of acetate tape.

    b. During the curing period, do not permit traffic of any nature or depositing of objects, temporary or otherwise, on the curing blankets.

4. Method 4, Curing Compound Method:

    a. Spray the surface with two coats of liquid curing compound. Apply in accordance with the manufacturer's instructions to cover the surface with a uniform film that will seal thoroughly. Apply second coat at 90 degrees to the first coat.

b. Apply curing compound immediately after completion of the finish on unformed surfaces and within two hours after removal of forms on formed surfaces. Repair formed surfaces within the said two-hour period; provided, however, that any such repairs which cannot be made within the said two-hour period shall be delayed until after Method 1, 2, or 3 has been applied. When repairs are to be made to an area on which curing compound has been applied, first sandblast the area to remove the curing compound, then repair.

c. Wherever curing compound may have been applied to surfaces against which concrete subsequently is to be placed and to which it is to adhere, remove the curing compound entirely by sandblasting prior to the placing of new concrete.

d. Where the curing compound method is used, exercise care to avoid damage to the seal during the curing period. Should the seal be damaged or broken before the expiration of the curing period, repair the damaged portions immediately by the application of additional curing compound.

3.06 SHOTCRETE PLACING, CURING, AND FINISHING

A. Surface Preparation: Exterior surfaces of the concrete core wall, which will receive strand wrapping, shall be abrasive blasted, regardless of the forming method used, by a mechanical etching or shotblast system combined with a vacuum recovery system, or a waterblasting system. Systems that have not been used successfully in the past to prepare circular tank wall surfaces for shotcreting and strand wrapping or systems that rely on sandblasting or steel shot without a vacuum system will not be allowed. The surface shall be abrasive blasted sufficiently to remove laitance, form oil, or other types of coatings. The surface shall be cut to a minimum CSP5 profile, as established by the International Concrete Repair Institute (ICRI), over a minimum of 90% of the surface being prepared as measured over any 1-foot-square area. The prestressing subcontractor who is performing the abrasive blasting shall make available to the inspector ICRI sample coupons to assist in evaluating the abrasive cut.

B. Placing:

1. Apply shotcrete using the wet mix process. Nozzles shall be mounted on power-driven machinery maintaining the nozzle parallel with and at right angle to the surface being sprayed. No manual application of shotcreting will be accepted except for repair work or architectural treatment. Start shotcreting at the bottom of the wall and progress around the tank wall before moving up the wall. Do not build up the shotcrete in front of the strands or reinforcing when applying shotcrete behind strands or reinforcing. The minimum shotcrete cover over the outermost wrapped strand shall be 1.5 inches.

2. Each layer of shotcrete shall have sufficiently set to eliminate sagging during application of the next layer.

3. Research has shown that moisture in the corewall prior to shotcrete improve the bond between layers.

4. Do not apply shotcrete if the wind velocity exceeds 5 mph or air temperature is less than 55°F.

5. Remove and replace shotcrete that is damaged by rain, wind, or frost.

6. Apply shotcreting in layers of approximately 3/8 inch to 1/2 inch in thickness until the total thickness has been obtained. Protect adjacent buildings, concrete surfaces, equipment, and vehicles during shotcrete application. Repair damage resulting from shotcreting operations.

7. The air capacity of the compressor shall be large enough that the minimum amount of air to be available at the nozzle shall be no less than 400 cfm, whether or not air from the same air supply is used for other purposes.

8. Deliver shotcrete materials to the jobsite in ready-mix trucks from batching plants. Job mixing will be accepted provided automatic weigh batch plants are used.

9. Shotcrete Covercoats Over Wrapped Strand:

    a. Cover each layer of wrapped prestressing steel with shotcrete until a minimum cover of 3/8 inch over the steel has been obtained.

    b. Apply the final covercoat in at least three layers of equal thickness to make up for the full thickness of shotcrete over the final strand layer.

    c. Complete each layer of shotcrete for the full circumference of the tank and substantially the full height of that layer before applying the next layer of shotcrete.

    d. Finishing: The finished wall surface shall be a vertical plane with no undulations. Shotcrete transition from multilayer strand wrap to single-layer strand wrap near the bottom of the wall shall be gradual. Finish shall be natural gun finish.

    e. Curing:

        i. Intermediate shotcrete layers that will not receive subsequent layers of shotcrete for 12 hours or more shall be kept damp until application of the subsequent layers.

        ii. Completed shotcrete surfaces that do not receive additional coatings shall be water cured for a period of at least seven days by encapsulating the entire shotcrete surface with plastic sheeting. Lap and seal the plastic sheeting to properly cure the shotcrete. Do not use membrane curing methods utilizing curing compounds or wax-based residuals.

3.07 CIRCUMFERENTIAL PRESTRESSING

A. Stressing System: Prestress walls circumferentially by prestressing strand that is wound onto the wall at the uniform strand load required. Provide the stressing system with means to continuously, instantaneously monitor and record the force in the strand at any location around the wall and maintain the force in the strand within a tolerance of ±1-1/2% of the ultimate strength of the prestressing. No manually recorded force readings will be accepted. No die-drawing of prestressing reinforcement is permitted. Upon completion of the stressing operation, all recordings shall become the property of the Owner.

B. In the event that gaps between the core wall and the wrapped prestressing material develop that exceed 3/8 inch, discontinue wrapping and build up the wall with shotcrete to provide the proper curvature. Alternatively, if approved by the Owner's Representative, the gaps may be dry-packed after wrapping is completed and before shotcreting is started.

C. Wrapping over intermediate shotcrete coats or built-up shotcrete areas may commence 12 hours after the shotcrete has been applied. The compressive stress applied to the mortar shall not exceed 80% of the compressive strength of the mortar at the time of wrapping.

D. Do not allow prestressing material exposed to excessive temperatures to increase by more than 50 degrees at any time during such application due to detrimental stress buildup or damage.

E. Application:

1. Do not start circumferential stressing until the concrete has reached a compressive strength of 3,000 psi. Under no condition shall concrete compressive stress exceed 55% of the concrete strength at the time of stressing. Wrapping over flash coats may commence 12 hours after the shotcrete has been applied providing that the shotcrete has reached a strength of 250 psi.

2. Anchor prestressing strand to the wall at least once for every reel to minimize the loss of strand in case of a strand break. Do not anchor one strand to a previously wrapped strand either temporarily or permanently. Join prestressed strands by splices that will develop 95% of the guaranteed ultimate strength of the strand. Splice material shall be the same alloy as the prestressing strand.

3. The average vertical spacing between any two strands wrapped circumferentially and to be encased in shotcrete shall have a minimum clearance of 1-1/2-strand diameters or 3/8 inch, whichever is larger. Strands not meeting the spacing requirements shall be spread or otherwise removed.

4. Do not bundle or drape strand around pipe or manhole openings. Spread any strands falling in such areas over a predetermined area above and below such wall openings in conformance with the above strand spacing requirements.

5. Place strands wrapped near openings no closer than 2 inches from the exterior opening surface.

6. If the strand-wrapping load is different from the specified design load, discontinue stressing operations until adjustments are made to the stressing system.

7. Do not use prestressing strand and anchors as a ground for welding operations.

F. Final Force:

1. The initial electronically (or substantial equivalent) recorded steel stress shall not exceed 75% or less than 70% of the guaranteed minimum ultimate strength (M.U.S.) of the steel at any time during and after stressing.

2. An automatic, continuously electronically (or substantial equivalent) monitored permanent recording of the applied force, at any point on the wire, at any point on and around the tank wall, shall be made during the entire circumferential prestressing application. Such recordings shall be based on a continuous sensing of the applied force on the strand between the tensioning drum and the wall as the strand is being wrapped and laid on the wall. The loss in stress in post-tensioned prestressed steel due to creep and shrinkage of concrete, creep of steel, and sequence stressing shall be assumed as 25,000 psi. The final stress is the low initial stress of 0.70 M.U.S. reduced by the stress loss of 25,000 psi. The final force is the steel section multiplied by the final stress. The final force shall be no less than the required working force required by design.

G. Force Readings: Manual, individual, or intermittent force readings taken on wrapped strand in full bodily contact with the wall will not be accepted. Force readings based on other than instantaneous force readings, as the strand is being tensioned and wrapped around the tank, will not be accepted. Calibrate recording equipment at an approved testing laboratory prior to starting the stressing operation.

H. Safety Precautions:

1. Every precaution shall be taken to keep personnel and visitors outside the danger area of breaking strands or bars.

2. At no time shall anyone stand in the line of stressed vertical tendons or stressed strand.

3. No work shall be performed by anyone, other than the prestressing crew, within 100 feet from the wrapping operation or the application of the vertical tendon stressing operation.

4. Where access to the site by unauthorized persons is outside the Contractor's control while prestressing work is in progress, Contractor shall erect protective fencing to prevent breaking strand from endangering such persons.

3.08 VERTICAL PRESTRESSING

A. General: Bars shall have a top and bottom anchor plate, cone nut, and duct enclosure with 1/2-inch-minimum grout tube connectors. Securely fasten duct enclosures at maximum 2-foot intervals to prevent movement. Accurately locate bars as shown in the drawings. Vertical bar components shall be assembled off the ground surface. Maximum tolerance shall be ±1/4 inch. Seal ducts to prevent intrusion of concrete.

B. Epoxy grout the bars in the enclosure duct after completion of stressing operation.

C. Cleaning Ducts: Flush vertical ducts with water immediately upon completion of the concrete vibrating operation after each lift of concrete. This procedure shall continue until placing and vibrating of concrete around the ducts has been completed. Add water at the top of the wall, through the top of the duct, and drain through the bottom of the grout tube. Blow ducts clean with compressed air.

D. There shall be no welding to anchor plates after the bars have been assembled, nor shall prestressing steel be used as a "ground" for welding operations.

E. Stressing System:

1. Provide the stressing system with means to continuously monitor and record the force-elongation for each stressed bar. The system shall be calibrated by an independent laboratory prior to the start of stressing operations and submit reports to Owner's Representative.

2. The force-elongation relationship must be constantly maintained from the beginning, starting with the removal of the slack to the point of lock-off and complete release of the force on the vertical prestressing steel after retraction of the stressing piston or equivalent stressing device.

F. Stressing Operations:

1. Perform stressing in either one or two operation. Perform initial stressing after the concrete in the wall attains the design compressive strength as confirmed by cylinder tests.

2. If a double stress operation is used, perform the final stressing after wall shotcreting is complete and shotcrete attains a compressive strength of 250 psi.

3. Perform stressing operations in the presence of the Owner's Representative.

G. Stressing Equipment:

1. Provide a continuously electronically (or substantial equivalent) monitored permanent force elongation record from zero to full force at the final lock-off for the vertical prestressing work. The ordinate of the permanent recording shall show the elongation in inches, and the abscissa shall show the force in pounds or kips. Manually recorded force and elongation readings will not be accepted. The vertical tendon stressing machinery shall have automatic electronic tensioning cutoff devices or equivalent means to ensure that the specified force and elongation is not exceeded at any time. The applied force, immediately after lock off for the final stressing operation on any tendon, shall be no less than 70% and the applied force before lock off shall be no greater than 75% of the minimum ultimate strength of the steel.

2. Force-elongation readings during the vertical tendon stressing operation shall become the property of the Owner.

H. Epoxy Grouting of Vertical Ducts:

1. Pressure grout tendon ducting and anchors with two-part epoxy under a minimum pressure of 100 psi. Grout tubes, valves, and anchor details shall be capable of holding a 200-psi pressure until the epoxy has cured.

2. Provide grouting equipment with a pressure gauge having a full-scale reading of 200 psi.

3. Ducts shall be clean and free of water and deleterious materials that would impair bonding of the grout or interfere with grouting procedures.

4. Provide grout injection pipes with positive mechanical shutoff valves.

5. Perform duct grouting at the lowest grout connection tube. Top of the epoxy grout shall be at least 1/2 inch above the top of the threaded bar.

6. In cold weather, especially during frosts, avoid the freezing of the grout. If the grouting procedure cannot be postponed, keep the wall temperature above the freezing point with hot blankets or by other means.

7. Upon completion of the vertical stressing and grouting operation, dry-pack the anchor pocket areas above the anchor nuts with a 1 cement to 2 sand mortar mix immediately after the epoxy coating on the inside can surface has become tacky. Alternatively, fill the metal can with concrete aggregates or epoxy.

8. Finish the dry-pack surface flush with the adjoining concrete surface.

3.09 SEISMIC CABLES

A. The strands shall be pre-bent before placing the units in wall and wall footings.

B. The strands shall be tied to the lower horizontal circumferential tie-bar on the vertical prestress tendons as shown on the Contractor's shop drawings.

C. Tie strands to the radial footing bars.

3.10 NEOPRENE BEARING PADS

A. Glue pads to the top of the concrete surface with a compatible rubber-cement glue. In addition to glue, dense small concrete blocks or plastic shims may be inserted between the pads and adjacent in-place reinforcing. Do not nail pads to the supporting concrete surface.

B. Fill voids, cavities, and spaces between neoprene bearing pads, water stop, and rubber-filler pads with a soft mastic that is compatible with neoprene, rubber, and plastic material.

C. Remove concrete that is deposited on the exposed sides of the pads.

3.11 FILLER PADS

Filler pads shall be of sufficient width to occupy the spaces under the wall and roof slab adjacent to the bearing pads and water stop. Attach filler pads to the supporting concrete surface as specified for neoprene bearing pads.

3.12 FLOOR SLAB CRACK REPAIRS

Repair slab cracks wider than 0.01 inch by cutting out a square-edged and uniformly aligned joint 3/8 inch wide by 1 inch deep and installing joint sealant per Section 030500. Alternately, cracks may be epoxy injected with an approved water-insensitive epoxy.

3.13 PAINTING AND COATING OF EXPOSED PORTIONS OF TANK WALLS AND ROOF SLAB

A. Surface Preparation: In accordance with manufacturer's recommendations.

B. Application: Brush, roller, or spray at a rate of 1 gallon per 100 square feet per coat. Apply two coats.

3.14 COATING APPLICATION

A. Each coat shall be free of runs, skips, or holidays.

B. Perform work in accordance with the manufacturer's recommendations, except for the above usage rate of the coating.

3.15 PROTECTION OF SURFACES NOT TO BE PAINTED

Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, and other surfaces not intended to be painted. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces. Protect adjacent surfaces from damage during surface preparation.

3.16 DISINFECTION

A. Disinfect the tank after construction is complete and prior to filling of the tank for testing or storage of potable water. Disinfect the tank again if subsequent test or construction operations contaminate the tank.

B. Disinfect tank per Section 331300.

3.17 LEAKAGE TESTING

A. Leakage testing of the tank shall be in accordance with Section 030510 prior to backfilling.

B. Provide labor and equipment for filling the tank with water. The Owner will furnish water for the first test. Make arrangements and pay for delivery of the water from the nearest Owner source to the tank.

C. The Contractor is responsible for any leaks and shall seal leaks with epoxy sealant.

3.18 INSPECTION FACILITIES

Provide the Owner's Representative with facilities for inspection including:

A. Lighting, ladders, safe staging, and manpower to move same.

B. Slump cones, shotcrete test cube plywood forms.

C. Stress-indicating instruments for prestressing.

END OF SECTION

SECTION 400500 GENERAL PIPING REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes the general requirements for selecting piping materials; selecting the associated bolts, nuts, and gaskets for flanges for the various piping services in the project; and miscellaneous piping items.

1.02 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit affidavit of compliance with referenced standards (e.g., AWWA, ANSI, ASTM, etc.).

C. Submit certified copies of mill test reports for bolts and nuts, including coatings if specified. Provide recertification by an independent domestic testing laboratory for materials originating outside of the United States.

D. Submit manufacturer's data sheet for gaskets supplied showing dimensions and bolting recommendations.

1.03 DEFINITIONS OF BURIED AND EXPOSED PIPING

A. Buried piping is piping buried in the soil, commencing at the wall or beneath the slab of a structure. Where a coating is specified, provide the coating up to the structure wall. Unless detailed otherwise, coating shall penetrate wall no less than 1 inch. Piping encased in concrete is considered to be buried. Do not coat encased pipe.

B. Exposed piping is piping in any of the following conditions or locations:

1. Above ground.

2. Inside buildings, vaults, or other structures.

3. In underground concrete trenches or galleries.

1.04 PIPING SERVICE

Piping service is determined by the fluid conveyed, regardless of the pipe designation. For example, pipes designated "Air Low Pressure," "Air High Pressure," and "Air" are all considered to be in air service.

1.05 DEFAULT PIPING MATERIALS

If no material is shown in the drawings, use the following piping materials:

Service	Size Range (inches)	Material	Specification Section
Buried	3 and smaller	Copper	402020
	4	FXL&C steel	402063
	6 and larger	CML&C steel	402063
Exposed	3 and smaller	Copper	402020
	6 and larger	CML & Epoxy Coated steel	402063

PART 2 - MATERIALS

2.01 MATERIALS SELECTION AND ALTERNATIVE MATERIALS

A. The Piping Schedule in the drawings lists the material and specification for piping service in the project. In locations where the piping material referenced on the Piping Schedule is not appropriate, the piping material is indicated in the drawings. Materials called out in the drawings shall govern over materials stated in the Piping Schedule.

B. The Piping Schedule in the drawings may show alternative piping materials for certain services. In such cases, the same pipe material shall be used for all pipe sizes in all locations for the given piping service. Do not intermix piping materials.

2.02 THREAD FORMING FOR STAINLESS STEEL BOLTS

Form threads by means of rolling, not cutting or grinding.

2.03 BOLTS AND NUTS FOR FLANGES FOR STEEL PIPING (SPECIFICATION SECTION 402063)

A. Bolts and nuts for Class 125 or 150 flanges (including AWWA C207, Class D) located outdoors above ground and in vaults and structures shall be carbon steel, ASTM A307, Grade B, hot-dipped galvanized per ASTM F2329.

B. Bolts and nuts for buried or submerged Class 125 or 150 flanges shall be type 316 stainless steel conforming to ASTM A193, Grade B8M for bolts and ASTM A194, Grade 8M for nuts.

C. Bolts used in flange insulation kits shall conform to ASTM A193 (Grade B7). Nuts shall conform to ASTM A194 (Grade 2H).

D. Provide washers for each nut. Washers shall be of the same material as the nuts.

2.04 LUBRICANT FOR STAINLESS STEEL BOLTS AND NUTS

Lubricant shall be chloride free and shall be RAMCO TG-50, Anti-Seize by RAMCO, Specialty Lubricants Corporation Husky™ Lube O'Seal, or equal.

2.05 GASKETS FOR FLANGES FOR STEEL PIPING IN WATER SERVICE (SPECIFICATION SECTION 402063)

A. Gaskets for flat face and raised face flanges shall be 1/8-inch thick and shall be one of the following non-asbestos materials:

1. Cloth-inserted rubber with a Shore "A" hardness of 75 to 85. Gaskets shall be suitable for a pressure of 200 psi at a temperature of 180°F. Products: Garlock Style 19 or equal.

2. Acrylic or aramid fiber bound with nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal. Gaskets shall be suitable for a pressure of 500 psi at a temperature of 400°F.

2.06 GASKETS FOR FLANGES FOR PVC PIPING

Gaskets for flanged joints shall be full faced, 1/8-inch thick, having a hardness of 50 to 70 durometer A. Gasket material shall be EPR.

2.07 THREADED CAPS FOR PROTECTION OF NUTS AND BOLT THREADS

Caps shall be high-density polyethylene, color black. The caps shall be filled with an anticorrosive lubricant to prevent nuts and bolts from rusting and corroding. Lubricant shall be suitable for use in potable water. Caps shall withstand temperatures from -40°F to 200°F. Caps shall be suitable to use in exposed, buried, and submerged service conditions. Products: Sap-Seal Products, Inc.; Advance Products and Systems, Inc., "Radolid"; or equal.

2.08 FLANGE INSULATION KITS

See Section 264213.

2.09 INSULATING UNIONS

See Section 264213.

PART 3 - EXECUTION

3.01 INSTALLING PIPE SPOOLS IN CONCRETE

Install pipes in walls and slabs before placing concrete. See Sections 030500 and 400762.

3.02 RAISED FACE AND FLAT FACE FLANGES

Where a raised face flange connects to a flat-faced flange, remove the raised face of the flange.

3.03 INSTALLING ABOVEGROUND OR EXPOSED PIPING

A. Provide pipe hangers and supports as detailed in the drawings and as specified in Section 400764.

B. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.

3.04 INSTALLING FLANGED PIPING

A. Set pipe with the flange bolt holes straddling the pipe horizontal and vertical centerline. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment. Before bolting up, align flange faces to the design plane within 1/16 inch per foot measured across any diameter. Align flange bolt holes within 1/8-inch maximum offset.

B. Inspect each gasket to verify that it is the correct size, material, and type for the specified service and that it is clean and undamaged. Examine bolts or studs, nuts, and washers for defects such as burrs or cracks and rust and replace as needed.

C. Clean flanges by wire brushing before installing flanged fittings. Clean flange bolts and nuts by wire brushing, lubricate carbon steel bolts with oil and graphite, and tighten nuts uniformly and progressively.

D. Bolt lengths shall extend completely through their nuts. Any that fail to do so shall be considered acceptably engaged if the lack of complete engagement is not more than one thread.

E. Do not use more than one gasket between contact faces in assembling a flanged joint.

F. Tighten the bolts to the manufacturer’s specifications, using the recommended cross bolt pattern in multiple steps of increasing torque, until the final torque requirements are achieved. Do not over torque.

G. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reset or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

H. Install threaded nut and bolt thread protection caps after completing the bolt, nut, and gasket installation. Install on submerged piping.

3.05 INSTALLING BLIND FLANGES

A. At outlets not indicated to be connected to valves or to other pipes and to complete the installed pipeline hydrostatic test, provide blind flanges with bolts, nuts, and gaskets.

B. Coat the inside face of blind flanges per Section 099000, System No. 7.

3.06 INSTALLING GROOVED-END PIPING

A. Install grooved-end pipe and fittings in accordance with the coupling manufacturer's recommendations and the following.

B. Clean loose scale, rust, oil, grease, and dirt from the pipe or fitting groove before installing coupling. Apply the coupling manufacturer's gasket lubricant to the gasket exterior including lips, pipe ends, and housing interiors.

C. Fasten coupling alternately and evenly until coupling halves are seated. Use torques as recommended by the coupling manufacturer.

D. Provide separate hangers and supports at both sides of flexible joints; see Section 400764.

3.07 INSTALLATION OF STAINLESS STEEL BOLTS AND NUTS

Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

END OF SECTION

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SECTION 400515 PRESSURE TESTING OF PIPING

PART 1 - GENERAL

1.01 DESCRIPTION

This section specifies the cleaning and hydrostatic and leakage testing of pressure piping.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Disinfection of Piping and Structures: 331300.

B. Manual, Check, and Process Valves: 400520.

C. Disinfecting Water Mains: LVMWD Standard Plans and Specifications of Water Mains and Facilities, Section 2.18.

D. Hydrostatic Testing of Water Mains: LVMWD Standard Plans and Specifications of Water Mains and Facilities, Section 2.17.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit test bulkhead locations and design calculations, pipe attachment details, and methods to prevent excessive pipe wall stresses.

C. Submit six copies of the test records to the Owner's Representative upon completion of the testing.

1.04 TESTING RECORDS

Provide records of each piping installation during the testing. These records shall include:

A. Date and times of test.

B. Identification of pipeline, or pipeline section tested or retested.

C. Identification of pipeline material.

D. Identification of pipe specification.

E. Test fluid.

F. Test pressure at low point in pipeline or pipeline section.

G. Remarks: Leaks identified (type and location), types of repairs, or corrections made.

H. Certification by Contractor that the leakage rate measured conformed to the specifications.

PART 2 - MATERIALS

2.01 MANUAL AIR-RELEASE VALVES FOR BURIED PIPING

Provide temporary manual air-release valves at test bulkheads for pipeline test. Construct the pipe outlet in the same manner as for a permanent air valve and after use, seal with a blind flange, pipe cap, or plug and coat the same as the adjacent pipe.

2.02 TEST BULKHEADS

Design and fabricate test bulkheads per Section VIII of the ASME Boiler and Pressure Vessel Code. Materials shall comply with Part UCS of said code. Design pressure shall be at least 2.0 times the specified test pressure for the section of pipe containing the bulkhead. Limit stresses to 70% of yield strength of the bulkhead material at the bulkhead design pressure. Include air-release and water drainage connections.

2.03 TESTING FLUID

A. Testing fluid shall be water.

B. For potable water pipelines, obtain and use only potable water for hydrostatic testing.

C. Submit request for use of water from waterlines of Owner 48 hours in advance.

2.04 TESTING EQUIPMENT

Provide calibrated pressure gauges, pipes, bulkheads, pumps, chart recorder, and meters to perform the hydrostatic testing.

PART 3 - EXECUTION

3.01 PRESSURE TESTING

A. Execute pressure testing in accordance with LVMWD Standard Plans and Specifications for Construction of Water Mains and Facilities, Section 2.17.

B. Test pressure shall be 150 psi unless otherwise noted on the plans.

END OF SECTION

SECTION 400520 MANUAL, CHECK, AND PROCESS VALVES

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, testing, and installation of manually operated valves, check valves, and process valves including gate, butterfly, ball, hose bibbs, and flap valves.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Connections to Existing Buried Pipelines: 020130.

B. Painting and Coating: 099000.

C. Polyethylene Sheet Encasement: 099754.

D. Fusion-Bonded Epoxy Linings and Coatings: 099761.

E. Backflow Preventers: 331220.

F. General Piping Requirements: 400500.

G. Pressure Testing of Piping: 400515.

H. Air-Release and Vacuum-Relief Valves: 400560.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit manufacturer's catalog data and detail construction sheets showing all valve parts. Describe each part by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Identify each valve by tag number to which the catalog data and detail sheets pertain.

C. Show valve dimensions including laying lengths. Show port sizes. Show dimensions and orientation of valve actuators, as installed on the valves. Show location of internal stops for gear actuators. State differential pressure and fluid velocity used to size actuators. For worm-gear actuators, state the radius of the gear sector in contact with the worm and state the handwheel diameter.

D. Show valve linings and coatings. Submit manufacturer's catalog data and descriptive literature.

E. Submit six copies of a report verifying that the valve interior linings and exterior coatings have been tested for holidays and lining thickness. Describe test results and repair procedures for each valve. Do not ship valves to project site until the reports have been returned by the Owner's Representative and marked "Resubmittal not required."

PART 2 - MATERIALS

2.01 GENERAL

A. Install valves complete with operating handwheels or levers, chainwheels, extension stems, floor stands, gear actuators, operating nuts, chains, and wrenches required for operation.

B. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached plate.

2.02 VALVE ACTUATORS

A. Provide lever or wrench actuators for exposed valves 6 inches and smaller. For larger valves, provide handwheels.

B. Where manually operated valves (size 4 inches and larger) are installed with their centerlines more than 6 feet 9 inches above the floor, provide chainwheel and guide actuators.

C. Provide 2-inch AWWA operating nuts for buried and submerged valves.

D. Provide enclosed gear actuators on butterfly, ball, and plug valves 6 inches and larger, unless electric motorized valve actuators are shown in the drawings. Gear actuators for valves 6 through 20 inches shall be of the worm and gear, or of the traveling nut type. Gear actuators for valves 24 inches and larger shall be of the worm and gear types. Gear actuators for motorized valves shall be of the worm and gear type, regardless of size.

E. Design gear actuators assuming that the differential pressure across the plug, gate, or disc is equal to the pressure rating of the valve and assuming a fluid velocity of 16 fps for valves in liquid. Size actuators using a minimum safety factor of 1.5 for valves in open/close service and 2.0 in modulating service.

F. Gear actuators shall be enclosed, oil lubricated, with seals provided on shafts to prevent entry of dirt and water into the actuator. Gear actuators for valves located above ground or in vaults and structures shall have handwheels. The actuators for valves in exposed service shall contain a dial indicating the position of the valve disc or plug. Gear actuators for buried or submerged valves shall have 2-inch-square AWWA operating nuts.

G. For buried or submerged service or valves installed in buried vaults, provide watertight shaft seals and watertight valve and actuator cover gaskets. Provide totally enclosed actuators designed for buried or submerged service.

H. Traveling nut and worm and gear actuators shall be of the totally enclosed design so proportioned as to permit operation of the valve under full differential pressure rating of the valve with a maximum pull of 40 pounds on the handwheel or crank. Provide stop limiting devices in the actuators in the open and closed positions. Actuators shall be of the self-locking type to prevent the disc or plug from creeping. Design actuator components between the input and the stop-limiting devices to withstand without

damage a pull of 200 pounds for handwheel or chainwheel actuators and an input torque of 300 foot-pounds for operating nuts when operating against the stops.

I. Handwheel diameters for traveling nut actuators shall not exceed 8 inches for valves 12 inches and smaller and shall not exceed 12 inches for valves 32 inches and smaller.

J. Self-locking worm gear shall be a one-piece design of gear bronze material (ASTM B427; or ASTM B84, Alloy C86200), accurately machine cut. Actuators for eccentric and lubricated plug valves may use ductile-iron gears provided the gearing is totally enclosed with spring-loaded rubber lip seals on the shafts. The worm shall be hardened alloy steel (ASTM A322, Grade G41500 or G41400; or ASTM A148, Grade 105-85), with thread ground and polished. Support worm-gear shaft at each end by ball or tapered roller bearings. The reduction gearing shall run in a proper lubricant. The handwheel diameter shall be no more than twice the radius of the gear sector in contact with the worm. Worm-gear actuators shall be Limitorque Model HBC, EIM Series W, or equal.

K. Design actuators on buried valves to produce the required torque on the operating nut with a maximum input of 150 foot-pounds.

L. Valve actuators, handwheels, or levers shall open by turning counterclockwise.

2.03 CAST-IRON VALVE BOXES WITH DEBRIS CAPS FOR BURIED VALVES

A. Valve boxes shall be two-piece sliding type, cast iron, with extension shafts. Units shall be as manufactured by Tyler Pipe, Geneco, Star Pipe Products, or equal. Extension pipes shall be cast iron or as shown in the drawings.

B. Coat buried cast-iron pieces per Section 099000, System No. 21.

2.04 EXTENSION STEMS FOR BURIED AND SUBMERGED VALVE ACTUATORS

A. Where the depth of the valve is such that its centerline is more than 4 feet below grade, provide operating extension stems to bring the operating nut to a point 6 inches below the surface of the ground and/or box cover. Where the valve is submerged, provide operating extension stems to bring the operating nut to 6 inches above the water surface. Extension stems shall be Type 316 stainless steel, solid core, and shall be complete with 2-inch-square operating nut. The connections of the extension stems to the operating nuts and to the valves shall withstand without damage a pull of 300 foot-pounds.

B. Extension stem diameters shall be as tabulated below:

Valve Size (inches)	Minimum Extension Stem Diameter (inches)
2	3/4
3, 4	7/8
6	1
8	1 1/8
10, 12	1 1/4
14	1 3/8
16, 18	1 1/2
20, 24, 30, 36	1 3/4

2.05 FLOOR STANDS, EXTENSION STEMS, AND EXTENSION STEM SUPPORT BRACKETS

A. When required by the installations, provide floor stands and extension stems for operation of valves. Floor stands shall be of the nonrising stem, indicating type, complete with steel extension stems, couplings, handwheels, stem guide brackets, and special yoke attachments as required by the valves and recommended and supplied by the stand manufacturer. Floor stands shall be cast-iron base type: Clow, Figure F-5515; Bingham and Taylor; Stockham; or equal. Handwheels shall turn counterclockwise to open the valves.

B. Provide Type 316 stainless steel anchor bolts.

C. Provide steel extension stems.

D. Provide adjustable stem guide brackets for extension stems. The bracket shall allow valve stems to be set over a range of 2 to 36 inches from walls. Provide bushings drilled to accept up to 2-inch-diameter stems. Base, arm, and clamp shall be ductile iron. Coat ductile iron components with fusion-bonded epoxy per Section 099761. Bushing shall be bronze (ASTM B584, Alloy C86400 or C83600). Bolts, nuts, screws, and washers (including wall anchor bolts) shall be Type 316 stainless steel. Provide slots in the bracket to accept 3/4-inch bolts for mounting the bracket to the wall. Products: Trumbull Industries, Inc., Adjustable Stem Guide or equal.

2.06 CHAINWHEELS AND GUIDES

Chainwheels and guides shall be Clow Figure F-5680, DeZurik Series W or LWG, Stockham, or equal. Chainwheels and guides shall be galvanized steel. Chains shall extend to within 4 feet of the operating floor. Chains shall be galvanized steel.

2.07 BOLTS AND NUTS FOR FLANGED VALVES

Bolts and nuts for flanged valves shall be as described in Section 400500.

2.08 GASKETS FOR FLANGES

Gaskets for flanged end valves shall be as described in Section 400500.

2.09 PAINTING AND COATING

A. Coat metal valves located above ground or in vaults and structures in accordance with Section 099000, System No. 15. Apply the specified prime and intermediate and finish coat at the place of manufacture. Finish coat shall match the color of the adjacent piping. Coat handwheels the same as the valves.

B. Coat buried metal valves at the place of manufacture per Section 099000, System No. 21.

C. Coat submerged metal valves, stem guides, extension stems, and bonnets at the place of manufacture per Section 099000, System No. 7.

D. Line the interior metal parts of metal valves 4 inches and larger, excluding seating areas and bronze and stainless steel pieces, per Section 099761. Apply lining at the place of manufacture.

E. Test the valve interior linings and exterior coatings at the factory with a low-voltage (22.5 to 80 volts, with approximately 80,000-ohm resistance) holiday detector, using a sponge saturated with a 0.5% sodium chloride solution. The lining shall be holiday free.

F. Measure the thickness of the valve interior linings per Section 099000. Repair areas having insufficient film thickness per Section 099000.

2.10 PACKING, O-RINGS, AND GASKETS

Unless otherwise stated in the detailed valve specifications, packing, O-rings, and gaskets shall be one of the following non-asbestos materials:

A. Teflon.

B. Kevlar aramid fiber.

C. Acrylic or aramid fiber bound by nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal.

D. Buna-N (nitrile).

2.11 RUBBER SEATS

Rubber seats shall be made of a rubber compound that is resistant to free chlorine and monochloramine concentrations up to 10 mg/L in the fluid conveyed.

2.12 VALVES

A. Gate Valves:

1. Ductile-Iron Resilient Wedge Tapping Gate Valves 4 Through 16 Inches (AWWA C515):

Valves shall comply with AWWA C515 and the following. Valves shall be of the bolted bonnet type with nonrising stems. Valve stems shall be Type 304 or 316 stainless steel or cast, forged, or rolled bronze. Stem nuts shall be made of solid bronze. Bronze for internal working parts, including stems, shall not contain more than 2% aluminum or more than 7% zinc. Bronze shall conform to ASTM B62 or ASTM B584 (Alloy C83600), except the stem bronze shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 30,000 psi, and a minimum of 10% elongation in 2 inches (ASTM B584 or B763, Alloy C87600 or C99500). Body bolts shall be Type 316 stainless steel. Ends shall be flanged, Class 125, ASME B16.1. One end shall have slotted bolt holes per AWWA C515, paragraph 4.4.1.3.4 to fit tapping machines.

Provide reduction thrust bearings above the stem collar. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar. Each valve shall have a smooth unobstructed waterway free from any sediment pockets.

Valves shall be lined and coated at the place of manufacture with either fusion-bonded epoxy or heat-cured liquid epoxy. Minimum epoxy thickness shall be 8 mils.

Manufacturers: Clow, AVK, American Flow Control, Mueller, Waterous, Kennedy, or equal.

2. Ductile-Iron Resilient Wedge Gate Valves 4 Through 36 Inches (AWWA C515):

Valves shall comply with AWWA C515 and the following. Valves shall be of the bolted-bonnet type with nonrising stems. Valve stems shall be Type 304 or 316 stainless steel or cast, forged, or rolled bronze. Provide operating nut for buried valves. Provide handwheel for exposed valves. Stem nuts shall be made of solid bronze. Bronze for internal working parts, including stems, shall not contain more than 2% aluminum or more than 7% zinc. Bronze shall conform to ASTM B62 or ASTM B584 (Alloy C83600), except the stem bronze shall have a minimum tensile strength of 60,000 psi, a minimum yield strength of 30,000 psi, and a minimum of 10% elongation in 2 inches (ASTM B584 or B763, Alloy C87600 or C99500). Body bolts shall be Type 316 stainless steel. End connections for exposed valves shall be flanged. End connections for buried valves shall be flange type.

Provide reduction thrust bearings above the stem collar. Stuffing boxes shall be O-ring seal type with two rings located in stem above thrust collar. Each valve shall have a smooth unobstructed waterway free from any sediment pockets.

Valves shall be lined and coated at the place of manufacture with either fusion-bonded epoxy or heat-cured liquid epoxy. Minimum epoxy thickness shall be 8 mils.

Manufacturers: Clow, AVK, American Flow Control, Waterous, Kennedy, or equal.

B. Butterfly Valves:

1. Thrust Bearings for Butterfly Valves:

Provide thrust bearings to hold the valve disc in the center of the valve seat. No bearings shall be mounted inside the valve body within the waterway. Do not use thrust bearings in which a metal bearing surface on the disc rubs in contact with an opposing metal surface on the inside of the body.

2. Bronze Components in Butterfly Valves:

Bronze components in contact with water shall comply with the following requirements:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

3. Port Sizes for Butterfly Valves:

For valves 24 inches and smaller, the actual port diameter shall be at least 93% of the nominal valve size. For valves larger than 24 inches, the port diameter shall not be more than 1.25 inches smaller than the nominal valve size. The dimension of the port diameter shall be the clear waterway diameter plus the thickness of the rubber seat.

4. Corrosion-Resistant Materials in Butterfly:

Where AWWA C504 requires “corrosion resistant” material, such material shall be one of the following:

a. Bronze as described above.
b. Type 304 or 316 stainless steel.
c. Monel (UNS N04400).
d. Synthetic nonmetallic material.

5. Seating Surfaces in Butterfly Valves:

Seating surfaces in valves having motorized actuators shall be stainless steel or nickel-copper per AWWA C504 or nickel-chromium alloy containing a minimum of 72% nickel and a minimum of 14% chromium.

6. Factory Leakage Testing:

   Perform factory leakage tests per AWWA C504 on both sides of the seat.

7. Flanged, Rubber-Seated Butterfly Valves 4 Through 72 Inches, Class 150B:

   Butterfly valves shall be short body, flanged type for exposed valves and valves in vaults or structures, and flanged joint for buried valves. Valve shall conform to AWWA C504, Class 150B. Minimum working differential pressure across the valve disc shall be 150 psi. Flanged ends shall be Class 125, ASME B16.1. Valve shafts shall be stub shaft or one-piece units extending completely through the valve disc. Materials of construction shall be as follows:

Component	Material	Specification
Body	ductile iron	AWWA C504
Exposed body cap screws and bolts and nuts	Stainless steel	ASTM A276, Type 304 or 316
Discs	Cast iron, ductile iron, or Ni-Resist	AWWA C504
Shafts, disc fasteners, seat retention segments, and seat fastening devices	Stainless steel	ASTM A276, Type 304 or 316
Seat material	Buna-N	—

   The rubber valve seat shall be secured to or retained in the valve body. Valves shall be Pratt, DeZurik Series BAW, Val-Matic, or equal.

C. Ball Valves

1. Full Port Threaded Bronze Ball Valves 2 Inches and Smaller (Low Lead):

   Ball valves, 2 inches and smaller, for water service shall have a pressure rating of at least 600 psi WOG at a temperature of 100°F. Provide full port ball and body design. Valves shall comply with MSS SP-110. Materials of construction shall be as follows:

Component	Material	Specification
Body	Bronze	ASTM B584, Alloy C89836
Ball	Bronze	ASTM B584, Alloy C89836 or Alloy C27450, chromium plated
Ball retainer	Bronze	ASTM B584, Alloy C89836 or ASTM B371, Alloy C69430
Stem	Bronze	Alloy C27450
Seats	Reinforced Teflon	—

Bronze alloys having a maximum lead content of 0.25%, a maximum zinc content of 7.0%, and a minimum copper content of 80% may be substituted for the bronze alloys specified above. Valves shall have threaded ends (ASME B1.20.1), nonblowout stems, and have plastic-coated lever actuators. Provide locking lever handle. Valves shall be Apollo 77CLF Series or equal.

2. Regular Port Threaded Stainless Steel Ball Valves 2 Inches and Smaller:

Stainless steel ball valves, 2 inches and smaller, for water service shall be rated at a minimum pressure of 1,500 psi WOG at a temperature of 100°F. Valve body, ball, and stem shall be Type 316 stainless steel, ASTM A276 or A351. Seat and seals shall be reinforced Teflon. Valves shall have lever actuators, plastic coated. Provide locking lever handle. Valves shall have threaded ends (ASME B1.20.1) and nonblowout stems. Valves shall be McCanna Figure M402, Worcester Series 48, Stockham Figure SD 2120-SSMO-R-T, Apollo 76-100 Series, or equal.

