

SPECIFICATION and CONTRACT
DOCUMENTS FOR
East Dunne Hillside Water
Reservoir Project



MORGAN HILL, CALIFORNIA
PUBLIC WORKS
DEPARTMENT

PREPARED BY
ENGINEERING DEPARTMENT

APRIL 2024

PROJECT LOCATION MAP



CITY OF MORGAN HILL
Engineering Division
Community Development Agency

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SITE MAP East Dunne Hillside Water Reservoir

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Feet



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NOTICE INVITING BIDS

1. **Bid Submission.** The City of Morgan Hill ("City"), will accept sealed bids for its East Dunne Hillside Water Reservoir Project ("Project"), by or before May 29, 2024, at 2:00 p.m., at its DEVELOPMENT SERVICES CENTER, located at 17575 PEAK AVENUE MORGAN HILL, California, at which time the bids will be publicly opened and read aloud.

2. **Project Information.**

2.1 Location and Description. The Project is located at 3000 East Dunne Avenue, Morgan Hill, CA 95037, and is described as follows:

Construct a new 0.85 MG Steel Water Reservoir, associated sitework, grading and offhaul, retaining walls, inlet & outlet piping and valves, Overflow/ Drain Piping, Storm Drainage piping and Biofiltration treatment, new tank access road, site perimeter fencing, new electrical meter pedestal, electrical and controls. Replacement of existing pumps at Existing Booster Pump Station.

2.2 Time for Final Completion. The Project must be fully completed within 1067calendar days from the start date set forth in the Notice to Proceed. City anticipates that the Work will begin on or about June/July 2024, but the anticipated start date is provided solely for convenience and is neither certain nor binding.

3. **License and Registration Requirements.**

3.1 License. This Project requires a valid California contractor's license for the following classification(s): **A-General Engineering Contractor**

3.2 DIR Registration. City will not accept a Bid Proposal from or enter into the Contract with a bidder, without proof that the bidder and its Subcontractors are registered with the California Department of Industrial Relations ("DIR") to perform public work pursuant to Labor Code Section 1725.5, subject to limited legal exceptions.

4. **Contract Documents.** The plans, specifications, bid forms and contract documents for the Project, and any addenda thereto ("Contract Documents") may be obtained from the City of Morgan Hill, at 17575 Peak Avenue, Morgan Hill, CA, (408) 778-6480. Electronic copies of the Contract Documents are available on USB thumb drive for twenty-five dollars (\$25.00). If mailing by USPS, a ten-dollar (\$10.00) charge will be added. To download plans and specifications at no charge, register at www.publicpurchase.com.

5. Bid Proposal and Security.

5.1 Bid Proposal Form. Each Bid must be submitted using the Bid Proposal form provided with the Contract Documents.

5.2 Bid Security. The Bid Proposal must be accompanied by bid security of ten percent of the maximum bid amount, in the form of a cashier's or certified check made payable to City of Morgan Hill, or a bid bond executed by a surety licensed to do business in the State of California on the Bid Bond form included with the Contract Documents. The bid security must guarantee that within ten (10) days after City issues the Notice of Award, the successful bidder will execute the Contract and submit payment and performance bonds, insurance certificates and endorsements, valid Certificates of Reported Compliance as required under the California Air Resources Board's In-Use Off-Road Diesel-Fueled Fleets Regulation (13 CCR § 2449 et seq.) ("Off-Road Regulation"), if applicable, and any other submittals required by the Contract Documents and the Notice of Award.

6. Prevailing Wage Requirements.

6.1 General. Pursuant to California Labor Code Section 1720 *et seq.*, this Project is subject to the prevailing wage requirements applicable to the locality in which the Work is to be performed for each craft, classification or type of worker needed to perform the Work, including employer payments for health and welfare, pension, vacation, apprenticeship and similar purposes.

6.2 Rates. The prevailing rates are available online at <http://www.dir.ca.gov/DLSR>. Each Contractor and Subcontractor must pay no less than the specified rates to all workers employed to work on the Project. The schedule of per diem wages is based upon a working day of eight hours. The rate for holiday and overtime work must be at least time and one-half.

6.3 Compliance. The Contract will be subject to compliance monitoring and enforcement by the California Department of Industrial Relations, pursuant to Labor Code Section 1771.4.

- 7. Performance and Payment Bonds.** The successful bidder will be required to provide performance and payment bonds each for one hundred percent of the Contract Price as further described in the Contract Documents.
- 8. Substitution of Securities.** Substitution of appropriate securities in lieu of retention amounts from progress payments is permitted under Public Contract Code Section 22300.

- 9. Subcontractor List.** Each Subcontractor must be registered with the DIR to perform work on public projects. Each bidder must submit a completed Subcontractor List form with its Bid Proposal, including the name, location of the place of business, California contractor license number and DIR registration number and percentage of the Work to be performed (based on the base bid price) for each Subcontractor who will perform Work or service or fabricate or install Work for the prime contractor in excess of one-half (1/2) of one percent (1%) of the bid price, using the Subcontractor List form included with the Contract Documents. For street or highway construction, this requirement applies to any subcontract of \$10,000 or more.
- 10. Instructions to Bidders.** All bidders should carefully review the Instructions to Bidders for more detailed information before submitting a Bid Proposal. The definitions provided in Article 1 of the General Conditions apply to all of the Contract Documents, as defined therein, including this Notice Inviting Bids.
- 11. Estimated Cost.** The estimated construction cost is \$8.0M

By: Michelle Bigelow

Date: April 30, 2024

Publication Dates: 1) May 3, 2024 2) May 10, 2024

END OF NOTICE INVITING BIDS

INSTRUCTIONS TO BIDDERS

Each Bid Proposal submitted to the City of Morgan Hill ("City") for its East Dunne Hillside Water Reservoir Project ("Project") must be submitted in accordance with the following instructions and requirements:

1. Bid Submission.

1.1 General. Each Bid Proposal must be signed, sealed and submitted to City, using the form provided in the Contract Documents, by or before the date and time set forth in Section 1 of the Notice Inviting Bids, or as amended by subsequent addendum. Faxed or emailed Bid Proposals will not be accepted, unless otherwise specified. Late submissions will be returned unopened. City reserves the right to postpone the date or time for receiving or opening bids. Each bidder is solely responsible for all of its costs to prepare and submit its bid and by submitting a bid waives any right to recover those costs from City. The bid price(s) must include all costs to perform the Work as specified, including all labor, materials, supplies, and equipment and all other direct or indirect costs such as applicable federal, state, and local taxes, insurance and overhead.

1.2 Bid Envelope. The envelope containing the sealed Bid Proposal and all required forms and attachments must be clearly labeled and addressed as follows:

BID PROPOSAL
Morgan Hill Development Services Center
East Dunne Hillside Water Reservoir Project
City of Morgan Hill
17575 Peak Avenue
Morgan Hill, CA 95037
Attention: Bid Opening
Bid Date: May 29, 2024
Bid Time: 2:00 P.M.

The envelope must also be clearly labeled, as follows, with the bidder's name, address, and its registration number with the California Department of Industrial Relations ("DIR") for bidding on public works contracts (Labor Code sections 1725.5 and 1771.1):

[Contractor company name]
[Street address]
[City, state, zip code]
DIR Registration No. _____

1.3 DIR Registration. Subject to limited legal exceptions for joint venture bids and federally-funded projects, City will not accept a Bid Proposal from a bidder without proof that the bidder is registered with the DIR to perform public work under Labor Code Section 1725.5.

Please note: If City is unable to confirm that the bidder is currently registered with the DIR, City may disqualify the bidder and return its bid unopened (Labor Code Section 1725.5 and 1771.1(a)).

- 2. Bid Proposal Form and Enclosures.** Each Bid Proposal must be completed in ink using the Bid Proposal form included with the Contract Documents. The Bid Proposal form must be fully completed without interlineations, alterations, or erasures. Any necessary corrections must be clear and legible, and must be initialed by the bidder's authorized representative. A Bid Proposal submitted with exceptions or terms such as "negotiable," "will negotiate," or similar, will be considered nonresponsive. Each Bid Proposal must be accompanied by bid security, as set forth in Section 4 below, and by a completed Subcontractor List and NonCollusion Declaration using the forms included with the Contract Documents, and any other required enclosures, as applicable.
- 3. Authorization and Execution.** Each Bid Proposal must be signed by the bidder's authorized representative. A Bid Proposal submitted by a partnership must be signed in the partnership name by a general partner with authority to bind the partnership. A Bid Proposal submitted by a limited liability company (LLC) must be signed in the name of the LLC by a member or manager with authority to bind the LLC. A Bid Proposal submitted by a corporation must be signed with the legal name of the corporation, followed by the signature and title of an officer of the corporation with full authority to bind the corporation to the terms of the Bid Proposal.
- 4. Bid Security.** Each Bid Proposal must be accompanied by bid security of ten percent of the maximum bid amount, in the form of a cashier's check or certified check, made payable to the City, or bid bond using the form included in the Contract Documents and executed by a surety licensed to do business in the State of California. The bid security must guarantee that, within ten days after issuance of the Notice of Award, the bidder will: execute and submit the enclosed Contract for the bid price; submit payment and performance bonds for 100% of the maximum Contract Price; submit the insurance certificates and endorsements; and submit valid Certificates of Reported Compliance as required by the Off-Road Regulation, if applicable, and any other submittals, if any, required by the Contract Documents or the Notice of Award.