3. Bronze Hose Bibbs:

Hose bibbs of size 1/2 inch, 3/4 inch, and 1 inch shall be all bronze (ASTM B62 or ASTM B584, Alloy C83600) with rising or nonrising stem, composition disc, bronze or malleable iron handwheel, and bronze stem (ASTM B99, Alloy C65100; ASTM B371, Alloy C69400; or ASTM B584, Alloy C87600). Packing shall be Teflon or graphite. Valves shall have a pressure rating of at least 125 psi for cold-water service. Threads on valve outlet shall be American National Standard fire hose coupling screw thread (ASME B1.20.7). Valves shall be Jenkins Figure 112, 113, or 372; Nibco Figure T-113-HC; or equal.

D. Check Valves:

See Section 331220 for check valves used in backflow prevention assemblies.

PART 3 - EXECUTION

3.01 VALVE SHIPMENT AND STORAGE

A. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Install closures at the place of valve manufacture prior to shipping. For studded openings, use all the nuts needed for the intended service to secure closures. Alternatively, ship flanged valves 3 inches and smaller in separate sealed cartons or boxes.

B. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Install caps or plugs at the place of valve manufacture prior to shipping. Alternatively, ship valves having threaded openings or end connections in separate sealed cartons or boxes.

C. Store resilient seated valves in sealed polyethylene plastic enclosures with a minimum of one package of desiccant inside. Store resilient seated valves in the open or unseated position. Valves with adjustable packing glands shall have the packing gland loosened

prior to storage. Inspect valves at least once per week, replace desiccant if required and repair damaged storage enclosures. Do not store valves with resilient seats near electric motors or other electrical equipment.

D. Inspect valves on receipt for damage in shipment and conformance with quantity and description on the shipping notice and order. Unload valves carefully to the ground without dropping. Use forklifts or slings under skids. Do not lift valves with slings or chain around operating shaft, actuator, or through waterway. Lift valves with eyebolts or rods through flange holes or chain hooks at ends of valve parts.

E. Protect the valve and actuators from weather and the accumulation of dirt, rocks, and debris. Do not expose rubber seats to sunlight or ozone for more than 30 days. Also, see the manufacturer's specific storage instructions.

F. Make sure flange faces, joint sealing surfaces, body seats, and disc seats are clean. Check the bolting attaching the actuator to the valve for loosening in transit and handling. If loose, tighten firmly. Open and close valves having manual or power actuators to make sure the valve operates properly and that stops or limit switches are correctly set so that the valve seats fully. Close valve before installing.

3.02 FACTORY PRESSURE TESTING

A. Hydrostatically test the valve pressure-containing parts at the factory per the valve specification or per the referenced standard. If no testing requirement is otherwise specified or described in the referenced standards, then test with water for 30 minutes minimum at a pressure of 1.5 times the rated pressure but not less than 20 psig. Test shall show zero leakage. If leaks are observed, repair the valve and retest. If dismantling is necessary to correct valve deficiencies, then provide an additional operational test and verify that the valve components function.

B. The chloride content of liquids used to test austenitic stainless steel materials shall not exceed 50 ppm. To prevent deposition of chlorides as a result of evaporative drying, remove residual liquid from tested parts at the conclusion of the test.

3.03 INSTALLING VALVES—GENERAL

A. Remove covers over flanged openings and plugs from threaded openings, after valves have been placed at the point to which the valves will be connected to the adjacent piping. Do not remove valves from storage cartons or boxes until they are ready to be installed.

B. Handle valves carefully when positioning, avoiding contact or impact with other equipment, vault or building walls, or trench walls.

C. Clean valve interiors and adjacent piping of foreign material prior to making up valve to pipe joint connection. Prepare pipe ends and install valves in accordance with the pipe manufacturer's instructions for the joint used. Do not deflect pipe-valve joint. Do not use a valve as a jack to pull pipe into alignment. The installation procedure shall not result in bending of the valve/pipe connection with pipe loading.

D. Make sure valve ends and seats are clean. Check exposed bolting for loosening in transit and handling and tighten to manufacturer's recommendations. Open and close the valve to make sure it operates properly and that stops or limit switches are correctly set so that the vane, ball, gate, needle, diaphragm, disc, plug, or other seating element seats fully. Close the valve before installing. Check coatings for damage and repair. Handle valves carefully when positioning, avoiding contact or impact with other equipment or structures.

E. Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

3.04 INSTALLING EXPOSED VALVES

A. Unless otherwise indicated in the drawings, install valves in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the floor with their operating stems vertical. Install valves in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the floor with their operating stems horizontal.

B. Install valves on vertical runs of pipe that are next to walls with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

3.05 INSTALLING BURIED VALVES

A. Connect the valve, coat the flanges, apply tape wrapping and polyethylene encasement, and place and compact the backfill to the height of the valve stem.

B. Place block pads under the extension pipe to maintain the valve box vertical during backfilling and repaving and to prevent the extension pipe from contacting the valve bonnet.

C. Mount the upper slip pipe of the extension in midposition and secure with backfill around the extension pipe. Pour the concrete ring allowing a depression so the valve box cap will be flush with the pavement surface.

D. In streets without concrete curbs and in open areas, install the valve box as for a paved area with concrete curb except include a marker post. Cut the marker post from 4-inch by 4-inch dense structural grade Douglas fir No. 2 surfaced on four sides to a length of 5 feet. Chamfer the top. Set the post in concrete, 2 feet into the ground, away from traffic, and to the side of the pipeline. Coat with a seal and finish coat of white alkyd exterior paint. On the side facing the valve, letter in black the word "VALVE" and the distance in feet from the marker post to the valve box cap.

3.06 FIELD COATING BURIED VALVES

A. Coat flanges of buried valves and the flanges of the adjacent piping, and the bolts and nuts of flanges and mechanical joints, per Section 099000, System No. 15.

B. Wrap buried metal valves smaller than 6 inches with cold-applied wax tape per Section 099752.

C. Wrap buried metal valves 6 inches and larger with polyethylene sheet per Section 099754.

3.07 ASSEMBLING JOINTS

A. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

B. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.

C. Install lug-type valves with separate hex head machine bolts at each bolt hole and each flange (two bolts per valve bolt hole).

D. Install grooved-end couplings for valves in accordance with Section 400500.

3.08 INSTALLING EXTENSION STEM GUIDE BRACKETS

Install at 6- to 8-foot centers. Provide at least two support brackets for stems longer than 10 feet, with one support near the bottom of the stem and one near the top.

3.09 MOUNTING GEAR ACTUATORS

The valve manufacturer shall select and mount the gear actuator and accessories on each valve and stroke the valve from fully open to fully closed prior to shipment.

3.10 FIELD INSTALLATION OF GEAR ACTUATOR

Provide the actuator manufacturer's recommended lubricating oil in each actuator before commencing the field testing.

3.11 VALVE FIELD TESTING

A. Test valves for leakage at the same time that the connecting pipelines are hydrostatically tested. See Section 400515 for pressure testing requirements. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace any leaking valves and retest.

B. Operate manual valves through three full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. Do not backfill buried valves until after verifying that valves operate from full open to full closed. If valves stick or bind, or do not operate from full open to full closed, repair or replace the valve and repeat the tests.

C. Gear actuators shall operate valves from full open to full close through three cycles without binding or sticking. The pull required to operate handwheel- or chainwheel-operated valves shall not exceed 40 pounds. The torque required to operate valves

having 2-inch AWWA nuts shall not exceed 150 ft-lbs. If actuators stick or bind or if pulling forces and torques exceed the values stated previously, repair or replace the actuators and repeat the tests. Operators shall be fully lubricated in accordance with the manufacturer's recommendations prior to operating.

END OF SECTION

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SECTION 400560 AIR-RELEASE AND VACUUM-RELIEF VALVES

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and installation of combination air-release valves.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Painting and Coating: 099000.

B. Fusion-Bonded Epoxy Linings and Coatings: 099761.

C. General Piping Requirements: 400500.

D. Pressure Testing of Piping: 400515.

E. Manual, Check, and Process Valves: 400520.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit manufacturer's catalog data and detail drawings showing all valve parts and described by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show linings and coatings.

PART 2 - MATERIALS

2.01 BOLTS, NUTS, AND GASKETS FOR FLANGED VALVES

See Section 400500 and specification for the pipe to which the valve is attached.

2.02 VALVE DESIGN AND OPERATION

A. Valve design shall comply with AWWA C512, except as modified herein. Valves shall have a minimum working pressure of 3 psi and a maximum working pressure of at least 200 psi.

B. Combination air valves 4 inches and larger for water service shall consist of an air and vacuum valve with an air-release valve attached to it or integral with it. Connect the attached air-release valve to the air and vacuum valve with standard weight steel piping (ASME B36.10) and an isolation ball valve.

2.03 MATERIALS OF CONSTRUCTION

A. Materials of construction for combination air valves for water service shall be as follows:

Item	Material	Specification
Body and cover	Cast iron	ASTM A48, Class 35; or ASTM A126, Class B
	Stainless steel	AISI Type 304
Float, lever or linkage, air-release mechanism, poppet, guide rod, guide bushings, fasteners, other internal metal parts	Stainless steel	AISI Type 316
Plugs	Bronze	See paragraph E below
Seat, plunger, needle	Buna-N	–

B. Bronze in contact with water shall have the following chemical characteristics:

Constituent	Content
Zinc	7% maximum
Aluminum	2% maximum
Lead	8% maximum
Copper + Nickel + Silicon	83% minimum

C. Rubber seats shall be made of a rubber compound that is resistant to free chlorine and monochloramine concentrations up to 10 mg/L in the fluid conveyed.

D. Body and cover bolts, nuts, and cap screws shall be Type 316 stainless steel.

2.04 VALVE END CONNECTIONS

A. Valves shall have flanged ends.

B. Flanges for Class 150 valves shall comply with ASME B16.1, Class 125.

2.05 VALVES

Combination Air Valves, 4 Inches, Class 150: Provide flanged outlet above the top cover and orifice. Minimum orifice size for the air-release valve shall be 3/16 inch. Combination air-release valves shall be A.R.I. USA Inc. D-060-C HF, or equal.

PART 3 - EXECUTION

3.01 FACTORY TESTING

A. Test each valve per AWWA C512, Section 5 and the following.

B. Hydrostatically test the pressure-containing parts at the factory with water for 30 minutes minimum at a pressure of 1.5 times the rated pressure but not less than 20 psig. Test shall show zero leakage. If leaks are observed, repair the valve and retest. If dismantling is necessary to correct valve deficiencies, provide an additional operational test per AWWA C512, Section 5 for each affected valve.

C. The chloride content of liquids used to test austenitic stainless steel materials shall not exceed 50 ppm. To prevent deposition of chlorides as a result of evaporative drying, remove residual liquid from tested parts at the conclusion of the test.

3.02 PAINTING AND COATING

Line and coat cast-iron valves with fusion-bonded epoxy per Section 099761. Do not coat seating areas and plastic, bronze, stainless steel, or other high alloy parts.

3.03 SHIPMENT AND STORAGE

A. Identify the equipment with item and serial numbers. Material shipped separately shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number of the equipment for which it is intended. In addition, ship crated equipment with duplicate packing lists, one inside and one on the outside of the shipping container.

B. Pack and ship one copy of the manufacturer’s standard installation instructions with the equipment. Provide the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite and before start-up.

C. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Provide closures at the place of pump manufacture prior to shipping. For studded openings, use all the nuts needed for the intended service to secure closures.

D. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Provide caps or plugs at the place of pump manufacture prior to shipping.

E. Clearly identify lifting points and lifting lugs on the valves. Identify the recommended lifting arrangement on boxed equipment.

3.04 INSTALLATION

A. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseat or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.

B. Clean threaded joints by wire brushing or swabbing. Apply Teflon® joint compound or Teflon® tape to pipe threads before installing threaded valves. Joints shall be watertight.

C. Do not use duct tape and plastic for covering the ends of pipe flanges. Use a solid metal cover with rubber gasket to cover flange openings during installation. These metal covers shall remain in place until the piping is connected to the valves.

D. Do not spring flanges of connecting piping into position. Separately work connecting piping systems into position to bring the piping flanges into alignment with the matching valve flanges. Do not move valves to achieve piping alignment. Do not use electrical heating stress relieving to achieve piping alignment.

E. Line up pipe flange bolt holes with valve nozzle bolt holes within 1/16 inch maximum offset from the center of the bolt hole to permit insertion of bolts without applying any external force to the piping.

F. Flange face separation shall be within the gasket spacing ±1/16 inch. Use only one gasket per flanged connection.

3.05 VALVE FIELD PRESSURE TESTING

Test valves at the same time that the connecting pipelines are pressure tested. See Section 400515 for pressure testing requirements. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the test pressure.

END OF SECTION

SECTION 400722 FLEXIBLE PIPE COUPLINGS AND EXPANSION JOINTS

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and installation of flexible gasketed sleeve-type compression pipe couplings for steel pipe; expansion joints 4 inches in diameter and smaller for steel pipe; flexible expansion joints; and couplings for connecting different pipe materials.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Painting and Coating: 099000.

B. Cold-Applied Wax Tape Coating: 099752.

C. Polyethylene Sheet Encasement: 099754.

D. Fusion-Bonded Epoxy Linings and Coatings: 099761.

E. Cathodic Protection and Joint Bonding: 264213.

F. General Piping Requirements: 400500.

G. Pressure Testing of Piping: 400515.

H. Wall Pipes, Seep Rings, and Penetrations: 400762.

I. Pipe Hangers and Supports: 400764.

J. General Requirements for Steel Piping: 402001.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit manufacturer's catalog data on flexible pipe couplings and expansion joints. Show manufacturer's model or figure number for each type of coupling or joint for each type of pipe material for which couplings and joints are used. Show coatings.

C. Submit manufacturer's recommended torques to which the coupling bolts shall be tightened for the flexible gasketed sleeve-type compression pipe couplings.

D. Show materials of construction by ASTM reference and grade. Show dimensions.

E. Show number, size, and material of construction of tie rods and lugs for each thrust harness on the project.

PART 2 - MATERIALS

2.01 COUPLING SYSTEM DESIGN AND COMPONENT UNIT RESPONSIBILITY

The coupling manufacturer shall furnish the gaskets, bolts, nuts, glands, end rings, and hardware for pipe couplings of all types and shall design these components as an integral system. Design the gaskets for the coupling and appropriately size to provide a watertight seal at the design pressure and temperature. Ship gaskets, bolts, nuts, glands, end rings, and hardware for pipe couplings with the pipe coupling and clearly label indicating the origin of the material, including place and date of manufacture. Package the manufacturer's printed installation instructions with each pipe coupling.

2.02 CARBON STEEL FLEXIBLE PIPE COUPLINGS AND FLANGED COUPLING ADAPTERS

A. Steel couplings shall have center sleeves and end rings made of carbon steel conforming to AWWA C219, Section 4. Minimum center sleeve length shall be 5 inches for pipe sizes 3/4 inch through 4 1/2 inches, 7 inches for pipe sizes 5 inches through 24 inches, and 10 inches for pipe sizes larger than 24 inches.

B. Sleeve bolts in exposed service shall be carbon steel per AWWA C219, Section 4. Sleeve bolts in buried or submerged service shall be Type 316 stainless steel per AWWA C219, Section 4.

C. End rings shall be cast, forged, or hot rolled in one piece. Do not use rings fabricated from two or more shapes.

D. Wall thickness of sleeve shall be at least that specified for the size of pipe in which the coupling is to be used.

2.03 JOINT HARNESSES

A. Tie bolts or studs shall be as shown in the following table. Bolt or stud material shall conform to ASTM A193, Grade B7. Nuts shall conform to ASTM A194, Grade 2H. Lug material shall conform to ASTM A36, ASTM A283, Grade B, C, or D, or ASTM A285, Grade C. Lug dimensions for steel pipe shall be as shown in AWWA Manual M11 (2004 edition), Figure 13-20, using the number and size of lugs as tabulated below.

TIE BOLTS OR STUD REQUIREMENTS FOR FLEXIBLE PIPE COUPLINGS FOR STEEL PIPE				
	Tie Bolt or Stud Minimum Requirements			
	150 psi		300 psi	
Nominal Pipe Size (inches)	No. Bolts or Studs and Size (inches)	Minimum Pipe Wall Thickness (inches)	No. Bolts or Studs and Size (inches)	Minimum Pipe Wall Thickness (inches)
6	2 x 5/8	0.193	2 x 5/8	0.282
8	2 x 5/8	0.239	2 x 5/8	0.354
36	4 x 1 3/8	0.313	6 x 1 3/8	0.375

B. Select number and size of bolts based on the test pressure shown in Section 400515. Stagger bolts equally around pipe circumference. Where odd number is tabulated, place odd bolt at top. For test pressures less than or equal to 150 psi, use the 150-psi design in the table above. For test pressures between 150 and 300 psi, use the 300-psi design in the table above.

C. Provide washer for each nut. Washer material shall be the same as the nuts. Minimum washer thickness shall be 1/8 inch.

2.04 FLEXIBLE PIPE COUPLINGS FOR PLAIN-END STEEL PIPE

Couplings shall be steel, Dresser Style 38, Smith-Blair Type 411, Baker Series 200, or equal.

2.05 FLEXIBLE PIPE COUPLINGS FOR PLAIN-END DUCTILE-IRON PIPE

A. Couplings for pipe 12 inches and smaller shall be cast iron, Dresser Style 253 or 253 long sleeve, Smith-Blair Type 441, Baker Series 228, or equal.

B. Couplings for pipe larger than 12 inches shall be cast iron or steel, Dresser Style 38 or 253, Smith-Blair Style 411, Baker Series 228, or equal.

2.06 TRANSITION COUPLINGS

Couplings for connecting different pipes having different outside diameters shall be steel: Dresser Style 62 or 162, Smith-Blair Series 413, Baker Series 212 or 220, or equal. Couplings shall have an internal full circumference ring pipe stop at the midpoint of the coupling. Inside diameter of coupling pipe stop shall equal inside diameter of smaller diameter pipe.

2.07 FLANGED COUPLING ADAPTERS FOR STEEL PIPE

Adapters for steel pipe shall be steel: Dresser Style 128, Smith-Blair Type 913, or equal. Flange ends shall match the flange of the connecting pipe; see detail piping specifications.

2.08 TYPE 1 EXPANSION JOINTS: FOR COPPER PIPE

Expansion joints for copper pipe shall be all bronze: Metraflex Model HPMF expansion compensator, Hyspan Model 8509 or 8510 expansion compensator, or equal. Expansion compensators shall have antitorque devices to protect the bellows. Minimum working pressure shall be 175 psig.

2.09 TYPE 5 EXPANSION JOINTS: ARCH RUBBER TYPE (24 INCHES AND LARGER)

A. Expansion joints shall be rubber, arch type, with integral flat-face ANSI Class 125/150 flanges.

1. Cover Elastomer: Ethylene-propylene-diene monomer (EPDM) by Nordel.

2. Tube Elastomer: Ethylene-propylene-diene monomer (EPDM) by Nordel.

3. Arch Type: Filled.

4. Fluid: Potable water.

5. Fluid Temperature Range: 40°F to 105°F.

6. Ambient Temperature Range: 30°F to 120°F.

B. Minimum working pressure shall be 100 psi. Provide steel thrust plates, retaining rings, and control rods. Products: Proco Style 233, General Rubber Style 1075, or equal.

2.10 BOLTS AND NUTS FOR FLANGES

See Section 400500.

PART 3 - EXECUTION

3.01 SHIPMENT AND STORAGE OF FLEXIBLE PIPE COUPLINGS AND EXPANSION JOINTS

A. Inspect on receipt for damage in shipment and conformance with quantity and description on the shipping notice and order. Unload carefully to the ground without dropping. Do not load or unload by inserting forklift tines or lifting chains inside the waterway. Use nonmetallic slings, padded chains, or padded forklift tines to lift items. Lift with eyebolts or rods through flange holes or chain hooks at ends.

B. Protect from weather and the accumulation of dirt, rocks, and debris. Do not expose rubber seats to sunlight or ozone for more than 30 days. Also, see the manufacturer's specific storage instructions.

C. Make sure flange faces, joint sealing surfaces, body seats, and disc seats are clean.

D. Do not allow stainless steel couplings or other items to contact carbon steel surfaces during storage, handling, or installation and erection at the site.

3.02 INSTALLATION OF FLEXIBLE PIPE COUPLINGS AND EXPANSION JOINTS

A. Clean oil, scale, rust, and dirt from pipe ends. Clean gaskets in flexible pipe couplings before installing.

B. Install expansion joints per manufacturer's recommendations, so that 50% of total travel is available for expansion and 50% is available for contraction.

C. Do not spring flanges or ends of connecting piping into position. Separately work connecting piping system into position to bring the piping flanges or ends into alignment with the matching coupling flanges or joints. Do not move couplings to achieve piping alignment.

D. Line up pipe flange bolt holes with coupling or joint flange bolt holes within 1/16 inch maximum offset from the center of the bolt hole to permit insertion of bolts without applying any external force to the piping.

E. Flange face separation shall be within the gasket spacing ±1/16 inch. Use only one gasket per flanged connection.

F. Lubricate bolt threads with graphite and oil prior to installation.

G. Thoroughly clean contact surfaces of gaskets and pipe ends of flexible pipe couplings just prior to assembly for a distance equal to center-sleeve length plus 2 inches. Install flexible pipe couplings such that the center sleeves are centered over the gap between the ends of the pipes being joined. Install centerline gaps per AWWA C219, Table 5 unless otherwise indicated. Install harnessed flexible pipe couplings in straight-run piping such that 50% of the total travel of the center sleeve or permissible centerline gap is available for expansion and 50% of the travel is available for contraction. In assembling the bolted or studded harnesses of flexible pipe couplings, tighten the nuts gradually and equally at diametrically opposite sides until snug. Do not misalign the harness bolts or studs. Tighten such that bolts or studs carry equal loads. Do not use wrenches or power fastening tools to tighten the nuts.

3.03 PAINTING AND COATING

A. Coat buried flexible pipe couplings (including joint harness assemblies), transition couplings, segmented sleeve couplings, and flanged coupling adapters per Section 099000, System No. 21. Coat buried bolt threads, tie bolt threads, and nuts per Section

099000, System No. 24. Then wrap the couplings with cold-applied wax tape per Section 099752 and with polyethylene wrap per Section 099754.

B. Coat flexible pipe couplings (including joint harness assemblies), transition couplings, segmented sleeve couplings, and flanged coupling adapters located indoors, in vaults and structures, and above ground with the same coating system as specified for the adjacent pipe. If the adjacent pipe is not coated, coat couplings per Section 099000, System No. 15. Apply prime coat at factory.

C. Line flexible pipe couplings and segmented sleeve couplings per Section 099000, System No. 7.

D. Alternatively, line and coat flexible pipe couplings and segmented sleeve couplings with fusion-bonded epoxy per Section 099761.

E. Coat, expansion joints, and couplings located above ground or in vaults and structures with the same coating system as specified for the adjacent pipe. If the adjacent pipe is not coated, coat couplings per Section 099000, System No. 15. Color shall match the color of the connecting pipe.

3.04 BONDING FLEXIBLE PIPE COUPLINGS AND SEGMENTED SLEEVE COUPLINGS

Bond buried flexible pipe couplings that are connected to steel pipe as described in Section 264213.

3.05 HYDROSTATIC TESTING

Hydrostatically test flexible pipe couplings, expansion joints, segmented sleeve couplings, and expansion compensators in place with the pipe being tested. Test in accordance with Section 400515.

END OF SECTION

SECTION 400762 WALL PIPES, SEEP RINGS, AND PENETRATIONS

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, installation, and testing of steel, cast-iron, and ductile-iron wall pipes and sleeves (including wall collars and seepage rings) and penetrations.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. General Concrete Construction: 030500.

B. Painting and Coating: 099000.

C. Fusion-Bonded Epoxy Linings and Coatings: 099761.

D. General Piping Requirements: 400500.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit detail drawings for fabricated steel or cast-iron wall and floor pipes and sleeves, wall flanges, seep rings, and sealing materials. Show dimensions and wall thicknesses.

C. Show flange sizes and the appropriate ANSI or AWWA flange dimensional standard where flanged end wall pipes or penetrations are used.

D. Show grooved-end dimensions and AWWA grooved-end dimensional standard where grooved-end wall pipes or penetrations are used.

E. List coating systems to be applied, manufacturer, and dry thickness of coatings. Call out coatings where coatings are to be applied.

F. List materials of construction, with ASTM material reference and grade.

G. Submit manufacturer's instructions for installing rubber annular hydrostatic sealing devices.

PART 2 - MATERIALS

2.01 GENERAL

A. Use fabricated steel wall sleeves when containing rubber annular hydrostatic sealing devices through which piping passes.

B. Use only fabricated steel or stainless steel wall pipes when connecting to steel pipe.

C. Class 150 steel flanges shall conform to AWWA C207, Class D. Flanges shall be flat face. Flanges shall match the flange on the connecting pipe.

D. See Section 400500 for flange bolts and gaskets.

2.02 FABRICATED STEEL WALL PIPES AND SLEEVES

A. Provide fabricated steel wall pipes and sleeves with ends as shown in the drawings for connection to adjacent steel pipes, or for containing pipes, where they pass through concrete walls. Provide seepage ring or wall flange on wall pipes and sleeves passing through concrete walls and slabs that are to be watertight. Wall thickness shall be the same as the pipe wall thickness when connecting to steel pipe. Minimum wall thickness for sleeves containing pipes shall be standard weight per ASME B36.10 for sleeves 42 inches and smaller.

B. Wall flanges shall be in the form of a steel wall collar welded to the steel sleeve or penetration. Cut welded wall collars from a 1/4-inch steel ring. Attach the collar to a steel wall pipe or sleeve with full circle, 3/16-inch fillet welds. Welding procedures shall be in accordance with ASME B31.3, Chapter V.

C. Steel pipe used in fabricating wall sleeves containing pipes shall comply with ASTM A53 (Type E or S), Grade B; ASTM A135, Grade B; ASTM A139, Grade B; or API 5L. Wall pipes connecting to steel pipe shall be of the same material as the connecting pipe. Wall collar material shall comply with ASTM A36, A105, A181, or A182.

D. Pressure test at least one of each size of fabricated steel wall sleeve or penetration and collar assemblies at the place of fabrication to demonstrate watertightness of the seal between the collar and the sleeve. The test shall be at a pressure of 20 psig for four hours' duration and shall show zero leakage.

2.03 RUBBER ANNULAR HYDROSTATIC SEALING DEVICES

A. Rubber annular hydrostatic sealing devices shall be of the modular mechanical type, utilizing interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe sleeve and the passing pipe. Assemble links to form a continuous rubber belt around the pipe, with a pressure plate under each bolthead and nut.

B. Materials of construction shall be as follows:

Compound	Material
Pressure plate	carbon steel
Bolts and nuts for links	Type 316 stainless steel
Sealing element	EPDM rubber

C. The size of the wall sleeve needed to accommodate the passing pipe shall be as recommended by the rubber annular seal manufacturer.

D. Provide centering blocks in 25% of the sealing elements on pipelines larger than 12 inches in diameter.

E. The rubber annular hydrostatic sealing devices shall be Link Seal as manufactured by Thunderline Corporation; Innerlynx as manufactured by Advance Products & Systems, Inc.; or equal.

2.04 BOLTS, NUTS, AND GASKETS FOR FLANGED-END WALL PIPES

See Section 400500.

2.05 POLYETHYLENE FOAM FILLER FOR PIPE PENETRATIONS

Packing foam shall be an extruded closed-cell polyethylene foam rod, such as Minicel backer rod, manufactured by Industrial Systems Department, Plastic Products Group of Hercules, Inc., Middletown, Delaware; Ethafoam, as manufactured by Dow Chemical Company, Midland, Michigan; or equal. The rod shall be 1/2 inch larger in diameter than the annular space.

2.06 POLYURETHANE SEALANT FOR PIPE PENETRATIONS

Sealant shall be multipart, polyurethane sealant, to cure at ambient temperature, for continuous immersion in water. Install as recommended by the manufacturer. Products: SIKA Sikaflex 2C or equal.

2.07 PAINTING AND COATING

A. Line and coat sleeves and pipes (except stainless steel) with fusion-bonded epoxy per Section 099761.

B. Coat penetrations and sleeves exposed, above ground, or in vaults and structures in accordance with Section 099000, System No. 15 or fusion-bonded epoxy coatings are shown in the drawings or specified elsewhere.

C. Coat submerged sleeves and penetrations per Section 099000, System No. 7 unless fusion-bonded epoxy coatings are shown in the drawings or specified elsewhere.

D. Coat buried sleeves and penetrations per Section 099000, System No. 21 or with fusion-bonded epoxy per Section 099761.

E. Do not coat stainless steel sleeves and penetrations.

PART 3 - EXECUTION

3.01 LOCATION OF PIPES AND SLEEVES

A. Provide a wall or floor pipe where shown in the drawings and wherever piping passes through walls or floors of tanks or channels in which the water surface is above the pipe penetration.

B. Provide a floor sleeve where shown in the drawings and wherever plastic pipe, steel, or stainless steel pipe 3 inches and smaller or stainless steel or copper tubing passes through a floor or slab. Provide a rubber annular sealing device in the annular space between the sleeve and the passing pipe or tubing.

C. Provide wall sleeves where shown in the drawings and wherever plastic, steel or stainless steel pipe 3 inches and smaller, or stainless steel or copper tubing passes through a wall. Provide a single rubber annular seal when the wall is 8 inches thick or

less. Provide two rubber annular seals (one at each end of the sleeve) when the wall is more than 8 inches thick. Pack the annular space with polyethylene foam filler and fill the ends of the penetration with 2 inches of elastomeric sealant on both sides of the structure.

D. Where wall sleeves are installed in which water is on one or both sides of the channel or wall, provide two rubber annular seals (one at each end of the sleeve).

E. Where pipes pass through walls or slabs and no sleeves or wall or floor pipe with seep ring is provided, pack the annular space with polyethylene foam filler and fill the ends of the penetration with 2 inches of elastomeric sealant on both sides of the structure.

3.02 INSTALLATION IN NEW CONCRETE WALLS AND SLABS

Install wall pipes and sleeves in walls before placing concrete. Do not allow any portion of the pipe or sleeve to touch any of the reinforcing steel. Install wall pipe or sleeve and collar assembly axially aligned with the piping to which it will be attached or will contain. Provide supports to prevent the pipe or sleeve from displacing or deforming while the concrete is being poured and is curing.

3.03 INSTALLATION IN DRY FLOORS AND SLABS

Install pipe sleeves and spools in concrete floors and slabs which do not have water over them such that the sleeve or pipe extends from the bottom of the floor or slab to 2 inches above the floor or slab unless shown otherwise in the drawings.

3.04 INSTALLATION OF WALL PIPES HAVING FLANGED END CONNECTIONS

A. Check alignment before grouting in place or pouring concrete. Realign if the sleeve is not properly aligned.

B. Install flanged end wall sleeves or penetrations with bolt holes of the end flanges straddling the horizontal and vertical centerlines of the sleeve.

3.05 QUALIFICATIONS OF WELDERS

Welder qualifications shall be in accordance with AWS D1.1.

3.06 INSTALLATION OF RUBBER ANNULAR HYDROSTATIC SEALING DEVICES

Install in accordance with the manufacturer's instructions.

3.07 FIELD TESTING

Check each wall penetration for leakage at the time the hydraulic structure is tested for leakage; see Section 033000. Penetrations shall show zero leakage.

END OF SECTION

SECTION 400764 PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and installation of pipe hangers and supports including accessory items, such as anchor bolts and screws, and neoprene isolation pads.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Painting and Coating: 099000.

B. Wall Pipes, Seep Rings, and Penetrations: 400762.

C. Flexible Pipe Couplings and Expansion Joints: 400722.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Provide line drawings of each piping system to the scale shown in the drawings, locating each support or hanger. Identify each type of hanger or support by the manufacturer's catalog number or figure.

C. Provide installation drawings and manufacturer's catalog information on each type of hanger and support used. Clearly indicate the actual pipe outside diameter (not just nominal pipe size) that is used for the hangers and supports.

PART 2 - MATERIALS

2.01 DESIGN CRITERIA

A. Not all pipe supports or hangers required are shown in the drawings. Provide pipe supports for every piping system installed. Support piping by pipe support where it connects to mechanical equipment.

B. Pipe support and hanger components shall withstand the dead loads imposed by the weight of the pipes, fittings, and valves (all filled with water), plus valve actuators and any insulation, and shall have a minimum safety factor of five based on material ultimate strength.

2.02 HANGER AND SUPPORT SYSTEMS

A. Pipe hangers and supports shall be as manufactured by Anvil, Unistrut, B-Line, Superstrut, or equal.

B. Construct special hangers and supports if detailed in the drawings. Select galvanized or plain option in below.

C. Unless otherwise stated in the drawings, pipe hangers and supports shall be hot-dipped galvanized per ASTM A153 carbon steel (ASTM A36, A575, or A576). Bases, rollers, and anchors shall be steel as described above or may be cast iron (ASTM A48). Pipe clamps shall be stainless steel.

2.03 WAFFLE ISOLATION PADS

Mason Type "W"; Machinery Installation Systems "Unisorb" Type S, SB, F, or FB; or equal. Provide minimum 1/4-inch thickness.

2.04 NEOPRENE ISOLATING SLEEVES FOR METAL PIPE 6 INCHES AND SMALLER

Unistrut P2600, B-Line "Vibrocushion," or equal.

2.05 ANCHOR BOLTS AND SCREWS

Anchor bolts and screws for attaching pipe supports and hangers to walls, floors, ceilings, and roof beams shall be Type 316 stainless steel, ASTM A276 or F593. Nuts shall be Type 316 stainless steel, ASTM A194, Grade 8M or ASTM F594, Type 316 stainless steel.

PART 3 - EXECUTION

3.01 PIPE HANGER AND WALL SUPPORT SPACING

Install pipe hangers and wall supports on horizontal and vertical runs at the spacing shown or detailed in the drawings. Provide hanger rods (for horizontal runs) and wall supports of the sizes shown or detailed in the drawings.

A. Pipe Hanger or Wall Support Spacing for PVC Pipe:

Pipe Size (inches)	**Maximum Support or Hanger Spacing (feet)**	**Minimum Rod Size (inches)**
3/4	4	3/8
1	4	3/8
1 1/2	5	3/8
2	5	3/8
2 1/2	5	1/2
3	6	1/2

B. For piping services not described, provide hangers and supports per MSS SP-58.

3.02 INSTALLING PIPE HANGERS AND SUPPORTS

A. Provide separate hangers or supports at each valve. Provide one hanger or support around each end of the valve body or on the adjacent connecting pipe within one pipe diameter of the valve end. Provide additional hangers or supports to relieve eccentric loadings imposed by offset valve actuators.

B. Provide separate hangers or supports at each pipe elbow, tee, or fitting. Provide separate hangers or supports on both sides of each nonrigid joint or flexible pipe coupling.

C. Adjust pipe hangers per MSS SP-58.

D. Install leveling bolts beneath support baseplates. Provide 1-inch thick grout pad beneath each base or as shown on the drawings.

E. Install piping without springing, forcing, or stressing the pipe or any connecting valves, pumps, and other equipment to which the pipe is connected.

3.03 INSTALLING NEOPRENE ISOLATING SLEEVES

Install a sleeve around each metal pipe 6 inches and smaller at the point of bearing or contact with the pipe hanger or support.

3.04 PAINTING AND COATING

A. Grind welds of fabricated steel pipe supports smooth, prepare surface by sandblasting, and apply coating system.

B. Paint exposed pipe hangers and supports to match the color of the adjacent wall using System No. 15 per Section 099000. If the adjacent wall is not painted, paint the hangers and supports to match color code of the largest pipe on the support.

C. Coat submerged pipe hangers and supports per Section 099000, System No. 7.

END OF SECTION

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SECTION 402001 GENERAL REQUIREMENTS FOR STEEL PIPING

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes general requirements for materials, fabrication, installation, and testing of steel pipe (including fabricated stainless steel pipe).

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Painting and Coating: 099000.

B. Fusion-Bonded Epoxy Linings and Coatings: 099761.

C. Cathodic Protection and Joint Bonding: 264213.

D. General Piping Requirements: 400500.

E. Pressure Testing of Piping: 400515.

F. Flexible Pipe Couplings and Expansion Joints: 400722.

G. Pipe Hangers and Supports: 400764.

H. Fabricated Steel Specials: 402050.

I. Steel Transmission Pipe (6 to 42 Inches): 402063.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit materials list showing material of pipe and fittings with ASTM reference and grade. Submit manufacturer's certification of compliance with referenced standards, e.g., ASTM A53, A135, and AWWA C200. Provide recertification by an independent domestic testing laboratory for materials originating outside of the United States.

C. For piping 6 inches and larger, submit piping layout drawings showing location and dimensions of pipe and fittings. Include laying lengths of valves, meters, in-line pumps, and other equipment determining piping dimensions. Label or number each fitting or piece of pipe and provide the following information for each item:

1. Material of construction, with ASTM or API reference and grade.

2. Wall thickness of steel cylinder.

3. Mortar lining thickness (if pipe has been specified to have a mortar lining).

4. Mortar coating thickness, where mortar coating is required.

5. Paint prime coating, where prime coat is required.

6. Manufacturer's certificates of compliance with referenced pipe standards, e.g., ASTM A53, ASTM A135, API 5L, AWWA C200.

7. Show weld sizes and dimensions of grooved-end collars, flanges, reinforcing collars, wrapper plates, and crotch plates.

D. Submit coating application test records for field measuring paint coating thickness and holiday detection for each pipe section and fitting. Describe repair procedures used.

1.04 NDT QUALIFICATION

Personnel performing NDT shall meet the requirements of AWWA C200, Section 5 or shall be qualified as an AWS Certified Welding Inspector (CWI or SCWI) or shall hold a current AWS Radiographic Interpreter Certification.

PART 2 - MATERIALS

2.01 STEEL PIPE CYLINDERS

A. The yield strength of the steel for pipe and fabricated fittings having grooved-end joints shall be minimum 35,000 psi.

B. Straight runs of pipe upstream of flowmeters shall be smooth. The inside diameters of such pipes shall match the inside diameters of the flowmeters.

C. Provide seamless pipe or pipe having straight longitudinal weld seams where pipe passes through rubber annular sealing devices. Alternatively, grind the exterior weld seams of spiral welded pipe flush with the exterior pipe surface where the pipe passes through the rubber annular sealing devices.

2.02 FITTINGS

See Section 402050.

2.03 JOINTS

A. Provide plain-end pipe where flexible pipe couplings are to be provided. Provide lugs for thrust harnesses where shown in the drawings, per Section 400722.

B. Where piping connects to wall pipes, meters, valves, or other equipment, the pipe ends shall match the ends of the wall pipes, meters, valves, or equipment.

2.04 OUTLETS AND NOZZLES

A. Outlets of size 3 inches and smaller shall be of the thredolet type, per MSS SP-97 and AWWA M11 (2004 edition), Figure 13-26. Outlets shall be 3,000-pound WOG forged steel per ASTM A105 or ASTM A216, Grade WCB. Threads shall comply with ASME

B1.20.1. Outlets shall be Bonney Forge Co. "Thredolet," Allied Piping Products Co. "Branchlet," or equal.

B. Alternatively, threaded openings not less than 2 inches or more than 3 inches in nominal size shall be a flat-bottom half-coupling conforming to ASME B16.11, Class 3000 and AWWA M11 (2004 edition), Figure 13-25. Where the mounting surface is curved to a diameter of 36 inches or less, the mounting diameter shall be the same as that of the surface upon which it is to be mounted. Forge the threaded outlet and its plug from steel conforming to ASTM A105 or ASTM A181, Class 70.

C. For outlets 3 inches and smaller in piping smaller than 4 inches, use a tee with a threaded outlet.

D. For outlets larger than 3 inches, use a tee with a flanged outlet.

2.05 GROOVED-END COUPLINGS

A. Grooved-end couplings shall be ductile iron, ASTM A536, Grade 60-40-18 or 65-45-12. Gaskets shall conform to ASTM D2000 and be of the following materials:

Piping Service	Gasket Material
Water	EPDM
Sewage, sludge	Nitrile
Fuel oil, gasoline	Nitrile

B. Bolts. See Section 400500.

C. Couplings for connecting to grooved-end valves shall be Victaulic Style 77 to match the valve ends.

D. Grooved-end adapter flanges for pipe 18 inches and smaller having a maximum test pressure of 200 psi shall comply with ASME B16.1, Class 125 dimensions. Flanges shall be Victaulic Style 741 or 742, Gustin-Bacon Figure 154, or equal.

2.06 FLANGES

A. Forged flange material shall conform to ASTM A105, A181, or A182. Steel flange material shall conform to ASTM A283 (Grade C or D), A285 (Grade C), or A36.

B. Flanges shall comply with AWWA C207, Class D or E as follows. Use welding neck flanges conforming to ASME B16.5 in piping 10 inches and smaller where connecting to lug or wafer-style valves and in all sizes where connecting to wrought steel elbows and tees. Flanges shall be flat faced. Use Class D pressure class of flanges.

C. Provide flat-faced flanges as described above where connecting to cast-iron flanges and where otherwise indicated.

D. Blind flanges shall comply with AWWA C207, Table 7.

2.07 BOLTS, NUTS, AND GASKETS FOR FLANGES

See Section 400500.

2.08 LUBRICANT FOR STAINLESS STEEL BOLTS AND NUTS

See Section 400500.

2.09 MORTAR FOR REPAIRING MORTAR-LINED AND -COATED STEEL PIPE

A. Mortar shall be a two-component, polymer-modified, portland cement, fast-setting, nonsag mortar that can be used for horizontal, vertical, and overhead surfaces. The mortar shall incorporate a penetrating corrosion inhibitor. Mortar shall be ANSI/NSF 61 approved for potable water service. Material shall meet the following requirements:

Parameter	ASTM Specification	Value
Flexural strength (28 days)	C293	2,000 psi minimum
Splitting tensile strength (28 days)	C496	900 psi minimum
Bond strength (28 days)	C882	2,200 psi minimum
Compressive strength (28 days)	C109	7,000 psi minimum

B. Products: SikaTop 123 Plus with FerroGard 901 corrosion inhibitor and Sika Armatec 110 EpoChem primer or equal.

PART 3 - EXECUTION

3.01 FABRICATION, ASSEMBLY, AND ERECTION

A. Beveled ends for butt-welding shall conform to ASME B16.25. Remove slag by chipping or grinding. Surfaces shall be clean of paint, oil, rust, scale, slag, and other material detrimental to welding. When welding the reverse side, chip out slag before welding.

B. Fabrication shall comply with ASME B31.3, Chapter V. Welding procedure and performance qualifications shall be in accordance with Section IX, Articles II and III, respectively, of the ASME Boiler and Pressure Vessel Code.

C. The minimum number of passes for welded joints shall be as follows:

Steel Cylinder Thickness (inch)	Minimum Number of Passes for Welds
Less than 0.1875	1
0.1875 through 0.25	2
Greater than 0.25	3

Welds shall be full penetration.

D. Use the shielded metal arc welding (SMAW) submerged arc welding (SAW), gas-shielded flux-cored arc welding (FCAW), or gas-metal arc welding (GMAW) process for shop welding. Use the SMAW process for field welding.

E. Welding preparation shall comply with ASME B31.3, paragraph 328.4. Limitations on imperfections in welds shall conform to the requirements in ASME B31.3, Table 341.3.2 and paragraph 341.4 for visual examination.

F. Identify welds in accordance with ASME B31.3, paragraph 328.5.

G. Clean each layer of deposited weld metal prior to depositing the next layer of weld metal, including the final pass, by a power-driven wire brush.

H. Welding electrodes for carbon steel piping shall comply with AWS A5.1, A5.17, A5.18, A5.23, or A5.36. Carbon steel flux cored wire shall have a maximum boron content of 0.006%.

3.02 REINFORCEMENT FOR SPECIALS

See Section 402050.

3.03 SHOP TESTING OF FABRICATED OR WELDED COMPONENTS

After completion of fabrication and welding in the shop and prior to the application of any lining or coating, test each component according to the referenced standards. Test fabricated fittings per AWWA C200. Test the seams in fittings that have not been previously shop hydrostatically tested by the dye penetrant method as described in ASME Boiler and Pressure Vessel Code Section VIII, Appendix 8 and Section V, Article 6. In lieu of the dye penetrant method of testing, completed fittings may be hydrostatically tested. Use the field hydrostatic test pressure or 125% of the design pressure, whichever is higher.

3.04 PRODUCT MARKING

Plainly mark each length of straight pipe and each special and fitting at the bell end to identify the design pressure or head, the steel wall thickness, the date of manufacture,

and the proper location of the pipe item by reference to the layout schedule. For beveled pipe, show the degree of bevel and the point on the circumference to be laid uppermost.

3.05 INSTALLING FLANGED PIPING

See Section 400500.

3.06 INSTALLATION OF STAINLESS STEEL BOLTS AND NUTS

See Section 400500.

3.07 INSTALLING GROOVED-END PIPING

See Section 400500.

3.08 INSTALLING ABOVEGROUND OR EXPOSED PIPING

See Section 400500.

3.09 INSTALLING BURIED PIPING

A. Bond buried joints as described in Section 264213. Provide cathodic protection test solutions as specified in Section 264213.

3.10 APPLICATION OF MORTAR FOR REPAIRING MORTAR-LINED AND -COATED STEEL PIPE

A. Remove deteriorated mortar surfaces of dirt, oil, grease, and bond-inhibiting materials. Repair area shall be at least 1/8-inch deep. The exposed aggregate surface shall have a minimum surface profile of ±1/16 inch. Clean surface by saturating with clean water. Then allow to dry such that there is no standing water during mortar application. Apply primer.

B. Scrub repair mortar into the substrate, filling pores and voids. Apply mortar material against the edge of the area to be repaired, working toward the center. After filling repair, consolidate and then screed. Apply mortar in multiple lifts to the thickness necessary to match the thickness of the mortar lining or coating. Where multiple lifts are required, score the top surface of each lift to produce a roughened surface for the next lift. Allow the preceding lift to reach final set per the mortar manufacturer's recommended minimum time before applying additional mortar material. Saturate surface of the lift with clean water. Scrub fresh mortar into the preceding lift. Allow mortar to set and then finish for a smooth surface.

C. Moist cure with wet burlap and polyethylene, a fine mist of water, or water-based curing compound. Commence curing immediately after finishing the final mortar lift. Protect mortar from direct sunlight, wind, rain, and frost.

3.11 FIELD HYDROSTATIC TESTING

Hydrostatically test pipe and fittings in the field in accordance with Section 400515. Test pipe and fitting to 150 psi, unless otherwise noted in the specifications or drawings.

3.12 PAINTING AND COATING

A. Coat pipe located above ground or in vaults and structures per Section 099000, using the coating systems shown in the Piping Schedule in the drawings. Prime coats shall be shop applied.

B. Pipe that is to be encased in concrete shall have no coating, unless shown otherwise in the drawings.

C. Coat the ends of plain-end buried pipe where flexible pipe couplings are to be installed per Section 099000, System No. 7. Apply coating in shop.

D. Coat submerged pipe (including bolts and nuts) per Section 099000, System No. 7. Apply coating in shop.

E. The coating thickness on pipe ends having grooved-end joints (gasket seating surface and the entire groove) and on the coupling key, shoulder, gasket pocket, and bolt pad mating surfaces of the groove-end couplings shall be 8 to 10 mils.

F. Coat exposed grooved-end couplings the same as the adjacent pipe or with fusion-bonded epoxy per Section 099761.

G. Coat the interior metal surfaces of blind flanges per Section 099000, System No. 7.

3.13 COATING BURIED AND SUBMERGED BOLTS, NUTS, AND TIE RODS

Provide stainless steel nuts and bolts for flanges and fittings in buried and submerged service in accordance with Section 400500. Stainless steel nuts and bolts shall be coated with cold-applied wax tape per Section 099752.

3.14 FIELD THICKNESS MEASUREMENT AND REPAIR OF PAINT COATINGS FOR STEEL PIPE

A. Field repair shop applied prime coats per Section 099000.

B. Test linings and coatings per ASTM G62, Method B, with a holiday detector set at 125 volts per mil coating thickness. Repair holidays and pinholes by applying the prime, intermediate, and finish coatings to each holiday or pinhole and retest.

C. Measure the lining and coating thickness on each pipe section using a calibrated coating thickness gauge. Make five separate spot measurements (average of three readings) spaced evenly over every 15 linear feet (or fraction thereof) to be measured. Make three gauge readings for each spot measurement of either the substrate or the paint. Move the

probe a distance of 1 to 3 inches for each new gauge reading. Discard any unusually high or low gauge reading that cannot be repeated consistently. Take the average (mean) of the three gauge readings as the spot measurement. The average of five spot measurements for each area shall not be less than the specified thickness. No single spot measurement in any area shall be less than 80%, or more than 120%, of the specified thickness. One of three readings that are averaged to produce each spot measurement may underrun by a greater amount. If a section of the pipe, item, or piece of equipment does not meet these criteria, remove the entire lining or coating and recoat the entire item or piece of equipment.

D. Thickness determination shall meet the following requirements:

1. No individual reading shall be below 75% of specified thickness.

2. Individual spot readings (consisting of three point measurements within 3 inches of each other) shall have an average not less than 80% of specified thickness.

3. The average of all spot readings shall be equal to or greater than nominal thickness specified.

E. Thickness determinations shall be conducted using a Type 1 magnetic thickness gauge as described in SSPC PA2 specification.

F. If the item has an insufficient film thickness, clean and topcoat the surface with the specified finish coatings to obtain the specified coverage. Sandblast or power-sand visible areas of chipped, peeled, or abraded coating, feathering the edges. Then coat in accordance with the specifications. Work shall be free of runs, bridges, shiners, laps, or other imperfections.

END OF SECTION

SECTION 402020 COPPER TUBING

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, installation, and testing of copper tubing and fittings for water and air service.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Trenching, Backfilling, and Compacting: 312316.

B. Disinfection of Piping and Structures: 331300.

C. General Piping Requirements: 400500.

D. Pressure Testing of Piping: 400515.

E. Manual, Check, and Process Valves: 400520.

F. Wall Pipes, Seep Rings, and Penetrations: 400762.

G. Pipe Hangers and Supports: 400764.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit materials list showing material of tubing and fittings with ASTM reference and grade.

C. Submit manufacturer's catalog data and descriptive literature for wye strainers, unions, and coatings.

D. Submit manufacturer's catalog data and descriptive literature for solder.

PART 2 - MATERIALS

2.01 TUBING

Copper tubing shall conform to ASTM B88. Tubing located above floors or suspended from ceilings shall be Type L, hard drawn, except that tubing utilizing nut-and-ferrule fittings and joints shall be soft annealed (Temper O). Buried tubing or tubing located beneath floor slabs shall be Type K, annealed.

2.02 PIPE AND NIPPLES

Short threaded nipples and pipe shall be brass conforming to ASTM B43 or copper conforming to ASTM B42, regular wall thickness, except that nipples and pipe of sizes 1 inch and smaller shall be extra strong. Threads shall conform to ASME B1.20.1.

2.03 SOLDER JOINT FITTINGS

A. Wrought copper solder joint seamless fittings shall be designed for use with copper water tube and conform to ASTM B75 and ASME B16.22. Material shall be UNS C10200, C12000, or C12200.

B. Cast copper solder joint pressure fitting shall be designed for use with copper water tube and conform to ASME B16.18.

2.04 THREADED FITTINGS FOR BRASS AND COPPER PIPE AND NIPPLES

Cast bronze threaded fittings shall conform to ASME B16.15, Classes 125 and 250. Use Class 125 fittings for test pressures of 200 psi and less. Use Class 250 fittings for test pressures of greater than 200 psi but less than 400 psi.

2.05 NUT AND FERRULE FITTINGS

Fittings shall be brass and of the Swagelok type as manufactured by Crawford Fitting Company, utilizing a nut and dual ferrule design to connect to tubing. End connections shall be of the union type.

2.06 SOLDER

Solder shall be 95-5 (95% tin, 5% antimony) conforming to ASTM B32, Grade Sb5.

2.07 SOLDERING FLUX

Soldering flux shall comply with ASTM B813.

2.08 WYE STRAINERS

Wye strainers shall be bronze, ASTM B61 or B62, with 60-mesh Type 304 or 316 stainless steel screens. Working pressure shall be at least 150 psi. Provide bronze plug on the tapped blowoff outlet. Provide one spare screen for each strainer. Strainers shall be Walworth Figure 3699-1/2, Muessco No. 351, or equal.

2.09 UNIONS

Unions shall be the same size as the pipe or tube, three part, with copper flare end connections. Unions shall be bronze, ASTM B61 or B62. Unions shall be Mueller H-15400, Jones J-1528, or equal.

2.10 INSULATING UNIONS

See Section 264213.

PART 3 - EXECUTION

3.01 GENERAL

A. Piping and tubing penetrations through walls, slabs, and floors shall be as detailed in the drawings and as specified in Section 400762.

B. Pipe and tube hangers and supports shall be as detailed in the drawings and as specified in Section 400764.

3.02 JOINT AND FITTING SELECTION

A. Use soldered joints and fittings in exposed tubing service. Use soldered joints and fittings in buried service.

B. Fittings and joints 3/8 inch and smaller in exposed service may be of the nut-and-ferrule type with flared end connections or compression joint connections.

C. Use threaded joints and fittings in buried and exposed copper and brass piping.

3.03 PRESSURE TESTING

Test copper tubing and piping for leakage in accordance with Section 400515. See Section 400515 for test pressures.

3.04 MAKING SOLDERED JOINTS

A. Tube cutters shall always be sharp. Do not take too deep a cut with each turn of the cutter or back and forth motion of a saw blade.

B. Cut tubing square and remove burrs. Clean both the inside and outside of fitting and pipe ends with steel wool and muriatic acid before soldering. Prevent annealing of fittings and tubing when making connections. Do not miter joints for elbows or notch straight runs of pipe for tees.

C. Make soldered joints in accordance with ASTM B828. Solder shall penetrate to the full depth of the cup in joints and fittings. Solderers shall comply with ASME B31.3, paragraph 333.

3.05 INSTALLING TUBING AND PIPE

A. Do not drag tubing out of tubing rack. Do not drag tubing across cement, asphalt, gravel, or any other surface that could scratch it.

B. Bends in soft copper tubing shall be long sweep. Shape bends with shaping tools. Form bends without flattening, buckling, or thinning the tubing wall at any point.

C. Install tube and pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.

D. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to male pipe threads before installing threaded fitting. Joints shall be watertight.

E. Install buried tubing in accordance with Section 312316.

F. Install aboveground or exposed tubing per Section 400500.

3.06 CONNECTING COPPER TUBING TO STEEL

Provide an insulating union per Section 264213 at the point of transition from copper tubing or piping to ferrous piping.

3.07 INSTALLING UNIONS

Provide unions on exposed piping and tubing 3 inches and smaller as follows:

A. At every change in direction (horizontal and vertical).

B. Downstream of valves, 6 to 12 inches.

C. Every 40 feet in straight tubing and piping runs.

D. Where shown in the drawings.

3.08 CHLORINATION OF POTABLE WATERLINES

See Section 331300.

END OF SECTION

SECTION 402050 FABRICATED STEEL SPECIALS

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and fabrication of steel pipe specials of sizes 4 through 42 inches, in accordance with AWWA C200, C205, and C208 and C226 and the following options and restrictions, for use in transmission and distribution mains.

1.02 SPECIALS

A special is defined as any piece of pipe other than a normal full-length straight section. This includes but is not limited to elbows, manhole sections, short pieces, reducers, adapter sections with special ends, sections with outlets, etc.

At the Contractor's option (at no increase in cost to the Owner) and where specifically required on the Drawings, butt-welding fittings conforming to ANSI-B16.9 shall be used. Butt-welding fittings shall be made of carbon steel conforming to ASTM A234, Grade B, conforming to the pressure rating and coating and lining of the adjacent pipe.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Painting and Coating: 099000.

B. Fusion-Bonded Epoxy Linings and Coatings: 099761.

C. General Piping Requirements: 400500.

D. Pressure Testing of Piping: 400515.

E. General Requirements for Steel Piping: 402001.

F. Steel Transmission Pipe (6 to 42 Inches): 402063.

1.04 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit drawings for fabricated steel specials showing dimensions, wall thickness, reinforcing at openings, type of coating, and lining. Label or number each special and provide the following information:

1. Material of construction, with ASTM or API reference and grade.

2. Paint primer coating, where primer coat is required.

3. Weld sizes and dimensions of grooved-end collars, flanges, reinforcing collars, wrapper plates, and crotch plates.

C. Submit affidavit of compliance with referenced standards (e.g., AWWA C208, ASTM A53, etc.).

D. Submit welding procedure specifications (WPS) and procedure qualification records (PQR) for each welding process and welder qualification records (WQR) for each welder and welding operator.

E. Submit certified original copies of mill test reports on each heat from which steel is rolled. Tests shall include physical and chemical properties. Submit certified original copies of mill test reports for flanges including details of stress relief used. Manufacturer's certificates of compliance with referenced pipe standards, e.g., ASTM A53, ASTM A135, API 5L. Provide recertification by an independent domestic testing laboratory for materials originating outside of the United States.

F. Submit dimensional check reports on each steel pipe special after fabrication.

G. Submit manufacturer's certificates of welding consumables used for shop and field welding.

PART 2 - MATERIALS

2.01 FITTINGS AND SPECIALS

A. Provide cement-mortar lined and coated fabricated steel fittings for buried service.

B. Provide fabricated fusion-bonded epoxy-lined and coated or cement-mortar lined steel fittings for exposed service. Coat mortar-lined fittings per Section 099000, System No. 7.

C. Mortar Lining: See Section 402063.

D. Ends of the fittings shall be compatible with the pipe joint for the particular type of pipe to which the steel fittings or specials connect.

2.02 STEEL FITTINGS

A. A fitting is defined as a special piece of pipe other than a normal straight section. Elbows, tees, crosses, manhole sections, reducers, and sections with outlets are fittings.

B. Unless stated otherwise in the detailed pipe specifications, fittings shall comply with ASME B16.9 or AWWA C208, as follows:

1. Specials and wrought steel butt-welded fittings 4 through 10 inches shall comply with ASME B16.9. Material for carbon steel fittings shall comply with ASTM A234, Grade WPB. Elbows shall be of the long-radius type unless otherwise shown in the drawings.

2. For tees and crosses, comply with ASME B16.9 or AWWA C208, Figure 1 and Table 1. Minimum wall thickness shall be as specified for the pipe cylinder.

3. For reducing tees, laterals, wyes, reducers, and tangent outlets, comply with AWWA C208, Section 4. Reducers complying with ASME B16.9 may also be used.

4. For mitered elbows 42 inches and smaller, provide a minimum radius of 2.5 times the pipe diameter (2.5D) unless otherwise indicated. Provide the number of pieces and wall thicknesses "t" as tabulated below:

Class A (degrees)	**Class B (degrees)**	**No. of Pieces**
0 to 30	0 to 22.5	2
31 to 60	22.5 to 45	3
61 to 90	45 to 67.5	4
	67.5 to 90	5

Pipe Nominal Diameter (inches)	**Design Internal Pressure (psi)**		
	125 or Less	**More Than 125 but Less Than or equal to 200**	**More Than 200 but Less Than or equal to Pmax**
20 and less	Class A (t = 0.375 in.)	Class A (t = 0.375 in.)	Class A (Pmax = 300 psi) (t = 0.375 in.)
More than 20 but less than or equal to 30	Class A (t = 0.375 in.)	Class A (t = 0.375 in.)	Class B (Pmax = 300 psi) (t = 0.375 in.)
More than 30 but less than or equal to 36	Class A (t = 0.375 in.)	Class B (t = 0.375 in.)	Class B (Pmax = 250 psi) (t = 0.500 in.)

5. Elbows fabricated to a minimum centerline radius in excess of 2.5 times the diameter of the pipe may be fabricated from previously tested pipe manufactured in accordance with Section 402063. Minimum thickness shall be equal to the thickest adjacent straight pipe, with a plate offset tolerance at the butt joints of 0 inches. Tolerance may be increased commensurate with an equal increase in thickness.

6. Locate field-welded lap joints no closer than 4 feet 0 inches to a miter.

C. If not otherwise shown in the drawings, assume the design pressure to be 125 psi and a test pressure of 150 psi.

D. Material for fabricated carbon steel fittings 12 through 30 inches in diameter shall be the same as the pipe or shall comply with ASTM A283 (Grade D), ASTM A36, ASTM A572 (all grades), ASTM A1011, or ASTM A1018. Material for fabricated fittings larger than 30 inches shall be the same as the pipe or shall comply with ASTM A572 (all grades). Carbon content: 0.25% maximum.

E. Maximum circumferential stress at the design pressure: 40% of minimum yield stress. Minimum wall thickness of steel fittings other than mitered elbows shall be the same as the pipe of same size per ASME B36.10.

F. Minimum mortar lining thickness of carbon steel fittings shall be 1/4 inch. Mortar lining thickness and I.D. dimensions for specials larger than 10 inches shall be such that the lining inside diameter equals the nominal pipe size.

2.03 FLANGES

See Section 402001.

2.04 BOLTS, NUTS, AND GASKETS FOR FLANGES

See Section 400500.

2.05 OUTLETS AND NOZZLES IN STEEL SPECIALS

See Section 402001.

PART 3 - EXECUTION

3.01 FABRICATION, ASSEMBLY, AND ERECTION OF STEEL SPECIALS

See Section 402001.

3.02 REINFORCEMENT FOR FITTINGS 42 INCHES AND SMALLER

A. Provide additional reinforcement of fittings and specials where noted on the drawings.

B. Where additional reinforcement is not noted on the drawings, the requirement for additional reinforcement of fabricated fittings at branches and openings shall be determined by the procedure given in ASME B31.3, paragraph 304.3 and Appendix H. If additional reinforcement is noted on the drawings or determined by the procedure to be required, it shall be accomplished as described below.

C. Select the type of reinforcement for fittings with outlets from the following table:

$$R = \frac{\text{ID outlet}}{\text{ID main run x sinB}}$$

where B = Angle between the longitudinal axis of the main run and the branch

R	Type of Reinforcement
Maximum of 0.5	Collar
Maximum of 0.7	Wrapper Plate
No limit	Crotch Plate

When outlets are located opposite each other in a special (i.e., a cross), the limiting values of "R" shall be 0.25 and 0.35, respectively.

3.03 COLLAR REINFORCEMENT

A. For collar reinforcement, select an effective shoulder width "W" of a collar from the inside surface of the steel outlet to the outside edge of the collar, measured on the surface of the cylinder of the main run, such that:

$$W = (1/3 \text{ to } 1/2) \text{ x } \frac{\text{ID outlet}}{\text{sinB}}$$

B. For collar reinforcement of tangential outlets, use

$$\text{SinB} = \sqrt{\frac{\text{OD outlet}}{\text{OD main run}}}$$

C. The minimum thickness "T" of the collar is determined by:

$$T = \frac{P \times ID\ main\ run \times ID\ outlet \times (2 - \sin B)}{4 \times F \times W \times \sin B}$$

where:

P = Design pressure
F = Allowable design stress
= 40% of minimum yield stress
B = As in Part 2 above.

D. Collars may be oval in shape or rectangular with rounded corners.

3.04 WRAPPER PLATE REINFORCEMENT

For a wrapper plate, use the above collar formula except that the wrapper is of thickness "T," its total width is (2W + ID outlet/sinB), and it extends entirely around the main pipe diameter portion of the steel fitting.

3.05 CROTCH PLATE REINFORCEMENT

Base crotch plate design on Swanson, H.S. et al., *Design of Wye Branches for Steel Pipes*, summarized in AWWA M11 (2004 edition), Chapter 13.

3.06 FABRICATING MORTAR-LINED MANHOLES AND OUTLETS

Where openings in the pipe shell for manholes, outlets, or other purposes are required, remove a sufficient quantity of the spun mortar lining to accommodate the welding of steelwork at the opening while the lining is in a sufficiently green condition to facilitate its separation from the steel plate surface. Cut the opening in the steel plate and then weld the manhole thimble and reinforcement collar or other steelwork in place. At all times during these operations, keep the spun mortar lining continuously moist. After completion of the welding and of the testing for leakage, remove damaged lining, prepare the interior surfaces, place or restore the lining in the pipe by the pneumatic method, line the manhole or outlet thimble with mortar by hand plastering, and promptly resume the required water spray cure of the lining.

3.07 SHOP TESTING OF FABRICATED SPECIALS

See Section 402001.

3.08 FIELD HYDROSTATIC TESTING

See Section 402001.

END OF SECTION

SECTION 402051 INSTALLATION OF BURIED STEEL PIPE

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes placement of pipelines fabricated of steel, with cement-mortar lining and cement-mortar coating and pipe bedding, pipeline closures, connections, and encasement.

1.02 RELATED WORK DESCRIBED ELSEWHERE

A. General Concrete Construction: 030500.

B. Cathodic Protection and Joint Bonding: 264213.

C. Trenching, Backfilling, and Compacting: 312316.

D. Disinfection of Piping and Structures: 331300.

E. General Piping Requirements: 400500.

F. Pressure Testing of Piping: 400515.

G. General Requirements for Steel Piping: 402001.

H. Fabricated Steel Specials: 402050.

I. Steel Transmission Pipe (6 to 42 Inches): 402063.

1.03 SUBMITTALS

Submit shop drawings in accordance with Section 013300.

A. Submit installation schedule.

B. Submit installation methods for pipes to be installed in casings.

C. Submit weld procedure specifications, procedure qualification records, and welder qualification certificates.

D. Submit schedule for pressure testing and disinfection

PART 2 - MATERIALS

2.01 PIPE MATERIAL

See pipe schedule in drawings.

2.02 BOLTS AND NUTS FOR FLANGES

See Section 400500.

2.03 GASKETS FOR FLANGES

See Section 400500.

PART 3 - EXECUTION

3.01 DELIVERY AND TEMPORARY STORAGE OF PIPE AT SITE

A. Deliver pipe to the areas identified as Contractor Staging area on the approved project drawings. Do not block access to owner facilities.

B. Keep plastic caps in place over the ends of each pipe until immediately prior to installation. Add water to interior of pipe if plastic cap is temporarily removed and replaced or repaired. Do not remove the plastic caps placed over the ends until the pipe is ready to be placed in the trench. Plastic caps may be opened temporarily to spray water inside the pipe for moisture control.

C. Transport pipe to the jobsite on padded bunks with nylon tie-down straps to protect the pipe.

3.02 HANDLING OF PIPE

A. Lift pipes with spreader beams or wide belt slings or as recommended by the pipe manufacturer. Do not use cable slings or chains directly bearing on the pipe. Lift pipes at two points, at approximately 1/3 to 1/4 of the pipe length from the pipe ends.

B. Maintain internal braces placed in pipes 24 inches and larger in diameter until backfilling is completed.

C. Maintain at least one brace at each end of steel pipe to be lined in the field. Provide additional vertical stulls before installing and backfilling welded steel pipe.

3.03 SANITATION OF PIPE INTERIOR

A. During laying operations, do not place tools, dirt, rock, food, clothing, trash, or other materials in the pipe.

B. When pipelaying is not in progress, including the noon hour, close the ends of the pipe with a vermin- and child-proof plug.

3.04 PLACEMENT OF PIPE IN TRENCH

A. Control water in trench per Section 312316.

B. Lay pipes uphill if the grade exceeds 10%.

C. If in rock, complete excavation to a uniform foundation free of protruding rocks. Complete stabilization of foundation, per Section 312316, then place material specified for the bedding in Section 312316 to bring the trench bottom to grade.

D. Place and compact the bedding as detailed in the drawings.

E. Cut a depression to accommodate the pipe bell and external joint filler form and spaces to permit removal of the pipe handling slings.

F. Lay each section of pipe in the order and position shown on the installation schedule. Lower the pipe onto the bedding and install it to line and grade along its full length on firm bedding, except at the bell and at the sling depressions. Tolerances on grade are 1/4 inch. The tolerance on line is 1 inch.

G. At the completion of each day where exposed pipes occur, protect pipe ends by installing a sealed cap until work resumes on the pipeline.

H. When installing beveled pipe, do not deviate from the pipe top mark by more than 2 inches from the vertical line passing through the pipe center.

I. Elongate the vertical diameter of welded steel pipe 1%. Do not remove the stulls until the backfill is complete.

3.05 FLANGED CONNECTIONS

A. Lubricate nuts and bolts per Section 400500 prior to installation.

B. Coat flanges and bolts and nuts with wax tape per Section 099752 and provide polyethylene sheet per Section 099754

3.06 FIELD WELDED JOINTS

A. Provide welded joints where detailed in the drawings.

B. Field welding and welder's qualification shall be in accordance with AWWA C206 except as modified herein. Welder's qualification shall be in accordance with Section IX, Part QW, of the ASME Boiler and Pressure Vessel Code. Any welder performing work shall have been qualified for the process involved within the past three years.

C. Where interior joint welds are detailed in the drawings, backfill to 1 foot over the pipe except at the joints. Complete the interior weld prior to filling the outside joint recess with cement mortar.

D. In lieu of exterior welded joints, the interior may be welded where the pipe diameter is 30 inches or greater.

E. If joint rings are rusted or pitted where weld metal is to be deposited, clean them by wire brushing or sand blasting.

F. Preheat the joints to be welded where required in accordance with Table 1 of AWWA C206.

G. To apply a fillet weld to the exterior joint, caulk the recess between the bell and spigot with a rod and weld two or more passes. Complete each pass around the entire circumference of the pipe before commencing the next pass. Use the electrodes recommended by the pipe fabricator. Do not deposit more than 1/8 inch of throat thickness per pass.

H. Complete each pass around the entire circumference of the pipe before commencing the next pass. Use the electrodes recommended by the pipe fabricator. Do not deposit more than 1/8 inch of throat thickness per pass.

I. Do not heat the concrete adjacent to the joint rings.

J. Clean each layer of deposited weld metal prior to depositing the next layer of weld metal, including the final pass, by a power-driven wire brush.

K. Provide closure lap joints at intervals of approximately 500 feet either by lengthening the bell to provide 3 inches of longitudinal adjustment beyond the normal lap-joint requirements or by using a butt strap. Set the special closure lap joints so that the pipe will be stabbed deeper than the normal closed position to such an extent that upon cooling and contraction of the pipe, the final closure-joint weld may be made at the approximate normal closed position. Weld all joints either side of the closure joints. Weld the closure joints during the coolest hour of the 24-hour day. When possible, the closure-joint welds shall be made when the steel temperature is approximately equal to the lowest operating temperature.

3.07 PIPELINE CLOSURE ASSEMBLIES

A. Field trimming of pipe when approved by the Owner's Representative shall be normal to the axis of the pipe only.

B. Employ pipeline closure assemblies to connect sections of pipeline laid from opposite directions and to adjust the field length of the pipeline to meet structures, other pipelines, and points established by design stations. Select either follower ring design or butt strap design. Install follower ring closures as recommended by the pipe manufacturer.

C. Center the shaped steel butt straps over the ends of the pipe sections they are to join. On pipes 39 inches in diameter and smaller, weld the butt straps to the outside of the pipes with complete circumferential fillet welds equal in size to the thinnest part being joined. Refer to the details shown in the drawings when joining larger pipes.

D. Cement-mortar line closure assemblies to a mortar thickness at least equal to the adjoining standard pipe sections. Clean the steel with wire brushes and apply a cement and water wash coat prior to applying the cement mortar. Where more than a 4-inch joint strip of mortar is required, place welded wire mesh reinforcement in 2-inch by 4-inch pattern of No. 13 gauge over the exposed steel.

E. Install the mesh so that the wires on the 2-inch spacing run circumferentially around the pipe. Crimp the wires on the 4-inch spacing to support the mesh 3/8 inch from the metal pipe surface. Steel-trowel finish the interior mortar to match adjoining mortar-lined pipe sections.

F. Coat the exterior of closure assemblies with mortar, or pour a concrete encasement, to cover all steel by at least 1 1/2 inches. Protect exterior mortar to retard drying while curing.

3.08 OPERATIONS INCIDENTAL TO JOINT COMPLETION

A. Install metallic jumper bond or bars where detailed in the drawings.

B. Plan joint completion to accommodate temporary test bulkheads for hydrostatic testing.

3.09 COMPLETION OF INSIDE MORTAR JOINTS FOR PIPES 24 INCHES IN DIAMETER AND SMALLER

A. Insert a tight-fitting swab or squeegee in the joint end of the installed pipe to be joined.

B. When ready to insert the spigot, coat the face of the cement-mortar lining at the bell with a sufficient amount of stiff cement and water mortar to fill the space between adjacent mortar linings of the two pipes to be joined.

C. Immediately after joining the pipes, draw the swab or squeegee through the pipe to remove all excess mortar and expel it from the open pipe end.

3.10 COMPLETION OF INSIDE MORTAR JOINTS FOR PIPES GREATER THAN 24 INCHES IN DIAMETER

A. Backfill the trench before applying interior lining at field welded joints.

B. Working inside the pipe, remove foreign substances that adhere to the steel joint rings, clean them, and pack cement mortar into each joint. Finish the surface with a steel trowel to match the adjoining pipes.

C. Remove excess mortar and other construction debris from the pipe interior.

3.11 COMPLETION OF EXTERIOR PIPE JOINTS UTILIZING STEEL JOINT RINGS

A. Fill outside joint recess with cement-mortar grout using a fabric form placed around the joint and secured with steel straps.

B. Apply cement mortar to the outside of buried joints per Section 4.7.3 of AWWA C205. Use foam-lined diapers to bridge the outside of the buried joint and maintain the specified mortar coating thickness. Pour and rod the mortar from one side only until it is visible on the opposite side.

C. In approximately one hour, top off the joint with additional grout and shade with backfill material.

D. Start the backfilling operations specified in Section 312316 immediately after completion of the field joints.

3.12 REMOVAL OF INTERNAL BRACING

A. Do not remove the stulls placed in welded steel pipe until the backfill is completed.

B. Do not remove the cross bracing in pipe to be encased until the encasement and subsequent backfill is completed.

3.13 PIPE EMBEDMENT

Provide sufficient space along each side of the pipe and the trench wall to observe that the embedment material fills all spaces below pipe spring line under the pipe haunches.

3.14 PROTECTION OF MORTAR LINING

Until the pipeline is filled with water, install bulkheads and apply moisture inside the bulkheaded portions in a manner that will effectively prevent the drying out of the mortar lining.

3.15 PLACEMENT OF PIPE IN CASINGS

A. Join one section of pipe at a time. Do not damage pipe by dragging or sliding on concrete or asphalt. Use pipeline casing insulators to move pipe through casing.

B. Install casing spacers at the spacing shown on the drawings.

C. Do not allow contact between exposed metal of pipe and metal casing or liner plates.

D. Limit diameter variations to 1% of the nominal diameter.

END OF SECTION

SECTION 402063 STEEL TRANSMISSION PIPE (6 TO 42 INCHES)

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, fabrication, and testing of cement-mortar lined and cement-mortar coated welded steel pipe with fittings and special pieces, fabricated in accordance with AWWA C200 and C205, and the following. Size range is 6 inches through 42 inches.

1.02 SPECIALS

A special is defined as any piece of pipe other than a normal full length of straight section. This includes elbows, manhole sections, short pieces, reducers, adapter sections with special ends, sections with outlets, etc. Fabricate specials in accordance with Section 402050.

1.03 RELATED WORK SPECIFIED ELSEWHERE

A. Painting and Coating: 099000.

B. Cathodic Protection and Joint Bonding: 264213.

C. Trenching, Backfilling, and Compacting: 312316.

D. Disinfection of Piping and Structures: 331300.

E. General Piping Requirements: 400500.

F. Pressure Testing of Piping: 400515.

G. Flexible Pipe Couplings and Expansion Joints: 400722.

H. General Requirements for Steel Piping: 402001.

I. Fabricated Steel Specials: 402050.

J. Installation of Buried Steel or Concrete Pipe: 402051.

1.04 QUALIFICATIONS OF MANUFACTURERS

A. Pipe lining and coating, whether factory applied or field applied, is an element of the completed pipe. Only manufacturers who provide completed lined and coated pipe are considered qualified for project work.

B. Supervisors of cement-mortar coating operations shall have at least two years of continuous recent experience in the application of cement-mortar coating systems for steel pipe.

1.05 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit detailed shop drawings for the pipe together with erection profile drawings showing:

1. The location, order of installation, length, internal diameter, plate or sheet thickness, and designation by number of each steel pipe section and fabrication.

2. The centerline station and elevation to which the spigot end of each pipe, within the limits of horizontal or vertical curve and at changes of grade or elevation, will be laid.

3. The elements of curves and bends, both in horizontal and vertical alignment, including elements of the resultant true angular deflections in cases of combined curvature.

4. Pipe internal diameter, wall thickness, location of welded seams, and design internal pressure.

5. The limits of each reach of field-welded joints and of concrete encasement.

6. Locations of longitudinal and circumferential joints in the pipe, fabricated fittings, manholes, and cylinders for cast-in-place pipe.

7. Details and locations of bulkheads for hydrostatic testing of pipeline.

8. Details and locations of closures for length adjustment and for construction convenience.

9. Locations of manholes and other points of access including for placement of mortar lining at field joints and removal of test bulkheads.

10. Locations of valves and other mechanical equipment.

C. Submit shop drawings for specials and fittings per Section 402050.

D. Submit joint details.

E. Submit details of lining and coating.

F. Submit drawings of butt straps, couplings, flanges, and expansion joints which are to be supplied separately.

G. Submit details of bulkheads and of their method of attachment to the pipeline.

H. Submit certified original copies of mill test reports for each heat from which steel is rolled. Tests shall include physical and chemical properties.

I. Submit certified original copies of mill test reports for flanges including details of stress relief used.

J. Submit manufacturer's certificates of compliance with referenced pipe standards, e.g., ASTM A53, ASTM A135, API 5L. Provide recertification by an independent domestic testing laboratory for materials originating outside of the United States.

K. Submit dimensional check reports for each steel pipe section after fabrication.

L. Submit certificates of welding consumables used for shop and field welding.

M. Submit welding procedure specifications (WPS) and procedure qualification records (PQR) for each welding process and welder qualification records (WQR) for each welder and welding operator. Submit bend and tensile test coupons concurrently with welder qualification and procedure qualification records.

N. Submit test reports on physical properties of rubber used in the gaskets.

O. Cement: Submit test reports from the supplier showing that the cement delivered to the work complies with the specifications.

P. Sand: Submit sieve analysis, ASTM C136; test of organic impurities in sands for concrete, ASTM C40; test of the effect of organic impurities in fine aggregate on the strength of mortar, ASTM C87.

Q. Submit affidavits of compliance with referenced standards (e.g., AWWA C200, C203, etc.) with each required submittal.

PART 2 - MATERIALS

2.01 DESIGN CRITERIA

A. Weld all joints except at couplings or as otherwise shown on drawings.

B. Obtain the following information from the drawings:

1. Elevation of the pipe centerline and of the final ground surface.
2. Alignment of the pipeline.
3. Internal diameter (ID).

C. Pipe Design Pressure: 125 psi.

D. Field Hydrostatic Test HGL: 150 psi.

E. Specials: See Section 402050.

2.02 STEEL SHEET OR PLATE

A. ASTM A36 (36,000 psi); ASTM A283, Grade C (30,000 psi) or Grade D (33,000 psi); ASTM A285, Grade C or D; ASTM A1011, Grade 30 (30,000 psi) or Grade 33 (33,000 psi); ASTM A1018, Grade 33 (33,000 psi).

B. Order the steel plate and sheet by thickness with a maximum allowable variation of not more than 0.01 inch less than the thickness specified. The maximum yield strength shall be 53,000 psi.

C. The carbon content shall not exceed 0.25%. The steel shall have a maximum carbon equivalent (CE) of 0.45%.

2.03 MILL-MANUFACTURED STEEL PIPE

ASTM A53, Type E or S, Grade B; ASTM A106, Grade B; or ASTM A135, Grade B. Minimum wall thickness shall be standard weight per ASME B36.10.

2.04 MORTAR LINING AND COATING

Comply with pipe schedule in drawings. If a pipe is not listed on the drawings, refer to LVMWD Standard Specifications, Section 1.3.

2.05 FLANGES

A. See Section 402001.

B. Provide forged steel slip-on flanges or welding neck flanges for companion flanges and connections.

2.06 BOLTS, NUTS, AND GASKETS FOR FLANGES

See Section 400500.

2.07 LENGTH OF PIPE SECTIONS

For diameters of 30 inches and greater: up to 40 feet; for smaller diameters: 30 feet or less unless spreader beams are used in lifting the pipe sections at the third points, in which case lengths up to 40 feet may be used.

2.08 TYPE OF PIPE ENDS FOR PIPE 24 INCHES AND SMALLER

Slip joint for field lap welding.

2.09 TYPE OF PIPE ENDS FOR PIPE LARGER THAN 24 INCHES

Expanded bell and Carnegie spigot for field-welded lap joints except where other ends are detailed in the drawings or where butt-strap or flanged joints are used.

2.10 OUTLETS AND NOZZLES

See Section 402001.

2.11 FITTINGS AND SPECIALS

See Section 402050.

2.12 FLANGE INSULATION KITS AND OTHER CATHODIC PROTECTION MATERIALS

See Section 264213.