- 4.1 Withdrawal of Bid Proposals.** A Bid Proposal may not be withdrawn for a period of 90 days after the bid opening without forfeiture of the bid security, except as authorized for material error under Public Contract Code Section 5100 *et seq.*
- 5. Requests for Information.** Questions or requests for clarifications regarding the Project, the bid procedures, or any of the Contract Documents must be submitted in writing to David Gittleson, PE, Associate Engineer, at david.gittleson@morganhill.ca.gov. Oral responses are not authorized and are not binding on the City. Bidders should submit any such written inquiries at least five Working Days before the scheduled bid opening. Questions received any later might not be addressed before the bid deadline. An interpretation or clarification by City in response to a written inquiry will be issued in an addendum.
- 6. Pre-Bid Investigation.**
- 6.1 General.** Each bidder is solely responsible at its sole expense for diligent and thorough review of the Contract Documents, examination of the Project site, and reasonable and prudent inquiry concerning known and potential site and area conditions prior to submitting a Bid Proposal. Each bidder is responsible for knowledge of conditions and requirements which reasonable review and investigation would have disclosed. However, except for any areas that are open to the public at large, bidders may not enter property owned or leased by the City or the Project site without prior written authorization from City.
- 6.2 Document Review.** Each bidder is responsible for review of the Contract Documents and any informational documents provided “For Reference Only,” e.g., as-builts, technical reports, test data, and the like. A bidder is responsible for notifying City of any errors or omissions, inconsistencies, or conflicts it discovers in the Contract Documents prior to submitting a Bid Proposal, subject to the limitations of Public Contract Code Section 1104. Notification of any such errors, omissions, inconsistencies, or conflicts must be submitted in writing to the City no later than five Working Days before the scheduled bid opening. (See Section 5, above.) City expressly disclaims responsibility for assumptions a bidder might draw from the presence or absence of information provided by City.
- 6.3 Project Site.** Questions regarding the availability of soil test data, water table elevations, and the like should be submitted to the City in writing, as specified in Section 5, above. Any subsurface exploration at the Project site must be done at the bidder’s expense, but only with prior written authorization from City. All soil data and analyses available for inspection or provided in the Contract Documents apply only to the test

hole locations. Any water table elevation indicated by a soil test report existed on the date the test hole was drilled. The bidder is responsible for determining and allowing for any differing soil or water table conditions during construction. Because groundwater levels may fluctuate, difference(s) in elevation between ground water shown in soil boring logs and ground water actually encountered during Project construction will not be considered changed Project site conditions. Actual locations and depths must be determined by bidder's field investigation. The bidder may request access to underlying or background information on the Project site in City's possession that is necessary for the bidder to form its own conclusions, including, if available, record drawings or other documents indicating the location of subsurface lines, utilities, or other structures.

6.4 Utility Company Standards. The Project must be completed in a manner that satisfies the standards and requirements of any affected utility companies or agencies (collectively, "utility owners"). The successful bidder may be required by the third-party utility owners to provide detailed plans prepared by a California registered civil engineer showing the necessary temporary support of the utilities during coordinated construction work. Bidders are directed to contact the affected third-party utility owners about their requirements before submitting a Bid Proposal.

7. **Bidders Interested in More Than One Bid.** No person, firm, or corporation may submit or be a party to more than one Bid Proposal unless alternate bids are specifically called for. However, a person, firm, or corporation that has submitted a subcontract proposal or quote to a bidder may submit subcontract proposals or quotes to other bidders.
8. **Addenda.** Any addenda issued prior to the bid opening are part of the Contract Documents. Subject to the limitations of Public Contract Code section 4104.5, City reserves the right to issue addenda prior to bid time. Each bidder is solely responsible for ensuring it has received and reviewed all addenda prior to submitting its bid. Bidders should check City's website periodically for any addenda or updates on the Project at: <http://www.publicpurchase.com>
9. **Brand Designations and "Or Equal" Substitutions.** Any specification designating a material, product, thing, or service by specific brand or trade name, followed by the words "or equal," is intended only to indicate quality and type of item or service desired, and bidders may request use of any equal material, product, thing, or service. All data substantiating the proposed substitute as an "equal" item or service must be submitted with the written request for substitution. This provision does not apply to materials, products, things, or services that may lawfully be designated by a specific brand or trade name under Public Contract Code Section 3400(c).

9.1 Pre-Bid Requests. Any request for submission made before the Contract is awarded must be submitted to the City Engineer at least ten (10) days before the opening of bids so that all interested bidders may be notified of any approved alternative.

9.2 Post-Award Requests. After the Contract is awarded, Contractor may submit a substitution within fourteen (14) days after the date of award of the Contract, or as specified in the Special Conditions.

10. Bid Protest. Any bid protest against another bidder must be submitted in writing and received by City at the City Attorney's Office at 17575 Peak Avenue, Morgan Hill, CA, (Fax: (408) 779-1592 or Email to cynthia.hasson@morganhill.ca.gov), before 5:00 p.m. no later than two Working Days following bid opening ("Bid Protest Deadline") and must comply with the following requirements:

10.1 General. Only a bidder who has actually submitted a Bid Proposal is eligible to submit a bid protest against another bidder. Subcontractors are not eligible to submit bid protests. A bidder may not rely on the bid protest submitted by another bidder, but must timely pursue its own protest. If required by City, the protesting bidder must submit a non-refundable fee in the amount specified by City, based upon City's reasonable costs to administer the bid protest. Any such fee must be submitted to City no later than the Bid Protest Deadline, unless otherwise specified. For purposes of this Section 10, a "Working Day" means a day that City is open for normal business, and excludes weekends and holidays observed by City. Pursuant to Public Contract Code Section 4104, inadvertent omission of a Subcontractor's DIR registration number on the Subcontractor List form is not grounds for a bid protest, provided it is corrected within 24 hours of the bid opening or as otherwise provided under Labor Code Section 1771.1(b).

10.2 Protest Contents. The bid protest must contain a complete statement of the basis for the protest and must include all supporting documentation. Material submitted after the Bid Protest Deadline will not be considered. The protest must refer to the specific portion or portions of the Contract Documents upon which the protest is based. The protest must include the name, address, email address, and telephone number of the protesting bidder and any person submitting the protest on behalf of or as an authorized representative of the protesting bidder.

10.3 Copy to Protested Bidder. Upon submission of its bid protest to City, the protesting bidder must also concurrently transmit the protest and all supporting documents to the protested bidder, and to any other bidder who has a reasonable prospect of receiving an award depending upon the

outcome of the protest, by email or hand delivery to ensure delivery before the Bid Protest Deadline.

10.4 Response to Protest. The protested bidder may submit a written response to the protest, provided the response is received by City before 5:00 p.m., within two Working Days after the Bid Protest Deadline or after actual receipt of the bid protest, whichever is sooner (the “Response Deadline”). The response must include all supporting documentation. Material submitted after the Response Deadline will not be considered. The response must include the name, address, email address, and telephone number of the person responding on behalf of or representing the protested bidder if different from the protested bidder.

10.5 Copy to Protesting Bidder. Upon submission of its response to the bid protest to City, the protested bidder must also concurrently transmit by email or hand delivery, by or before the Response Deadline, a copy of its response and all supporting documents to the protesting bidder and to any other bidder who has a reasonable prospect of receiving an award depending upon the outcome of the protest.

10.6 Exclusive Remedy. The procedure and time limits set forth in this Section are mandatory and are the bidder’s sole and exclusive remedy in the event of a bid protest. A bidder’s failure to comply with these procedures will constitute a waiver of any right to further pursue a bid protest, including filing a Government Code Claim or initiation of legal proceedings.

10.7 Right to Award. City reserves the right, acting in its sole discretion, to reject any bid protest that it determines lacks merit, to award the Contract to the bidder it has determined to be the responsible bidder submitting the lowest responsive bid, and to issue a Notice to Proceed with the Work notwithstanding any pending or continuing challenge to its determination.

- 11. Reservation of Rights.** City reserves the unfettered right, acting in its sole discretion, to waive or to decline to waive any immaterial bid irregularities; to accept or reject any or all bids; to cancel or reschedule the bid; to postpone or abandon the Project entirely; or to perform all or part of the Work with its own forces. The Contract will be awarded, if at all, within ninety days after opening of bids or as otherwise specified in the Special Conditions, to the responsible bidder that submitted the lowest responsive bid. Any planned start date for the Project represents the City’s expectations at the time the Notice Inviting Bids was first issued. City is not bound to issue a Notice to Proceed by or before such planned start date, and it reserves the right to issue the Notice to Proceed when the City determines, in its sole discretion, the appropriate time for commencing the

Work. The City expressly disclaims responsibility for any assumptions a bidder might draw from the presence or absence of information provided by the City in any form. Each bidder is solely responsible for its costs to prepare and submit a bid, including site investigation costs.

12. **Bonds.** Within ten calendar days following City's issuance of the Notice of Award to the apparent low bidder, the bidder must submit payment and performance bonds to City as specified in the Contract Documents using the bond forms included in the Contract Documents. All required bonds must be calculated on the maximum total Contract Price as awarded, including additive alternates, if applicable.
13. **License(s).** The successful bidder and its Subcontractor(s) must possess the California contractor's license(s) in the classification(s) required by law to perform the Work. The successful bidder must also obtain a City business license within ten days following City's issuance of the Notice of Award. Subcontractors must also obtain a City business license before performing any Work.
14. **Ineligible Subcontractor.** Any Subcontractor who is ineligible to perform work on a public works project under Labor Code Sections 1777.1 or 1777.7 is prohibited from performing work on this Project.
15. **Evidence of Responsibility.** Within twenty-four (24) hours following a request by City, a bidder must submit to City satisfactory evidence showing the bidder's financial resources, the bidder's experience in the type of work being required by City, the bidder's organization available for the performance of the Contract and any other required evidence of the bidder's qualifications to perform the proposed Contract. City may consider such evidence before making its decision awarding the proposed Contract.
16. **In-Use Off-Road Diesel-Fueled Fleets.** If the Project involves the use of vehicles subject to the California Air Resources Board's In-Use Off-Road Diesel-Fueled Fleets Regulation (13 CCR § 2449 et seq.) ("Off-Road Regulation"), then within ten calendar days following City's issuance of the Notice of Potential Award to the successful bidder, the bidder must submit to City valid Certificates of Reported Compliance for its fleet and its listed Subcontractors, if applicable, in accordance with the Off-Road Regulation, unless exempt under the Off-Road Regulation.
17. **Subcontractor Work Limits.** The prime contractor must perform at least 50% of the Work on the Project, calculated as a percentage of the base bid price, with its own forces, except for any Work identified as "Specialty Work" in the Contract Documents. The total bid amount for any such Specialty Work, as shown on the Bid Schedule, may be deducted from the

base bid price before computing the 50% self-performance requirement. The remaining Work may be performed by qualified Subcontractor(s). The “Steel Tank” bid item is considered Specialty Work.

18. **Bidder’s Questionnaire.** A completed, signed Bidder’s Questionnaire using the form provided with the Contract Documents and including all required attachments must be submitted within 48 hours following a request by City. A bid that does not fully comply with this requirement may be rejected as nonresponsive. A bidder who submits a Bidder’s Questionnaire which is subsequently determined to contain false or misleading information, or material omissions, may be disqualified as non-responsible.
19. **Bid Schedule.** Each bidder must complete the Bid Schedule form with unit prices as indicated, and submit the completed Bid Schedule with its Bid Proposal.

19.1 Incorrect Totals. In the event a computational error for any bid item (base bid or alternate) results in an incorrect extended total for that item, the submitted base bid or bid alternate total will be adjusted to reflect the corrected amount as the product of the estimated quantity and the unit cost. In the event of a discrepancy between the actual total of the itemized or unit prices shown on the Bid Schedule for the base bid, and the amount entered as the base bid on the Bid Proposal form, the actual total of the itemized or unit prices shown on the Bid Schedule for the base bid will be deemed the base bid price. Likewise, in the event of a discrepancy between the actual total of the itemized or unit prices shown on the Bid Schedule for any bid alternate, and the amount entered for the alternate on the Bid Proposal form, the actual total of the itemized prices shown on the Bid Schedule for that alternate will be deemed the alternate price. Nothing in this provision is intended to prevent a bidder from requesting to withdraw its bid for material error under Public Contract Code § 5100 et seq.

19.2 Estimated Quantities. The quantities shown on the Bid Schedule are estimated and the actual quantities required to perform the Work may be greater or less than the estimated amount. The Contract Price will be adjusted to reflect the actual quantities required for the Work based on the itemized or unit prices provided in the Bid Schedule, with no allowance for anticipated profit for quantities that are deleted or decreased, and no increase in the unit price, and without regard to the percentage increase or decrease of the estimated quantity and the actual quantity.

- 20. Safety Orders.** If the Project includes construction of a pipeline, sewer, sewage disposal system, boring and jacking pits, or similar trenches or open excavations, which are five feet or deeper, each bid must include a bid item for adequate sheeting, shoring, and bracing, or equivalent method, for the protection of life or limb, which comply with safety orders as required by Labor Code Section 6707.
- 21. For Reference Only.** The following documents are provided “For Reference Only,” as defined in Section 3.4 of the General Conditions:

Geotechnical Investigation Report, dated 8-11-2016.

Supplemental Geotechnical Recommendations, dated 1-12-24

END OF INSTRUCTIONS TO BIDDERS

BID PROPOSAL

East Dunne Hillside Water Reservoir Project

_____ (“Bidder”) hereby submits this Bid Proposal to the City of Morgan Hill (“City”) for the above-referenced project (“Project”) in response to the Notice Inviting Bids and in accordance with the Contract Documents referenced therein.

1. **Base Bid.** Bidder proposes to perform and fully complete the Work for the Project as specified in the Contract Documents, within the time required for full completion of the Work, including all labor, materials, supplies, and equipment and all other direct or indirect costs including, but not limited to, taxes, insurance, and all overhead for the following price (“Base Bid”):
\$ _____.

2. **Addenda.** Bidder agrees that it has confirmed receipt of or access to, and reviewed, all addenda issued for this Bid. Bidder waives any claims it might have against the City based on its failure to receive, access, or review any addenda for any reason. Bidder specifically acknowledges receipt of the following addenda:

Addendum:	Date Received:	Addendum:	Date Received:
#01	_____	#05	_____
#02	_____	#06	_____
#03	_____	#07	_____
#04	_____	#08	_____

3. **Bidder’s Certifications and Warranties.** By signing and submitting this Bid Proposal, Bidder certifies and warrants the following:
 - 3.1 **Examination of Contract Documents.** Bidder has thoroughly examined the Contract Documents, and represents that, to the best of Bidder’s knowledge there are no errors, omissions, or discrepancies in the Contract Documents subject to the limitations of Public Contract Code Section 1104.
 - 3.2 **Examination of Worksite.** Bidder has had the opportunity to examine the Worksite and local conditions at the Project location.
 - 3.3 **Bidder Responsibility.** Bidder is a responsible bidder, with the necessary ability, capacity, experience, skill, qualifications, workforce, equipment, and resources to perform or cause the Work to be performed in accordance with the Contract Documents and within the Contract Time.

- 3.4 Responsibility for Bid.** Bidder has carefully reviewed this Bid Proposal and is solely responsible for any errors or omissions contained in its completed Bid. All statements and information provided in this Bid Proposal and enclosures are true and correct to the best of Bidder's knowledge.
- 3.5 Nondiscrimination.** In preparing this Bid, the Bidder has not engaged in discrimination against any prospective or present employee or Subcontractor on grounds of race, color, ancestry, national origin, ethnicity, religion, sex, sexual orientation, age, disability, or marital status.
- 4. Award of Contract.** By signing and submitting this Bid Proposal, Bidder agrees that if Bidder is awarded the Contract for the Project, then within ten days following issuance of the Notice of Award to Bidder, Bidder will do all of the following:
- 4.1 Execute Contract.** Enter into the Contract with City in accordance with the terms of this Bid Proposal, by signing and submitting to City the Contract prepared by City using the form included with the Contract Documents;
- 4.2 Submit Required Bonds.** Submit to City a payment bond and a performance bond, each for one hundred percent (100%) of the Contract Price, using the bond forms provided and in accordance with the requirements of the Contract Documents;
- 4.3 Insurance Requirements.** Submit to City the insurance certificate(s) and endorsement(s) as required by the Contract Documents; and
- 4.4 Certificates of Reported Compliance.** Submit to City valid Certificates of Reported Compliance for its fleet and its listed Subcontractors, if applicable, if the Project involves the use of vehicles subject to the Off-Road Regulation. (See Section 16 of the Instructions to Bidders.)
- 5. Wage Theft Prevention.** All Bidders are expected to have read and understand the "Wage Theft Prevention Policy" adopted by the City Council on July 26, 2017.
- The undersigned Bidder certifies that neither Bidder nor its principals have been found by a final court judgement or final administrative action of an investigatory agency to have violated federal, state, or local wage and hour laws within the past five years from the date of the submitted bid. Bidder or its principals who are unable to so certify, must disclose wage and hour violations, and shall provide a copy of (i) the court order and judgment and/or final administrative decision; and (ii) documents demonstrating either

that the order/judgment has been satisfied, or if the order/judgment has not been fully satisfied, a written and signed description of Bidder's efforts to date to satisfy the order/judgment. Signing this bid shall constitute signature of this Certification.