2.13 PREFORMED JOINT-FILLER MATERIAL, BACKING ROD, AND BOND BREAKER FOR PIPES PENETRATING CONCRETE WALLS OR ENCASED IN CONCRETE

A. Preformed joint-filler material shall be of the preformed nonextruding-type joint filler constructed of cellular neoprene sponge rubber or polyurethane of firm texture. Do not use bituminous fiber-type joint filler. No-extruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D1752 for Type I.

B. Backer rod shall be an extruded closed-cell polyethylene foam rod. The material shall be compatible with the joint sealant material used and shall have a tensile strength of not less than 40 psi and compression deflection of approximately 25% at 8 psi. The rod shall be 1/8 inch larger in diameter than the joint width, except that a 1-inch-diameter rod shall be used for a 3/4-inch-wide joint.

C. Bond breaker shall be Super Bond Breaker as manufactured by Burke Company, San Mateo, California; Hunt Process 225-TU as manufactured by Hunt Process Co., Santa Fe Springs, California; Select Cure CRB as manufactured by Select Products Co., Upland, California; or equal. It shall contain a fugitive dye so that areas of application will be readily distinguishable from concrete.

2.14 SHOP-APPLIED PROTECTIVE COATING FOR PIPE TO BE ENCASED IN CONCRETE, JOINT RINGS, SEEP RINGS, AND THRUST RINGS

Use System No. 18 per Section 099000.

2.15 SHOP-APPLIED PROTECTIVE COATING FOR BARE STEEL DURING SHIPPING

Use System No. R per Section 099000.

PART 3 - EXECUTION

3.01 FABRICATING LONGITUDINAL, SPIRAL-SEAM, AND GIRTH WELDS FOR PIPE SMALLER THAN 36 INCHES

Fabricate the pipe cylinder by full penetration butt-welding: spiral seam or straight seam. Limit girth welds to two per pipe section, full penetration butt-welded. Limit longitudinal welds to one seam for pipe diameters up to 30 inches and two seams for 30- to 36-inch diameters. Stagger longitudinal and spiral-seam joints of adjacent shell courses.

3.02 FABRICATING LONGITUDINAL, SPIRAL-SEAM, AND GIRTH WELDS FOR PIPE 36 INCHES AND LARGER

A. Fabricate the pipe cylinder by full penetration butt-welding: spiral seam or straight seam. When using straight seams, fabricate pipe with either a single longitudinal seam and multiple courses of from 7 feet 6 inches to 10 feet, or else with a single course having not more than the number of longitudinal seams shown in the following table:

Pipe Nominal Diameter (inches)	**No. of Seams**
36 to 60	2
61 to 90	3
91 to 120	4

B. Where more than one longitudinal seam is used, the plates shall be of equal widths. Stagger the longitudinal joints of adjacent courses.

C. When using spiral seams, coil splices shall be a minimum of 2 feet away from the ends of the pipe cylinder.

3.03 FABRICATING LAP JOINTS

Design and fabricate lap joints of the bell-and-spigot type such that, when properly assembled in the field, the maximum clearance between faying surfaces and weld location restrictions specified will not be exceeded. For purposes of this section, faying surfaces are the overlapping surfaces at the pipe joint.

3.04 GENERAL REQUIREMENTS FOR FORMING PIPE 36 INCHES AND LARGER

A. Before rolling or forming longitudinal edges, plates shall be lap broken by a continuous rolling operation or be formed in a press having dies that are machined to the proper radius. The pressure exerted during the lap breaking operation shall be sufficient to secure a true and uniform curve at the edges of the plate. Roll or press form plates to the specified diameter.

B. Continually remove scale and other foreign matter accumulating on the plate during the rolling and forming operation by an air blast so that it will not be rolled or pressed into the surface of the plate. Keep the surfaces of breaker dies and rolls clear of bits of metal or other accumulated materials during forming operations.

C. Form each section of pipe to a true circle of the specified diameter throughout its entire length so as to produce a finished pipe truly round and free from dents, kinks, and abrupt changes in curvature. The outside circumference of the finished pipe shall not be less than its design value and shall not exceed its design value by more than 0.4%.

D. Complete rolling and forming prior to making butt welds.

E. Do not heat or hammer for any forming operation.

F. Minimum Radius: Do not use any forming process in which the plates are bent or otherwise formed during any stage of the process to a curvature of appreciably smaller radius than the radius of curvature corresponding to the specified diameter of the pipe.

3.05 FORMING BELLS

A. Shape the bells to accommodate the spigot penetration shown in the drawings or specified herein. Form the bell on an expanding press or by being thrust axially over a die in such a manner as to stretch the steel plate beyond its elastic limit to a round bell of required diameter and shape, avoiding injurious reduction in plate thickness at any point and avoiding impairment of the physical properties of any part of the plate.

B. Do not use any process in which the bell is formed by rolling.

C. Bells for mitered pipe shall be normal to the axis of the adjacent course of the adjoining pipe, and the axis of any such bell shall be parallel to the axis of such adjacent course.

3.06 PREPARATION OF EDGES

A. Machine or face the ends and edges of plates or sheets for butt welds. Inspect sheared edges of plates or sheets over 1/4 inch in thickness for cracks. Do not use plates or sheets with edges containing such cracks.

B. If the ends are faced with a cutting torch, remove irregularities and scale due to burning by grinding or chipping.

C. The dimensions and shape of the edges of the plates to be joined by welding and the gap between the plates shall be such as to allow thorough fusion and complete penetration. Form the edges of plates to accommodate the various welding conditions. Remove projecting burrs. Do not use hammering to shape the edges preparatory to welding.

D. Cut plates true to line so that the edges, when in position for welding, shall be straight, parallel, and in contact on longitudinal seams.

E. The maximum gap or offset between the edges of plates and sheets shall not be more than 1/6 the thickness or 1/16 inch, whichever is less.

3.07 PREPARATION FOR WELDING

A. Take special care in the layout of joints in which fillet welds are to be used in order to ensure the fusion of the weld material at the bottom of fillet. Prior to welding, fit the plates closely. During welding, hold them firmly together.

B. Tack weld or clamp in place the edges of butt joints in proper alignment and so hold throughout the welding process. Do not use dogs, clips, lugs, or equivalent devices welded to the steel plate for the purpose of forcing it into position.

C. Prior to welding, clean the surfaces of plates and sheets to be welded by an automatic process of all scale and rust for a distance of not less than 1 inch and of all oil or grease for a distance of not less than 3 inches from the welding edge and on both sides of the plates in the case of butt joints.

D. Remove grease or oil with lye or other solvent. Do not use kerosene or any heavier petroleum solvent.

E. Perform blasting and other cleaning prior to any tack welding of steel. Should inspection indicate a greater amount of porosity at the tack welds than in the remainder of the welds, sandblast the tack welds prior to automatic welding.

F. Depositing Weld Metal Over a Previously Welded Surface: Remove all scale, slag, and welding flux thereon by a roughing tool, chisel, air chipping hammer, or other means to prevent inclusion of impurities in the weld metal. Perform peening at an angle to avoid driving impurities into the weld.

3.08 ALIGNING BUTT-WELDED JOINTS (SHOP WELDING)

Align the edges to be joined so that complete penetration and fusion of the joint is accomplished. The offset in abutting edges shall not exceed 1/16 inch at circumferential seams and shall not exceed 1/32 inch at longitudinal seams.

3.09 FABRICATION, ASSEMBLY, AND ERECTION

A. See Section 402001.

B. Make welds in such manner and on such time schedule as to avoid residual internal stresses in the welded joints and stresses due to temperature changes in the completed pipelines. Weld longitudinal seams before girth seams.

C. There shall be no greater evidence of oxidation in the metal of the weld than in the metal of the unwelded plate. Welded joints shall be of a type that will produce complete fusion of the plates and shall be free from unsound metal, pinholes, porosity, and cracks.

D. Any pipe section which shows irregularities in shape after welding may be rerolled to make it cylindrical but in no case shall it be reformed by hammering. In no event shall reforming be permitted of pipe sections which after welding are found to have abrupt changes in curvature at longitudinal seams, unless such welds are subsequently removed and rewelded following the reforming operation.

3.10 SHOP LONGITUDINAL, SPIRAL-SEAM, AND CIRCUMFERENTIAL JOINTS

A. Where welding on pipe smaller than 24 inches is done from one side only, remove the bead on the inside of the pipe by chipping or grinding so that the finished weld on the inside of the pipe will be practically flush with the plates. The inside bead will in no case be required to be larger than the outside bead but shall be of sufficient size so that, upon its removal, the inside fusion lines and any defects near the under surface of the weld metal will be exposed.

B. If complete penetration and reinforcement on both sides of butt-welded joints are not satisfactorily accomplished when the welding is done from one side, then chip out the reverse side to the extent necessary to secure a clean surface of the originally deposited weld metal and make an automatic welding pass on the reverse side. The bead on the inside of the pipe shall be not more than 1/16 inch in height, and the width of the bead shall be not less than 3/8 inch with smoothly tapered edges. Before making the second weld, chip out the underside of the first weld with a round-nosed tool until entirely solid and clean metal is reached.

C. There shall be no valley, groove, or undercut along the edge of or in the center of the weld. The deposited metal shall be fused smoothly and uniformly into the plate surface at the edges of the joint.

D. If the normal welding process is interrupted for any reason, take special care when welding is resumed to get full penetration and thorough fusion between the weld metal and the plates and the weld metal previously deposited. Where welding is interrupted by faulty machine operation, chip back the weld to where the presence of solid, clean metal indicates correct machine operation before resuming welding operations.

E. Shop circumferential joints shall be double butt-welded. The details of shop circumferential joints shall conform to the requirements for longitudinal joints, provided that the inside weld shall be made first. Circumferential joints in bends and welded fabricated fittings need not be made by automatic welding methods.

3.11 FABRICATING PLATE FLANGES AND CROTCH PLATES

When plate flanges or crotch plates are made from butt-welded segments, do not place the joints between segments adjacent to longitudinal joints in adjoining steel plate sections. Stress-relieve flanges and crotch plates made from butt-welded segments. Stress relief shall be as specified in the ASME Pressure Vessel Code, Section VIII, Part UW.

3.12 SHOP TESTING OF FABRICATED OR WELDED COMPONENTS--GENERAL

A. Test each component after completion of fabrication and welding in the shop and prior to the application of any lining or coating.

B. See Section 402001.

3.13 ADDITIONAL REQUIREMENTS FOR SHOP TESTING OF PIPE 36 INCHES AND LARGER

A. Test each section of steel pipe with the joint rings attached in the shop by the hydrostatic test method.

B. Test each section of fabricated bend. Use the hydrostatic test method.

C. Test each section of pipe with manholes and outlets attached after completion of the shop hydrostatic test per Section 402001.

3.14 HYDROSTATIC, RADIOGRAPHIC, ULTRASONIC, SOAP AND COMPRESSED AIR, LIQUID PENETRANT, AND MAGNETIC PARTICLE TEST METHODS

See Section 402001.

3.15 LONG RADIUS CURVES AND VERTICAL CURVES

A. For curved alignment, use straight or beveled pipe of normal or one-half normal lengths pulled partially open on one side of the joint or use pipes with a welded mitered bend of up to 10 degrees next to the joint ring. Design pipes with a bend in excess of 10 degrees as specials.

B. Deflections of Square-Ended Pipe: The angular deflection at any field joint in square-ended pipe shall not exceed a pull of one-half the watertight extensibility of the joint. Do not use angular deflections at butt-strap joints.

C. Beveled Pipe: Use pipe sections having beveled bell ends for curves and angles in the alignment which cannot be accomplished using the maximum allowable deflection at square-ended pipe joints. Beveled pipe sections used in curved alignment shall be of standard length except when shorter sections are required to limit the radius of curvature in which case all sections shall be of equal length. Do not bevel spigot ends. The beveled end of a pipe shall not have a deflection from a plane perpendicular to the pipe axis exceeding 5 degrees.

D. Fabricated Bends:

1. Do not use fabricated bends for angles in the alignment unless shown in the drawings or permitted by the Owner's Representative. Deflection between the centerline of adjacent courses shall not exceed 11-1/4 degrees, and girth seams shall be double butt-welded in the shop.

2. Radius of curvature for the axis of fabricated bends: See Section 402050.

3.16 MANHOLES, OUTLETS, PASS HOLES, AND CLOSURES

A. See Section 402050.

B. Manhole and outlet sleeves shall be vertical unless otherwise shown in the drawings.

C. Forged Steel Outlets for Convenience: The Contractor may also provide, at his own expense, forged steel threaded outlets for use in passing hose or lead wires into the pipe. Tap the outlets standard pipe thread, weld to the pipe, and close after use with solid forged steel plugs. The plugs shall not project beyond the inner surface of the pipe shell. Retap the pipe thread in the outlet to correct any distortion caused by welding. Apply a seal weld made by at least two passes around the inside or outside of the plug after it has been inserted in final position in the field.

D. Coat outlets, plugs, and closures inside and outside to match the adjacent coated surfaces in the same manner as specified for outlets and as required at field joints in the pipe.

E. Closures: Furnish closing courses and short sections of pipe to ensure the correct location of outlets, angles, and other pipeline features and to accommodate the pipeline installation, lining, and field-testing programs. Closing courses and short sections of steel pipe shall be not less than 4 feet in length. Accurately form the inside diameter of butt-straps to match the largest outside diameter of the adjacent steel cylinders to which they are to join.

3.17 APPLICATION OF COATINGS

A. Mixing Mortar for Shop Coating Machine and Shop Pneumatic Placement: Thoroughly mix the sand and cement in a dry state before depositing in the placing machine or its hopper. The mixing operation shall continue for a period of not less than one minute after all sand and cement is placed in the mixer. The sand shall contain or be moistened with 5% to 10% of water by volume and shall not be mixed with the cement until just before placing in the hopper in order to minimize partial setting of the cement. Use dry-mixed materials promptly after mixing. Discard any materials that remain in the hopper longer than 45 minutes after mixing. Rebound, recovered clean and free of foreign matter, may be reused as sand in a quantity not to exceed 20% of the total sand requirements.

B. Perform the entire coating operation as a one-station operation where the pipe is supported at the ends in a manner that will permit the application of the specified coatings. No additional handling following the initial setup of the pipe section, from application of primer and cement-mortar coating, will be allowed. No application involving rollers to support the pipe during the primer application or cement-mortar coating application will be permitted.

C. Coat the exposed pipe ends at flexible pipe couplings per Section 099000, System No. 7.

D. Paint the exposed portion of pipe to be encased in concrete, joints, seep rings, and thrust rings per Section 099000, System No. 18.

E. See Section 402001 for additional requirements.

3.18 PROTECTING MORTAR-LINED PIPE

Immediately after the mortar lining has been completed, place internal bracing at the uncoated ends of the pipe to prevent the maximum and minimum diameter at any point from deviating 1/2% of the nominal diameter and leave in place until stulls or bracing are placed in the pipe as required by the specifications or shown in the drawings for installing steel pipe, except that braces may temporarily be removed when the pipe is placed in the coating machine and replaced immediately after removing the pipe from the coating machine. After the lining has received the minimum cure and prior to the mortar coating, add additional interior braces, if required. Where braces are placed on coated areas, provide sufficient bearing surface at the ends of the braces inside the pipe so no damage will be done to the mortar lining. After installation of the pipe, remove any damaged lining and replace it with new pneumatically applied mortar lining.

3.19 INSTALLING BLIND FLANGES

See Section 400500.

3.20 PRODUCT MARKING

See Section 402001.

3.21 DELIVERY

See Section 402051.

END OF SECTION

SECTION 402078 STAINLESS STEEL TUBING

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section includes materials and installation of stainless steel tubing and fittings 2 inches in diameter and smaller.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Trenching, Backfilling, and Compacting: 312316.

B. General Piping Requirements: 400500.

C. Pressure Testing of Piping: 400515.

D. Manual, Check, and Process Valves: 400520.

E. Wall Pipes, Seep Rings, and Penetrations: 400762.

F. Pipe Hangers and Supports: 400764.

G. General Requirements for Steel Piping: 402001.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit materials list showing material of pipe and fittings with ASTM reference and grade. Submit manufacturer's catalog data for swaged fittings and joints.

C. Submit fitting manufacturer's instructions for assembling fittings and joints.

PART 2 - MATERIALS

2.01 TUBING

A. Tubing shall conform to ASTM A269, Grade TP 316, seamless. Hardness shall not exceed Rockwell B80. Tube wall thicknesses shall be as follows:

Tube O.D. (inches)	Minimum Wall Thickness (inches)	Tube O.D. (inches)	Minimum Wall Thickness (inches)
1/8	0.028	3/4	0.065
3/16	0.028	7/8	0.072
1/4	0.028	1	0.083
5/16	0.035	1 1/4	0.109
3/8	0.035	1 1/2	0.134
1/2	0.042	2	0.165
5/8	0.058		

B. Tubing shall be free of scratches. Tubing shall be suitable for bending and flaring.

C. Tubing shall be heat-treated, which shall consist of quenching in water or rapidly cooling by other means at a rate sufficient to prevent precipitation of carbides, as demonstrated by the capability of passing practice ASTM A262, Practice E (Supplementary Requirement S4 in ASTM A269).

2.02 FITTINGS AND JOINTS

A. Fittings and joints shall be of the SWAGELOK type as manufactured by Crawford Fitting Company, utilizing a nut and dual ferrule design to connect to tubing. Fitting and joint material shall comply with ASTM A479, Type 316, or ASTM A182, Grade F304. End connections shall be of the union type.

B. Joints connecting two straight tubes together shall be of the nut and ferrule union type.

2.03 PROTECTIVE END CAPS

Provide protective end caps on each piece of tubing, completely sealing the piece from contamination during shipment and storage. Provide the same type of seals on each fitting, or ship and store fittings in sealed boxes or containers.

2.04 OUTLETS AND NOZZLES

Use a tee with nut and ferrule union ends to connect to the tubing and with an outlet to match the connecting valve or instrument.

2.05 CONNECTIONS TO THREADED-END VALVES

When connecting tubing to threaded-end valves, provide tube to female NPT connectors. Provide a threaded Schedule 80S Type 316 stainless steel nipple (ASTM A312, seamless) between the connector and the valve end.

2.06 SPARE PARTS

A. Provide the following spare parts:

Quantity	Description
6	Nuts of each size used on the project
2	Hydraulic swaging units

B. Pack the spare parts in a wooden box; label with the manufacturer's name and local representative's name, address, and telephone number; and attach list of materials contained therein.

PART 3 - EXECUTION

3.01 INSTALLING TUBING

A. Do not drag tubing out of tube racks. Do not drag tubing across any surface that could scratch it.

B. Keep tube cutters and saws sharp. Do not cut too deeply with each turn of the cutter or motion of the saw.

C. Deburr tube ends before inserting into fittings and joints. Clean both the inside and outside of fitting and pipe ends before making up joints. Do not miter joints for elbows or notch straight runs of pipe for tees. Do not kink tubing.

D. Bends in tubing shall be long sweep. Provide the straight length of tubing recommended by the fitting and joint manufacturer to allow the tube to be inserted into the fitting. Shape bends with shaping tools. Form bends without flattening, buckling, or thinning the tubing wall at any point. Do not use bends to make turns greater than 45 degrees. Use fittings to make turns greater than 45 degrees.

3.02 INSTALLING BURIED TUBING

Install in accordance with Section 312316.

3.03 INSTALLING EXPOSED TUBING

A. Install tubing without springing, forcing, or stressing the tubing or any adjacent connecting valves or equipment.

B. Provide pipe hangers and supports as specified in Section 400764.

3.04 INSTALLING FITTINGS AND JOINTS

A. Follow the manufacturer's instructions for installing fittings and joints.

B. For fittings and joints larger than 1 inch, use the manufacturer's hydraulic swaging unit to make up the connections.

3.05 FIELD HYDROSTATIC TESTING

A. See Section 402001.

B. Do not allow test water to remain in the tubing for more than five days. Drain and dry the tubing after completing the testing.

END OF SECTION

SECTION 402350 DRAINAGE AND PLUMBING PIPING

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials, installation, and testing of drainage and plumbing piping associated with structures, and equipment. Piping includes drain and underdrain piping. This Section does not pertain to Storm Drain piping 18” or larger.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Painting and Coating: 099000.

B. Trenching, Backfilling, and Compacting: 312316.

C. General Piping Requirements: 400500.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit data sheets for each type of drainage piping. Provide confirmation that proposed pipe and/or fittings meet the referenced specifications.

PART 2 - MATERIALS

2.01 NATIONAL SANITATION FOUNDATION MARKING

The National Sanitation Foundation marking is not required for piping in nonpotable water drainage service.

2.02 MATERIAL SELECTION

The piping material for a particular service is indicated in the drawings.

2.03 PVC DRAINPIPE AND FITTINGS (PVC-DRAIN)

A. Materials shall conform to ASTM D1784, Type I Grade 1 (Cell Classification 12454-B) or Type I Grade 2 (Cell Classification 12454-C).

B. Pipe shall be PVC plastic pipe conforming to ASTM D1785, Schedule 80.

C. Fittings and Couplings:

1. Threaded-type fittings and couplings shall be PVC plastic pipefittings conforming to ASTM D2464, Schedule 80. Size range 1/8 through 6 inches.

2. Schedule 80 socket-type fittings and couplings shall be PVC plastic pipefittings conforming to ASTM D2467. Size range 1/8 through 12 inches.

D. Solvent cement shall conform to ASTM D2564 for interference-type joints in sizes 1/8 through 6 inches. Follow fitting manufacturer's recommendations for larger sizes and all noninterference-type joints.

2.04 PVC PERFORATED UNDERDRAIN PIPE AND FITTINGS (PVC-UNDERDRAIN)

A. Pipe shall be perforated or nonperforated PVC sewer pipe and drainpipe conforming to ASTM D2729. Leak detection pipe under the Reservoir shall be perforated only in their designated quadrants. See drawings.

B. Perforations shall be two rows of 1/2-inch-diameter holes, 5 inches on centers, with rows separated by 120 degrees of arc centered at pipe bottom.

C. Couplings shall be PVC.

D. Fittings shall be nonperforated PVC fittings conforming to ASTM D2729.

2.05 FILTER BEDS FOR UNDERDRAINS

A. Use crushed rock in conjunction with an outer envelope of filter fabric to form a permeable encasement around the perforated underdrain piping.

B. Crushed rock shall be uncombined coarse aggregate for portland cement concrete conforming to ASTM C33, Class Designation 3S. Determine gradation as provided below, depending upon the size of perforations in the underdrain piping:

1. At least 50% of the product, measured by weight, shall be retained on an ASTM E11 standard series sieve of same nominal size as the perforation diameter. Alternatively, at least 50% of the product, measured by weight, shall be retained on an ASTM E11 standard series sieve that is 20% larger in size than the width of the perforation slot.

2. In no case shall the gradation be finer than size No. 8 (3/8 inch to No. 8).

C. Filter fabric shall conform to Section 313219.

PART 3 - EXECUTION

3.01 INSTALLING ABOVEGROUND AND EXPOSED PIPING

A. See Section 400500.

B. Piping penetrations through walls, slabs, and floors shall be as detailed in the drawings and as specified in Section 400762.

C. Inspect pipe before installation. Repair or patch any damaged areas on interior and exterior coatings with material matching the original lining and coating.

3.02 STORAGE AND HANDLING OF PVC PIPE

Store loose pipes on racks with a maximum support spacing of 3 feet. Avoid scratching the pipe surface. Cover to protect from sunlight.

3.03 INSTALLING DRAINAGE PIPING

A. Make changes in direction in drainage piping by using 45-degree wyes, long- or short-sweep 1/4 bends, 1/6 bends, 1/8 bends, 1/16 bends, or by a combination of these or equivalent fittings.

B. Slope horizontal lines as shown in the drawings. If no slope is shown, slope at a rate of 1/4 inch per foot, except for reservoir perimeter drains which are to be placed with no slope.

C. Provide cleanouts where shown and where required by local codes.

D. Close openings for connections with screw plugs until used. Close handholes at once. Remove any earth or foreign matter that may get into sewer. Remove and plug any existing piping made obsolete by the work of this project.

3.04 TRENCHWORK

A. Conform to Section 312316, except as specified in this section.

B. Pipe Base and Pipe Zone Construction: Pipe base and pipe zone materials shall be in accordance with the following table:

Drainpiping Type	Materials (Section 312316)	
	Pipe Base	Pipe Zone
PVC-Drain	Imported Sand	Imported Sand

Underdrain Piping Type	
PVC-Underdrain	Use crushed rock and filter fabric specified in Section 313219, for filter beds for underdrains.

C. Filter Beds for Underdrains: Construct filter beds for underdrains in the trench zones defined as pipe base and pipe zone in Section 312316. Place filter fabric so as to create an envelope around a crushed rock encasement of the underdrain piping or tubing. Place crushed rock against the filter fabric and the underdrain so as to entirely fill the pipe base and pipe zone backfill area. Extend the filter fabric over the top of the pipe zone and provide sufficient material to allow an overlap of at least 12 inches. To complete the envelope, bring the two layers together, not as an overlap, but as an appendage. Fold the two-layer appendage once and stitch the resulting four layers together with yarn.

3.05 INSTALLING PVC PIPING

Follow instructions in ASTM D2855 for joining PVC-drainpiping.

3.06 INSTALLING PERFORATED UNDERDRAIN PIPING AND TUBING

A. Install on firm prepared pipe base after filter fabric and initial layer of crushed rock have been placed. Use string lines and stake to ensure piping is placed at uniform design slope.

B. Place perforations down.

C. Holding filter fabric to trench walls with spikes or other means, place additional crushed rock in layers (4 inches maximum) on each side of piping or tubing to complete the filter bed for underdrain as specified in Section 313219. Use special care to ensure that piping or tubing haunches and side walls receive full, firm, and uniform support.

D. Complete outer filter fabric envelope by removing fabric from trench walls and placing it over the top of the filter beds, lapping fabric as specified above.

E. Flush each section of underdrain between access points by introducing a sufficient amount of clean water to produce velocities in excess of 2.0 fps, until the water reaching the respective downstream access point appears clean. Remove silt, sand, and debris from each downstream access point.

3.07 LEAKAGE TESTING OF BURIED PIPING

A. Where any section of the piping contains concrete encasement, do not make the pressure test until at least 10 days after the concrete has been placed. When testing plastic piping, fill the pipe to be tested with water and allow it to soak for at least 48 hours to absorb water before conducting the pressure test.

B. Apply and maintain the test pressure by means of a hydraulic force pump. Maintain the test pressure for a minimum duration of one hour. After the test pressure is reached, use a meter to measure the additional water added to maintain the pressure. This amount of water is the loss due to leakage in the piping system. The allowable leakage rate is defined by the formula:

$$L = \frac{ND(P)^{1/2}}{7{,}400}$$

in which:

L = Allowable leakage (gallons/hour).
N = Number of rubber gasket joints in the pipe tested.
D = Diameter of the pipe (inches).
P = 5-psig test pressure.

C. Repair and retest any pipes showing leakage rates greater than that allowed in the above formula.

D. Do not test perforated underdrain or corrugated steel drainpipe.

END OF SECTION

SECTION 405000 PROCESS CONTROL AND INSTRUMENTATION SYSTEM (PCIS) GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section of the specifications includes materials, testing, and installation of process control and instrumentation system as specified herein and indicated on the drawings.

B. These specifications shall not be interpreted as permission or direction to violate any governing code or ordinance. Equipment, materials, and workmanship shall comply with the latest revisions of the following codes and standards:

1. Instrumentation: ISA - The Instrumentation, Systems, and Automation Society.

2. Wiring: National Electrical Code (NEC), ISA S5.3 and S5.4.

3. Control Panels: NEMA Standards Publication 250-2003.

4. Control Logic: NFPA 79.

5. Piping: ANSI B31.3 (instrumentation piping).

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. PCIS Loop Descriptions: 405010

B. Instrumentation Equipment: 405020

C. PLC, HMI, and UPS: 405040

D. Fiber-optic Data Transmission System: 405070

E. Instrument Control Panel (ICP): 405080

F. Appendix A

1.03 SCOPE OF WORK AND COORDINATION

A. The work involves furnishing all hardware and software, installation, labor, material, equipment, and engineering in strict compliance with the contract documents for the Las Virgenes Municipal Water District - 1235-ft Backbone Improvements 5 MG Reservoir Project.

B. The Contractor shall provide Instrument Control Panel ICP-27 in accordance with Appendix A.

C. The Contractor shall modify the existing Filtration Plant PLC Panel to house new Ethernet switch and patch panel. The Contractor shall connect new Ethernet switch with existing Ethernet switch for SCADA interfacing. Existing Filtration Plant PLC Panel modifications shall be in accordance to the drawings, specifications, and Appendix A.

D. The following work will be performed by:

1. Programming of new PLC by the District system integrator.

2. Modifications to the existing SCADA software by the District.

1.04 SUBMITTALS

A. Submit shop drawings in accordance with the General Conditions and Section 013300.

B. Submittals shall be in three-ring hardcover binders and arranged for convenient use including tab sheets, all indexed, and cross referenced with a separate index for each item

C. Provide manufacturers cut sheets and manuals for all hardware to be provided.

D. Provide an Instrument Index.

E. Provide installation, mounting, and anchoring details for all field instruments.

F. Provide ISA type instrumentation data sheets for each component, together with a technical product brochure or bulletin. The data sheets, as a minimum, shall show:

1. Instrument tag designation.

2. Component name.

3. Manufacturer's model number.

4. Calibrated range.

5. Instrument location.

6. Input and output characteristics.

7. Scale range and units (if any) and multiplier (if any).

8. Requirements for electric supply

G. Group the data sheets together in the submittal by type. Provide individual data sheets for each instrument with one brochure or bulletin to cover all identical uses of that component.

H. Complete detailed bills of material: Detailed bill of material for all components shall be provided including complete manufacturers name and model number, quantity to be provided, and cross references to data sheet sections.

I. Operation, Maintenance, and Repair Manuals (OMM):

1. The organization of the initial submittal required above shall be compatible to eventual inclusion as one volume of the operation, maintenance, and repair manuals.

2. Operation manuals shall be prepared and submitted to the Owner's Representative for preliminary review in six copies. When the Owner's Representative is satisfied that these are complete and properly prepared, six final sets shall be delivered to the Owner's Representative.

3. The complete OMM shall contain the following:

a. All the information included in the preliminary equipment submittal, the detailed installation submittal, and the additional information required herein, all bound in hard-cover binders and arranged for convenient use including tab sheets, all indexed and cross referenced with a separate index for each item.

b. Calibration and maintenance instructions.

c. Trouble-shooting instructions.

d. Instructions for ordering replacement parts.

J. Under this section, the Contractor shall furnish the following:

1. Instrumentation equipment (Section 405020).

2. PLC, HMI, and UPS (Section 405040).

3. Fiber-Optic Data Transmission System (Section 405070)

4. Instrument Control Panel (ICP) (Section 405080).

5. Spare parts per Sections 405020, 405040, 405070, and 405080.

6. Special tools and test equipment required by the supplier.

7. Installation, integration and testing.

8. Documentation.

9. Operator training.

10. Warranty (one year).

11. Shipping and receiving.

K. All calibration and final checkout of the process control and instrumentation system shall be witnessed by the Owner's Representative to determine if the system complies with the contract documents.

L. The Contractor shall be responsible for coordinating and interfacing with equipment supplied under these contract documents and with the District system integrator, which are an integral part of the system. Interfacing shall be incorporated in the detailed systems drawings and data section of the contract documents.

M. The system supplier shall be experienced in the design, installation, and service of this type of equipment. In the event of a dispute as to the acceptability of the system supplier, the Owner's Representative shall make the final determination.

1.05 GUARANTEE

A. The Contractor shall repair or replace defective components, rectify malfunctions, correct faulty workmanship, all at no additional cost to the Owner during the warranty period.

B. To fulfill this obligation, the Contractor shall utilize qualified technical service personnel Services shall be performed within five calendar days after notification by the Owner's Representative.

PART 2 - MATERIALS

2.01 DESIGNATIONS OF COMPONENTS

In these specifications and on the plans, all systems, and other elements are represented schematically and are designated by numbers, as derived from criteria in ISA standards. The nomenclature and numbers designated herein and on the plans shall be employed exclusively throughout shop drawings, data sheets, and the like. Any other symbols, designations, and nomenclature unique to a manufacturer's standard methods shall not replace those prescribed above, as used herein, and on the plans.

2.02 INSTRUMENT TAGGING

Attach a stainless-steel tag to the instrument at the factory. Permanently mark the stainless-steel tag with the instrument tag number and the instrument calibration range. The manufacturer's standard metal nameplate as a minimum shall denote model number, serial number, operating electrical voltage and amperage (when applicable), and date of manufacture.

2.03 INSTRUMENT SYSTEM POWER

A. Power provided for the instrument system at the facility shall be 120-volt a-c, single phase, 60 Hz.

B. Where d-c power supplies are not furnished integral with any one instrument system loop, then provide separate solid-state power supplies.

2.04 MATCHING STYLE, APPEARANCE, AND TYPE

All display instruments of each type shall represent the same outward appearance, having the same physical size and shape and the same size and style of numbers and pointers.

PART 3 - EXECUTION

3.01 UNIFORMITY OF COMPONENTS

Components, which perform the same or similar functions, shall, to the greatest degree possible, be of the same or similar type, the same manufacture, the same grade of construction, the same size, and the same appearance.

3.02 MOUNTING OF EQUIPMENT AND ACCESSORIES

A. Mount equipment in accordance with the installation detail drawings as prepared by the Contractor and reviewed by the Owner's Representative. Mount equipment so that they are rigidly supported, level and plumb, and in such a manner as to provide accessibility; protection from damage; isolation from heat, shock, and vibration; and freedom from interference with other equipment, piping, and electrical work. Do not install consoles, cabinets, and panels until heavy construction work adjacent to computer and telemetry equipment has been completed to the extent that there shall be no damage to the equipment.

B. Locate devices, including accessories, where they shall be accessible from grade, except as shown otherwise.

C. Mount local equipment in cabinets or existing panels as specified. Mount associated I/O terminals on a common panel or rack; mounting panels and rack shall be baked enamel.

D. Coordinate the installation of the electrical service to components related to the system to assure a compatible and functionally correct system. All accessories shall be coordinated and installation supervised by the Contractor.

E. Test the completed system after installation to assure that all components are operating with the specified range and all interlocks are functioning properly.

F. Tubing Valves and Fittings: All instrument tubing manifolds shall be Type 316 stainless steel, unless otherwise specified elsewhere in these specifications. Tubing runs to

transmitters shall be installed with a positive slope in one direction. Fittings and valves shall be Type 316 stainless steel. Block/bleed valves shall be as manufactured by Hex Valve Series HB59, or equal.

3.03 CALIBRATION

A. Each instrument requiring factory calibration shall be furnished with calibration data. The calibration data shall be factory certified.

B. Calibrate systems after installation in conformance with the component manufacturer's instructions. This shall provide that those components having adjustable features are set carefully for the specific conditions and applications of this installation and that the components and/or systems are within the specified limits of accuracy. Defective elements, which cannot achieve proper calibration or accuracy, either individually or within a system, shall be replaced. Accomplish this calibration work by a technical field representative of the single instrument supplier. He shall certify in writing to the Owner’s Representative that all calibrations have been made and that all systems are ready to operate.

3.04 FIELD TESTING

A. Exercise systems through field tests in the presence of the Owner in order to demonstrate achievement of the specified performance.

B. Coordinate field tests dependent upon completion of work specified elsewhere. Schedule tests among all parties involved so that the tests may proceed without delays or disruption by uncompleted work.

3.05 5-DAY ACCEPTANCE TEST

A. When systems are assessed to have been successfully carried through a complete field acceptance test and the Owner concurs in this assessment, a date to start the system acceptance test involving the Owner's operating personnel will be agreed upon.

B. The PICS system supplier shall recheck the systems at this time to verify proper operation, and make final adjustments. The PICS system testing shall consist of five (5) consecutive days of continuous testing by the PICS supplier utilizing the Owner's day shift working hours. The PCIS supplier shall be on call ready to respond to the site within two hours after day shift working hours and on weekends. The Owner’s representative will determine the severity of the problem to the best of his ability and contact the Contractor for disposition. This arrangement will in no way relieve the system supplier of responding within 2 hours and resolving the problem in a mutually agreed upon time frame not greater than 48 hours.

C. The acceptance tests shall have a success factor of 99% system uptime. If the system should fail below the 99% factor, the PCIS supplier shall correct the system problems. System start-up shall start over again from day one. This will continue until the system functions for twenty-one consecutive days with a 99% uptime success factor.

3.06 OPERATOR TRAINING (1 DAY)

A. Provide the Owner's operating personnel and/or the Owner’s Representative with one (1) day of formal instruction in the functions and operations of each system provided under this contract. The training shall cover overall system theory, hardware architecture, the operating system, programming instruction in the applicable languages, utility, programs, system generation, and diagnostics. The programming instruction shall include program development, coding, sample programs, and debugging at every programming level. Actual programming exercises and hands-on experience shall be emphasized. Emphasis shall also be placed on safety features and features, which may require readjustment, resetting or checking, and recalibration by them from time to time.

B. Provide the training sessions at the Owner's facilities and on the equipment furnished under this contract. The education and instruction of operating personnel shall be by a qualified instructor familiar with the requirements for this project. Each training session shall be for eight hours of formal instruction. Session dates shall be directed by the Owner. There will be one (1) non-consecutive one-day training sessions, which shall not coincide with any system testing or start-up activities.

END OF SECTION

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SECTION 405010 PROCESS CONTROL AND INSTRUMENTATION SYSTEM LOOP DESCRIPTIONS

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

Process Control and Instrumentation System (PCIS) General Requirements: 405000.

1.02 SUBMITTALS

Provide submittals per Section 405000.

1.03 DESCRIPTION

A. The descriptions, together with the detail drawings, instrumentation diagrams, comprise the functional design criteria of the Process Instrumentation and Control System (PCIS). The process and instrumentation diagrams (P&IDs) represent the basic concept of the PCIS requirements, whereas the descriptions supplement the instrumentation diagrams.

B. The PCIS Supplier shall utilize the descriptions and P&IDs as the basic criteria for the design of the instrumentation schematics, control software, preparation of data sheets, wiring diagrams, piping layouts, assembly drawings, and other requirements set forth in these specifications.

C. The PCIS will provide an integrated control and reporting system. The function of this system is to monitor, control, report, and safeguard the system. The PCIS system will be based on remote terminal units, linked to a SCADA computer and peripherals, with selected monitoring and alarm functions displayed in the control room.

D. Status-to-Command Disagreement (STCD): Provide a STCD alarm for all equipment controlled with the control system. The STCD alarm shall be initiated if a piece of equipment is commanded to start/stop or open/close by a PLC and the appropriate run or position status is not reported back within a time interval.

E. Provide high-high, high, low, low-low, rate of change and instrument fail alarms for all analog points in the system. If a particular alarm is used by ladder logic, or requires to be displayed at local Operator Interface, that alarm shall be implemented at the PLC.

F. All software switches shall be implemented with associated time delays. Time delay value shall be pre-programmed initially to 10 seconds, unless specified otherwise.

G. All flow values and motors elapsed running time shall be totalized and stored at the PLC. Resetting of those totals shall be coordinated with Owner's Representative during submittal stage.

H. If a field instrument with an analog output has additional alarm discrete (dry contact) outputs, at least one common alarm discrete output shall be interfaced with a PLC to send an advisory alarm to SCS.

I. All scaling of analog signals shall be implemented at the PLCs. Each PLC shall interface with an Operator Interface and with PLC network/SCADA System using data in engineering units.

J. At each PLC the processor shall monitor the internal operation of the PLC and communication system for failures. If a failure is detected, a dry contact closure shall close and illuminate the "PLC Fail Light" at an ICP.

K. SCADA System shall monitor communication with each PLC. If a communication failure with a PLC is detected, an alarm shall be generated and logged.

1.04 RELATED WORK SPECIFIED ELSEWHERE

A. PCIS General Requirements: 405000.

B. Instrumentation Equipment: 405020.

C. Programmable Logic Controller and Operator Interface: 405040.

D. Instrument Control Panel (ICP): 405080.

PART 2 - MATERIALS

2.01 LOOPS 6102-101 AND 6102-102, DOMESTIC WATER FEED

A. The operator shall control the domestic water feed valve via open/close software switches at the SCS. PLC shall monitor the valve status and transmit to SCS for indication and logging.

B. The flowmeter (6102-FIT-102) flow rate signal shall be monitored by the PLC. The PLC shall monitor flow meter pulse signals and calculate the total volume. The instantaneous flow rate and totalized volume shall be transmitted to the SCS for indication and recording. A flow transmitter fail signal shall be transmitted to the SCS for alarm and logging.