The City, at its sole discretion, may disqualify a bidder based on one or more disclosed judgments consistent with the criteria set forth in the Policy.

6. **Bid Security.** As a guarantee that if awarded the Contract, Bidder will perform its obligations under Section 4 above Bidder is enclosing bid security in the amount of ten percent (10%) of its maximum bid amount in one of the following forms (check one):

_____ A cashier's check or certified check payable to City of Morgan Hill and issued by _____ Bank in the amount of \$_____.

_____ A bid bond, using the Bid Bond form included with the Contract Documents, payable to City of Morgan Hill and executed by a surety licensed to do business in the State of California.

7. **Iran Contracting Act.** Bidder certifies that it is not identified on a list created under the Iran Contracting Act, Public Contract Code Section 2200 *et seq.* (the "Act"), as a person engaging in investment activities in Iran, as defined in the Act, or is otherwise expressly exempt under the Act.

This Bid Proposal is hereby submitted on _____, 20__:

s/ _____
Name and Title [print]

Company Name License # and Classification

DIR Registration #

Address Phone

City, State, Zip Fax

END OF BID PROPOSAL

BID SCHEDULE I – GENERAL

East Dunne Hillside Water Reservoir Project

This Bid Schedule must be completed in ink and included with the sealed Bid Proposal. Pricing must be provided for each Bid Item as indicated. Items marked “(SW)” are Specialty Work that must be performed by a qualified Subcontractor. The lump sum or unit cost for each item must be inclusive of all costs, whether direct or indirect, including profit and overhead. The sum of all amounts entered in the “Extended Total Amount” column must be identical to the Base Bid price entered in Section 1 of the Bid Proposal Form. Quantities shown are required for bid purposes and may or may not be final pay quantities. Actual quantities, if different, must be substantiated during the Project by the Contractor (either by field measurement, trucking tags, or other means acceptable to the Engineer).

AL = Allowance
LF = Linear Foot

CF = Cubic Feet
LS = Lump Sum

CY = Cubic Yard
SF = Square Feet

EA = Each LB = Pounds
TON = Ton (2000 lbs.)

Bid Item No.	Description of Bid Item	Estimated Quantity/Unit of Measure	Unit Price	Extended Total Amount
1	Mobilization	Lump Sum	\$	\$
2	SWPPP Preparation	Lump Sum	\$	\$
3	SWPPP Monitoring Activities	Lump Sum	\$	\$
4	SWPPP Reporting	3 Each	\$	\$
5	Erosion Control-Hydroseed	Lump Sum	\$	\$
6	Perimeter Silt fencing	Lump Sum	\$	\$
7	Slope Wattles	Lump Sum	\$	\$
8	Drain Inlet protection	17 Each	\$	\$
9	Surveying & Construction Staking	Lump Sum	\$	\$
10	Clearing, Demolition, and Restoration	Lump Sum	\$	\$
11	Site Excavation & Fill	Lump Sum	\$	\$
12	Soil Nail Retaining Walls	Lump Sum	\$	\$
13	MSE Retaining Walls including guardrail	Lump Sum	\$	\$
14	Tank Foundation and Pad	Lump Sum	\$	\$
15	Steel Tank (Specialty work)	Lump Sum	\$	\$
16	Tank Cathodic Protection System	Lump Sum	\$	\$
17	16" Tank Connection	2 Each	\$	\$

18	16" Inlet Waterline	410 Linear Feet	\$	\$
19	10" Outlet Waterline	20 Linear Feet	\$	\$
20	12" Outlet Waterline	286 Linear Feet	\$	\$
21	Storm Drainage System	Lump Sum	\$	\$
22	Storm Biofiltration System and Outlet	Lump Sum	\$	\$
23	V-Ditch	1,740 Linear Feet	\$	\$
24	Valley Gutter	73 Linear Feet	\$	\$
25	Asphalt Concrete Paving	12,700 Square Feet	\$	\$
26	6' Chain Link Fencing and Gate	510 Linear Feet	\$	\$
27	4' Chain Link Fencing	250 Linear Feet	\$	\$
28	Bollards	24 Each	\$	\$
29	Landscaping and Irrigation	Lump Sum	\$	\$
30	Electrical, Controls & Communications	Lump Sum	\$	\$
31	Booster Pump Station Mechanical Modifications	Lump Sum	\$	\$
32	Booster Pump Station Electrical and Controls Modifications	Lump Sum	\$	\$
33	Initial Startup and Contract Closeout	Lump Sum	\$	\$
34	Supplemental	Lump sum	\$40,000	\$40,000

Bid Schedule I Total	

*Final Pay Quantity

TOTAL BASE BID: Items 1 through ____ inclusive: \$_____

Note: The amount entered as the "Total Base Bid" should be identical to the Base Bid amount entered in Section 1 of the Bid Proposal form.

END OF BID SCHEDULE

SUBCONTRACTOR LIST

For each Subcontractor who will perform a portion of the Work in an amount in excess of one-half of 1% of the Bidder's total Base Bid,¹ the bidder must list a description of the Work, the name of the Subcontractor, its California contractor license number, the location of its place of business, its DIR registration number, and the portion of the Work that the Subcontractor is performing based on a percentage of the Base Bid price.

Bidders: Please print legibly. Illegible forms may be rejected.

DESCRIPTION OF WORK	SUBCONTRACTOR NAME	CALIFORNIA CONTRACTOR LICENSE NUMBER	DIR REG. NO.	LOCATION OF BUSINESS	LOCAL VENDOR ² YES/NO	PERCENT OF WORK

END OF SUBCONTRACTOR LIST

¹ For street or highway construction this requirement applies to any subcontract of \$10,000 or more.

² A Subcontractor is considered local if its principal place of business is within the city limits of Morgan Hill.

NONCOLLUSION DECLARATION

(To be executed by bidder and submitted with bid)

The undersigned declares:

I am the _____ [title] of
_____ [business name], the party making the
foregoing bid.

The bid is not made in the interest of, or on behalf of, any undisclosed person, partnership, company, association, organization, or corporation. The bid is genuine and not collusive or sham. The bidder has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid. The bidder has not directly or indirectly colluded, conspired, connived, or agreed with any bidder or anyone else to put in a sham bid, or to refrain from bidding. 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. All statements contained in the bid are true. The bidder has not, directly or indirectly, submitted his or her bid price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, to any corporation, partnership, company, association, organization, bid depository, or to any member or agent thereof, to effectuate a collusive or sham bid, and has not paid and will not pay, any person or entity for such purpose.

Any person executing this declaration on behalf of a bidder that is a corporation, partnership, joint venture, limited liability company, limited liability partnership, or any other entity, hereby represents that he or she has full power to execute, and does execute, this declaration on behalf of the bidder.

This declaration is intended to comply with California Public Contract Code § 7106 and Title 23 U.S.C. § 112.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct and that this declaration is executed on _____
[date], at _____ [city], _____ [state].

s/ _____

Name [print]

BID BOND

_____ (“Bidder”) has submitted a bid, dated _____, 20____ (“Bid”), to the City of Morgan Hill (“City”) for work on the **East Dunne Hillside Water Reservoir Project** (“Project”). Under this duly executed bid bond (“Bid Bond”), Bidder as Principal and _____, its surety (“Surety”), are bound to City as obligee in the penal sum of ten percent (10%) of the maximum amount of the Bid (the “Bond Sum”). Bidder and Surety bind themselves and their respective heirs, executors, administrators, successors and assigns, jointly and severally, as follows:

1. **General.** If Bidder is awarded the Contract for the Project, Bidder will enter into the Contract with City in accordance with the terms of the Bid.
2. **Submittals.** Within ten days following issuance of the Notice of Award to Bidder, Bidder must submit to City the following:
 - 2.1 **Contract.** The executed Contract, using the form provided by City in the Project contract documents (“Contract Documents”);
 - 2.2 **Payment Bond.** A payment bond for one hundred percent (100%) of the maximum Contract Price, executed by a surety licensed to do business in the State of California using the Payment Bond form included with the Contract Documents;
 - 2.3 **Performance Bond.** A performance bond for one hundred percent (100%) of the maximum Contract Price, executed by a surety licensed to do business in the State of California using the Performance Bond form included with the Contract Documents;
 - 2.4 **Insurance.** The insurance certificate(s) and endorsement(s) required by the Contract Documents, and any other documents required by the Instructions to Bidders; and
 - 2.5 **Certificates of Reported Compliance.** Valid Certificates of Reported Compliance for its fleet and its listed Subcontractors, if applicable, in accordance with the In-Use Off-Road Diesel-Fueled Fleets Regulation (13 CCR § 2449 et seq.) (“Off-Road Regulation”), if the Project involves the use of vehicles subject to the Off-Road Regulation; and any other documents required by the Instructions to Bidders or Notice of Potential Award.
3. **Enforcement.** If Bidder fails to execute the Contract or to submit the bonds, and insurance certificates and endorsements, and valid Certificates of Reported Compliance, as required by the Contract Documents, Surety guarantees that Bidder forfeits the Bond Sum to City. Any notice to Surety may be given in the manner specified in the Contract and delivered or transmitted to Surety as follows:

Attn: _____
Address: _____
City/State/Zip: _____
Phone: _____
Fax: _____
Email: _____

- 4. Duration; Waiver.** If Bidder fulfills its obligations under Section 2, above, then this obligation will be null and void; otherwise it will remain in full force and effect for ninety days following the bid opening or until this Bid Bond is returned to Bidder, whichever occurs first. Surety waives the provisions of Civil Code Sections 2819 and 2845.

This Bid Bond is entered into and is effective on _____, 20_____.

SURETY:

s/ _____

Name: _____

Title: _____

(Attach Acknowledgement, Notary Seal, and Attorney-In-Fact Certificate)

CONTRACTOR:

s/ _____

Name: _____

Title: _____

APPROVED AS TO FORM:

By: _____
Donald A. Larkin, City Attorney

Date: _____

BIDDER'S QUESTIONNAIRE

East Dunne Hillside Water Reservoir Project

Within forty-eight (48) hours following a request by City, a bidder must submit to City a completed, signed Bidder's Questionnaire using this form and all required attachments, including clearly labeled additional sheets as needed. City may request the Questionnaire from one or more of the apparent low bidders following the bid opening, and may use the completed Questionnaire as part of its investigation to evaluate a bidder's qualifications for this Project. The Questionnaire must be filled out completely, accurately, and legibly. Any errors, omissions, or misrepresentations in completion of the Questionnaire may be grounds for rejection of the bid or termination of a Contract awarded pursuant to the bid.

Part 1: General Information

Bidder Business Name: _____ ("Bidder")

Check One: ☐ Corporation / State of Incorporation _____
☐ Limited Liability Company/ State of Formation _____
☐ Partnership
☐ Sole Proprietorship
☐ Joint Venture of: _____
☐ Other: _____

Main Office Address:

Phone: _____

Fax: _____

Local Office Address and Phone: _____

Website address: _____

Owner of Business: _____

Contact Name and Title: _____

Contact phone and email: _____

Bidder's California Contractor's License Number(s): _____

Bidder's DIR Registration Number: _____

Part 2: Bidder Experience

1. How many years has Bidder been in business under its present business name? _____ years

2. Has Bidder completed projects similar in type and size to this Project as a general contractor? ____ Yes ____ No

3. Has Bidder ever been disqualified from a bid on grounds that it is not responsible, or otherwise disqualified or debarred from bidding under state or federal law? ____ Yes ____ No

If yes, provide additional information on a separate sheet regarding the disqualification or debarment, including the name and address of the agency or owner of the project, the type and size of the project, the reasons that Bidder was disqualified or debarred, and the month and year in which the disqualification or debarment occurred.

4. Has Bidder ever been terminated for cause, alleged default, or legal violation from a construction project, either as a general contractor or as a subcontractor?

____ Yes ____ No

If yes, provide additional information on a separate sheet regarding the termination, including the name and address of the agency or owner of the subject project, the type and size of the project, whether Bidder was under contract as a general contractor or a subcontractor, the reasons that Bidder was terminated, and the month and year in which the termination occurred.

5. Provide information about Bidder's past projects performed as general contractor as follows:

5.1 Six most recently completed public works projects within the last three years;

5.2 Three largest completed projects within the last three years; and

5.3 Any project which is similar to this Project including scope and character of the work.

6. Use separate sheets to provide all of the following information for each project identified in response to the above three categories:

- 6.1 Project name
- 6.2 Location
- 6.3 Owner
- 6.4 Owner contact (name, address, email, and phone number)
- 6.5 Prime contractor, if applicable (name, address, email, and phone number);
- 6.6 Architect or engineer name
- 6.7 Architect or engineer contact (name, email, and phone number)
- 6.8 Project and/or construction manager (name and current phone number)
- 6.9 Description of project, scope of work performed
- 6.10 Initial contract value (at time of bid award)
- 6.11 Final cost of construction (including change orders)
- 6.12 Original scheduled completion date
- 6.13 Time extensions granted (number of days)
- 6.14 Actual date of completion
- 6.15 Number and amount of stop notices or mechanic's liens filed
- 6.16 Amount of liquidated damages assessed against Bidder
- 6.17 Nature and resolution of any project-related claim, lawsuit, mediation and/or arbitration involving Bidder.

Part 3: Safety

1. Provide Bidder's Experience Modification Rate (EMR) for the last three years:

Year	EMR

2. Complete the following, based on information provided in Bidder's CalOSHA Form 300 or Form 300A, Annual Summary of Work-Related Illnesses and Injuries, from the most recent past calendar year:

- 2.1 Number of lost workday cases: _____
- 2.2 Number of medical treatment cases: _____
- 2.3 Number of deaths: _____

3. Has Bidder ever been cited, fined, or prosecuted by any local, state, or federal agency, including OSHA, CalOSHA, or EPA, for violation of any law, regulation, or requirements pertaining to health and safety?

_____ Yes _____ No

If yes, provide additional information on a separate sheet regarding each such citation, fine, or prosecution, including the name and address of the agency or owner of the project, the type and size of the project, the reasons for and nature of the citation, fine, or prosecution, and the month and year in which the incident giving rise to the citation, fine, or prosecution occurred.

4. Name, title, and email for person responsible for Bidder's safety program:

_____	_____	_____
Name	Title	Email

_____	_____	_____
Name	Title	Email

Part 4: Verification

In signing this document, I, the undersigned, declare that I am duly authorized to sign and submit this Bidder's Questionnaire on behalf of the named Bidder, and that all responses and information set forth in this Bidder's Questionnaire and accompanying attachments are, to the best of my knowledge, true, accurate and complete as of the date of submission. **I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.**

Signature: _____ Date: _____

By [name, title]: _____

END OF BIDDER'S QUESTIONNAIRE

CONTRACT

This public works contract ("Contract") is entered into by and between the City of Morgan Hill ("City") and _____ a (State of formation)(type of entity) ("Contractor") for work on the East Dunne Hillside Water Reservoir Project Project ("Project").

The parties agree as follows:

1. **Award of Contract.** In response to the Notice Inviting Bids, Contractor has submitted a Bid Proposal to perform the Work to construct on the Project. On _____, 2024, City authorized award of this Contract to Contractor for the amount set forth in Section 4, below.
2. **Contract Documents.** The Contract Documents incorporated into this Contract include and are comprised of all of the documents listed below. The definitions provided in Article 1 of the General Conditions apply to all of the Contract Documents, including this Contract.
 - 2.1 Notice Inviting Bids;
 - 2.2 Instructions to Bidders;
 - 2.3 Addenda, if any;
 - 2.4 Bid Proposal and attachments thereto;
 - 2.5 Contract;
 - 2.6 Payment and Performance Bonds;
 - 2.7 General Conditions;
 - 2.8 Special Conditions;
 - 2.9 Project Plans and Specifications;
 - 2.10 Change Orders, if any;
 - 2.11 Notice of Award;
 - 2.12 Notice to Proceed; and
 - 2.13 Geotechnical Investigation, dated August 11, 2017
 - 2.14 Supplementary Geotechnical Design Recommendations, dated January 12, 2024
3. **Contractor's Obligations.** Contractor will perform all of the Work required for the Project, as specified in the Contract Documents. Contractor must provide, furnish, and supply all things necessary and incidental for the timely performance and completion of the Work, including all necessary labor, materials, supplies, tools, equipment, transportation, onsite facilities, and utilities, unless otherwise specified in the Contract Documents. Contractor must use its best efforts to diligently prosecute and complete the Work in a professional and expeditious manner and to meet or exceed the performance standards required by the Contract Documents.

4. **Payment.** As full and complete compensation for Contractor's timely performance and completion of the Work in strict accordance with the terms and conditions of the Contract Documents, City will pay Contractor

_____ Dollars
(\$ _____) (the "Contract Price"), for all of Contractor's direct and indirect costs to perform the Work, including all labor, materials, supplies, equipment, federal, state, and local taxes, insurance, bonds and all overhead costs, in accordance with the payment provisions in the General Conditions.