2.02 LOOPS 6112-104 TO 6112-108: ICP MONITORING

A. The PLC shall monitor the panel intrusion alarm and transmit to SCADA for indication and logging.

B. The PLC shall monitor the battery voltage of the battery backup system. Voltage value shall be transmitted to the SCS for indication and recording.

C. The PLC shall energize the "PLC Fail" light upon detecting a PLC failure.

2.03 LOOP 6112-111, 5MG RESERVOIR LEVEL MONITORING

The 5MG reservoir level shall be monitored by level transmitter 6112-LIT-111.

2.04 LOOP 6112-125: IRRIGATION SYSTEM

A. The Irrigation Controller will call the Irrigation Pump to start and stop in accordance to scheduled irrigation times. The PLC shall monitor the Irrigation Pump Run status, Fail alarm, and discharge pressure signals. Signals shall be transmitted to the SCS for indication and recording.

B. The PLC shall generate a Low Irrigation Pressure Alarm if the pump discharge pressure is below an operator entered setpoint while the pump is running.

PART 3 - EXECUTION

See Section 405000.

END OF SECTION

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SECTION 405020 INSTRUMENTATION EQUIPMENT

PART 1 - GENERAL

1.01 DESIGNATIONS OF COMPONENTS

In these specifications and on the plans, all systems, meters, instruments, and other elements are represented schematically and are designated by numbers, as derived from criteria in ISA standards. The nomenclature and numbers designated herein and on the plans shall be employed exclusively throughout shop drawings, data sheets, and the like. Any other symbols, designations, and nomenclature unique to a manufacturer's standard methods shall not replace those prescribed above, as used herein, and on the plans.

1.02 RELATED WORK SPECIFIED ELSEWHERE

Process Control and Instrumentation System (PCIS) General Requirements: 405000.

1.03 SUBMITTALS

Submit shop drawings in accordance with Section 405000.

1.04 SIGNAL CHARACTERISTICS

Wherever possible and feasible, components shall be of electronic solid-state design and systems shall utilize the same signal characteristics throughout each and all of the several systems; transmission signals shall be 4 mA to 20 mA. The combined power supply and transmitter loops shall, when tested with appropriate precision resistors, present a voltage signal of 1- to 5-volt DC. Signal isolators shall be provided where required.

PART 2 - MATERIALS

2.01 PRESSURE TRANSMITTER (LEVEL MONITOR)

A. The pressure transmitter shall be of the microprocessor-based type 2-wire system. The transmitter shall operate from a 24 V dc source. The output signal shall be 4 mA to 20 mA dc. The transmitter shall be housed in a NEMA 4 enclosure.

B. Configuration data shall be stored in nonvolatile EEPROM memory in the transmitter electronics module. This data shall be retained in the transmitter when power is interrupted, so the transmitter shall be functional immediately upon power up. The transmitter shall perform continuous self-tests. In the event of a problem, the transmitter shall activate the user-selected analog output warning. A HART Communicator or other HART-based communications device shall be able to interrogate the transmitter to determine the problem. The transmitter shall output specific information to the communicator identifying the problem for fast and easy corrective action.

C. The pressure transmitter shall provide an electronic signal proportional to the calibrated pressure range. The pressure-sensing element shall be silicone oil filled with a process media operating temperature range of -40 °F to 250 °F. An integral stainless steel block/bleed manifold (pre-assembled to the transmitter and leak checked) shall be provided for each transmitter. The manifold shall have a block and a vent/test valves.

D. Provide the pressure transmitter with the following features:

1. Independent external zero and span adjustments.

2. Overrange protection.

3. Integral digital indicator, calibrated in engineering units.

4. Accuracy of the pressure transmitter shall be ±0.1% of calibrated span.

E. The pressure transmitter shall be manufactured by Rosemount, Model 2088 with Model 306RT1 Block-and-Bleed Manifold.

PRESSURE TRANSMITTER (LEVEL MONITOR)		
	GENERAL	
1.	Tag No.	6112-LIT-111
2.	P&ID No.	N-03
3.	Service	Tank Level
4.	Type	Strain Gage
5.	Function	Transmit Level
	ELEMENT	
6.	Element Material	316 SST
7.	Body Material Mfg.	Std.
8.	Connection Size	1/2-inch NPT
	TRANSMITTER	
9.	Location	Instrument Enclosure
10.	Mounting	Instrument Enclosure
11.	Area Class	NEMA 4
12.	Calibration	0-23 feet
13.	Output	4 mA - 20 mA dc
14.	Indication	Yes
15.	Output to	PLC-27
16.	Power	24 V dc
17.	Install. Detail	Dwg. N-04

2.02 INSTRUMENT ENCLOSURE

A. Provide instrument enclosures to house tank level transmitters. Each enclosure shall be NEMA 4X made of UV Resistant ABS.

B. Enclosure shall be insulated with a 1" wall of Urethane insulation.

C. Transition fittings shall be provided for impulse tubing entry into the enclosure.

D. Instrument Mounting

1. Enclosure manufacturer shall provide necessary hardware for supporting the instruments within the enclosure.

2. Interior hardware shall be protected from corrosion.

3. External hardware shall be protected from corrosion. Metal parts shall be hot-dip galvanized per ASTM A123 or be epoxy powder coated.

E. Provide the enclosure with the following features:

1. Hinges and latches made of 316 SST.

2. Accessory drain.

3. Lid supports, which shall be easily disassembled for easy removal of enclosure cover.

F. Select the enclosure and its components to address the following environmental conditions:

1. Low ambient temperature: 0 °F.

G. Enclosure shall be O'Brien "A" Series, or equal.

H. Mount the enclosure on a 40-in high pipe stand. The stand shall be 2" NPS Schedule 40, hot-dip galvanized per ASTM A123 for corrosion-resistance. The stand shall be O'Brien Cat. No. FP40, or equal.

2.03 SPARE PARTS

The Contractor shall furnish to the Owner all necessary spare parts of components required to maintain the system. Prior to final acceptance of work, the Contractor shall provide a spare parts listing of all necessary spare parts and quantities for review by the Owner's Representative. The spare parts shall include, but not be limited to, the following minimum requirements:

MINIMUM SPARE PARTS LIST	
Part Description	Quantity
Pressure Transmitter (Level Monitor)	1 complete unit

The Contractor shall deliver to the Owner all the required spare parts upon final acceptance of the work. The spare parts shall not be used as replacement parts during the guarantee period.

END OF SECTION

SECTION 405040 PROGRAMMABLE LOGIC CONTROLLER AND OPERATOR INTERFACE

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes requirements for materials, testing, and installation of a control system.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Process Control and Instrumentation System (PCIS) General Requirements: 405000.

B. Appendix A

1.03 SUBMITTALS

Provide submittals per Section 405000.

PART 2 - MATERIALS

2.01 DESIGNATIONS OF COMPONENTS

In these specifications and on the plans, all systems, and other elements are represented schematically and are designated by numbers, as derived from criteria in ISA standards. The nomenclature and numbers designated herein and on the plans shall be employed exclusively throughout shop drawings, data sheets, and the like. Any other symbols, designations, and nomenclature unique to a manufacturer's standard methods shall not replace those prescribed above, as used herein, and on the plans.

2.02 PROGRAMMABLE LOGIC CONTROL SYSTEM

A. A fully integrated programmable logic control system shall be furnished as specified in this section. The programmable logic control system hardware shall be intelligent process control units with analog and discrete I/O for process interface.

B. The a-c power of the control system will be 120-volt +/-10% a-c, 60 hertz, single phase derived from line power. The system shall be designed to operate satisfactorily from 0 °C to 60 °C ambient temperature for the PLC.

2.03 PROGRAMMABLE LOGIC CONTROLLER (PLC)

A. The PLC shall be a 16-bit programmable logic controller microprocessor-based stand-alone device. It shall be a process and logic controller designed for industrial environments. It shall be capable of a mix of logic, timing, counting, computation, library of preprogrammed subroutines, and PID loop control capabilities necessary for the unit process application. The PLC shall utilize a "prepackaged"/"preprogrammed" approach to functionality to allow its use by personnel who have no formal training in digital equipment, digital communications, or software programming.

B. The PLC shall come complete with central processor, memory, power supply, interconnecting cables, and discrete and analog I/O interfaces.

C. The logic and variable memory shall be read/write RAM. All RAM shall have integral battery backup that will maintain the memory for a minimum of six months upon a utility power failure. The logic and variable memory shall have a sufficient ladder logic location for programming all specified functions plus 25% spare memory.

D. The PLC shall have the following features:

E. Logic Control: The PLC shall be capable of performing the same functions as conventional logic systems including on delay timers, off delay timers, counters, and drum sequencers.

F. Compare Function: The PLC shall perform the compare function that compares two integers or floating point numbers for less than, equal to, greater than, and not equal to. The programmed function shall energize when true and de-energize it when false.

1. Move Function: The PLC function shall move an integer or floating point value from one memory location to another memory location when an internal permissive is enabled.

2. Math Function: The PLC shall be capable of performing addition, subtraction, multiplication, and division on integer or floating point numbers.

3. Analog Controllers: The PLC processor shall perform all the functions of the conventional three-mode (PID) analog controller. The controller shall perform proportional only control, proportional plus reset, and proportional plus reset plus derivative and integral only control. The controller shall be the conventional three-mode controller.

4. The PLC shall be able to generate PID loops with a minimum sample time of 1.0 second. PID tuning constants shall have the following adjustable range:

Proportional Gain	0.0% to 99.99%
Reset Time	0.01 to 999.99 minutes
Derivative Time	0.00 to 999.99 minutes

5. Time-of-Day Clock: The PLC shall have an internal time-of-day clock/calendar running independently of the CPU.

6. PLC System Alarm: The PLC processor shall monitor the internal operation of the PLC system for failures. If a failure is detected, the system shall shut down and freeze all inputs and outputs in their last states until the error is cleared. As a minimum, the following failures shall cause the PLC to shut down:

   a. Memory failure.

   b. Memory parity error.

   c. I/O cycle failure.

   d. Operating system error.

G. Input/Output:

1. The PLC discrete input modules shall be 24-volt DC or 120-volt AC and have noise filters or use other techniques to reject short-time constant noise and 60-Hz pickup.

2. The PLC discrete output modules shall be 120-volt AC, or 24-volt DC solid-state drivers suitable for operating control relays. Each discrete output module shall include fuses and fuse blown indicators.

3. The PLC analog inputs shall be suitable for accepting 4 mA to 20 mA from either 2- or 4-wire transmitters. The input power shall be from an external 24-volt DC power supply. The analog to digital converter shall have a 12-bit minimum resolution with an overall accuracy of 0.5% at 60 °C.

4. Discrete PLC I/O modules shall have individual LED status lights for each I/O point.

5. All discrete and analog modules shall have terminal blocks for termination of the I/O wires.

6. Individual I/O points shall be capable of withstanding low energy common mode transients to 1,500 volts.

H. Spare I/O

1. Pre-wired Spare I/O: Spare I/O shall not include I/O shown or specified as future. Provide PLCs with the following minimum unused pre-wired I/O.

a. 25% for each I/O type.

I. Each PLC shall be able to communicate to an Ethernet network.

J. The PLC manufacturer and model shall be in accordance with Appendix A.

2.04 ETHERNET SWITCH

A. Ethernet switch shall be DIN-rail mountable. Ethernet switch shall be in full compliance with standards set forth by IEEE 802.3. Switch shall have five Ethernet ports (four copper and one fiber), as minimum. LEDs on each port shall indicate link data rate and activity status. A power LED shall indicate that power is applied to the.

B. Ethernet Switch shall meet the following specific requirements:

1. Operation: 10/100 Mbps, full and half duplex, auto-negotiation

2. Switching properties: store & forward

3. Number of MAC addresses: 2000

4. Up to 1.0 Gb/s maximum throughput

5. Minimum of 64K of message memory

6. Interface: RJ-45 10/100BaseTX ports, 100BaseFX Multimode Port with ST Connectors

7. MDIX auto cable sensing

8. Operating temperature: -20°C to 70°C

9. Operating humidity: 10% to 95% (noncondensing)

10. MTBF: 100,000 hours minimum

C. The Ethernet switch manufacturer and model shall be in accordance with Appendix A.

2.05 BATTERY BACKUP SYSTEM

Battery backup system shall be in accordance with Appendix A.

2.06 SPARE PARTS

The Contractor shall furnish to the Owner all necessary spare parts of components required to maintain the system. Prior to final acceptance of work, the Contractor shall provide a spare parts listing of all necessary spare parts and quantities for review by the Owner's Representative. The spare parts shall include the following minimum requirements:

	Part Description	Quantity
1.	PLC DI/DO Base	1 each
2.	Ethernet Switch	1 each

The Contractor shall deliver to the Owner all the required spare parts upon final acceptance of the work. The spare parts shall not be used as replacement parts during the guarantee period.

PART 3 - EXECUTION

A. REFER TO SECTION 405000.

END OF SECTION

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SECTION 405070 FIBER-OPTIC DATA TRANSMISSION SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes requirements for materials, testing, and installation of Fiber-Optic Data Transmission System.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. PCIS General Requirements: 405000.

B. PLC: 405040.

C. Control Panels: 405080.

D. Appendix A

1.03 CONTRACTOR SUBMITTALS

A. General: Shop drawings shall be submitted in conformance with the requirements of Section 013300 - Submittals, Section 405000 - PCIS General Requirements, and Section 405080- Control Panels.

B. System Drawings: The following information shall be submitted:

1. Communications system block diagram.

2. Details of connector installations.

3. Details of cable installation, cable entrance into and terminations inside enclosures.

4. Communications splice plan.

C. System drawings shall meet the following requirements:

1. All fiber-optic cables shall be identified by unique numbers.

2. All strands, including spares, shall be identified by unique numbers.

3. All patch panels shall be identified by unique numbers.

4. All couplings shall be identified, including ones with no fiber terminations.

PART 2 - MATERIALS

2.01 DESIGNATIONS OF COMPONENTS

In these specifications and on the plans, all systems and other elements designated by numbers, as derived from criteria in ISA standards. The nomenclature and numbers designated herein and on the plans shall be employed exclusively throughout shop drawings, data sheets, and the like. Any other symbols, designations, and nomenclature unique to a manufacturer's standard methods shall not replace those prescribed above, as used herein, and on the plans.

2.02 GENERAL

A. Current Technology: All data communication equipment and materials shall be the most recent field-proven models marketed by their manufacturers at the time of submittal of the shop drawings unless otherwise required to match existing equipment.

B. Transmission Media: All transmission media, including connectors, patch panels, etc., shall be manufactured by a single manufacturer and shall include a manufacturer 25-year extended product warranty. Approved manufacturers include CommScope, Inc., Corning Cable Systems, or equal.

C. Equipment to be utilized indoors shall be rated for continuous operation under ambient environmental conditions of 0 °C to 50 °C (32 °F to 122 °F) and 10% to 95% relative humidity, noncondensing. Fiber optic cables to be utilized outdoors shall be rated for continuous operation under ambient environmental conditions of -20 °C to 70 °C (-4 °F to 158 °F). Under this requirement fiber cables shall be rated higher than electronics and other equipment to ensure the use of quality performing fibers with minimal performance variation due to temperature fluctuation.

2.03 FIBER PROPERTIES

A. All multimode fibers in the cable must be usable and meet required specifications. Each optical fiber shall be sufficiently free of surface imperfections and inclusions to meet the optical, mechanical and environmental requirements of this specification. Each optical fiber shall consist of a doped silica core surrounded by a concentric glass cladding. Each fiber shall be a matched clad design, graded index optical fiber. Each optical fiber shall be proof tested by the fiber manufacturer at a minimum of 100 kpsi (0.7 GN/m2). The fiber shall be coated with a dual layer acrylate protective coating, which shall be in physical contact with the cladding surface. The attenuation specification shall be a maximum value for each cabled fiber at 23 °C ± 5 °C on the original shipping reel. The multimode fiber utilized in the optical fiber cable shall meet EIA/TIA-492AAAA-A-1997, “Detail Specification for 62.5-µm Core Diameter/125-µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers". The core diameter shall be 62.5 µm ± 2.5 µm. The cladding diameter shall be 125.0 µm ± 2.0 µm. The cladding non-circularity shall be < 1.0%. The core-to-cladding concentricity shall be ≤ 12.0 µm. The coating diameter shall be 245 µm ± 10

μm. The optical fiber shall have a graded refractive index profile. The numerical aperture shall be 0.275 ± 0.015. The maximum attenuation shall be 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm. In achieving IEEE 802.3 performance, the optical fiber shall support laser-based Gigabit Ethernet (GbE) operation in the 1000BASE-SX operating window (850 nm) at 300 meters, and in the 1000BASE-LX operating window (1300 nm) at 550 meters. The minimum LED bandwidth shall be 200/500 MHz•km at 850/1300 nm, and the minimum cabled restricted mode launch (RML) bandwidth shall be 220 MHz•km at 850 nm. There shall be no point discontinuities greater than 0.1 dB at either 850 nm or 1300 nm. The attenuation coefficient at 1380 nm shall not exceed the attenuation coefficient at 1300 nm by more than 1.0 dB/km. The attenuation due to 100 turns of fiber around a 75 mm ± 2 mm diameter mandrel shall not exceed 0.5 dB at 850 nm.

2.04 OUTDOOR FIBER-OPTIC CABLE

A. Cable shall be armored, loose-tube design with dry waterblocking for outdoor duct and aerial installations. Buffer tubes shall be made from polypropylene. Each buffer tube shall contain a gel-free water-swellable material for water-blocking protection. The gel-free water-swellable material shall be non-nutritive to fungus, electrically non-conductive, and homogenous. It shall also be free from dirt and foreign matter. The buffer tubes shall be gel-free and be manufactured to a standard 3.0 mm in size, regardless of fiber count, to reduce the number of required installation and termination tools. Cable shall be comprised of water-swellable yarns and/or tapes, central strength members, co-polymer coated corrugated steel tape armor, dielectric strength members (as required), ripcord(s) and MDPE jacket. Cable shall have a storage temperature range of -40 °C to 70 °C, an installation temperature range of -30 °C to +70 °C, and an operating temperature range of -40 °C to +70 °C. The outdoor fiber-optic cable shall be designed to be used in underground conduits and direct buried applications. The cable shall contain twelve (12) optical fibers. The cable shall have a steel armored jacket and a medium-density polyethylene outer jacket.

B. Cable shall be listed with Rural Utilities Service (RUS) 7 CFR 1755.900 and be fully compliant with ICEA S-87-640 “Standard for Optical Fiber Outside Plant Communications Cable”. Manufacturer shall be ISO 9001 registered. Cable and fiber manufacturer shall be vertically integrated to ensure long-term reliability of the cabled fiber and to ensure the availability of fully integrated technical support.

C. Cables shall be rated to withstand an installation tensile load of not less than 2700 N (600 lb) as defined under EIA/TIA FOTP-33 and a long-term tensile rating of 890 N.

D. The cable shall be tested in accordance with FOTP-41, "Compressive Loading Resistance of Fiber Optic Cables." The cable shall withstand a minimum compressive load of 220 N/cm (125 lbf/in) applied uniformly over the length of the sample. The 220 N/cm (125 lbf/in) load shall be applied at a rate of 2.5 mm (0.1 in) per minute. The load shall be maintained for a period of 10 minutes. The change in attenuation shall not exceed 0.3 dB at 1300 nm for multimode fiber.

E. Cable shall be as follows, or equal:

1. Multimode:

a. CommScope Catalog Number O-012-LA-6F-F12NS,

b. Corning Cable P/N 012KUC-T4130D20

2.05 FIBER ENCLOSURES (PATCH PANELS)

A. Fiber enclosures housings finish color shall be the manufacturer's standard, unless otherwise indicated. Housings may be rack or wall mounted. Provide a minimum of 12 fiber connection points. Each patch panel shall include an area for spare cable and splice trays.

B. Wall mounted fiber enclosures shall be CommScope Catalog Number WFE-024-BK with 2 (two) Type WFE-PNL fiber panels, Corning Cable WCH series fully loaded with Corning Cable CCH-CP style single-mode or multi-mode adapter panels, dependent on fiber and connector type. If single-mode ST-compatible adapters, Corning Cable P/N WCH-02P-1219T; if multimode ST-compatible adapters, Corning Cable P/N WCH-02P-1215T.

2.06 FIBER-OPTIC CONNECTORS

A. Fiber-optic connectors shall be the straight tip (ST type), bayonet style, field installable, self-aligning and centering. Fiber-optic connectors shall match the fiber core and cladding diameters. The connector alignment ferrule shall be ceramic. The connector shall have a short boot for strain relief. Fiber-optic equipment and cable shall use the same type connectors for correct mating. Typical connector insertion loss shall be 0.3 dB. The connector shall meet the requirements of TIA/EIA-568B.3.

B. Connectors shall be CommScope Catalog Number MFC-STU-09 (multimode), SFC-STU-09 (single mode); Corning Cable P/N 95-101-52-SP (multimode), 95-201-52-SP (single-mode), or equal.

C. If loose tube, outside plant cable is to be directly terminated, buffer tube fan-out kits shall be used to build the fiber diameter to 900 µm, allowing for fiber protection and strain relief. Buffer tube fan-out kit shall be CommScope Catalog Number KIT-090-012, Corning Cable P/N FAN-BT25-12, or equal.

2.07 FIBER PATCH CORDS

A. Multimode patch cord connectors shall be measured for insertion loss with the following values for each connector: typical of 0.3 dB and maximum of 0.5 dB. Connectors shall be multimode ST compatible. Optical fiber cable types shall be suitable for use in indoor spaces and shall contain a riser-rated jacket. Patch cord shall contain 62.5/125 µm graded-index, multimode fiber compliant with TIA/EIA-568-B.3. Patch cord jacket color shall be orange.

B. Patch cord shall be available in different lengths.

C. Patch cord shall be CommScope Catalog Number RFJ-01SP29-6F-STE-01-STE, Corning Cable P/N 505001K3141001M, or equal.

PART 3 - EXECUTION

3.01 GENERAL

A. Execution requirements of Section 405000 - Process Control and Instrumentation Systems apply to the WORK of this Section.

B. All necessary interconnections, services, and adjustments required for a complete and operable data transmission system shall be provided as shown on the drawings. The Contractor shall verify the complete operation of the data transmission system in conjunction with field testing associated with systems supported by the fiber-optic data transmission system. Prior to formal acceptance testing, field tests shall include a power attenuation test and a gain margin test. These tests shall be performed on each link and repeated from the opposite end of each link.

3.02 INSTALLATION

A. All system components and appurtenances shall be installed in accordance with the manufacturer's instructions and as shown. Conduits shall be used for installation of fiber-optic cables. All fibers (including spares) of fiber-optic cables entering a PLC cabinet shall be terminated at a patch panel. Interfacing between a fiber-optic cable and a PLC fiber-optic communications module or a fiber-optic repeater shall be through a patch panel.

B. A short cable slack of 10 feet minimum for repair shall be provided for all Fiber-Optic Cable Segments (FOCS) longer than 100 feet.

C. There shall be no splices in the fiber optic cables.

3.03 TESTING

A. Power attenuation test shall be performed at the light wavelength of the transmitter to be used on the circuit being tested. The flux shall be measured at the receiver end and shall be compared to the flux injected at the transmitter end. There shall be a jumper added at each end of the circuit under test so that end connector loss shall be validated. Rotational optimization of the connectors will not be permitted. If the circuit loss exceeds the calculated circuit loss by more than 2 dB, the circuit is unsatisfactory and shall be examined to determine the problem. The Owner's Representative shall be notified of the problem and what procedures the Contractor proposes to eliminate the problem. The Contractor shall prepare a report documenting the results of the test to be submitted to the Owner’s Representative.

B. The Contractor shall test and verify that each circuit has a gain margin, which exceeds the circuit loss by at least 6 dB.

END OF SECTION

SECTION 405080 INSTRUMENT CONTROL PANEL (ICP)

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes requirements for materials, testing, and installation of the cabinets and consoles to be provided by the system contractor under Section 405000.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Grounding and Bonding: 260526

B. Process Control and Instrumentation System (PCIS) General Requirements: 405000.

C. Appendix A

1.03 SUBMITTALS

Provide submittals per Section 405000.

PART 2 - MATERIALS

2.01 FREE-STANDING INSTRUMENT CONTROL PANEL

A. The panel shall be a floor-mounted NEMA 4X enclosure and shall be constructed from 14-gage formed stainless-steel throughout. Access door shall have door bars on inside surface and continuous hinges. All exposed edges and welds on the enclosure shall be ground smooth. No penetration through the cabinet door or exterior with rivets, screws, bolts, or back of panel nuts shall be allowed. The enclosure shall provide protection against dirt, dust, oil, and water. The interior shall be provided with a formed 12-gage subpanel for attaching surface-mounted components. All components shall be attached with screws, and the subpanel shall be threaded.

B. Rivets or back of panel nuts, screws, or bolts shall not be allowed. No panel penetration is allowed, except for the conduit entry.

C. Provide a fluorescent lamp in the panel. Each interior shall be equipped with a 120 V, 20 A duplex utility outlet and a dedicated single-pole, 20 A, 120 V circuit breaker protecting the outlet and the lamp. The utility outlet and the lamp shall be powered by utility power.

D. Provide four additional circuit breakers for site lighting, panel external receptacle, and future needs.

E. A folding shelf at least 18 inch wide and a documentation pocket shall be provided at the panel. The shelf shall be secured to the door bars in a way to allow vertical adjustment of the shelf location.

F. Panel shall be UL listed.

G. Ground control panel per plans and Section 260526.

H. Temperature Control:

1. Contractor shall provide temperature control features, to maintain internal cabinet temperature within the limits required by the equipment installed in the cabinet.

2. Submit cooling system sizing calculations, as part of the enclosure submittal. Calculations shall be based on a maximum ambient temperature of 116 degrees F.

I. The enclosure manufacturer shall be in accordance with Appendix A.

2.02 PANEL CONTROL CIRCUIT DEVICES AND COMPONENTS

A. General: All components, except those on the front panels, shall be mounted behind on fixed or swing-out panels; terminal blocks for field connections shall be mounted on fixed channels located near the bottom of the sections but clear of the conduit entry area. Fixed panels shall be located so as not to prevent access within the cabinets to other components, wiring, and terminal blocks on fixed panels or front panels.

B. All electrical devices within the panel shall be identified by tag number, machine printed on a label visible from the panel interior. Labels shall be made of durable plastic tape with an adhesive backing. The labels shall have rounded corners and shall be consistent in size throughout the panel.

C. Control Relays: The relays manufacturer and model shall be in accordance with Appendix A.

D. Circuit Breakers: Circuit breakers shall be single-pole, 120-volt, 20-ampere rating.

E. Feed-Through Terminal Blocks: Feed-through terminal blocks manufacturer and model shall be in accordance with Appendix A.

F. Fuse Terminal Blocks: Fuse terminal blocks manufacturer and model shall be in accordance with Appendix A.

G. Disconnect Terminal Blocks: Disconnect terminal blocks s manufacturer and model shall be in accordance with Appendix A.

H. DC Power Supplies: DC power supplies manufacturer and model shall be in accordance with Appendix A.

I. Receptacles: Duplex receptacles shall be molded composition, ivory, specification grade, with finder groove face. Duplex receptacles for 120-volt, single-phase, 3-wire service to be rated 20 amperes, 125 volts, back or side wired, NEMA Type 5-20R. Duplex receptacles shall be Arrow-Hart No. 5352I, Bryant No. BRY5362-I, Hubbell No. CR5362-I, or equal.

J. Indicating Lights: Indicating light shall be push-to-test transformer type with LED.

2.03 PANEL CONTROL CIRCUIT WIRING

A. Wire Type and Size: Instrumentation signal cables shall be of the type used for process control with shielded pairs or triads with polyvinyl jacket and overall shield over the multiple pairs or triads. The instrumentation cable shall be rated 300 volts at 90 °C or better. The size of the instrumentation cable shall be AWG No. 18 with seven strands minimum, unless otherwise specified elsewhere. All instrumentation cables shall meet all the requirements of IPCEA S-61-402 and shall be UL listed.

B. 120-volt AC wiring within the panel shall be AWG No. 14 THHN. Main power (120-volt AC) to the panels shall be wired using color coded AWG No. 12. AC power to all system power supplies. Wires shall be color coded in accordance with the following table:

Black	L1 (hot)
White	L2 (neutral)
Red	AC control circuits
Blue	DC circuits
Yellow	Interlock control circuits wired from an external power source
Green	Equipment ground

C. All interfacing between the cabinets and the field shall be accomplished at a terminal strip (TB-1). No internal panel wiring shall be connected to terminals on the "field side" of TB-1. Likewise, no field wiring shall be connected to terminals on the "panel side" of TB-1.

D. All intentionally grounded, grounding, and bonding conductors shall be sized by NEC Article 250 as required.

E. Wires carrying voltage from external devices and one wire from an analog loop shall be terminated at the disconnect terminal block.

F. Only one wire shall be terminated at each side of a terminal block. A bridge bar shall be used for cross connection.

G. Wiring run from components on a swing-out panel to other components on a fixed panel shall be made up in tied bundles. These shall be tied with nylon wire ties and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at terminals.

H. Wiring run to control devices on the front panels shall be tied together at short intervals and secured to the inside face of the panel using Panduit adhesive mounts with Eastman No. 910 adhesive.

I. Wiring to rear terminals on panel-mount instruments shall be run in plastic wireways secured to horizontal brackets run above or below the instruments in about the same plane as the rear of the instruments.

J. Signal conditioners and control interface relays shall be provided wherever proper instrument interfacing dictates use of these components. Each auxiliary device shall be assigned a tag number and shall appear on the panel shop drawings.

K. Wire Marking:

1. Each signal and circuit conductor connected to a given electrical point shall be designated by a single unique number. These numbers shall be marked on all conductors at every terminal. Wire numbers shall be in accordance with Appendix A.

2. The markers shall be permanent sleeve type with machine printed black markings. Markers shall be Thomas & Betts Series EZS, Tyco Series RPS, or equal.

L. Terminal Marking: Each terminal shall be identified by a single unique number in accordance with Appendix A. Hand-written labels shall not be allowed. The match between the terminal identification and the wire identification is not required.

M. All electrical devices within the panel shall be identified by tag number, machine printed on a label visible from the panel interior. Labels shall be laminated plastic with an adhesive backing. The labels shall be consistent in size throughout the panel.

2.04 SPARE PARTS

A. The Contractor shall furnish to the Owner all necessary spare parts of components required to maintain the system. Prior to final acceptance of work, the Contractor shall provide a spare parts listing of all necessary spare parts and quantities for review by the Owner's Representative. The spare parts shall include, but not be limited to, the following minimum requirements:

MINIMUM SPARE PARTS LIST	
Part Description	**Quantity**
1. Power supply	1 each type
2. Relays	2 each type

B. The Contractor shall deliver to the Owner all the required spare parts upon final acceptance of the work. The spare parts shall not be used as replacement parts during the guarantee period.

PART 3 - EXECUTION

3.01 REFER TO SECTION 405000

END OF SECTION

SECTION 409115 MAGNETIC FLOWMETERS

PART 1 - GENERAL

1.01 DESCRIPTION

This section describes requirements for magnetic flowmeters.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Painting and Coating: 099000.

B. Pressure Testing of Piping: 400515.

C. Equipment, Piping, Duct, and Valve Identification: 400775.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 01330.

B. Submit manufacturer's catalog data and detail drawings showing dimensions, pressure rating, coatings, and meter parts and describe by material of construction specifications (such as AISI, ASTM, SAE, or CDA) and grade or type. Furnish manufacturer’s application performance guarantee with submittals.

C. Show meter laying lengths.

PART 2 - MATERIALS

2.01 MANUFACTURERS

A. The meter flow tube and transmitter shall be by the same manufacturer.

B. The magnetic flowmeter and transmitter shall be manufactured by one of the following:

1. ABB Instrumentation, Rochester, New York:

Magnetic Flowmeter with Transmitter: Model WaterMaster.

2. Endress+Hauser, Greenwood, Indiana:

a. Magnetic Flowmeter: Model Promag W.

b. Transmitter: Model Promag 50.

C. The manufacturer shall have a minimum of five years' experience in the manufacture of bipolar d-c magnetic flowmeters.

2.02 METER DESIGN

A. The magnetic flowmeter shall be an obstructionless pipeline-mounted instrument to magnetically measure the flow of the process media. The output signal shall not be affected by changes in fluid viscosity or density and shall have zero point stability and auto zeroing functions. Provide the magnetic flowmeter with the following features:

1. Drip- and splash-proof sensor, capable of withstanding temporary submersion of up to 30 feet of water for 48 hours.

2. Integral terminal box with watertight cable seals.

3. Interconnecting cables.

B. Provide stainless steel grounding rings and grounding straps per manufacturer’s requirements.

2.03 MATERIALS OF CONSTRUCTION--FLANGELESS METERS

A. The flow tube shall be flangeless wafer construction with cast aluminum enclosure. Provide bolting kit.

B. Liner and electrodes shall be as indicated in the subsection on "Service Conditions."

2.04 MATERIALS OF CONSTRUCTION--FLANGED METERS

A. The flow tube shall be Type 304 stainless steel with carbon steel flanges.

B. Liner and electrodes shall be as indicated in the subsection on "Service Conditions."

2.05 INDICATOR/TOTALIZER

The indicator/totalizer shall accept the process flow signal from the magnetic flowmeter and convert its electrical output signals directly proportional to the instantaneous metered flow rate. The housing shall be suitable for field mounting.

2.06 TRANSMITTER

A. The transmitter shall be microprocessor based with flow rate indicator in engineering units, forward, reversed, and net flow totalizer, all in user-selectable engineering units. The display shall also be capable of indicating alarm status and velocity of fluid. The transmitter shall be mounted as indicated in the instrument list.

B. The preamplifier input impedance shall be a minimum of 10E+11 ohms.

C. Power Requirements: 117-volt ac, ±10%, 60 hertz.

D. Totalized flow and programmed configuration shall be maintained in memory for up to 10 years.

2.07 INTERCONNECTING CABLE

The interconnecting cable between the sensor and the transmitter shall be furnished by the magnetic flowmeter manufacturer.

2.08 PERFORMANCE

The overall system's performance shall be as follows:

A. Accuracy: 0.5% of flow rate with minimum fluid velocity of 1 fps.

B. Repeatability: ±0.1% of flow rate.

C. The accuracy of each meter shall be verified by calibration in a flow laboratory traceable to the U.S. National Institute of Standards and Technology.

D. Adjustable full-scale range.

E. Outputs: Bidirectional, isolated 4- to 20-mA d-c and either 24-volt d-c scaled pulse, or 0- to 10-KHz frequency.

F. Minimum Conductivity: 5 micromho/centimeter.

G. Power Consumption: 20 watts maximum.

H. Temperature Limits, Ambient: -20°F to +140°F.

I. Temperature Limits, Process: Elastomers +160°F, Teflons +300°F, ceramic 350°F.

J. Field Selectable Low Flow Cutoff: 0% to 10%.

K. The flowmeter shall have a positive zero return (PZR) input controlled by an external dry contact.

L. Environmental Rating: NEMA 4X for both sensor and electronics whether remote or sensor mounted.

M. The meter shall have empty pipe detection.

N. A common alarm discrete output (a dry contact or a transistor switch) shall be provided for remote indication of fault conditions.

PART 3 - EXECUTION

3.01 SERVICE CONDITIONS

1.	P&ID No.	N-03
2.	Service	Domestic Water

3.	Tag No.	6102-FE-102
4.	Metering Tube	
	Size Flg.	6-inch
	Rating (psi)	150 psi
5.	Metering Tube Material	Stainless Steel
6.	Liner Material	Poly-urethane
7.	Electrode Material	316 SST
8.	Elec. Class.	NEMA 4X

9.	Tag No.	6102-FIT-102
10.	Flow Rate Ind. Scale	0-2000 GPM
11.	Flow Totalizer Multiplier	100 gallons
14.	Elec. Class.	4X
15.	Mounting	On Flow Tube

16.	Process Media	Potable Water
20.	Flow (gpm) (min/max)	0-2,000 GPM
21.	Velocity (fps) (min/max)	0 to 23 fps
22.	Press. (psig) (min/max)	10 to 150 psi
23.	Temp. (°F) (min/max)	50 to 70^{o} F

3.02 PAINTING AND COATING

Coat exposed carbon steel components of meter tube and sensor the same as the adjacent piping. Apply the specified prime and intermediate and finish coat at the place of manufacture. Finish coat shall match the color of the adjacent piping.

END OF SECTION

SECTION 409210 ELECTRIC MOTOR ACTUATOR FOR BUTTERFLY VALVES

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and installation of a electric motor actuator for a butterfly valve.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Painting and Coating: 099000.

B. Manual, Check, and Process Valves: 400520.

C. Pipe Hangers and Supports: 400764.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit manufacturer's catalog data showing motor actuator parts and materials of construction, referenced by AISI, ASTM, SAE, or CDA specification and grade. Show motor actuator dimensions and weights. Show coatings.

C. Show the maximum torque required to open and close each motor-actuated valve.

D. Submit certified factory performance test records.

E. Submit motor data including nameplate data, insulation type, duty rating, and torque output at duty rating.

F. Submit electrical schematic drawings and wiring diagrams showing physical locations of components.

PART 2 - MATERIALS

2.01 ACTUATOR IDENTIFICATION

A. Motor actuators shall have the name of the manufacturer cast or molded onto the actuator body or shown on a permanently attached plate in raised letters.

2.02 ACTUATOR DESIGN

15-minute duty cycle; NEMA 4 enclosure (motor, controls, push buttons); open-stop-close operation; 120-volt, 60-hertz, 3-phase power supply; valve to remain in last position upon loss of control signal.

2.03 ACTUATOR TORQUE REQUIREMENTS

A. The rated output torque of the motor actuator shall be at least 1.5 times the maximum torque required to open or close the valve at any position including seating and unseating conditions when subjected to the most severe operating condition including any mechanical friction and/or other restrictive conditions that are inherent in the valve assembly. Do not include hammer-blow effect in sizing the actuator to comply with this torque requirement. Coordinate with the valve manufacturer to assure that the motor actuator stall torque output does not exceed the torque limits of the valve operating stem or shaft.

B. Maximum torque shall include seating or unseating torque, bearing torque, dynamic torque, and hydrostatic torque. Assume that the differential pressure across the valve is equal to the pressure or head rating of the valve.

C. Assume a maximum pipeline fluid velocity of 16 fps with the valve fully open, unless a higher velocity is specified in the detailed valve specification.

2.04 DESIGN OF TYPE 1 ELECTRIC MOTOR ACTUATORS

A. Actuators shall comply with AWWA C542, except as modified herein. Output capacity of motors shall be sufficient to open or close the valve against the maximum differential pressure when the voltage is 10% above or below normal at the specified service conditions. Motors shall have Class F or H insulation system. Provide motor with torque output (at duty rating) that exceeds the requirements of the following paragraphs including safety factor.

B. Design the actuator to move valves from fully closed to fully open in the time specified in the subsection on “Service Conditions.”

C. Provide a reversing starter, three overloads (one in each ungrounded leg) or two motor thermal cutouts, 120-volt control power transformer, local-off-remote selector switch, stop-open-close push buttons, and open and closed indicator lights. Provide magnetic starters in actuators for open/close operation and solid-state starters in actuators for modulating operation. Provide dry contact for remote indication of the actuator mode of operation. The contact shall be closed when the local-off-remote selector switch is in the remote position and the internal control power exists.

D. Provide a separate (remote) NEMA 4 enclosure with local/remote selector switch, stop-open-close push buttons, and open and closed indicator lights for motor actuators over 6 feet 6 inches above floor or deck in lieu of integral controls.

E. Do not use external conduit for wiring any components within the actuator.

F. Gear actuators shall be totally enclosed and factory-grease packed or oil lubricated. The power gearing shall consist of helical gears of heat-treated steel. Worm gears shall be alloy bronze accurately cut with a hobbing machine. Worm shall be hardened steel alloy. Design gears for 24-hour continuous service with an AGMA rating of 1.50.

G. Position switches shall be integrally geared to the actuator and shall be adjustable and capable of actuation at any point between fully opened and fully closed positions. The position switches shall operate while the actuator is either in manual or in motor operation. Provide motor actuators with position switches capable of being separately used to provide remote indication of end of travel in each direction and to stop motion at the end of travel in each direction.

H. Provide two individually adjustable torque switches to protect the valve and motor against overload in the opening and closing directions. To prevent hammering, the torque switch shall not reclose until the valve is made to travel in the opposite direction.

I. Provide a manually operated handwheel that shall not rotate during electrical operation. In the event electrical power is interrupted, handwheel operation shall be activated by a hand lever attached to the mechanism. While the valve is being operated manually, the motor shall not rotate. Upon restoration of electrical power, the handwheel shall automatically disengage. Design the handwheel diameter such that hand operation will not damage the valve.

J. The position switch and torque switch contacts shall be capable of interrupting at least 0.2-ampere inductive load at 125-volt dc or 6-ampere inductive load at 120-volt ac.