5. **Time for Completion.** Contractor will fully complete the Work for the Project, meeting all requirements for Final Completion, within 1067 calendar days from the commencement date given in the Notice to Proceed ("Contract Time"). By signing below, Contractor expressly waives any claim for delayed early completion.
6. **Liquidated Damages.** As further specified in Section 5.4 of the General Conditions, if Contractor fails to complete the Work within the Contract Time, City will assess liquidated damages in the amount of One Thousand Five Hundred Dollars (\$1,500) per day for each day of unexcused delay in achieving Final Completion, and such liquidated damages may be deducted from City's payments due or to become due to Contractor under this Contract.
7. **Labor Code Compliance.**
- 7.1 **General.** This Contract is subject to all applicable requirements of Chapter 1 of Part 7 of Division 2 of the Labor Code, including requirements pertaining to wages, working hours and workers' compensation insurance, as further specified in Article 9 of the General Conditions.
- 7.2 **Prevailing Wages.** This Project is subject to the prevailing wage requirements applicable to the locality in which the Work is to be performed for each craft, classification or type of worker needed to perform the Work, including employer payments for health and welfare, pension, vacation, apprenticeship, and similar purposes. Copies of these prevailing rates are available online at <http://www.dir.ca.gov/DLSR>.
- 7.3 **DIR Registration.** City will not enter into the Contract with a bidder without proof that the bidder and its Subcontractors are registered with the California Department of Industrial Relations to perform public work pursuant to Labor Code Section 1725.5, subject to limited legal exceptions.
8. **Workers' Compensation Certification.** Pursuant to Labor Code Section 1861, by signing this Contract, Contractor certifies as follows: "I am aware of the provisions of Labor Code Section 3700 which require every employer to be 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 the Work on this Contract."

9. **Conflicts of Interest.** Contractor, its employees, Subcontractors, and agents, may not have, maintain, or acquire a conflict of interest in relation to this Contract in violation of any City ordinance or requirement, or in violation of any California law, including Government Code Section 1090 *et seq.*, or the Political Reform Act, as set forth in Government Code Section 81000 *et seq.* and its accompanying regulations. Any violation of this Section constitutes a material breach of the Contract.
10. **Independent Contractor.** Contractor is an independent contractor under this Contract and will have control of the Work and the means and methods by which it is performed. Contractor and its Subcontractors are not employees of City and are not entitled to participate in any health, retirement, or any other employee benefits from City.
11. **Notice.** Any notice required by the Contract Documents must be made in writing, signed, dated, and sent to the other party by personal delivery, U.S. Mail, a reliable overnight delivery service, or by email as a PDF (or comparable) file. Notice is deemed effective upon delivery unless otherwise specified. Notice for each party must be given as follows:

City

City of Morgan Hill
17575 Peak Avenue
Morgan Hill, CA 95037
Phone: (409) 779-7259
Attn: City Clerk
Email: michelle.bigelow@morganhill.ca.gov
Copy to: david.gittleson@morganhill.ca.gov

Contractor:

Name: _____
Address: _____
City/State/Zip: _____
Phone: _____
Attn: _____
Email: _____
Copy to: _____

12. **General Provisions.**

- 12.1 **Assignment and Successors.** Contractor may not assign its rights or obligations under this Contract, in part or in whole, without City's written consent. This Contract is binding on Contractor's and City's lawful heirs, successors and permitted assigns.

- 12.2 Third Party Beneficiaries.** There are no intended third-party beneficiaries to this Contract.
- 12.3 Governing Law and Venue.** This Contract will be governed by California law and venue will be in the Superior Court of Santa Clara County, and no other place. Contractor waives any right it may have pursuant to Code of Civil Procedure Section 394, to file a motion to transfer any action arising from or relating to this Contract to a venue outside of Santa Clara County, California.
- 12.4 Amendment.** No amendment or modification of this Contract will be binding unless it is in a writing duly authorized and signed by the parties to this Contract.
- 12.5 Integration.** This Contract and the Contract Documents incorporated herein, including authorized amendments or Change Orders thereto, constitute the final, complete, and exclusive terms of the agreement between City and Contractor.
- 12.6 Severability.** If any provision of the Contract Documents is determined to be illegal, invalid, or unenforceable, in whole or in part, the remaining provisions of the Contract Documents will remain in full force and effect.
- 12.7 Iran Contracting Act.** If the Contract Price exceeds \$1,000,000, Contractor certifies, by signing below, that it is not identified on a list created under the Iran Contracting Act, Public Contract Code Section 2200 *et seq.* (the “Act”), as a person engaging in investment activities in Iran, as defined in the Act, or is otherwise expressly exempt under the Act.
- 12.8 Authorization.** Each individual signing below warrants that he or she is authorized to do so by the party that he or she represents, and that this Contract is legally binding on that party. If Contractor is a corporation, signatures from two officers of the corporation are required pursuant to California Corporations Code Section 313. If Contractor is a partnership, signature by a general partner with authority to bind the partnership is required. If Contractor is a limited liability company (LLC), a signature by a member or manager with authority to bind the LLC is required.
- 12.9 Electronic Signatures.** Unless otherwise prohibited by law or City policy, the Parties agree that an electronic copy of a signed contract, or an electronically signed contract, has the same force and legal effect as a contract executed with an original ink signature. The term “electronic copy of a signed contract” refers to a transmission by facsimile, electronic mail, or other electronic means of a copy of an original signed contract in a portable document format. The term “electronically signed contract” means a contract that is executed by applying an electronic signature using technology approved by the City.

[Signatures are on the following page.]

AS SET FORTH IN CA. CORP. CODE § 313, TWO SIGNATURES ARE REQUIRED FOR CALIFORNIA CORPORATIONS:
(1) CHAIRPERSON OF THE BOARD, PRESIDENT, OR VICE PRESIDENT; AND
2) SECRETARY, ASSISTANT SECRETARY, CHIEF FINANCIAL OFFICER, OR ASSISTANT TREASURER.

The parties agree to this Contract as witnessed by the signatures below:

CITY OF MORGAN HILL:

Christina J. Turner
City Manager

Date: _____

Attest:

Michelle Bigelow
City Clerk

Date: _____

Approved as to Form:

Donald A. Larkin
City Attorney

Date: _____

CONTRACTOR:
[NAME OF CONTRACTOR]

Signature

Name/Title [print]

Date: _____

*Corporate entities must provide a
second signature:*

Signature

Name/Title [print]

Date: _____

Contractor's License Number(s)

Expiration Date(s)

Seal:

Contractor's DIR Registration Number(s)

Expiration Date

END OF CONTRACT

PAYMENT BOND

The City of Morgan Hill ("City") and _____ ("Contractor") have entered into a contract for work on the **East Dunne Hillside Water Reservoir Project** Project ("Project"). The Contract is incorporated by reference into this Payment Bond ("Bond").

1. **General.** Under this Bond, Contractor as principal and _____, its surety ("Surety"), are bound to City as obligee in an amount not less than _____ Dollars (\$_____) ("Bond Sum"), under California Civil Code Sections 9550, *et seq.*, to ensure payment to authorized claimants. This Bond is binding on the respective successors, assigns, owners, heirs, or executors of Surety and Contractor
2. **Surety's Obligation.** If Contractor or any of its Subcontractors fails to pay a person authorized in California Civil Code Section 9100 to assert a claim against a payment bond, any amounts due under the Unemployment Insurance Code with respect to work or labor performed under the Contract, or any amounts required to be deducted, withheld, and paid over to the Employment Development Department from the wages of employees of Contractor and its Subcontractors, under California Unemployment Insurance Code Section 13020, with respect to the work and labor, then Surety will pay the obligation.
3. **Beneficiaries.** This Bond inures to the benefit of any of the persons named in California Civil Code Section 9100, so as to give a right of action to those persons or their assigns in any suit brought upon this Bond. Contractor must promptly provide a copy of this Bond upon request by any person with legal rights under this Bond.
4. **Duration.** If Contractor promptly makes payment of all sums for all labor, materials, and equipment furnished for use in the performance of the Work required by the Contract, in conformance with the time requirements set forth in the Contract and as required by California law, Surety's obligations under this Bond will be null and void. Otherwise, Surety's obligations will remain in full force and effect.
5. **Waivers.** Surety waives any requirement to be notified of alterations to the Contract or extensions of time for performance of the Work under the Contract. Surety waives the provisions of Civil Code Sections 2819 and 2845. City waives the requirement of a new bond for any supplemental contract under Civil Code Section 9550. Any notice to Surety may be given in the manner specified in the Contract and delivered or transmitted to Surety as follows:

Attn: _____
Address: _____
City/State/Zip: _____
Phone: _____
Email: _____

6. **Law and Venue.** This Bond will be governed by California law, and venue for any dispute pursuant to this Bond will be in the Superior Court of Santa Clara County, and no other place. Surety will be responsible for City's attorneys' fees and costs in any action to enforce the provisions of this Bond.
7. **Effective Date; Execution.** This Bond is entered into and is effective on _____, 20__.