K. Provide a lost motion device for open/close operation to permit the motor to reach full speed before the load is applied. Provide lost motion action for manual operation also. Do not provide lost motion device for modulating applications.

L. Provide minimum 10-watt space heater mounted in the actuator housing to prevent condensation and maintain the temperature in the actuator housing 5 degrees above the ambient temperature in the structure. Heater shall be on at all times.

M. Motor shall de-energize in the event of a stall when attempting to unseat a jammed valve.

N. Provide a time delay to prevent instant reversal of the actuator motor.

O. Provide terminal connections for external remote controls fed from an internal 24-volt or 120-volt supply.

P. Electric motor actuators shall be manufactured by Beck Electric Actuators, Model 11-160.

PART 3 - EXECUTION

3.01 SERVICE CONDITIONS

Fluid	Max. Flow (gpm)	Max. Dif. Press. (psi)	Opening/ Closing Time (seconds)	Separate (Remote) Control Enclosure Required?
Water	2,000 GPM	100 psi	30 to 55 seconds	No

3.02 FACTORY PERFORMANCE TESTING OF MOTOR ACTUATOR

Test each actuator prior to shipment in accordance with AWWA C542, Section 5.3. The application torque shall be the maximum torque required to open or close the valve at any position including seating and unseating conditions.

3.03 PAINTING AND COATING

Coat electric motor actuator the same as the valve to which it is attached. Color of finish coat shall match the color of the valve to which the actuator is attached.

3.04 SHIPMENT, STORAGE, AND TEMPORARY INSTALLATION BEFORE START-UP

A. Prepare equipment for shipment per AWWA C542, Section 6.2 and the following. The preparation shall make the equipment suitable for six months of outdoor storage from the time of shipment, with no disassembly required before operation, except for inspection of bearings and seals.

B. Identify the equipment with item and serial numbers. Material shipped separately shall be identified with securely affixed, corrosion-resistant metal tags indicating the item and serial number of the equipment for which it is intended. In addition, ship crated equipment with duplicate packing lists, one inside and one on the outside of the shipping container.

C. Pack and ship one copy of the manufacturer’s standard installation instructions with the equipment. Provide the instructions necessary to preserve the integrity of the storage preparation after the equipment arrives at the jobsite and before start-up.

D. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Provide closures at the place of manufacture prior to shipping. For studded openings, use all the nuts needed for the intended service to secure closures.

E. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Provide caps or plugs at the place of manufacture prior to shipping.

F. Clearly identify lifting points and lifting lugs on the equipment or equipment package. Identify the recommended lifting arrangement on boxed equipment.

G. If actuators are stored or installed outside or in areas subject to temperatures below 40°F or are exposed to the weather prior to permanent installation, provide the manufacturer's recommended procedures for extended storage. Provide temporary covers over the actuator electrical components. Provide temporary conduits, wiring, and electrical supply to space heaters. Exercise each actuator from its fully open to fully closed position at least once every sevendays. Inspect electrical contacts before start-up.

3.05 FLOOR STANDS AND EXTENSION STEMS

Where shown in the drawings, mount the electric motor actuators on floor stands with extension stems as specified in Section 400520.

3.06 ATTACHING ELECTRIC ACTUATORS

The valve manufacturer shall mount the electric motor actuator and accessories on each valve and stroke the valve prior to shipment. Adjust limit switch positions and torque switches.

3.07 FIELD INSTALLATION

Install the valve and actuator as indicated in the drawings in accordance with the manufacturer's instructions. Keep units dry, closed, and sealed to prevent internal moisture damage during construction. Provide additional hangers and supports for actuators which are not mounted vertically over the valve or which may impose an eccentric load on the piping system.

3.08 FIELD TESTING OF MOTOR ACTUATORS

A. Test motor actuators as installed by measuring the current drawn (in amperes) by each motor for unseating, seating, and running conditions. The measured current shall not exceed the current measurement recorded during the factory performance test.

B. If the measured current drawn exceeds the above value, provide a larger motor or gear drive or adjust the actuator so that the measured amperage does not exceed the value.

C. Assure that limit switches are placed at their correct settings. Open and close valve twice and assure that limit switches function.

END OF SECTION

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SECTION 409715 PRESSURE GAUGES AND PRESSURE SWITCHES

PART 1 - GENERAL

1.01 DESCRIPTION

This section includes materials and installation of pressure gauges, vacuum gauges, compound pressure/vacuum gauges, digital combination pressure indicator/pressure switches/pressure transmitter, gauge protectors, diaphragm seals, pressure switches, and accessories.

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Pressure Testing of Piping: 400515.

B. Manual, Check, and Process Valves: 400520.

1.03 SUBMITTALS

A. Submit shop drawings in accordance with Section 013300.

B. Submit manufacturer's catalog data and descriptive literature. Call out materials of construction by ASTM reference and grade. Submit manufacturer's certificate of compliance with the referenced ANSI standards.

PART 2 - MATERIALS

2.01 PRESSURE GAUGES

A. Pressure range shall be as designated by the following type numbers shown in the drawings:

Type Number	Description	Pressure Range
1	Pressure	0 to 30 psi
2	Pressure	0 to 150 psi

B. If no type number is shown in the drawings, use Type 2 gauges.

C. Gauges 4 1/2 inches and larger shall comply with ASME B40.1, Grade 2A. Gauges shall incorporate the following features:

1. Solid or open front with side or rear blowout relief.

2. Pressure tight.

3. 270-degree arc with adjustable pointer.

4. Stem mounted.

5. Hermetically sealed unless specified to be liquid filled.

Size of gauge shall be 4 1/2 inches, unless otherwise indicated in the drawings. Stem or connection size shall be 1/4 inch.

D. Gauges smaller than 4 1/2 inches shall conform to ASME B40.1, Grade A. Otherwise, construction shall be as described above.

E. Materials of construction for Types 1 and 2 gauges shall be as shown in the following table:

Item	Material	Specification
Case	Stainless steel, aluminum, polypropylene, or phenolic plastic	AISI 316, 6061-T6
Bourdon tube	Stainless steel	AISI 316
Windows	Acrylic plastic	---
Ring	Stainless steel	AISI 316
Stem	Stainless steel	AISI 316
Dial face	Aluminum with clear baked-on acrylic coating	ASTM B209, 6061-T6

F. Gauges, diaphragm seals, snubbers, and tools shall be as manufactured by Ashcroft, Crosby, Marshalltown, Marsh, or equal.

2.02 DIGITAL PRESSURE GAUGE, PRESSURE SWITCH, AND PRESSURE TRANSMITTER

A. Pressure Range: 0 to 200 psi.

B. Wetted Materials and Sensor: Type 316 or 316L stainless steel.

C. Connection: 1/4-inch or 1/2-inch male NPT.

D. Provide polycarbonate front and back covers, anodized aluminum housing with NEMA 4X enclosure rating and Buna-N O-rings.

E. Power Supply: 12 to 24 volts ac/dc. Provide four-digit LED for local indication of pressure. Provide two SPDT Form C contacts for high and low pressure alarm signal transmission.

F. Electrical Rating: 0.5 ampere at 125 volts.

G. The two set points shall be adjustable by means of a menu accessible on the face of the device. Provide a 4- to 20-mA output signal for the pressure transmitter.

H. Products: Dwyer Series DPG-200 or equal.

2.03 GAUGE AND PRESSURE SWITCH PROTECTORS

A. Gauge and pressure switch protectors shall consist of three parts: a flexible, impermeable, elastomer cylinder; a captive sensing liquid; and a steel or stainless steel housing. The process liquid pressure shall be transmitted through the elastomer-lined cylinder wall and the sensing liquid to the pressure gauge. An attached 4-1/2-inch pressure gauge shall indicate the pressure. Gauge outlet in the spool or ring shall be threaded, 1/4- or 1/2-inch, per ASME B1.20.1. Spools shall be of either the isolation-spool type with flanged ends or of the isolation-ring type, fitting between two adjacent flanges. Determine the flange rating based on the test pressure shown in Section 400515. For test pressures 200 psi and less, use Class 150 flanges, ASME B16.5. For test pressures greater than 200 psi, use Class 300 flanges, ASME B16.5.

B. Materials of construction shall be as follows:

Item	Material	
	Type 1	**Type 2**
Housing, flanges	Type 316 stainless steel	Carbon steel
Flexible cylinder	Teflon	Buna N or neoprene
Sensing liquid	Silicone oil	Silicone oil

C. Use Type 2 gauge protectors if no type number is shown in the drawings.

D. Protectors shall be manufactured by Ronningen-Petter; Red Valve Company, Inc.; Onyx; or equal.

2.04 TYPE 1 DIAPHRAGM SEALS (STAINLESS STEEL)

A. Provide diaphragm seals with gauge assemblies and/or switch where shown in the drawings. Material of construction shall be Type 316 stainless steel. Mount the pressure gauge directly on the socket of the diaphragm seal top housing. Instrument (gauge) connection socket shall be 1/2 inch. Diaphragm seal connection socket shall be 1/2-inch NPT threaded female with flush connection. Pressure rating shall be at least that of the pressure gauge to which it is attached. Liquid filling shall be silicone or glycerin.

B. Gauge and diaphragm seal shall be assembled together at the factory, with the liquid fill included. Provide a Type 316 stainless steel plug or cock in the flush connection.

2.05 TYPE 2 DIAPHRAGM SEALS (PLASTIC)

A. Provide diaphragm seals with gauge assemblies where shown in the drawings. Bodies shall be molded CPVC with Viton membranes. Provide air bleed ports. Mount the pressure gauge directly on the socket of the diaphragm seal top housing. Instrument (gauge) connection shall be 1/2 inch. Diaphragm seal connection socket shall be 1/4-inch threaded female. Pressure rating shall be at least 150 psi. Products: Hayward Industrial Products, Inc., or equal.

B. Gauge and diaphragm seal shall be assembled together at the factory with the liquid fill included.

2.06 PIPE NIPPLES AND FITTINGS

A. Nipples for connecting gauges and pressure switches to piping shall be brass, regular weight, per ASTM B43. Fittings shall be bronze, Class 150 or 250, per ASME B16.15. Use Class 250 where the test pressure exceeds 200 psi. Size of nipple shall match the gauge or pressure switch connection size.

2.07 TOOLS FOR GAUGES

Provide two gauge tool kits, each containing a hand jack set, screwdriver, five reamers (minimum), two pin vise holders, wiggler, tweezer, and carrying case.

2.08 GAUGE COCKS

Gauge cocks shall be two way. Gauge cocks shall be brass or bronze, ASTM B16 or B62. End connections shall be NPT, female. Cocks shall be Lunkenheimer or equal.

PART 3 - EXECUTION

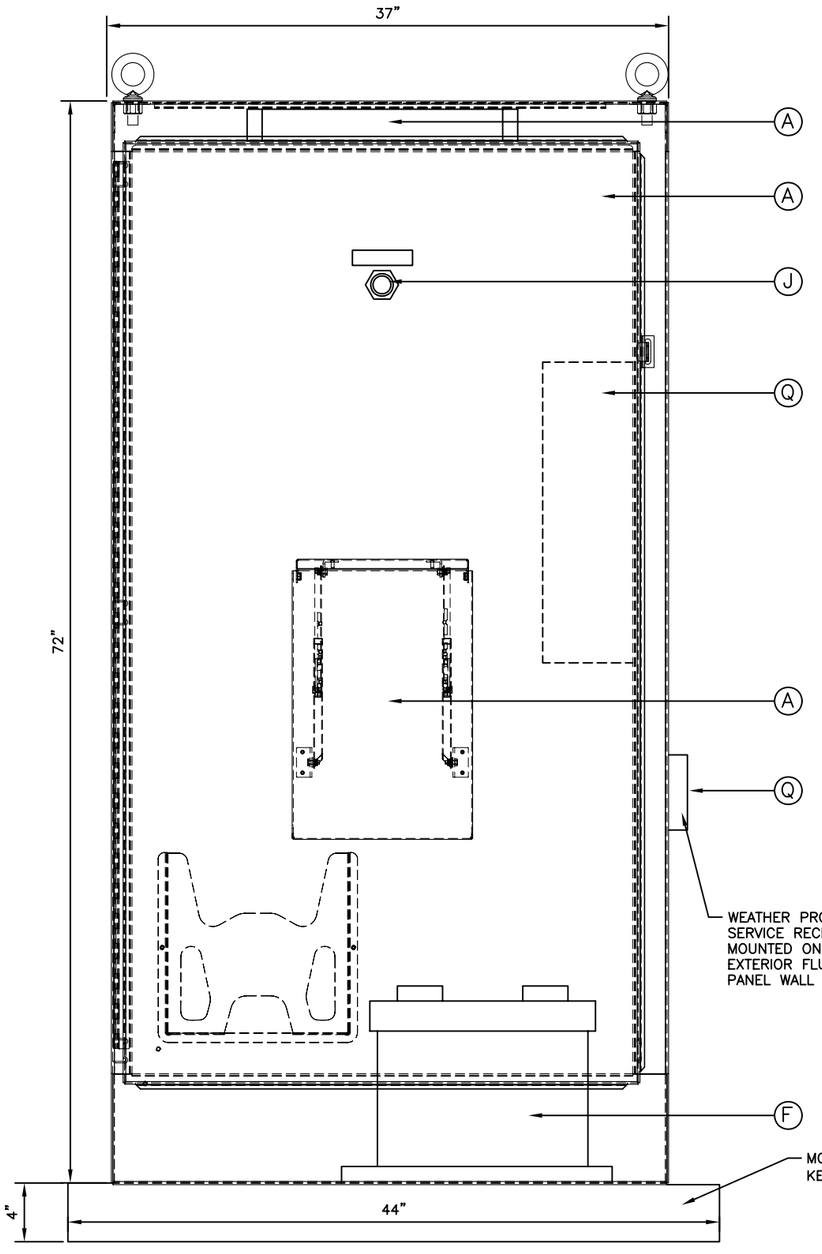
3.01 INSTALLATION

Install gauges and pressure switches before conducting pressure tests. Do not disassemble gauges from the factory-assembled diaphragm seals or isolation sleeves or rings.

END OF SECTION

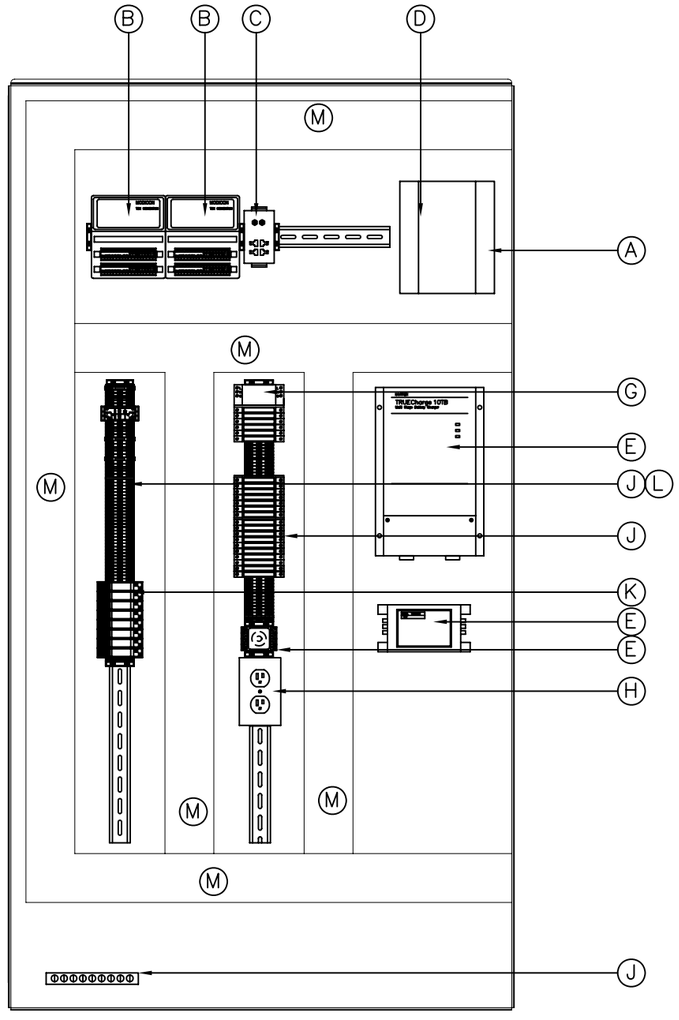
APPENDIX A

MSO DRAWINGS



TANK PANEL ENCLOSURE EXTERNAL LAYOUT

SCALE 1'=5"



TANK PANEL ENCLOSURE EXTERNAL LAYOUT

SCALE 1'=5"

ITEM	QUANTITY	DESCRIPTION	MANUFACTURER
A	1	NEMA 4X ENCLOSURE, 72" X 37" X 24", 3 PT LATCH	HOFFMAN A72H3724SSFS-3PT
	1	ENCLOSURE BACK PLATE 72" X 36"	HOFFMAN A72P36F1
	1	ENCLOSURE DOOR SHELF	HOFFMAN AASHLF1218
	1	ENCLOSURE LAMP HOLDER, 120 VAC	HOFFMAN LF120V15
	1	ENCLOSURE LAMP FLUORESCENT	HOFFMAN F6T5
	1	ENCLOSURE LAMP CABLE	HOFFMAN LPC72
B	1	PLC PROCESSOR, ETHERNET	MODICON 172 CCC 960 030
	1	PLC REAL TIME CLOCK MODULE	MODICON 171 PNN 210 32
	1	PLC ANALOG INPUT BASE	MODICON 170 AMM 090 10
	1	PLC DIGITAL INPUT/OUTPUT BASE 16T, 24 VDC	MODICON 170 ADM 350 10
	1	PLC INTERBUS S COMMUNICATION MODULE	MODICON 170 INT 110 00
	1	PLC INTERBUS S CABLE	MODICON 170 MCI 007 00
	2	PLC TERMINALS	MODICON 170 XTS 001 00
C	2	NETWORK SWITCH, 5 PORT, ST CONNECTORS	N-TRON 305FX-ST
	4	CAT5 PATCH CABLES	L-COM TRD815BL-7
D	2	FIBER OTPIC PATCH PANEL, WALL MOUNT	COMMSCOPE WFE-24-BK
	4	FIBER OTPIC PATCH PANEL FIBER PLATES	COMMSCOPE WFE-PNL
	4	FIBER OPTIC PATCH CABLES	COMMSCOPE RFJ-01SP29-6F-STE-01-STE
	AR	FIBER OPTIC CONNECTORS	COMMSCOPE MFC-STU-09
	2	FIBER OPTIC FAN OUT KITS	COMMSCOPE LIT-090-012
E	1	BATTERY CHARGER, 12 VDC, 10 AMP	XANTREX TRUECHARGE 10TB
	1	DC/DC CONVERTER 12/24 VDC, 100 W	VICOR VI-L03-EW
	1	LOW VOLTAGE DISCONNECT, 12 VDC, 10 AMP	MACROMATIC VAKP012D
	1	LOW VOLTAGE DISCONNECT BASE	MACROMATIC 70169-D
F	1	UPS BATTERY, 12 VDC, 100 AMP HR	C&D MPS12-100
	2	BATTERY QUICK CONNECTS	MCMASTER CARR 7043K1
	1	BATTERY CASE	MCMASTER CARR 69995K85
	1	PLYWOOD, 20" X 20" X 1"	MOUNT UNDER BATTERY CASE
G	1	AC SURGE PROTECTOR	PHOENIX CONTACT PT-2-PE/S-120AC/FM
H	1	DIN RAIL GFI RECEPTACLE	HUBBEL DRUBGFI15H
J	30	FUSE TERMINALS	ALLEN BRADLEY 1492-H6
	4	FUSE TERMINAL BARRIER	ALLEN BRADLEY 1492-N37
	4	FUSE TERMINAL JUMPER BAR	ALLEN BRADLEY 1492-N49, SJS
	80	FEED THROUGH TERMINALS	ALLEN BRADLEY 1492-J3
	5	FEED THROUGH TERMINAL BARRIER	ALLEN BRADLEY 1492-EBJ3
	5	FEED THROUGH TERMINALS JUMPER BARS	ALLEN BRADLEY 1492-CJJ5-10
	8	FEED THROUGH TERMINALS JUMPER BARS	ALLEN BRADLEY 1492-CJJ5-2
	5	DISCONNECT TERMINALS	ALLEN BRADLEY 1492-
	6	GROUND TERMINALS	ALLEN BRADLEY 1492-JG3
	10	TERMINAL END ANCHORS	ALLEN BRADLEY 1492-ERL35
	4	TERMINAL LABELS, 1-100	ALLEN BRADLEY 1492-
	2	DIODE, 1N4007, 32 VDC 1 A	
	2	SURGE PROTECTION TERMINAL PLUG IN	WEIDMULLER 8924470000
	2	SURGE PROTECTION TERMINAL BASE	WEIDMULLER 8924710000
	3	TERMINAL RAIL	WEIDMULLER 996497
	12	TERMINAL RAIL SUPPORTS	WEIDMULLER 049492
	1	GROUND BAR	SQUARE PKG9T
	30	FUSES, AGC, 10 AMP, 1 AMP, 2 AMP, 5 AMP	
	1	PANEL LIGHT RED, LED, PUSH TO TEST, 120 VAC	ALLEN BRADLEY 800T-QTH2R
	1	PANEL LABEL, 4" X 1" WHITE ON BLACK LETTERS	
K	8	RELAY DPDT, 24 VDC COIL, 5 AMP	ALLEN BRADLEY 700HK32Z24
	8	RELAY BASE, DPDT	ALLEN BRADLEY 700HN122
	2	RELAY JUMPER BAR	ALLEN BRADLEY 700HN180B
L	3	PRECISION RESISTORS, 250 OHM 3W	VISHAY DALE RS-2B 250 0.1
	1	PRECISION RESISTORS, 30K OHM 3W	VISHAY DALE RS-2B 30K 0.1
	1	PRECISION RESISTORS, 10K OHM 3W	VISHAY DALE RS-2B 10K 0.1
M	2	WIRE DUCT, 3" X 3" X 6' NARROW, WHITE	TAYLOR T3X3HDW
	2	WIRE DUCT, 3" COVER, WHITE	TAYLOR T3CW
N	AR	WIRE FERRULES	FERRULESDIRECT.COM
P	AR	WIRE BLUE -24 VDC	THHN
	AR	WIRE PURPLE -12 VDC	THHN
	AR	WIRE WHITE/BLUE STRIP 0 VDC	THHN
	AR	WIRE BLACK -120 VAC	THHN
	AR	WIRE WHITE - NEUTRAL	THHN
	AR	WIRE GREEN - GROUND	THHN
	AR	INSTRUMENT CABLE - 1 PAIR	BELDEN 87760
	AR	INSTRUMENT CABLE - 2 PAIR	BELDEN 87723
Q	1	PANELBOARD 120/240 VAC, 12 CIRCUIT	
	5	CIRCUIT BREAKER, 15 AMP, 120 VAC	
	1	PANEL BOARD NUETRAL BARD	
	1	PANEL BOARD GROUND BAR	
	1	RECEPTACLE, OUTDOOR DUPLEX WEATHERPROOF, FLUSH	

REGISTERED PROFESSIONAL ENGINEER
LLOYD TRICK
No. E014247
EXP. 06/30/2015
ELECTRICAL
STATE OF CALIFORNIA

1426-001.DWG
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LAS VIRGENES MUNICIPAL WATER DISTRICT
1235 FOOT BACKBONE IMPROVEMENTS PROJECT
WESTLAKE FILTRATION FACILITY 5MG TANK
TANK PANEL LAYOUT AND PARTS LIST

ISSUE No.	ISSUE DATE	DRWN BY	DES'D BY	CHK'D BY	ISSUED FOR
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SHEET 1 OF 9

DRAWING No. 1426–001

JOB No. 1426

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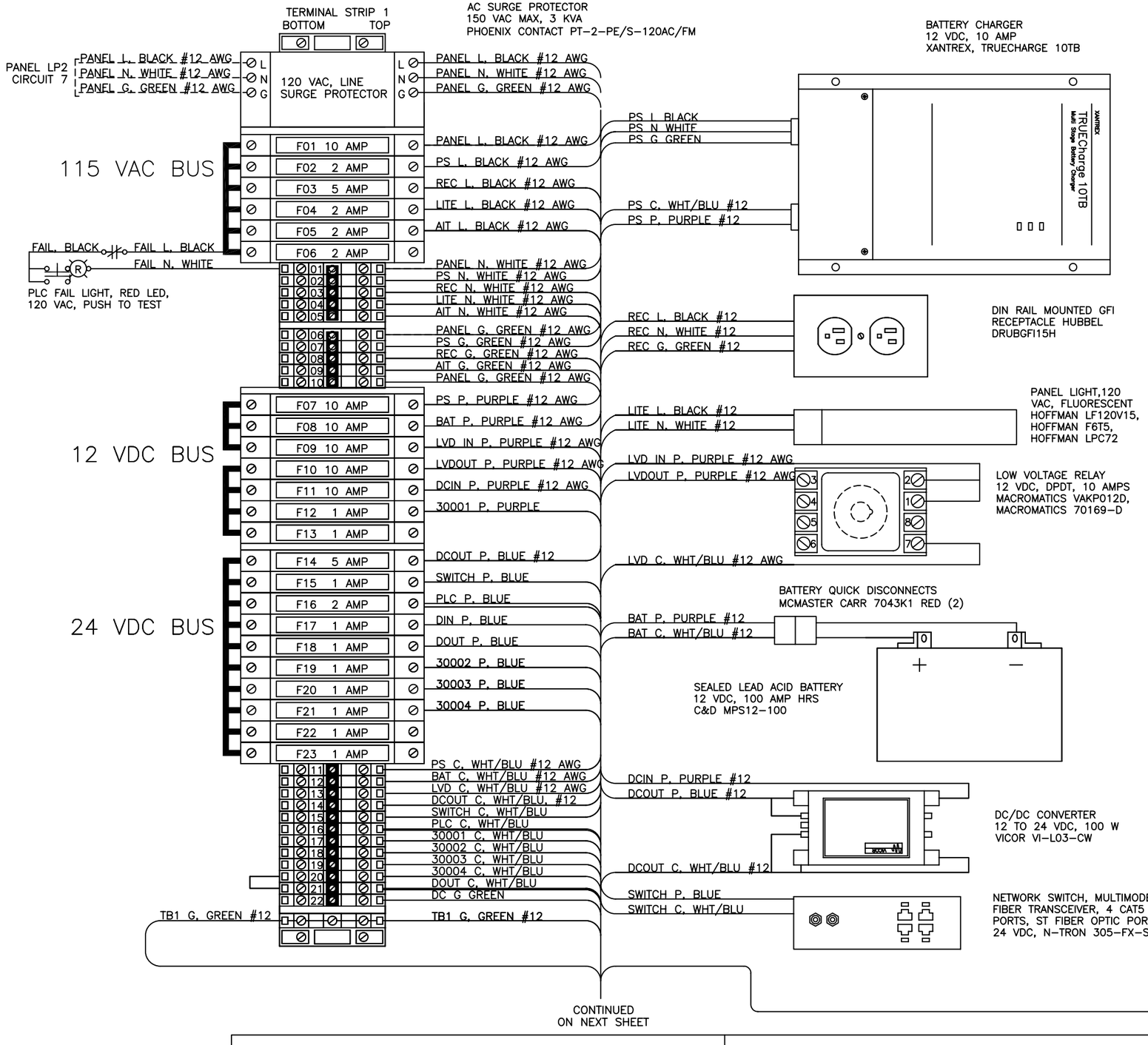

TERMINAL BLOCK TYPES AND PART NUMBERS LEGEND

FRONT VIEW	PART NUMBER	MANUFACTURER	DESCRIPTION
	996497	WEIDMULLER	SLOTTED ASSEMBLY RAIL, 35mm
	1492-J3	ALLEN BRADLEY	FEED-THROUGH TERMINAL BLOCK
	1492-EBJ3	ALLEN BRADLEY	END SECTION FOR FEED THROUGH TERMINAL
	1492-CJJ5-10	ALLEN BRADLEY	JUMPER BAR - 10 BLOCKS
	1492-JD3	ALLEN BRADLEY	DOUBLE LEVEL FEED-THROUGH TERMINAL BLOCK
	1492-EBJD3	ALLEN BRADLEY	END SECTION FOR DOUBLE LEVEL FEED THROUGH
	1492-H6	ALLEN BRADLEY	FUSE HOLDER TERMINAL BLOCK 1 1/4" X 1/4" FUSE
	1492-N37	ALLEN BRADLEY	
	1492-SJS	ALLEN BRADLEY	JUMPER BAR - 10 BLOCKS
	1492-JKD3	ALLEN BRADLEY	DISCONNECT SWITCH TERMINAL BLOCK
	1492-JG3	ALLEN BRADLEY	GROUND TO RAIL TERMINAL BLOCK
	1492-ERL35	ALLEN BRADLEY	END BRACKET
	8924470000 8924710000	WEIDMULLER	SURGE PROTECTION TERMINAL BLOCK
	049492	WEIDMULLER	TO SUPPORT TERMINAL RAIL AND ISOLATE TERMINAL STRIP FROM PANEL BACKPLATE MOUNT UNDER TERMINAL RAIL AT 8" INTERVALS

PANEL CONSTRUCTION NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL INTERIOR CONTROL PANEL WIRING (SHOWN SOLID) SHALL BE #18 AWG THHN OR HW, COLOR AS INDICATED.
2. ALL FIELD WIRING (SHOWN IN DASHED LINES) SHALL BE #14 AWG w/ TYPE THHN/THWN INSULATION, COLOR AS INDICATED, UNLESS SIZE INDICATED.
3. ALL WIRES SMALLER THAN 14 AWG SHALL USE WIRE FERRULES IN PANEL TERMINAL WHERE APPROPRIATE.
4. ALL WIRES SHALL HAVE HEAT SHRINK WIRE LABELS AS INDICATED; BRADY PS-187-150W.
5. ALL WIRES SHALL HAVE LABELS ON BOTH ENDS OF THE WIRE AS SHOWN ON THE DRAWINGS.
6. TERMINAL SUPPORTS SHALL BE PLACED AT 8" INTERVALS FOR ALL TERMINAL RAILS.
7. ALL EQUIPMENT, TERMINAL RAILS, AND WIRE DUCT SHALL BE MOUNTED WITH 10-32 SCREWS TO THE BACK PLATE WILL BE DRILLED AND TAPPED FOR THE SCREWS.
8. NO SELF TAPPING SCREWS SHALL BE ALLOWED FOR ANY MOUNTING.
9. MOUNT A CHART FOR FUSE SIZE AND FUNCTION ON INSIDE OF PANEL.
10. PANEL TO BE FABRICATED IN A UL-508 CERTIFIED PANEL SHOP.

REGISTERED PROFESSIONAL ENGINEER
CLOYD TRICK
No. E014247
EXP. 06/30/2015
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LAS VIRGENES MUNICIPAL WATER DISTRICT
1235 FOOT BACKBONE IMPROVEMENTS PROJECT
WESTLAKE FILTRATION FACILITY 5MG TANK
TANK PANEL POWER DISTRIBUTION DETAILS

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1	07/2013	LFT	LFT		REVIEW
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SHEET 2 OF 9
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JOB No. 1426
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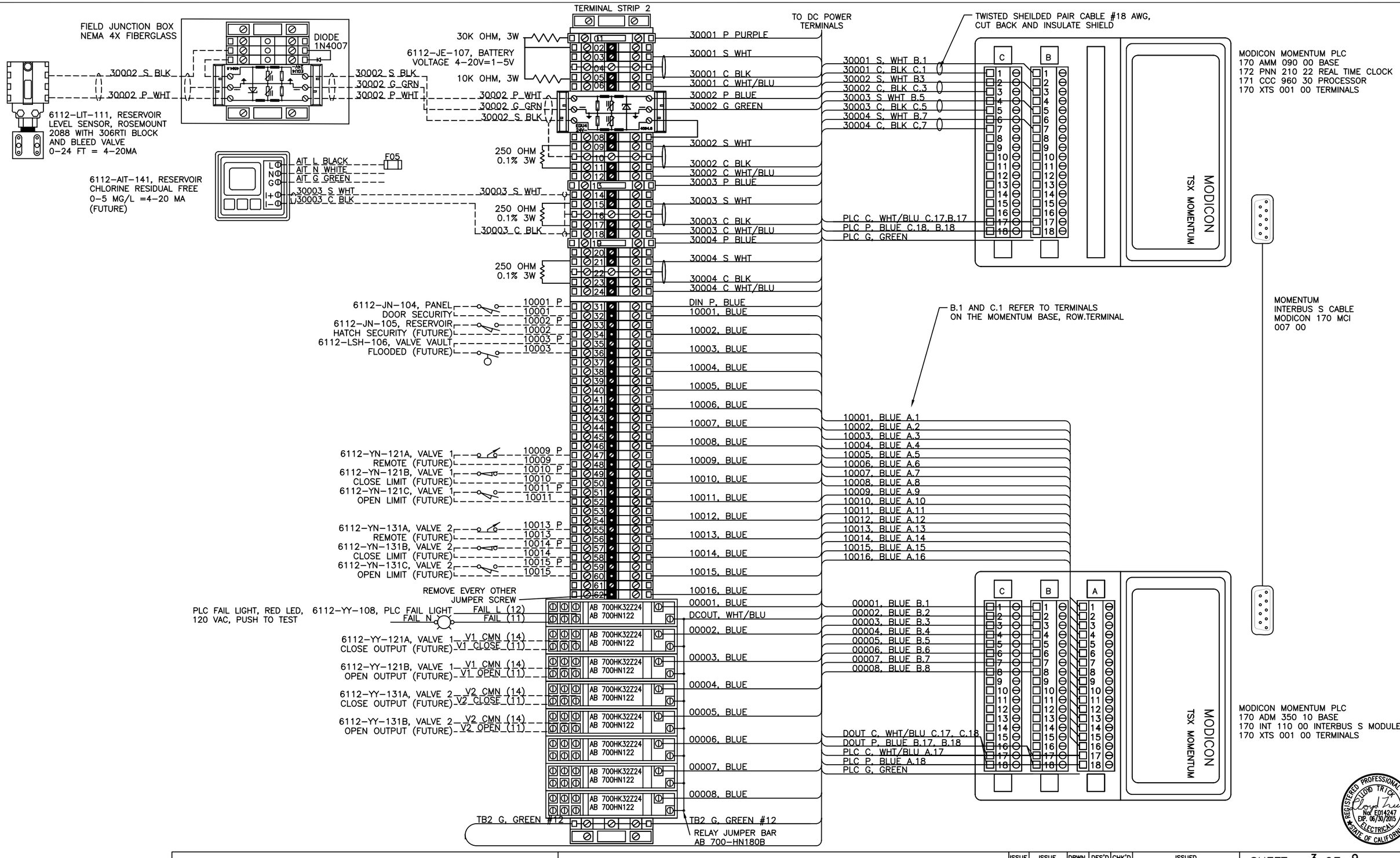

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1235 FOOT BACKBONE IMPROVEMENTS PROJECT
WESTLAKE FILTRATION FACILITY 5MG TANK
TANK PANEL ANALOG AND DIGITAL WIRING DETAILS

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JOB No. 1426
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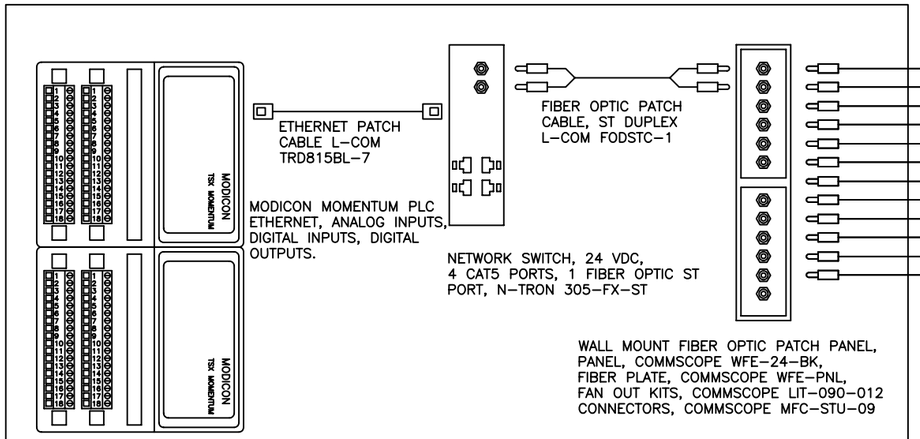


ETHERNET PATCH CABLE L-COM TRD815BL-7

MODICON MOMENTUM PLC ETHERNET, ANALOG INPUTS, DIGITAL INPUTS, DIGITAL OUTPUTS.

FIBER OPTIC PATCH CABLE, ST DUPLEX L-COM FODSTC-1

NETWORK SWITCH, 24 VDC, 4 CAT5 PORTS, 1 FIBER OPTIC ST PORT, N-TRON 305-FX-ST

WALL MOUNT FIBER OPTIC PATCH PANEL, PANEL, COMMSCOPE WFE-24-BK, FIBER PLATE, COMMSCOPE WFE-PNL, FAN OUT KITS, COMMSCOPE LIT-090-012 CONNECTORS, COMMSCOPE MFC-STU-09

EQUIPMENT LOCATED IN TANK CONTROL PANEL

FIBER OPTIC PATCH CABLE, ST DUPLEX L-COM FODSTC-1

TO EXISTING NETWORK SWITCH CISCO 2960

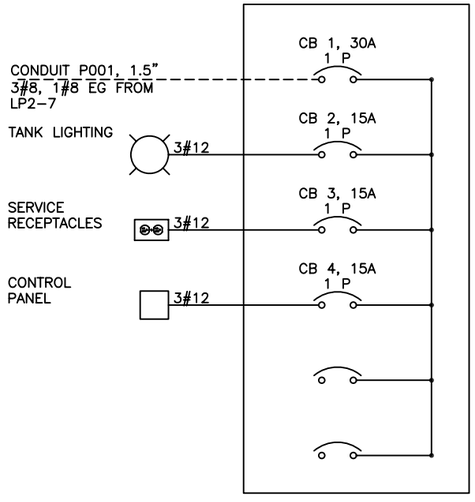
ETHERNET PATCH CABLE L-COM TRD815BL-7

NETWORK SWITCH, 24 VDC, 4 CAT5 PORT, 1 FIBER OPTIC ST PORT, N-TRON 305-FX-ST

WALL MOUNT FIBER OPTIC PATCH PANEL, PANEL, COMMSCOPE WFE-24-BK, FIBER PLATE, COMMSCOPE WFE-PNL, FAN OUT KITS, COMMSCOPE LIT-090-012 CONNECTORS, COMMSCOPE MFC-STU-09

EQUIPMENT LOCATED IN PLANT CONTROL PANEL IN ELECTRICAL ROOM

TANK PANEL BOARD
6 CIRCUIT, 50 AMP
120/240 VAC, WITH
NUETRAL AND GROUND BAR



PANEL BOARD MOUNTED IN TANK CONTROL PANEL

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LAS VIRGENES MUNICIPAL WATER DISTRICT
1235 FOOT BACKBONE IMPROVEMENTS PROJECT
WESTLAKE FILTRATION FACILITY 5MG TANK
TANK PANEL COMMUNICATIONS SCHEMATIC

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JOB No. 1426
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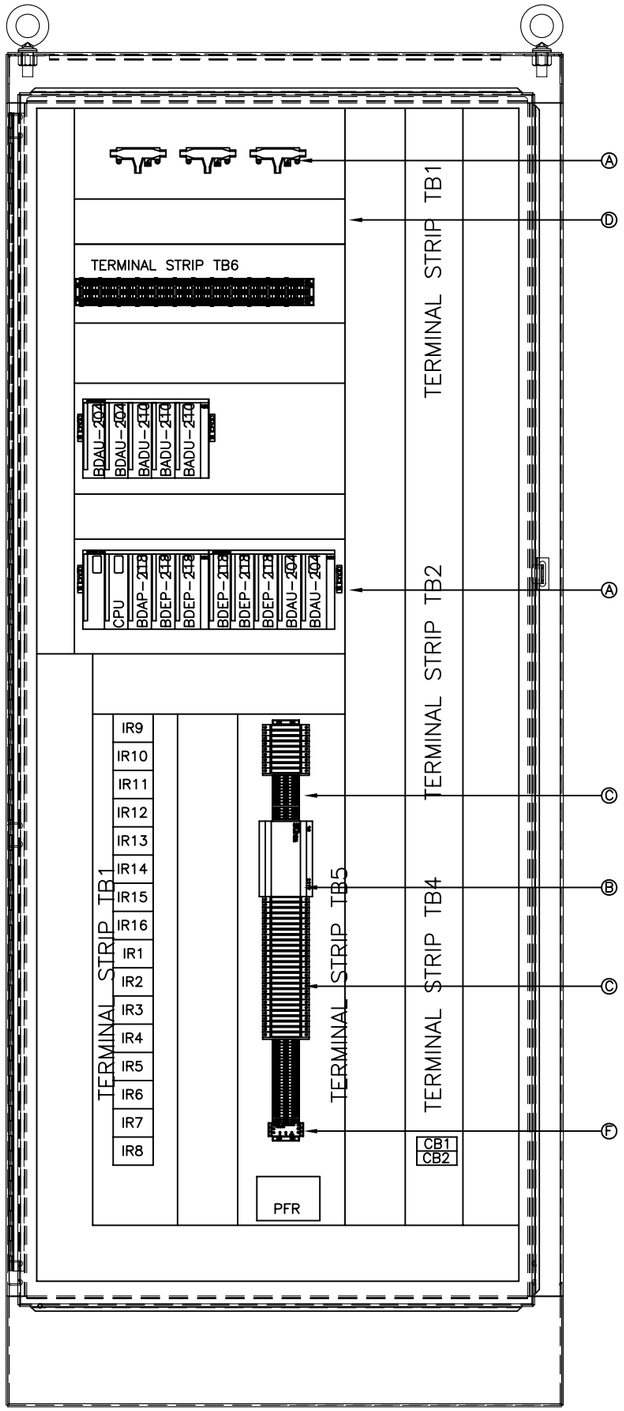
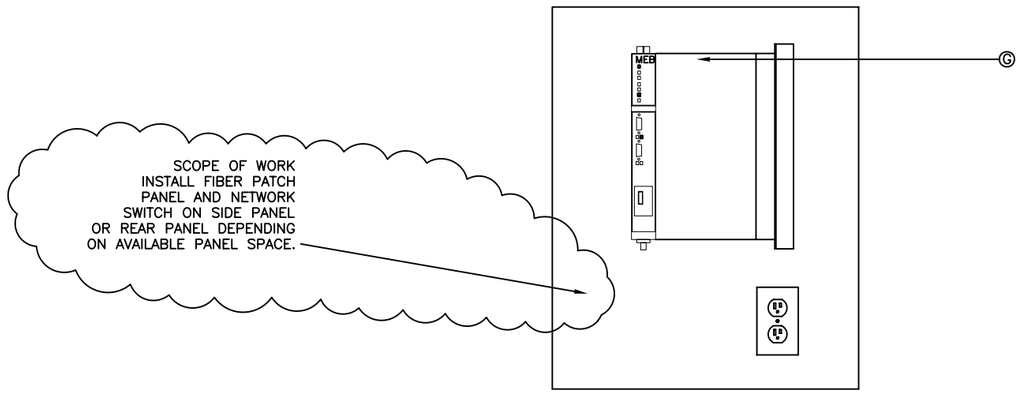


PLANT CONTROL PANEL – MODIFICATIONS

SCALE 1=5



PLANT CONTROL PANEL – SIDE PANEL MODIFICATIONS

SCALE 1=5

CONSTRUCTION NOTE:
THE FOLLOWING DRAWINGS ARE FOR AN EXISTING PLC WHERE NEW CONTROL DEVICES ARE BEING ADDED TO THE EXISTING PLC INPUTS AND OUTPUTS. THE NEW DEVICES AND WIRING ARE HIGHLIGHTED WITH A CLOUD AND ARE IDENTIFIED AS "SCOPE OF WORK" TEXT.

REGISTERED PROFESSIONAL ENGINEER
LLOYD TRICK
No. E014247
EXP. 06/30/2015
ELECTRICAL
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ITEM	QUANTITY	DESCRIPTION	MANUFACTURER, MODEL NUMBER
A	1	PROGRAMMABLE LOGIC CONTROLLER	MODICON, PC-E984-285
	1	PLC PRIMARY CHASSIS, 5 SLOT	MODICON, AS-HDTA-200
	2	PLC SECONDARY CHASSIS, 5 SLOT	MODICON, AS-HDTA-201
	1	DIGITAL OUTPUT MODULE, 115 VAC, 16 POINT	MODICON, AS-BDAP-218
	5	DIGITAL INPUT MODULE, 115 VAC, 16 POINT	MODICON, AS-BDEP-218
	3	ANALOG INPUT MODULE, 4 POINT	MODICON, AS-BADU-210
	4	ANALOG OUTPUT MODULE, 4 POINT	MODICON, AS-BDAU-204
	1	SUB RACK EXTENSION BUS CABLE	MODICON, AS-WXBT-201
	2	MODBUS PLUS TAP	MODICON, 990NAD230000
	2	MODBUS PLUS TAP CABLE, 2.4 M	MODICON, 990NAD21110
B	1	POWER SUPPLY, 24 VDC, 3.5 AMP	SIEMENS, 6EP1332-1SH31
C	36	FUSE TERMINALS	ALLEN BRADLEY, 1492-H6
	2	FUSE TERMINAL END PLATES	ALLEN BRADLEY, 1492-N37
	4	FUSE TERMINAL JUMPER BAR	ALLEN BRADLEY, 1492-N49
	170	FEED THROUGH TERMINALS	ALLEN BRADLEY, 1492-W3
	6	FEED THROUGH TERMINAL END PLATES	ALLEN BRADLEY, 1492-EB3
	5	FEED THROUGH TERMINAL JUMPER BARS	ALLEN BRADLEY, 1492-CJ510
	24	FEED THROUGH TERMINAL JUMPER BARS	ALLEN BRADLEY, 1492-CJ52
	12	DISCONNECT TERMINALS	ALLEN BRADLEY, 1492-WKD3
	15	GROUND TERMINALS	ALLEN BRADLEY, 1492-WG4
	3	TERMINAL RAIL	ALLEN BRADLEY, 199-DR1
	8	TERMINAL RAIL END ANCHORS	ALLEN BRADLEY, 1492-EA35
D	1	WIRE DUCT, 3' X 3'	PANDUIT
	1	WIRE DUCT COVER, 3"	PANDUIT
E	12	PRECISION RESISTORS, 250 OHM 1% 3 WATT	DALE RS-2B 250 1% 3W
F	1	LINE DRIVER, RS485	B&B ELECTRONICS, 485LDRC
G	1	ETHERNET TO MODBUS PLUS BRIDGE	NR&D, MEB-TCP-T
	1	ETHERNET TO MODBUS PLUS BRIDGE RACK	NR&D, NRK-2
	2	ETHERNET TO MODBUS PLUS BRIDGE CABLES	NR&D, NRC-902

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LAS VIRGENES MUNICIPAL WATER DISTRICT
1235 FOOT BACKBONE IMPROVEMENTS PROJECT
FILTRATION PLANT PLC CONTROL PANEL
PLC PANEL MODIFICATIONS & PARTS LIST

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JOB No. 1426
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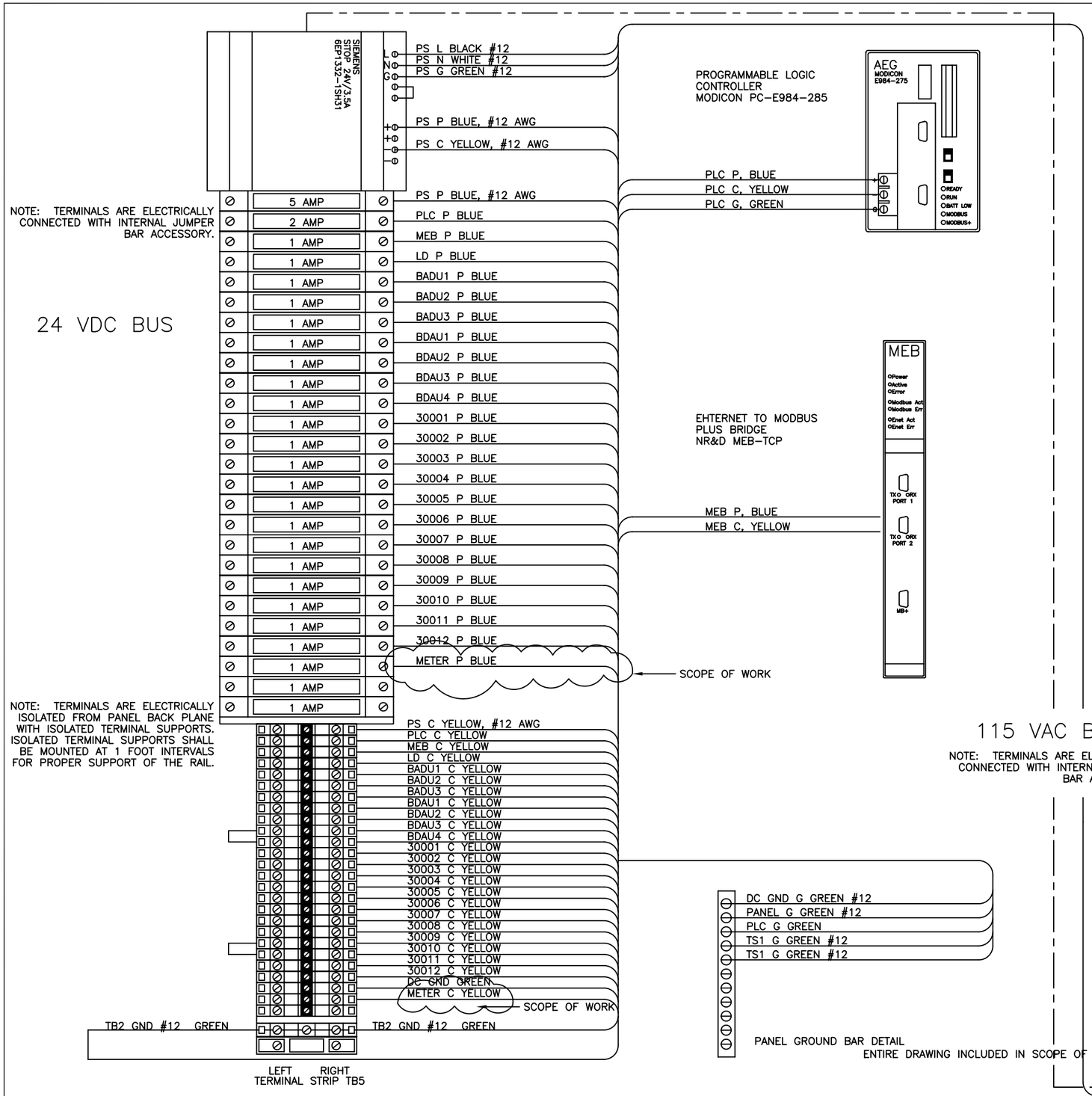

TERMINAL BLOCK TYPES AND PART NUMBERS

FRONT VIEW	PART NUMBER	MANUFACTURER	DESCRIPTION
	996497	WEIDMULLER	SLOTTED ASSEMBLY RAIL, 35mm
	1492-W3	AB	FEED-THROUGH TERMINAL BLOCK
	1492-EB3	AB	END SECTION FOR FEED THROUGH TERMINAL
	1492-CJ5-10	AB	JUMPER BAR - 10 BLOCKS
	1492-CJ5-2	AB	JUMPER BAR - 2 BLOCKS
	1492-H6	AB	FUSE HOLDER TERMINAL BLOCK 1 1/4" X 1/4" FUSE
	1492-N37	AB	END SECTION FOR FUSE TERMINAL BLOCK
	1492-N49	AB	JUMPER BAR - 10 BLOCKS
	1492-WKD3	AB	DISCONNECT SWITCH TERMINAL BLOCK
	1492-WG4	AB	GROUND TO RAIL TERMINAL BLOCK
	1492-EA35	AB	END ANCHORS
	049492	WEIDMULLER	TO SUPPORT TERMINAL RAIL AND ISOLATE TERMINAL STRIP FROM PANEL BACKPLATE MOUNT UNDER TERMINAL RAIL AT 8" INTERVALS

PANEL CONSTRUCTION NOTES:

1. UNLESS OTHERWISE SPECIFIED, ALL INTERIOR CONTROL PANEL WIRING (SHOWN SOLID) SHALL BE #18 AWG THHN OR HW, COLOR AS INDICATED.
2. ALL FIELD WIRING (SHOWN IN DASHED LINES) SHALL BE #14 AWG w/ TYPE THHN/THWN INSULATION, COLOR AS INDICATED.
3. ALL WIRES UNDER 12 AWG SHALL USE WIRE FERRULES IN PANEL TERMINAL WERE APPROPRIATE.
4. ALL WIRES SHALL HAVE HEAT SHRINK WIRE LABELS AS INDICATED; BRADEY PS-187-150W.
5. TERMINAL SUPPORTS SHALL BE PLACED AT 8" INTERVALS FOR ALL TERMINAL RAILS.
6. ALL EQUIPMENT, TERMINAL RAILS, AND WIRE DUCT SHALL BE MOUNTED WITH 10-32 SCREWS TO THE BACK PLATE WILL BE DRILLED AND TAPPED FOR THE SCREWS.
7. NO SELF TAPPING SCREWS SHALL BE ALLOWED FOR ANY MOUNTING.

REGISTERED PROFESSIONAL ENGINEER
FLOYD TRICK
No. E014247
EXP. 06/30/2015
ELECTRICAL
STATE OF CALIFORNIA

1426-006.DWG
MSO 10/2013

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LAS VIRGENES MUNICIPAL WATER DISTRICT
1235 FOOT BACKBONE IMPROVEMENTS PROJECT
FILTRATION PLANT PLC CONTROL PANEL
PLC PANEL AC&DC POWER WIRING DIAGRAM

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SHEET 6 OF 9
DRAWING No. 1426-006
JOB No. 1426
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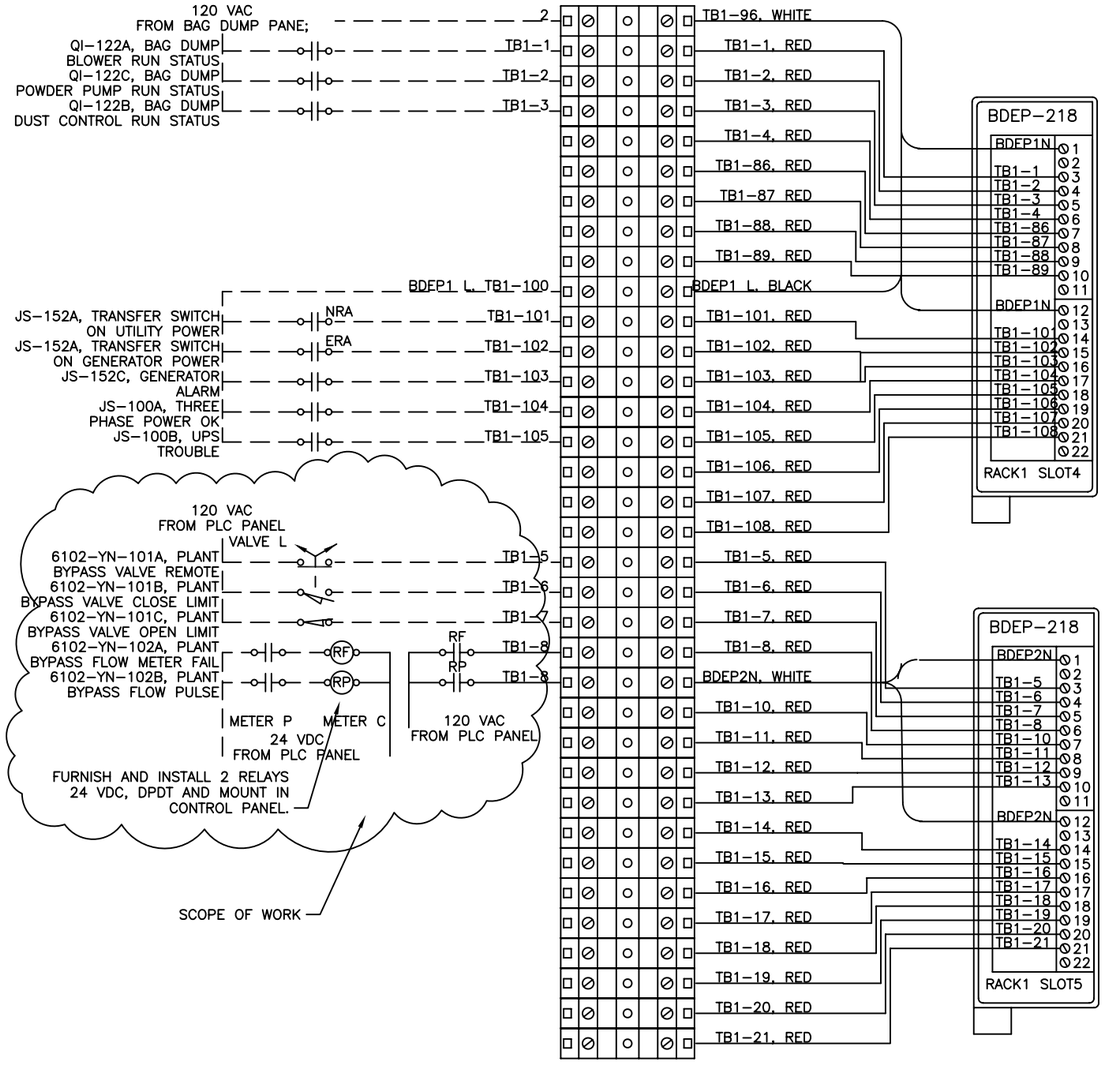

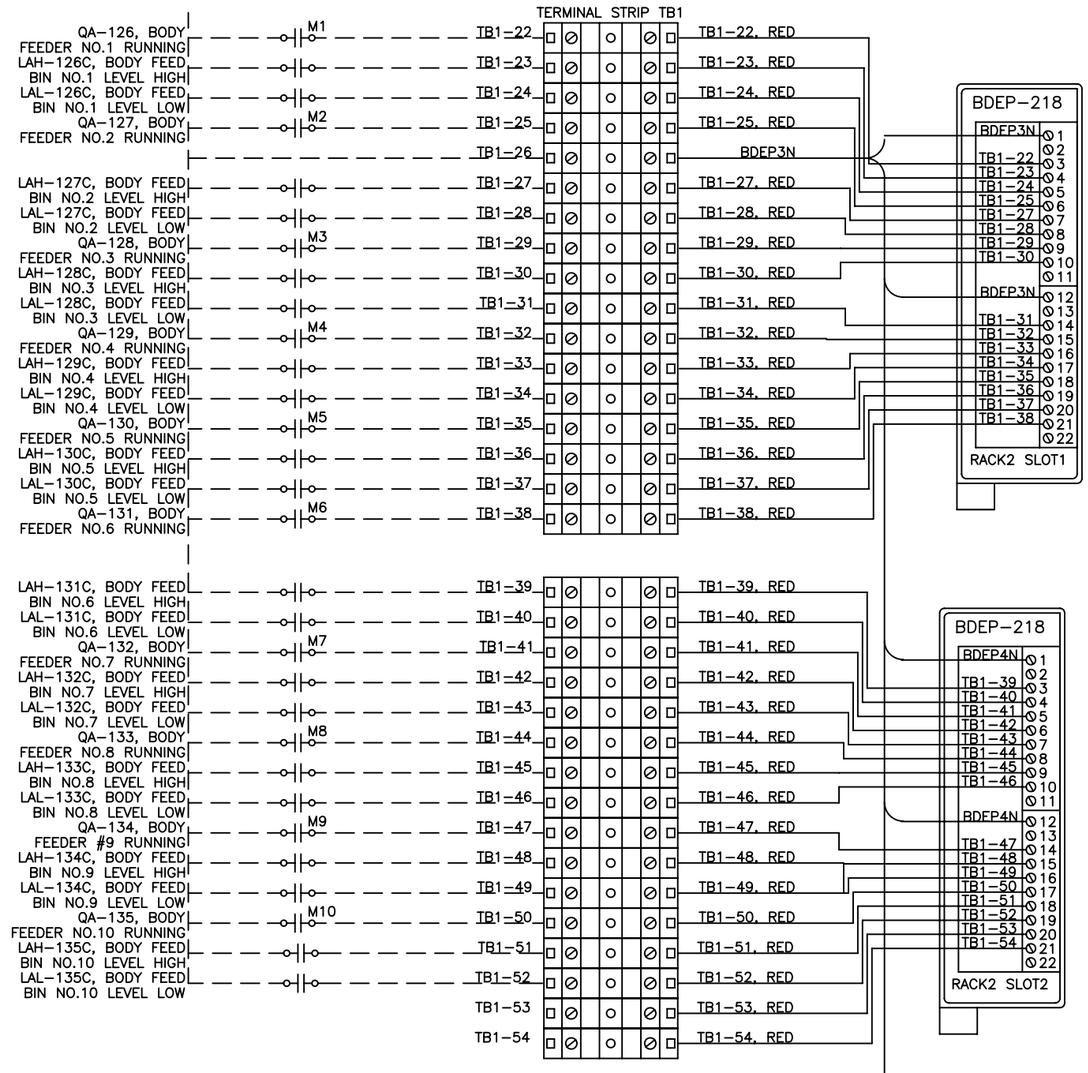

CONSTRUCTION NOTE: THE DIGITAL INPUTS ARE FEED FROM FIELD DEVICES. DE-ENERGIZE FIELD EQUIPMENT AND TEST FOR NO VOLTAGE PRIOR TO CONSTRUCTION.

REGISTERED PROFESSIONAL ENGINEER
LLOYD TRITCH
No. E014247
EXP. 06/30/2015
ELECTRICAL
STATE OF CALIFORNIA

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LAS VIRGENES MUNICIPAL WATER DISTRICT
1235 FOOT BACKBONE IMPROVEMENTS PROJECT
FILTRATION PLANT PLC CONTROL PANEL
PLANT PLC DIGITAL INPUT WIRING DIAGRAMS

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SHEET 7 OF 9
DRAWING No. 1426-007
JOB No. 1426
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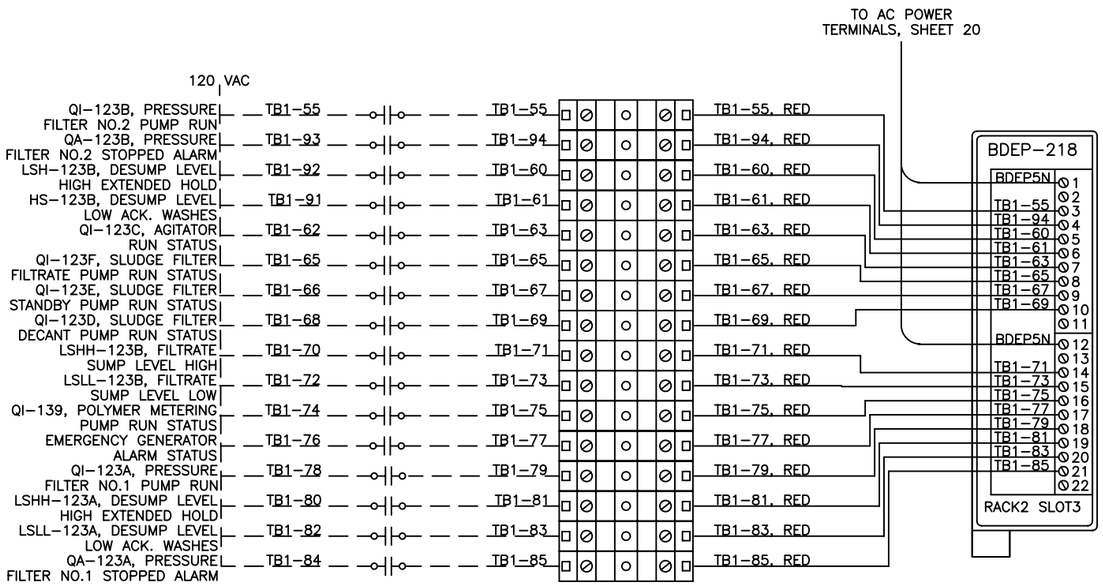
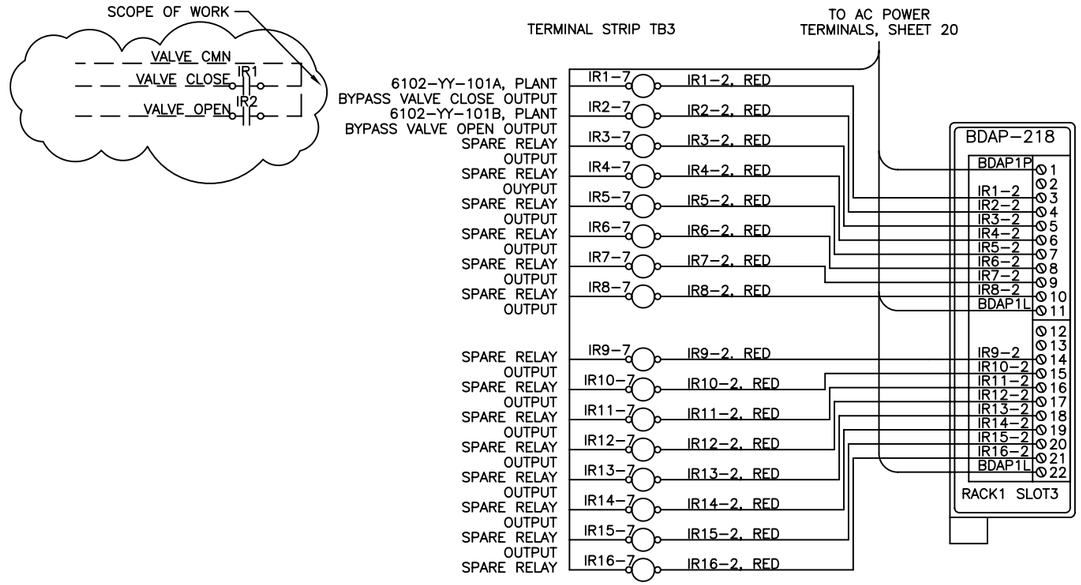
MSD 10/2013





CONSTRUCTION NOTE: THE DIGITAL INPUTS ARE FEED FROM FIELD DEVICES. DE-ENERGIZE FIELD EQUIPMENT AND TEST FOR NO VOLTAGE PRIOR TO CONSTRUCTION.

REGISTERED PROFESSIONAL ENGINEER
LLOYD TRICK
No. E014247
EXP. 06/30/2015
ELECTRICAL
STATE OF CALIFORNIA

1426-008.DWG
MSO 10/2013

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LAS VIRGENES MUNICIPAL WATER DISTRICT
1235 FOOT BACKBONE IMPROVEMENTS PROJECT
FILTRATION PLANT PLC CONTROL PANEL
PLC DIGITAL INPUT & OUTPUT WIRING DIAGRAMS

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SHEET 8 OF 9
DRAWING No. 1426-008
JOB No. 1426
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LT–123, WASTE DE SLUDGE SUMP LEVEL MILLTRONICS MULTIRANGER 0–12 FT = 4–20 MA

MILLTRONICS MULTIRANGER

120 VAC
NEUTRAL
GROUND
123 +, BLACK
123 –, WHITE

AIT–121A, FILTERED WATER TURBIDITY 0–5.0 NTU, 4–20 MA HACH 1720C

TB5
L1
2

120 VAC
NEUTRAL

TB1
1
2
3

121 –, WHITE
121 +, BLACK

FT–101B, RAW WATER RESERVOIR LEVEL 0–16 FT, 4–20 MA, DISPLAY ROSEMOUNT 1151GP5E12S1M1B1

1018 +, BLACK
1018 –, WHITE

FT–101B, FILTERED WATER RESERVOIR LEVEL 0–16 FT, 4–20 MA, DISPLAY ROSEMOUNT 1151GP5E12S1M1B1

121A +, BLACK
121A –, WHITE

CUT BACK AND INSULATE SHEILD (TYPICAL)

SEEPAGE 1 LEVEL, LIT–301, 0–15 IN

ULTRASONIC LEVEL TRANSMITTER LOOP POWERED, 8M, 4–20 MA, 18 TO 30 VDC, 0.1% ACCURACY SIEMENS LU 7ML52212CA11

TB2–16, BLACK
TB2–17, WHITE

6102–FIT–102, PLANT BYPASS FLOW METER

FIT–102 S
FIT–102 C

SCOPE OF WORK

TERMINAL STRIP TB6
TOP BOTTOM
LEFT SIDE OF TERMINAL STRIP

TO DC POWER TERMINALS, SHEET 20

TB2

123 +, BLACK
123 –, WHITE
1018 +, BLACK
1018 –, WHITE
121A +, BLACK
121A –, WHITE
121 +, BLACK
121 –, WHITE
138E +, BLACK
138E –, WHITE
FIT–102, WHT
FIT–102, BLK

250 OHM 1% 3W

30001 P BLUE
30001 S BLACK
30001 C WHITE
30001 C YELLOW
30002 P BLUE
30002 S BLACK
30002 C WHITE
30002 C YELLOW
30003 P BLUE
30003 S BLACK
30003 C WHITE
30003 C YELLOW
30004 P BLUE
30004 S BLACK
30004 C WHITE
30004 C YELLOW

SPACE LEFT FOR DRAWING CLARITY

30005 P BLUE
30005 S BLACK
30005 C WHITE
30005 C YELLOW
30006 P BLUE
30006 S BLACK
30006 C WHITE
30006 C YELLOW
30007 P BLUE
30007 S BLACK
30007 C WHITE
30007 C YELLOW
30008 P BLUE
30008 S BLACK
30008 C WHITE
30008 C YELLOW

SPACE LEFT FOR DRAWING CLARITY

30009 P BLUE
30009 S BLACK
30009 C WHITE
30009 C YELLOW
30010 P BLUE
30010 S BLACK
30010 C WHITE
30010 C YELLOW
30011 P BLUE
30011 S BLACK
30011 C WHITE
30011 C YELLOW
30012 P BLUE
30012 S BLACK
30012 C WHITE
30012 C YELLOW

TB5 G, #12 GREEN

BADU–210

BADU1P
30001S
30001C
30002S
30002C
30003S
30003C
30004S
30004C
BADU1C
RACK3 SLOT3

BADU–210

BADU2P
30005S
30005C
30006S
30006C
30007S
30007C
30008S
30008C
BADU2C
RACK3 SLOT4

BADU–210

BADU3P
30009S
30009C
30010S
30010C
30011S
30011C
30012S
30012C
BADU3C
RACK3 SLOT5

REGISTERED PROFESSIONAL ENGINEER
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LAS VIRGENES MUNICIPAL WATER DISTRICT
1235 FOOT BACKBONE IMPROVEMENTS PROJECT
FILTRATION PLANT PLC CONTROL PANEL
PLANT PLC ANALOG INPUT WIRING DIAGRAM

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MSO 10/2013

APPENDIX B

MND CHECKLIST

APPENDIX F
Mitigation Monitoring and Reporting Program

The California Environmental Quality Act (CEQA) requires that when a public agency completes an environmental document which includes measures to mitigate or avoid significant environmental effects, the public agency must adopt a reporting or monitoring program. This requirement ensures that environmental impacts found to be significant will be mitigated. This reporting or monitoring program must be designed to ensure compliance during project implementation (Public Resources Cods 21081.6).

In compliance with Public Resources Code Section 21080.6, the attached MITIGATION MONITORING AND REPORTING CHECKLIST has been prepared for the Las Virgenes Municipal Water District Backbone System Improvement Project. This Mitigation Monitoring and Reporting Checklist is intended to provide verification that all applicable Conditions of Approval relative to significant environmental impacts are monitored and reported. Monitoring will include: 1) verification that each mitigation measure has been implemented; 2) recordation of the action taken to implement each mitigation; and 3) retention of records in the Las Virgenes Municipal Water District Backbone System Improvement Project file.

This Mitigation Monitoring Program delineates responsibilities for monitoring the project, but also allows Las Virgenes Municipal Water District (LVMWD) flexibility and discretion in determining how to best monitor implementation. Monitoring procedures will vary according to the type of mitigation measure. Adequate monitoring consists of demonstrating that monitoring procedures took place and that mitigation measures were implemented.

Reporting consists of establishing a record that a mitigation measure is being implemented, and generally involves the following steps:

- The LVMWD distributes reporting forms to the appropriate persons for verification of compliance.
- Departments/agencies with reporting responsibilities will review the Initial Study/Environmental Checklist, which provides the general background information on the reasons for including specific mitigation measures.
- Problems or exceptions to compliance will be addressed to the LVMWD as appropriate.
- Periodic meetings may be held during project implementation to report on compliance of mitigation measures.
- Responsible parties provide the LVMWD with verification that monitoring has been conducted and ensure, as applicable, that mitigation measures have been implemented. Monitoring compliance may be documented through existing review and approval programs such as field inspection reports and plan review.

- The LVMWD or Applicant prepares a reporting form periodically during the construction phase and an annual report summarizing all project mitigation monitoring efforts.
- Appropriate mitigation measures will be included in construction documents and/or conditions of permits/approvals.

Minor changes to the Mitigation Monitoring Program, if required, would be made in accordance with CEQA and would be permitted after further review and approval by the LVMWD. Such changes could include reassignment of monitoring and reporting responsibilities, program redesign to make any appropriate improvements, and/or modification, substitution or deletion of mitigation measures subject to conditions described in CEQA Guidelines Section 15162. No change will be permitted unless the Mitigation Monitoring and Reporting Program continues to satisfy the requirements of Public Resources Code Section 21081.6.

MITIGATION MONITORING AND REPORTING PROGRAM CHECKLIST
BACKBONE SYSTEM IMPROVEMENT PROJECT

Mitigation Measure	Monitoring Process	Monitoring Timing	Responsible Person(s)	Date Completed
1. Aesthetics				
Aes-1: If permanent lighting is installed at the tank site, they shall be shielded from long range views and shall only be used in the event of nighttime maintenance or security needs, for short periods of time. Lighting shall be manually activated or on motion-activated (security).	Site Inspection	During Construction	LVMWD Field Engineering Inspector or Designee	By: _____ On:
Aes-2: The tank exterior shall be finished with a non-reflective material in an earth tone that blends in with the natural environment.	Site Inspection	During Construction	LVMWD Field Engineering Inspector or Designee	By: _____ On: _____
Aes-3: The District shall prepare and implement a vegetation restoration plan around the tank site including on slopes of the earthen berm. The restoration plan shall utilize native plants similar to the surrounding open space habitat in an effort to blend in with the surrounding habitat.	Site Inspection	During Construction	LVMWD Field Engineering Inspector or Designee	By: _____ On: _____
3. Air Quality				
Air-1: Construction operation on any unpaved road shall be suspended if winds exceed 25 mph.	Site Inspection	During Construction	LVMWD Field Engineering Inspector or Designee	By: _____ On: _____
Air-2: Water shall be used as dust suppression for construction activities. Non-potable water shall be used where feasible.	Site Inspection	During Construction	LVMWD Field Engineering Inspector or Designee	By: _____ On: _____
Air-3: Haul trucks shall be covered and two feet of freeboard shall be left between the top of the load and the top of the truck bed.	Site Inspection	During Construction	LVMWD Field Engineering Inspector or Designee	By: _____ On: _____
4. Biological Resources				
Bio-1: To avoid impacts to native nesting birds during the typical nesting season (March – August) along Reyes Adobe Road near the elementary school and creek crossing, the LVMWD shall retain a qualified biologist to conduct surveys within 500 feet of the construction corridor prior to construction or site preparation activities. Specifically, within 3 days of ground disturbance activities associated with construction or grading, a qualified biologist shall conduct weekly surveys to determine if active nests of bird species protected by the Migratory Bird Treaty Act (MBTA) or the California Fish and Game Code are present in the construction zone or within a distance determined by CDFG. The surveys shall continue on a weekly basis, with the last survey being conducted no more than three days prior to initiation of clearance or construction work. If ground disturbance activities are delayed, additional pre-construction surveys will be conducted such that no more than five	Biologist Verification	Pre-Construction	LVMWD Engineering Services to initiate contract with qualified biologist	By: _____ On: _____

MITIGATION MONITORING AND REPORTING PROGRAM CHECKLIST (continued)
BACKBONE SYSTEM IMPROVEMENT PROJECT

Mitigation Measure	Monitoring Process	Monitoring Timing	Responsible Person(s)	Date Completed
days will have elapsed between the last survey and the commencement of ground disturbance activities. No nesting surveys are necessary during the months of September through February. If active nests are found, clearing and construction activities within a buffer distance determined by CDFG, shall be postponed or halted until the nest is vacated and juveniles have fledged, as determined by the biologist, and there is no evidence of a second attempt at nesting during the same year. Limits of construction to avoid an active nest shall be established in the field with flagging, fencing, or other appropriate barriers; and construction personnel shall be instructed on the sensitivity of nest areas. The results of the survey, and any avoidance measures taken, shall be submitted to the CDFG within 30 days of completion of the pre-construction surveys.				
Bio-2: If active nests are found in the City of Agoura Hills, the City of Agoura Hill's Planning and Community Development Department shall be contacted immediately. Every effort shall be made to limit construction activities adjacent to active nests, including but not limited to the placement of fencing or other barriers. All barriers if needed for active nests located in oak trees shall require consultation and approval by the City of Agoura Hill's Oak Tree Consultant and shall be in accordance with the City's Oak Tree Preservation Guidelines, to ensure no impacts would occur to the oak trees during construction.	Biologist Verification	Pre-Construction	LVMWD Engineering Services to initiate contract with qualified biologist	By: _____ On: _____
Bio-3: Prior to construction, LVMWD shall retain a qualified biologist to conduct rare plant surveys within the tank site construction zone in compliance with CDFG Rare Plant Survey Guidelines. If rare plants are identified, LVMWD shall coordinate with CDFG and USFWS to relocate or compensate for the impacted plants.	Biologist Verification	Pre-Construction	LVMWD Engineering Services to initiate contract with qualified biologist	By: _____ On: _____
Bio-4: Prior to construction, LVMWD shall retain a qualified biologist to conduct red legged frog surveys sufficient to determine whether construction activities could encounter these animals. Biologists conducting the surveys shall be certified for survey work by CDFG for the species in question. Results of the surveys shall be submitted to CDFG and USFWS. If any indication of presence of any of these species is found, LVMWD will coordinate with CDFG and USFWS to avoid resulting in take of any individual. This may include altering construction times of year during non-nesting season or providing fencing around the construction zone to prevent animals from entering the construction zone.	Biologist Verification	Pre-Construction	LVMWD Engineering Services to initiate contract with qualified biologist	By: _____ On: _____
5. Cultural Resources				
Cul-1: Prior to any ground disturbing activity, those portions of the project area not surveyed within the past 5 years shall be surveyed by a qualified archaeologist (defined as an archaeologist meeting the Secretary of the Interior's Standards for professional archaeology). Any area that may subject to ground-disturbance, as a result of project implementation shall be surveyed. This includes the pipeline alignments and associated construction corridors, tank sites, and any associated access roads and borrow sites.	Site Inspection/Survey	Pre-Construction	LVMWD Engineering Services to initiate contract with qualified Archeologist	By: _____ On: _____

MITIGATION MONITORING AND REPORTING PROGRAM CHECKLIST (continued)
BACKBONE SYSTEM IMPROVEMENT PROJECT

Mitigation Measure	Monitoring Process	Monitoring Timing	Responsible Person(s)	Date Completed
Cul-2: Prior to any ground disturbing activity, any cultural resources that may be impacted by project implementation shall be evaluated further by a qualified archaeologist (defined as an archaeologist meeting the Secretary of the Interior's Standards for professional archaeology) to determine their eligibility to the California Register and potential significance under CEQA. This includes sites CAL-LAN-420, CA-LAN-669, CA-VEN-40, CA-LAN-726, CA-LAN-671, CA-LAN-1069, 19-100207, 19-100208, 19-100209, CA-LAN-467, CA-LAN-41, CA-LAN-1352, the Reyes Adobe, and any resources that may be newly recorded during the additional archaeological survey specified in Mitigation Measure CUL-1. This evaluation can be accomplished by implementing an archaeological testing and evaluation program, which shall consist of, at minimum: • conducting further archival research, • relocating, carefully mapping and recording known cultural resources, • performing test excavations, if necessary, if subsurface investigation or recovery of artifacts is required within the City of Agoura Hills jurisdiction, then coordination shall occur with the City of Agoura Hills Planning and Community Development Department, and notice shall be give to the Department one week prior to excavation work occurring, and • preparing a report that summarizes all archaeological work to date; details the results of the testing program; evaluates each resource for significance; and formulates recommendations for further work. If a resource is determined to be eligible, it shall be avoided during construction. If appropriate, prior to construction, a qualified archaeologist can mark exclusion zones around known archaeological sites to ensure they are not impacted by construction. If avoidance is not feasible, a site treatment plan or additional protection measures shall be developed in consultation with the City of Agoura Hills for resources within the City's jurisdiction. If the site evaluation results in an assessment that a resource is not eligible, no further work or protective measures shall be necessary.	Site Inspection/Survey	During Construction	LVMWD Engineering Services to initiate contract with qualified Archeologist	By: _____ On: _____
Cul-3: Monitoring by a qualified archaeologist and Native American representative during ground disturbing activities. Prior to issuance of a grading permit, an archaeologist meeting the Secretary of the Interior's Standards for professional archaeology shall be retained to monitor all ground-disturbing activities, including brush clearance and grubbing, related to construction of the proposed Calabasas and Agoura Hills pipeline alignments and Tank Site A. The duration and timing of monitoring shall be determined by the qualified archaeologist in consultation with the lead agency and based on the grading plans. In the event that cultural resources are unearthed during ground-disturbing activities, the archaeological monitor shall be empowered to halt or redirect ground-disturbing activities away from the vicinity of the find so that the find can be evaluated. Due to the sensitivity of the project area for Native American resources, at least one Native	Site Monitoring	During Construction	LVMWD Engineering Services to initiate contract with qualified Archeologist and Native American representative	By: _____ On: _____