SURETY:

s/ _____

Name: _____

Title: _____

CONTRACTOR:

s/ _____

Name: _____

Title: _____

(Attach Acknowledgment with Notary
Seal and Power of Attorney)

APPROVED AS TO FORM:

By: _____
Donald A. Larkin, City Attorney

Date: _____

END OF PAYMENT BOND

PERFORMANCE BOND

The City of Morgan Hill ("City") and _____ ("Contractor") have entered into a contract for work on the **East Dunne Hillside Water Reservoir Project** ("Project"). The Contract is incorporated by reference into this Performance Bond ("Bond").

1. **General.** Under this Bond, Contractor as principal and _____, its surety ("Surety"), are bound to City as obligee for an amount not less than _____ Dollars (\$) _____ (the "Bond Sum") to ensure Contractor's faithful performance of its obligations under the Contract. By executing this Bond, Contractor and Surety bind themselves and their respective heirs, executors, administrators, successors, and assigns, jointly and severally, to the provisions of this Bond.
2. **Surety's Obligations.** Surety's obligations are co-extensive with Contractor's obligations under the Contract. If Contractor fully performs its obligations under the Contract, including its warranty obligations under the Contract, Surety's obligations under this Bond will become null and void. Otherwise, Surety's obligations under this bond will remain in full force and effect.
3. **Waiver.** Surety waives any requirement to be notified of and further consents to any alterations to the Contract made under the applicable provisions of the Contract Documents, including changes to the scope of Work or extensions of time for performance of Work under the Contract. Surety waives the provisions of Civil Code Sections 2819 and 2845.
4. **Application of Contract Balance.** Upon making a demand on this Bond for completion of the Work prior to acceptance of the Project, City will make the Contract Balance available to Surety for completion of the Work under the Contract. For purposes of this provision, the Contract Balance is defined as the total amount payable by City to Contractor as the Contract Price minus amounts already paid to Contractor, and minus any liquidated damages, credits, or backcharges to which City is entitled under the terms of the Contract.
5. **Contractor Default.** Upon written notification from City that Contractor is in default under Article 13 of the Contract General Conditions, time being of the essence, Surety must act within the time specified in Article 13 to remedy the default through one of the following courses of action:

5.1 Arrange for completion of the Work under the Contract by Contractor, with City's consent, but only if Contractor is in default solely due to its financial inability to complete the Work;

5.2 Arrange for completion of the Work under the Contract by a qualified contractor acceptable to City, and secured by performance and payment bonds issued by an admitted surety as required by the Contract Documents, at Surety's expense, or

5.3 Waive its right to complete the Work under the Contract and reimburse City the amount of City's costs to have the remaining Work completed.

6. Surety Default. If Surety defaults on its obligations under the Bond, City will be entitled to recover all costs it incurs due to Surety's default, including legal, design professional, or delay costs.

7. Notice. Any notice to Surety may be given in the manner specified in the Contract and delivered or transmitted to Surety as follows:

Attn: _____

Address: _____

City/State/Zip: _____

Phone: _____

Fax: _____

Email: _____

8. Law and Venue. This Bond will be governed by California law, and venue for any dispute pursuant to this Bond will be in the Superior Court of Santa Clara County, and no other place. Surety will be responsible for City's attorneys' fees and costs in any action to enforce the provisions of this Bond.

[Signatures are on the following page.]

9. Effective Date; Execution. This Bond is entered into and effective on _____, 20____.

SURETY:

s/ _____

Name: _____

Title: _____

(Attach Acknowledgment with Notary
Seal and Power of Attorney)

CONTRACTOR:

s/ _____

Name: _____

Title: _____

APPROVED AS TO FORM:

By: _____
Donald A. Larkin, City Attorney

Date: _____

END OF PERFORMANCE BOND

GENERAL CONDITIONS

Article 1 - Definitions

Definitions. The following definitions apply to all of the Contract Documents unless otherwise indicated, e.g., additional definitions that apply solely to the Specifications or other technical documents. Defined terms and titles of documents are capitalized in the Contract Documents, with the exception of the following (in any tense or form): “day,” “furnish,” “including,” “install,” “work day,” or “working day.”

Allowance means a specific amount that must be included in the Bid Proposal for Work that may or may not be included in the Project, depending on conditions that will not become known until after bids are opened. If the Contract Price includes an Allowance and the cost of performing the Work covered by that Allowance is greater or less than the Allowance, the Contract Price will be increased or decreased accordingly.

Article, as used in these General Conditions, means a numbered Article of the General Conditions, unless otherwise indicated by the context.

Change Order means a written document duly approved and executed by City, which changes the scope of Work, the Contract Price, or the Contract Time.

City means the City of Morgan Hill, acting through its City Council, officers, employees, and authorized representatives.

City Engineer means the City Engineer for City and his or her authorized delegee(s) designated to oversee and manage the Project on City’s behalf.

Claim means a separate demand by Contractor for a change in the Contract Time or Contract Price, that has previously been submitted to City in accordance with the requirements of the Contract Documents, and which has been rejected by City, in whole or in part; or a written demand by Contractor objecting to the amount of Final Payment.

Contract means the signed agreement between City and Contractor for performing the Work required for the Project, and all documents expressly incorporated therein.

Contract Documents means, collectively, all of the documents listed as such in Section 2 of the Contract, including the Notice Inviting Bids; the Instructions to Bidders; addenda, if any; the Bid Proposal, and attachments thereto; the Contract; the Notice of Award and Notice to Proceed; the payment and performance bonds; the General Conditions; the Special Conditions; the Project Plans and Specifications; any Change Orders; and any other documents expressly made part of the Contract Documents. The Contract Documents do not

include documents provided “For Reference Only,” or documents that are intended solely to provide information regarding existing conditions.

Contract Price means the total compensation to be paid to Contractor for performance of the Work, as set forth in the Contract and as may be amended by Change Order or adjusted for an Allowance. The Contract Price is not subject to adjustment due to inflation or due to the increased cost of labor, material, supplies, or equipment following submission of the Bid Proposal. The Contract Price is deemed to include all applicable federal, state, and local taxes.

Contract Time means the number of days specified for complete performance of the Work, as set forth in the Contract and as may be amended by Change Order.

Contractor means the individual, partnership, corporation, or joint-venture that has signed the Contract with City to perform the Work.

Day means a calendar day unless otherwise specified.

Design Professional means the licensed individual(s) or firm(s) retained by City to provide architectural, engineering, or other design professional services for the Project. If no Design Professional has been retained for this Project, any reference to Design Professional is deemed to refer to the Engineer.

DIR means the California Department of Industrial Relations.

Drawings has the same meaning as Plans.

Engineer means the City Engineer for the City of Morgan Hill and his or her authorized delegee(s).

Excusable Delay is defined in Section 5.3(B), Excusable Delay.

Extra Work means new or unforeseen work added to the Project, as determined by the Engineer in his or her sole discretion, including Work that was not part of or incidental to the scope of the Work when the Contractor’s bid was submitted; Work that is substantially different from the Work as described in the Contract Documents at bid time; or Work that results from a substantially differing and unforeseeable condition.

Final Completion means Contractor has fully completed all of the Work required by the Contract Documents to the City’s satisfaction, including all punch list items, and any required commissioning or training, and has provided the City with all required submittals, including the instructions and manuals, product warranties, and as-built drawings.

Final Payment means payment to Contractor of the unpaid Contract Price, including release of undisputed retention, less amounts withheld or deducted pursuant to the Contract Documents.

Furnish means to purchase and deliver for the Project.

Government Code Claim means a claim submitted pursuant to California Government Code § 900 et seq.

Hazardous Materials means any substance or material identified now or in the future as hazardous under any Laws, or any other substance or material that may be considered hazardous or otherwise subject to Laws governing handling, disposal, or cleanup.

Including, whether or not capitalized, means “including, but not limited to,” unless the context requires otherwise.

Inspector means the individual(s) or firm(s) retained or employed by City to inspect the workmanship, materials, and manner of construction of the Project and its components to ensure compliance with the Contract Documents and all Laws.

Install means to fix in place for materials, and to fix in place and connect for equipment.

Laws means all applicable local, state, and federal laws, regulations, rules, codes, ordinances, permits, orders, and the like enacted or imposed by or under the auspices of any governmental entity with jurisdiction over any of the Work or any performance of the Work, including health and safety requirements.

Non-Excusable Delay is defined in Section 5.3(D), Non-Excusable Delay.

Plans means the City-provided plans, drawings, details, or graphical depictions of the Project requirements, but does not include Shop Drawings.