MITIGATION MONITORING AND REPORTING PROGRAM CHECKLIST (continued)
BACKBONE SYSTEM IMPROVEMENT PROJECT

Mitigation Measure	Monitoring Process	Monitoring Timing	Responsible Person(s)	Date Completed
American monitor shall also monitor all ground-disturbing activities related to construction of the proposed Calabasas and Agoura Hills pipeline alignments and Tank Site A. Selection of monitors shall be made by agreement of the Native American groups identified by the Native American Heritage Commission as having affiliation with the project area.				
Cul-4: Cease work if archaeological resources are discovered during ground-disturbing activities. If archaeological resources are encountered, all activity in the vicinity of the find shall cease until it can be evaluated by a qualified archaeologist. If the qualified archaeologist determines that the resources may be significant, the qualified archaeologist will notify the lead agency and will develop an appropriate treatment plan for the resources. The archaeologist shall consult with Native American monitors or other appropriate Native American representatives in determining appropriate treatment for unearthed cultural resources if the resources are prehistoric or Native American in nature. If the archaeological resources are located within the City of Agoura Hills jurisdiction then the City of Agoura Hills Planning and Community Development Department shall be notified immediately.	Site Monitoring	During Construction	LVMWD Engineering Services to initiate contract with qualified Archeologist and Native American representative	By: _____ On: _____
Cul-5: If human remains are encountered unexpectedly during construction excavation and grading activities, State Health and Safety Code Section 7050.5 requires that no further disturbance shall occur until the County Coroner has made the necessary findings as to origin and disposition pursuant to PRC Section 5097.98. If the remains are determined to be of Native American descent, the coroner has 24 hours to notify the Native American Heritage Commission. The NAHC will then identify the person(s) thought to be the Most Likely Descendent of the deceased Native American, who will then help determine what course of action should be taken in dealing with the remains. Per Public Resources Code 5097.98, the landowner shall ensure that the immediate vicinity, according to generally accepted cultural or archaeological standards or practices, where the Native American human remains are located, is not damaged or disturbed by further development activity until the landowner has discussed and conferred, as prescribed in this section (PRC 5097.98), with the most likely descendents regarding their recommendations, if applicable, taking into account the possibility of multiple human remains. If the human remains are encountered within the City of Agoura Hills jurisdiction then the City of Agoura Hills Planning and Community Development Department shall be notified immediately.	Site Monitoring	During Construction	LVMWD Engineering Services to initiate contract with qualified Archeologist and Native American representative	By: _____ On: _____
Cul-6: Prior to any ground disturbing activity, the project area shall by assessed for paleontological sensitivity by a qualified paleontologist, who shall conduct literature reviews, database searches, and pedestrian surveys as appropriate. Any area that may subject to ground-disturbance as a result of project implementation shall be surveyed. This includes the pipeline alignments and associated construction corridors, tank sites, and any associated access roads and borrow sites. The qualified paleontologist shall also prepare a report summarizing the results of the survey and a paleontological monitoring plan, if	Site Monitoring	Pre-Construction	LVMWD Engineering Services to initiate contract with qualified Paleontologist	By: _____ On: _____

MITIGATION MONITORING AND REPORTING PROGRAM CHECKLIST (continued)
BACKBONE SYSTEM IMPROVEMENT PROJECT

Mitigation Measure	Monitoring Process	Monitoring Timing	Responsible Person(s)	Date Completed
appropriate. This report shall be submitted to the lead agency and to the Los Angeles County Natural History Museum.				
Cul-7: If paleontological resources are encountered during the course of construction, the applicant shall halt or divert work and notify a qualified paleontologist who shall document the discovery as needed, evaluate the potential resource, assess the significance of the find, and develop an appropriate treatment plan in consultation with the applicant.	Site Monitoring	During Construction	LVMWD Engineering Services to initiate contract with qualified Paleontologist	By: _____ On: _____
6. Geology and Soils				
Geo-1: A site-specific geotechnical study shall be prepared for the proposed alignment prior to the commencement of construction activities. Project design shall comply with recommendations for construction identified in the study.	Prepare site specific Geotechnical Report	Pre-Construction	LVMWD Engineering Services to initiate contract with qualified Geologist	By: _____ On: _____
Geo-2: Prior to the issuance of the grading permit for the tank site, the District shall initiate consultation with the California Department of Resources Division of Safety of Dams regarding the construction of the tank site.	Consultation	Pre-Construction	LVMWD Project Manager to initiate consultation with California Department of Resources Division of Safety of Dams	By: _____ On: _____
9. Land Use and Planning				
Lan-1: LVMWD shall obtain a utility easement from the Las Virgenes Unified School District prior to project implementation, if the project crosses the school property.	Consultation	Pre-Construction	LVMWD Project Manager	By: _____ On: _____
Lan-2: Installation of the pipeline within the school access road and on school property shall occur when school is out of session to avoid unnecessary impacts to classroom activities including pick-up and drop-off.	Site Inspection	Pre-Construction	LVMWD Field Engineering Inspector or Designee	By: _____ On: _____
11. Noise				
Noi-1: Project construction shall be limited to normal construction hours except during the connection of the new pipes to the active system. All preparation before the connection shall be limited to the daytime hours, as well as backfill and other construction phases after the connection is made. Adjacent land uses within 100 feet of the construction site shall be notified about the estimated duration and hours of nighttime construction activity at least 30 days before the start of construction.	Site Monitoring	Pre-Construction	LVMWD Construction Administrator	By: _____ On: _____
Noi-2: All construction equipment shall have properly operating mufflers and be maintained in good operating condition.	Equipment Inspection	Pre- Construction	LVMWD Field Engineering Inspector or Designee	By: _____ On: _____

MITIGATION MONITORING AND REPORTING PROGRAM CHECKLIST (continued)
BACKBONE SYSTEM IMPROVEMENT PROJECT

Mitigation Measure	Monitoring Process	Monitoring Timing	Responsible Person(s)	Date Completed
Noi-3: All construction staging areas shall be as far away as is practical from the nearest sensitive receptor.	Site Inspection	Pre- Construction	LVMWD Field Engineering Inspector or Designee	By: _____ On: _____
Noi-4: Signs shall be posted at the construction site that include permitted construction days and hours, a day and evening contact number for the job site, and a contact name and number in the event of problems.	Site Inspection	Pre- Construction	LVMWD Field Engineering Inspector or Designee	By: _____ On: _____
Noi-5: The construction contractor shall implement the following measure whenever any major impulsive noise source is operating adjacent to or within 250 feet a school facility: • Perform the activity when school is not in session; • Perform the activity after school hours (i.e. late afternoon); • Perform the activity only during a small portion of any hour	Site Inspection	During Construction	LVMWD Field Engineering Inspector or Designee	By: _____ On: _____
Noi-6: The water tank construction contractor shall implement the following measure(s) whenever any major impulsive (such as blasting or pile driving) noise source is operating within 200 feet a residential home: • Notify Three Springs Neighborhood of blasting schedule through mailers, street signs, and the home owners association. Meet with closest neighbors within 200 feet of construction site to discuss blasting schedule. • Erect temporary barriers to separate the noise-generating equipment from adjacent residences if needed to meet noise thresholds; and • No blasting shall occur before 9:00 AM or after 4:00 PM.	Site Inspection	During Construction	LVMWD Field Engineering Inspector or Designee	By: _____ On: _____
Noi-7: The water tank construction contractor shall implement the following measures: • Equipment and trucks used for project construction shall use the best available noise control techniques (e.g., improved mufflers, use of intake silencers, ducts, engine enclosures, etc.). • Adjacent land uses within 200 feet of the construction site shall be notified about the estimated duration and hours of construction activity at least 30 days before the start of construction.	Site Inspection	During Construction	LVMWD Field Engineering Inspector or Designee	By: _____ On: _____
Noi-8: A Blasting Plan for construction shall be prepared and followed that includes the following: • A determination of the weight limit of the explosive per delay and other blast characteristics for the explosives to result in a PPV below 0.2 inches/second at the	Site Inspection	Pre-Blasting	LVMWD Field Engineering Inspector or Designee	By: _____ On: _____

MITIGATION MONITORING AND REPORTING PROGRAM CHECKLIST (continued)
BACKBONE SYSTEM IMPROVEMENT PROJECT

Mitigation Measure	Monitoring Process	Monitoring Timing	Responsible Person(s)	Date Completed
nearest sensitive receptor. • Primary components of the Blasting Plan shall include: – Identification of blast officer; – Scaled drawings of blast locations, and neighboring buildings, streets, or other locations which could be inhabited, as well as nearby structures that could be damaged; – Blasting notification procedures, lead times, and list of those notified. Public notification to potentially affected vibration and nuisance noise receptors describing the expected extent and duration of the blasting; – Description of means for transportation and on-site storage and security of explosives in accordance with local, state and federal regulations; – Minimum acceptable weather conditions for blasting and safety provisions for potential stray current (if electric detonation); – Traffic control standards and traffic safety measures (if applicable); – Required personal protective equipment; – Minimum standoff distances and description of blast impact zones and procedures for clearing and controlling access to blast danger; – Procedures for handling, setting, wiring, and firing explosives. Also procedures for handling misfires per Federal code; – Type and quantity of explosives and description of detonation device. Sequence and schedule of blasting rounds, including general method of excavation, lift heights, etc.; – Methods of matting or covering of blast area to prevent flyrock and excessive air blast pressure; – Description of blast vibration and air blast monitoring programs; – Dust control measures in compliance with applicable air pollution control regulations (to interface with general construction dust control plan); – Emergency Action Plan to provide emergency telephone numbers and directions to medical facilities. Procedures for action in the event of injury; – Material Safety Data Sheets for each explosive or other hazardous materials to be used; – Evidence of licensing, experience, and qualifications of blasters;				

MITIGATION MONITORING AND REPORTING PROGRAM CHECKLIST (continued)
BACKBONE SYSTEM IMPROVEMENT PROJECT

Mitigation Measure	Monitoring Process	Monitoring Timing	Responsible Person(s)	Date Completed
– Description of insurance for the blasting work. • If vibration results in damage to any nearby structures or utilities, or scenic rock faces, blasting shall immediately cease. The stability of segmental dams, retaining walls, existing slopes, creek canals, etc. shall be monitored and any evidence of instability due to blasting operations shall result in immediate termination of blasting. • Explosive materials shall be delivered in specially built vehicles marked with United Nations (UN) hazardous materials placards. Explosives and detonators shall be delivered in separate vehicles or be separated in compartments meeting U.S. Department of Transportation (DOT) rules within the same vehicle. Vehicles shall have at least two 10-pound Class-A fire extinguishers and all sides of the vehicles display placards displaying the UN Standard hazard code for the onboard explosive materials. Drivers shall have commercial driver licenses (CDL) with Hazmat endorsements, and drivers shall carry bill-of-lading papers detailing the exact quantities and code dates of transported explosives or detonators. • The contractor must comply with U.S. Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) table-of-distance requirements (CFR 27, U.S. Department of Justice, Alcohol, Tobacco, Firearms and Explosives Division Part 555) that restrict explosive quantities based on distance from occupied buildings and public roadways. Employees must also comply with the security requirements of the Safe Explosives Act (Title XI, Subtitle C of Public Law 107-296, Interim Final Rule), implemented in March 2003. These requirements require background checks for all persons that use, handle or have access to explosive materials; and responsible persons on a now required federal explosives license must submit photographs and fingerprints with the application to ATF. The contractor shall provide 24-hour security and/or the use of motion-detector and alarmed double wire fencing security measures around the stored explosives.				
Noi-9: Due to the close proximity of blasting to the dam and the nearest residence, a survey must be taken before the start of construction with photo, or video inventory of all existing cracks inside and outside buildings with sufficient detail for comparison after construction to determine whether actual vibration damage occurred from construction. The Las Virgenes Municipal Water District shall have ultimate responsibility for the costs of repairs to any damage caused by construction vibration.	Site Inspection	Pre-Blasting	LVMWD Field Engineering Inspector or Designee	By: _____ On: _____
15. Transportation/Traffic				
Tran-1: Prior to construction, the District shall develop and implement a traffic control plan. The traffic control plan shall ensure that construction would not result in delays or congestion on freeway off-ramps. LVMWD shall provide copies of the traffic control plan to Caltrans for review prior to project implementation. The traffic control plan shall limit construction to between the hours of 7:00 a.m. and 7:00 p.m. Monday through Friday except during the connection of the new pipes to the active system. For construction within the City	Traffic Control Plan	Pre-Construction	LVMWD Construction Administrator	By: _____ On: _____

MITIGATION MONITORING AND REPORTING PROGRAM CHECKLIST (continued)
BACKBONE SYSTEM IMPROVEMENT PROJECT

Mitigation Measure	Monitoring Process	Monitoring Timing	Responsible Person(s)	Date Completed
of Agoura Hills, the traffic control plan shall be submitted to City of Agoura Hills Public Works Department for review and approved at least 60 days prior to construction commencement.				

APPENDIX C

OAK TREE MITIGATION REPORT

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August 21, 2013
Rincon Project Number: 13-01131

Lindsay Cao, Project Manager
Las Virgenes Municipal Water District
4232 Las Virgenes Road
Calabasas, CA 91302

Subject: **Oak Tree Report for the 1235-FT Backbone Improvements – 5 Million Gallon Water Storage Tank Project, City of Westlake Village, Los Angeles County, California**

Dear Ms. Cao:

This Oak Tree Report provides the results of an oak tree inventory and health assessment survey conducted for the Las Virgenes Municipal Water District's (LVMWD) 1235-FT Backbone Improvements – 5 Million Gallon (MG) Water Storage Tank Project located within the City of Westlake Village, Los Angeles County, California. The purpose of the survey was to inventory protected oak trees located within the project area, visually assess each tree's status and health, and determine potential project impacts. Based on the results of the survey, appropriate avoidance, minimization, and protection measures were developed, and are reported herein.

Project Location and Description

The project site is located at the LVMWD's Westlake Filtration Plant (WFP) and Las Virgenes Reservoir within Westlake Village, California (Figure 1). The project site is bounded to the north and west by single-family residential neighborhoods, to the south by undeveloped lands, and to the east by the Las Virgenes Reservoir (Figure 2).

The proposed project includes construction of a 5 MG pre-stressed concrete tank located approximately 0.15 miles south of the existing WFP on an approximately 1,075 foot hilltop. Two parallel 36-inch inlet/outlet pipelines will be routed at least three feet below ground to connect the existing effluent filtered water pipeline near the northeast corner of the WFP. Based on the draft project plans (AECOM, 6/7/13), the pipeline will be routed, from south to north, from the proposed tank site on the hilltop north along a vegetated slope (Photo 1), across the reservoir dam embankment and dirt access road (Photo 2), through a paved access road adjacent to the west and north side of the WFP (Photo 3-6), ending near the northeast corner of the Plant. To provide potable water to the Tank during winter operations when the WFP is offline, a new 8-inch underground connection will be routed from the existing 8-inch pipeline at the northeastern corner of the WFP. As part of this effort, a domestic water assembly will be installed north of the WFP, including an above ground automated valve, magnetic flow meter, and backflow preventer. A berm will also be constructed to provide visual screening for a portion of the tank.

Regulatory Review

Within the city of Westlake Village, oak trees are considered a significant historical, aesthetic, and ecological resource, and are protected under Westlake Village Municipal Code Article 9, Chapter 9.21 Oak Tree Preservation Standards. Per the Standards, no person shall destroy, remove, relocate, or otherwise inflict damage on any tree of the oak genus (*Quercus*) which is greater than 4 inches in diameter at breast height (DBH), or in the case of multiple trunks, a combined DBH of 6 inches or greater. Damage includes an act causing injury to the root system or other parts of a tree including but not limited to cutting, operation of equipment or machinery, paving, trenching, or excavation within the dripline or ten feet of the trunk, whichever is greater (defined as the tree protection zone; TPZ). Removal, relocation, or construction proposed within the TPZ that has the potential to cause harm or damage may require an Oak Tree Permit and an Oak Tree Report, the second requirement of which would be met by this report.

Methodology

The oak tree survey was conducted in accordance with the requirements outlined in the City of Westlake Village's Oak Tree Preservation Standards. This included a visual above ground evaluation and a general health assessment of each identified protected tree and an evaluation of potential encroachment into each TPZ by project related activities. The survey area included the length of the proposed pipeline routes, the 5 MG tank footprint, domestic water assembly, and the proposed berm, plus a 50 foot buffer to ensure that any potential temporary and/or permanent project impacts to protected trees within or adjacent to the work area would be assessed.

All oak trees located within the survey area, regardless of DBH, were mapped and assessed pursuant to the City's Municipal Code. Specifically, the following information was recorded for each protected oak tree within the survey area:

1. Scientific and common name;
2. Mapped location of the trunk, canopy edge, and extent of the TPZ using a Trimble® Geo XT GPS unit;
3. Trunk diameter at 54 inches above ground using an English unit diameter tape;
4. Visual estimate of canopy height and maximum canopy width;
5. Visual health assessment and physical tree characteristics of the above ground portions, including trunk, branches, limbs, foliage, and insect or disease damage/infestation (Table 1);
6. Photo documentation, overall and close-up of any damage or unique characteristics; and
7. Assessment of potential temporary and/or permanent impacts associated with the project based on the location of the TPZ in relation to the proposed limit of work (LOW; outer extent of all project activities), direct construction footprint, and related expected activities (i.e. spoil or stockpiling, staging, vehicle access, etc.).

Additionally, the limits of the proposed construction footprint, including both temporary and permanent impacts, were mapped using a Trimble® Geo XT GPS unit.

Table 1. Overall Aesthetics, Structural Health, Overall Health and Cumulative Condition Rating Criteria

Rating	Structure
Excellent	In addition to attributes of a 'good' rating, the tree exhibits a well-developed root flare and a balanced canopy. Provides shading or wildlife habitat and is aesthetically pleasing.
Good	Trunk is well developed with well attached limbs and branches; some flaws exist but are hardly visible. Good foliage cover and density, annual shoot growth above average. Has minor aesthetic flaws.
Fair	Flaw in trunk, limb and branch development are minimal and are typical of this species and geographic region. Minimal visual damage from existing insect or disease, average foliage cover and annual growth.
Poor	Limbs or branches are poorly attached or developed. Canopy is not symmetrical. Trunk has lean. Branches or trunk have physical contact with the ground. May exhibit fire damage, responses to external encroachment/obstructions or existing insect/disease damage.
Dead	Trunk, limbs or branches have extensive visible decay or are broken. Canopy leaves are non-seasonally absent or uniformly brown throughout, with no evidence of new growth.

Results and Discussion

Rincon Certified Arborist/Municipal Specialist Julie Broughton (#WE-8726AM) conducted the oak tree site assessment survey on July 11, 2013. The proposed project footprint and expected construction activities boundary (proposed LOW) was developed from the Engineer's schematic (AECOM July 30, 2013) in relation to observed protected trees.

Field Survey Conditions. The survey area within the project site is primarily characterized by heavily disturbed ruderal habitat, landscaping, developed structures, and bare roads, with some disturbed native vegetation intermixed (Photos 1-6). Trees and mature shrubs present along the access road near the WFP included gum trees (*Eucalyptus* sp.), coast live oak (*Quercus agrifolia*), toyon (*Heteromeles arbutifolia*), sycamore (*Platanus racemosa*), and acacia (*Acacia* sp.). Vegetation at the proposed tank location is coast sage scrub habitat, dominated by California buckwheat (*Eriogonum fasciculatum*), deerweed (*Acmispon glaber*), and chamise (*Adenostoma fasciculatum*), with some non-native herbs and grasses.

Protected Trees. A total of nine oak trees, all coast live oak, were documented within the survey area (Table 2). All nine trees were located adjacent to the north and west sides of the WFP, between the edge of the paved access road and the property chain link fence line (Figure 3). Seven of the nine coast live oak trees qualified as protected trees by the City's Oak Tree Preservation Standards. Those not qualifying as protected included one oak tree (Tree #9) that had a DBH less than the required trunk diameter minimum (i.e. greater than 4 inches), and one tree (Tree #8) was assessed as dead (Table 2; Photo 8).

The seven protected oak trees ranged in height from 8 to 40 feet, had canopies that ranged between 5 to 25 feet in width, and had single trunks with girths of 5 to 11 inches (Table 2). Their cumulative health rating ranged between fair and good, with only minor health concerns noted. The majority of the health issues observed during the survey were related to poor scaffolding branch attachment (Photo 9), the presence of epicormics (subnormal branch development along the trunk), insect bore holes, and minor leaf die-back, none of which are individually detrimental to the overall health of a tree. The most common health issue observed (in five of the seven projected trees), was poor scaffolding branch attachment (at 90° angle from trunk instead of approximate 45° angle) which, with proper maintenance is not a significant long-term health issue. Tree #3 and Tree #4 had the

Table 2. Oak trees assessed within the survey area

Tree ID	Scientific Name	Common Name	DBH [1] (inches)	Estimated Tree Height (feet)	Maximum Canopy Width (feet)	Trunk Health	Canopy Health	Cumulative Health Rating	TPZ Extend Beyond LOW [2]	Comments
1	*Quercus agrifolia*	coast live oak	8	20	12	Good	Good	Good	Yes	Poor branch attachment, canopy overlap with tree #1. An 8" pipeline and domestic water assembly is proposed for installation within the TPZ.
2	*Quercus agrifolia*	coast live oak	11	25	15	Good	Good	Good	Yes	Poor branch attachment, canopy overlap with tree #2. An 8" pipeline and domestic water assembly is proposed for installation within the TPZ.
3	*Quercus agrifolia*	coast live oak	10	40	20	Fair	Fair	Fair	No	Epicormics, insect bore holes on trunk (Photo 11), poor branch attachment
4	*Quercus agrifolia*	coast live oak	11	35	25	Good	Fair	Fair	No	Poor branch attachment, epicormics (Photo 10), dead leaves within canopy (Photo 12)
5	*Quercus agrifolia*	coast live oak	6	10	10	Good	Good	Good	No	
6	*Quercus agrifolia*	coast live oak	11	25	25	Fair	Good	Good	Yes	Poor branch attachment (Photo 9) with included bark; 2 square feet of < 1 inch branches extend past proposed LOW 8 feet from the ground (1 foot long x 2 feet wide x 1 foot high)
7	*Quercus agrifolia*	coast live oak	5	8	5	Good	Good	Good	No	
8	*Quercus agrifolia*	coast live oak	9	12	0	Poor	Poor	Dead	N/A	Not protected, dead
9	*Quercus agrifolia*	coast live oak	4	6	5	Good	Good	Good	N/A	Not protected, less than required DBH

[1]Diameter at breast height (DBH) as measured at 54 inches above ground
[2]Tree protection zone (TPZ); proposed Limit of Work (LOW) adjacent to protected trees

lowest cumulative health rating due to the presence of at least two health factors, including epicormics (Photo 10), insect bore holes (Photo 11) and leaf die-back (Photo 12).

Potential Project Impacts to Protected Trees. The TPZ of the seven protected trees was overlaid with the proposed LOW, proposed trenching locations, and other related construction activity to determine potential project direct and indirect impacts (Figure 3). Trenching activities are proposed to occur north and west of the WFP primarily within the paved access roadway, except for the domestic water assembly and associated 8-inch underground pipeline that will extend into the unpaved area near the northeast corner of the WFP (Figure 3). Staging, stock or spoil piles, equipment/vehicle maintenance and refueling, and vehicle access associated with the project are expected to occur on the existing paved access road (i.e. south/east of the curb and proposed LOW fencing) except as described above. Potential impacts to the seven protected oak trees were assessed based on these assumptions.

Three trees (Tree #1, #2, and #6) have TPZs that extend into the proposed LOW (Figure 3). Installation of the above ground domestic water assembly and trenching for the associated 8-inch pipeline will occur within the TPZs of Trees #1 and #2 (Figure 3). Based on the project's plans, trenching activities associated with the assembly and the pipeline will occur up to six feet deep by two feet wide. Activities will occur within 4 – 5 feet of the south side of the trunk of Tree #1 and for a distance of approximately 27 feet within the TPZ of both Trees #1 and #2. Due to the proximity and depth of the proposed trenching and assembly installation activities to these trees, direct impacts to both trees are expected via root and canopy encroachment. As these two trees have overlapping canopies, with potentially overlapping root systems, identification of below ground encroachment to a specific tree is difficult to determine. However, trenching activities have the potential to encounter both structural and secondary roots of both trees. Secondary roots are generally 1 – 5 inches in diameter and tend to grow downward at a 45° angle, as compared to larger structural roots that generally parallel the ground surface or tap roots that grow vertically, directly below the tree. Root impacts may also occur via compaction during machinery movement and/or equipment/material placement during installation of the assembly and/or pipeline. Impacts to the tree's canopies may occur via branch removal and/or damage from machinery movement during trenching activities, although no primary scaffolding branches (i.e. branches that grow directly off of the trunk and are 4 inches in diameter or greater) are expected to be encountered. Incorporation of the protection measures listed below into the work program would be expected to reduce and minimize the extent of impacts to Trees #1 and #2. Regardless, the City's Oak Tree Protection Standards require an application for an oak tree permit for any construction activities that occur within the TPZ resulting in damage to the tree.

The eastern edge of Tree #6's canopy extends approximately one foot into (southeast) the LOW (1 foot long x 2 foot wide x 1 foot high = 2 square feet total). These outer branches occur approximately eight feet from the ground, are less than one inch in diameter, and total less than one percent of the total tree canopy. Per the current project design, project activities are not expected to require trimming or removal of the branches of Tree #6 that extend into the LOW. Direct impacts to this tree are expected to be avoided by redirection of machinery movement, thus eliminating any damage to the branches. Therefore, no damage to Tree #6 is expected and an oak tree permit would not be required for this tree.

Trees #3, #4, #5, and #7 have TPZs that occur outside the proposed LOW and are not expected to be impacted by construction activities (Figure 3). Therefore, an oak tree permit would not be required for these four trees. Additionally, due to the distance of the proposed trench from the trunk of Trees #3 – #7, no primary tap or structural roots are expected to be encountered during trenching

activities. Any roots that may be encountered during trenching are expected to be smaller secondary roots, that if cut cleanly at the trench wall would not be anticipated to cause any harm or damage to the tree.

Temporary impacts are expected to be limited to dust that may be generated during trenching activities and could settle on the canopy of the adjacent protected trees. The amount of dust generated from such activities is anticipated to be minimal and would be expected to wash away during subsequent rain events. As such, temporary impacts to protected trees from construction activities would be minor and not affect the long term health of the trees.

Recommended Tree Avoidance, Minimization, and Protection Measures

In order to maintain oak tree protection during all phases of construction, the following protection, avoidance, and minimization measures are recommended:

- Oak Tree Permit: Per Westlake Village's oak tree preservation standards, activities that will result in damage to a protected oak tree require an oak tree permit. For this project, it is recommended that this report be submitted along with an application for an oak tree permit for Tree #1 and Tree #2.
- Tree Protection Requirements Onsite and Training to Workers: A copy of this report and any subsequent applicable documents should be kept onsite during construction activities. A responsible individual(s) should provide tailgate training to all parties that will be performing work around the protected trees prior to the start of any construction activities. New crew members should be trained prior to beginning work.
- Tree Protection Fencing: Demarcate the TPZ (extent of dripline or ten feet from the trunk, whichever is greater) of Trees #3 – 7 or the LOW as described herein (i.e. curb edge of the existing paved access road) with fencing prior to the start of project mobilization or construction related activities. For Trees #1 and #2, demarcate the northern limit of trenching activities associated with installation of the domestic water assembly and the associated 8-inch pipeline, which is expected to be no closer than approximately 4 – 5 from the south side of the trunk of Tree #1. The fencing should be temporary, readily visible, and a minimum of 4-feet high. It should be constructed of chain link, orange plastic mesh fence, or a similarly durable material with stationary posts set at no greater than 10-foot intervals. The fencing should be maintained and remain in place during all phases of construction. Damaged fencing should be immediately repaired or replaced.
- Signage: One English language and one Spanish language, readily-visible, durable, waterproof sign should be installed on the fence, and should be placed at approximately 50-foot intervals. The size of each sign should be a minimum of 16 inches wide and the letter should be of sufficient size to fill the sign. The signage should be maintained and remain in place during all phases of construction. Damaged signage should be immediately repaired or replaced. The recommended lettering is:

WARNING
TREE PROTECTION ZONE
Entry prohibited. This fence shall remain in place
throughout the entire construction period.

- Tree Protection Zone Restrictions:
    - No ground disturbance, grading, trenching, construction activities, or structural development should occur within the TPZ of Trees #3 – #5 and #7. Such activities within the TPZs of Trees #1, #2, and #6 should be limited to those discussed herein within the delineated LOW and should be minimized to the greatest extent feasible. Based on the expected LOW boundary, no ground disturbance, grading, trenching, construction activities, or structural development should occur within 4 feet of the south side of the trunk of Tree #1 or beyond the outer (eastern) 1 foot of branches of Tree #6.
    - No vehicles, equipment, soil, or construction materials should be placed within the TPZ of Trees #3 – #7. Such activities within the TPZs of Trees #1 and #2 should only occur as discussed herein within the delineated LOW and should be minimized to the greatest extent feasible. Spoil piles associated with trenching activities and equipment and materials associated with the assembly should be placed on the south side of the trench (i.e. side furthest from the tree trunks). Only equipment, materials, and/or vehicles directly associated with these activities should enter the TPZ of Trees #1 and #2. Based on the expected LOW boundary, no vehicles, equipment, soil, or construction materials should be placed within 4 feet of the south side of the trunk of Tree #1.
    - No oil, gasoline, chemicals, paints, solvents, or other damaging materials should be placed or deposited within the TPZ or in drainage channels, swales, or other areas that may lead to the TPZ.
    - No grade changes should occur outside the TPZ that significantly alter the drainage to protected trees.
    - Protected trees should not be used for posting signs, supporting structures or equipment, or other such activities, and should be kept free of nails, screws, rope, wires, stakes, and other fastening devices or attachments.
- Structural Tree Roots (i.e. roots greater than 5 inches in diameter): Due to the distance of trenching activities from the trunks of Trees #3 – #7, no structural tree roots are expected to be encountered during trenching for these trees. Structural tree roots may be encountered during trenching for Trees #1 and #2. Therefore, should any roots greater than five inches in diameter be encountered during trenching operations within the TPZ of Trees #1 and #2, or within 20 feet of the TPZs of Trees #3 – #7, they should not be cut or otherwise damaged. Work should be conducted around these roots in a manner that avoids root damage, which may include tunneling under roots, or boring or drilling trenches. Any structural tree roots that are exposed by trenching or digging should be kept moist and covered with earth as soon as possible.

  Should any structural tree roots within the TPZ of Trees #1 and #2, or within 20 feet the TPZ of Trees #3 – #7, be damaged or require cutting/removal, the LVMWD should be immediately notified. Prior to any additional action that may (further) impact the root(s), an arborist should be retained to evaluate the root(s) to determine if it is from a protected tree(s). If the root(s) is determined to be from a protected tree(s), than the arborist should reassess project impacts to the tree(s), including the long term health and stability of the tree(s) based on the extent of the current or proposed impact. The arborist should also establish feasible avoidance and minimization measures to prevent (additional) unnecessary damage to the tree(s) and root(s), document any actual root impacts that have occurred, and determine if additional permitting or other mitigation may be required.

- Secondary Tree Roots (i.e. roots that are 1 – 5 inches in diameter): Any secondary roots that are encountered during trenching activities should be cleanly cut at the trench wall closest to the trees prior to backfilling. No split, cracked or damaged root areas should be left untrimmed.

- Pruning: No branch trimming/removal is anticipated except for Trees #1 and #2 and potentially for Tree #6. No branches 4 inches or greater in diameter should be trimmed or removed on Trees #1 and #2. Any branches less than 4 inches in diameter on Trees #1 and #2 that are damaged or require removal should be cleanly cut, and no split, cracked, or damaged branches should be left in place.

  Should any branches 4 inches in diameter or greater be damaged or require cutting/removal, the LVMWD should be immediately notified. Prior to any additional action that may (further) impact the branch(es), an arborist should be retained to reassess project impacts to the tree(s), including the long term health and stability of the tree(s) based on the extent of the current or proposed impact. The arborist should also establish feasible avoidance and minimization measures to prevent (additional) unnecessary damage to the tree(s) and canopy(s), document any actual branch impacts that have occurred, and determine if additional permitting or other mitigation may be required.

  Should the branches of Tree #6 that extend beyond the LOW need to be trimmed, or if they are damaged during construction activities, they should be cleanly cut. No split, cracked, or damaged branches should be left in place. Branch trimming/removal should be limited to only those branches on Tree #6 that occur beyond the LOW, as described herein. All pruning required for Trees #1, #2, and/or #6 should be conducted in compliance with the International Society of Arboriculture (ISA) Tree-Pruning Guidelines and ANSI Standard A300 (Part 1).

  Note that the bird breeding season generally occurs from February 1 through August 30. Pruning, removal, or other tree alteration during this time could potentially disrupt protected nesting birds. Should these activities be required during the bird breeding season, a qualified biologist should survey the subject area for active nests of protected bird species. If no nests are observed, than subsequent pruning activities would not be restricted with respect to nesting birds.

- Unanticipated Tree Damage: Unanticipated damage to protected trees or their TPZs from construction activities should be reported to the LVMWD within 24 hours. Depending upon the extent and nature of the damage, an incident report may be necessary by an arborist with an assessment of the tree damage, and additional permitting or other mitigation requirements.

- Best Management Practices: Best Management Practices should be maintained throughout all phases of construction to reduce and minimize dust and other airborne contaminants that could settle on the canopy of protected trees.

- If any unplanned encroachment into a TPZ of a protected tree not discussed herein becomes necessary at any phase during construction, an arborist should be retained to evaluate the proposed encroachment activities, (re)assess potential project impacts to protected trees, (re)establish feasible avoidance and minimization measures, document actual tree impacts, and determine if additional tree permitting may be required (prior to or after activities, depending upon the nature and timing of the activities and encroachment).

CONCLUSIONS

Project activities are expected to impact Trees #1 and #2. Such impacts are subject to conditions of an Oak Tree Permit, per the City of Westlake Village's oak tree preservation standards. As such, it is recommended that this report and an Oak Tree Permit application be submitted to the City prior to implementation of the 1235-FT Backbone Improvements – 5 Million Gallon Water Storage Tank Project (or at a minimum, any activity adjacent to the Westlake Filtration Plant and the protected trees). With implementation of the proposed project as described herein and adherence to the above tree avoidance, minimization, and protection measures, it is expected that no long term damage will occur Tree #6, or to the remaining four protected coast live oaks from either direct or indirect impacts.

Should project activities deviate from those described herein with respect to potential impacts to the seven protected oaks' TPZ, and as were used as a basis for this report's impact analysis and subsequent recommendations, a follow-up field visit and/or analysis and updated tree report may be warranted.

Sincerely,
RINCON CONSULTANTS, INC.

Julie Broughton, PhD (c)
Certified Arborist/Municipal Specialist
Member American Society of Consulting Arborists

Lacrissa Cook Davis, MESM
Principal

Attachments: *Figure 1. Regional Location Map*
Figure 2. Project Location Map
Figure 3. Tree Protection Map
Figures 4 – 6. Photo Pages (3)

Project Location

Imagery provided by ESRI and its licensors © 2013.

Regional Location

Figure 1

Imagery provided by CIRGIS, 2013.

Project Site

0 120 240 Feet

N

Project Location

Figure 2

Imagery provided by CIRGIS, 2013.

Project Site
Protected Tree
Unprotected Tree
Tree Protection Zone
Proposed Limit of Work

N

0 40 80 Feet

Tree Protection Zone

Figure 3

Photo 1. View from the west looking east across the proposed 5MG Tank placement.

Photo 2. View looking north across the dirt access road and western reservoir dam embankment. Las Virgenes Reservoir is on the right.

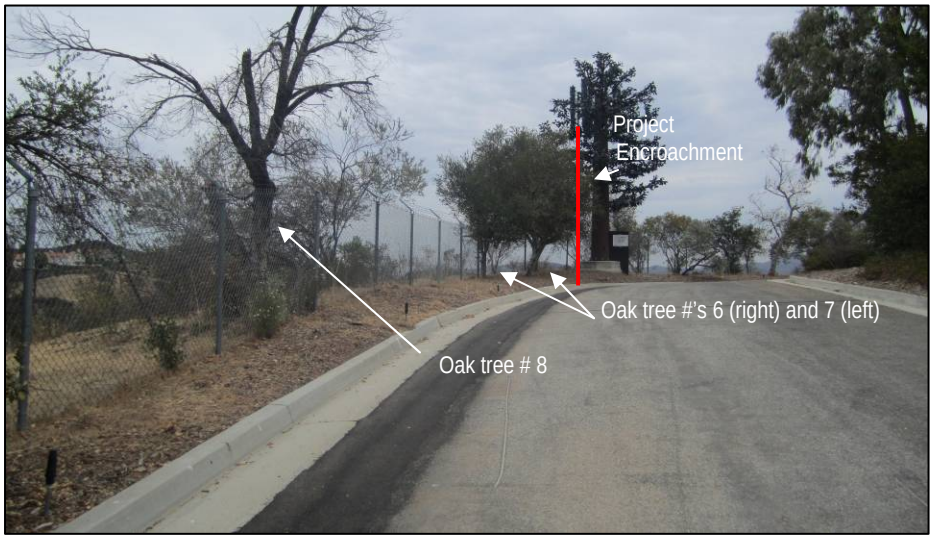

Photo 3. View looking north along western edge of the Westlake Filtration Plant. Project encroachment is delineated by red line at edge of Oak tree #6's canopy.

Photo 4. View looking east along northern boundary of the Plant. The proposed limit of work adjacent to the protected trees is the existing access road's curb.

Photograph Plate

Figure 4

Photo 5. View looking west along northern boundary of the proposed limits of work.

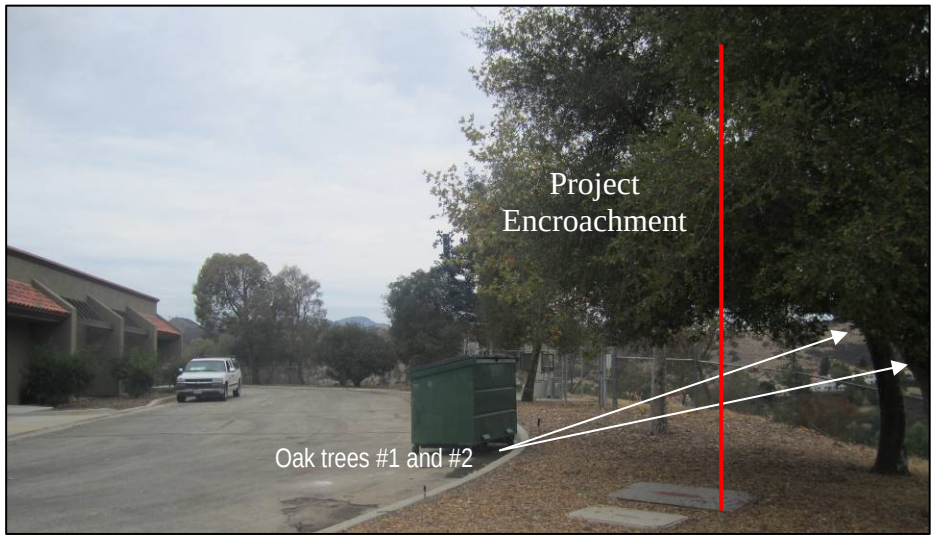

Photo 6. View looking west at the far northeast northern boundary of the proposed limits of work. Project encroachment is delineated by red line within the TPZ of Trees #1 & 2.

Photo 7. Tree #6 with one foot of TPZ encroachment into limits of work but outside the proposed trenching activities. Note property fence in background.

Photo 8. View of Tree #9, designated as dead, looking west.

Photograph Plate

Figure 5

Photo 9. Example of poor scaffolding branch attachment with a 90° angle of attachment as seen on Tree #2..

Photo 10. Example of epicormic growth (at arrows) as seen on Tree #4.

Photo 11. Insect bore holes on the trunk of Tree #3.

Photo 12. Canopy leaf die-back as observed on Tree #4.

Photograph Plate

Figure 6