Project means the public works project referenced in the Contract.

Project Manager means the individual designated by City to oversee and manage the Project on City’s behalf and may include his or her authorized delegate(s) when the Project Manager is unavailable. If no Project Manager has been designated for this Project, any reference to Project Manager is deemed to refer to the Engineer.

Recoverable Costs is defined in Section 5.3(F), Recoverable Costs.

Request for Information or RFI means a Contractor's written request for information about the Contract Documents, the Work, or the Project, submitted to City in the manner and format specified by City.

Section, when capitalized in these General Conditions, means a numbered section or subsection of the General Conditions, unless the context clearly indicates otherwise.

Shop Drawings means drawings, plan details or other graphical depictions prepared by or on behalf of Contractor, and subject to City acceptance, which are intended to provide details for fabrication, installation, and the like, of items required by or shown in the Plans or Specifications.

Specialty Work means Work that must be performed by a specialized Subcontractor with the specified license or other special certification, and that the Contractor is not qualified to self-perform.

Specifications means the technical, text specifications describing the Project requirements, which are prepared for and incorporated into the Contract by or on behalf of City, and does not include the Contract, General Conditions or Special Conditions.

Subcontractor means an individual, partnership, corporation, or joint-venture retained by Contractor directly or indirectly through a subcontract to perform a specific portion of the Work. The term Subcontractor applies to subcontractors, suppliers, fabricators, and equipment lessors of all tiers, unless otherwise indicated by the context. A third party such as a utility performing related work on the Project is not a Subcontractor, even if Contractor must coordinate its Work with the third party.

Technical Specifications has the same meaning as Specifications.

Work means all of the construction and services necessary for or incidental to completing the Project in conformance with the requirements of the Contract Documents.

Work Day or Working Day, whether or not capitalized, means a weekday when the City is open for business, and does not include holidays observed by City.

Worksite means the place or places where the Work is performed, which includes, but may extend beyond the Project site, including separate locations for staging, storage, or fabrication.

Article 2 - Roles and Responsibilities

2.1 City.

(A) **City Council.** The City Council has final authority in all matters affecting the Project, except to the extent it has delegated authority to the Engineer.

(B) **Engineer.** The Engineer, acting within the authority conferred by the City Council, is responsible for administration of the Project on behalf of City, including authority to provide directions to the Design Professional and to Contractor to ensure proper and timely completion of the Project. The Engineer's decisions are final and conclusive within the scope of his or her authority, including interpretation of the Contract Documents.

(C) **Project Manager.** The Project Manager assigned to the Project will be the primary point of contact for the Contractor and will serve as City's representative for daily administration of the Project on behalf of City. Unless otherwise specified, all of Contractor's communications to City (in any form) will go to or through the Project Manager. City reserves the right to reassign the Project Manager role at any time or to delegate duties to additional City representatives, without prior notice to or consent of Contractor.

(D) **Design Professional.** The Design Professional is responsible for the overall design of the Project, and to the extent authorized by City, may act on City's behalf to ensure performance of the Work in compliance with the Plans and Specifications, including any design changes authorized by Change Order. The Design Professional's duties may include review of Contractor's submittals, visits to any Worksite, inspecting the Work, evaluating test and inspection results, and participation in Project-related meetings, including any pre-construction conference, weekly meetings, and coordination meetings. The Design Professional's interpretation of the Plans or Specifications is final and conclusive.

2.2 Contractor.

(A) **General.** Contractor must provide all labor, materials, supplies, equipment, a services, and incidentals necessary to perform and timely complete the Work in strict accordance with the Contract Documents, and in an economical and efficient manner in the best interests of City, and with minimal inconvenience to the public.

(B) **Responsibility for the Work and Risk of Loss.** Contractor is responsible for supervising and directing all aspects of the Work to facilitate the efficient and timely completion of the Work. Contractor is solely responsible for, and required to exercise full control over the Work, including the construction means, methods, techniques, sequences, procedures, safety precautions and programs, and coordination of all

portions of the Work with that of all other contractors and Subcontractors, except to the extent that the Contract Documents provide other specific instructions. Contractor's responsibilities extend to any plan, method or sequence suggested, but not required by City or specified in the Contract Documents. From the date of commencement of the Work until either the date on which City formally accepts the Project or the effective date of termination of the Contract, whichever is later, Contractor bears all risks of injury or damage to the Work and the materials and equipment delivered to any Worksite, by any cause including fire, earthquake, wind, weather, vandalism, or theft.

(C) **Project Administration.** Contractor must provide sufficient and competent administration, staff, and skilled workforce necessary to perform and timely complete the Work in accordance with the Contract Documents. Before starting the Work, Contractor must designate in writing and provide complete contact information, including telephone numbers and email address, for the officer or employee in Contractor's organization who is to serve as Contractor's primary representative for the Project, and who has authority to act on Contractor's behalf. A Subcontractor may not serve as Contractor's primary representative.

(D) **On-Site Superintendent.** Contractor must, at all times during performance of the Work, provide a qualified and competent full-time superintendent acceptable to City, and assistants, as necessary, who must be physically present at the Project site while any aspect of the Work is being performed. The superintendent must have full authority to act and communicate on behalf of Contractor, and Contractor will be bound by the superintendent's communications to City. City's approval of the superintendent is required before the Work commences. If City is not satisfied with the superintendent's performance, City may request a qualified replacement of the superintendent. Failure to comply may result in temporary suspension of the Work, at Contractor's sole expense and with no extension of Contract Time, until an approved superintendent is physically present to supervise the Work. Contractor must provide written notice to City, as soon as practicable, before replacing the superintendent.

(E) **Standards.** Contractor must, at all times, ensure that the Work is performed in an efficient, skillful manner following best practices and in full compliance with the Contract Documents, Laws, and applicable manufacturer's recommendations. Contractor has a material and ongoing obligation to provide true and complete information, to the best of its knowledge, with respect to all records, documents, or communications pertaining to the Project, including oral or written reports, statements, certifications, Change Order requests, or Claims.

(F) **Meetings.** Contractor, its project manager, superintendent, and any primary Subcontractors requested by City, must attend a pre-construction conference, if requested by City, as well as weekly Project progress meetings scheduled with City. If applicable, Contractor may also be required to participate in coordination meetings with other parties relating to other work being performed on or near the Project site or in relation to the Project, including work or activities performed by City, other contractors, or other utility owners.

(G) **Construction Records.** Contractor will maintain up-to-date, thorough, legible, and dated daily job reports, which document all significant activity on the Project for each day that Work is performed on the Project. The daily report for each day must include the number of workers at the Project site; primary Work activities; major deliveries; problems encountered, including injuries, if any; weather and site conditions; and delays, if any. Contractor will take date and time-stamped photographs to document general progress of the Project, including site conditions prior to construction activities, before and after photographs at offset trench laterals, existing improvements, and utilities, damage, and restoration. Contractor will maintain copies of all subcontracts, Project-related correspondence with Subcontractors, and records of meetings with Subcontractors. Upon request by the City, Contractor will permit review of and/or provide copies of any of these construction records.

(H) **Responsible Party.** Contractor is solely responsible to City for the acts or omissions of any Subcontractors, or any other party or parties performing portions of the Work or providing equipment, materials, or services for or on behalf of Contractor or the Subcontractors. Upon City's written request, Contractor must promptly and permanently remove from the Project, at no cost to City, any employee, Subcontractor, or employee of a Subcontractor who the Engineer has determined to be incompetent, intemperate, or disorderly, or who has failed or refused to perform the Work as required under the Contract Documents.

(I) **Correction of Defects.** Contractor must promptly correct, at Contractor's sole expense, any Work that is determined by City to be deficient or defective in any way, including workmanship, materials, parts, or equipment. Workmanship, materials, parts, or equipment that do not conform to the requirements under the Plans, Specifications, and every other Contract Document, as determined by City, will be considered defective and subject to rejection. Contractor must also promptly correct, at Contractor's sole expense, any Work performed beyond the lines and grades shown on the Plans or established by City, and any Extra Work performed without City's prior written approval. If Contractor fails to correct or to take reasonable steps toward correcting defective Work within five days following notice from City, or within the time specified in City's notice

to correct, City may elect to have the defective Work corrected by its own forces or by a third party, in which case the cost of correction will be deducted from the Contract Price. If City elects to correct defective Work due to Contractor's failure or refusal to do so, City or its agents will have the right to take possession of and use any equipment, supplies, or materials available at the Project site or any Worksite on City property, in order to effectuate the correction, at no extra cost to City. Contractor's warranty obligations under Section 11.2, Warranty, will not be waived nor limited by City's actions to correct defective Work under these circumstances. Alternatively, City may elect to retain defective Work, and deduct the difference in value, as determined by the Engineer, from payments otherwise due to Contractor. This paragraph applies to any defective Work performed by Contractor during the one-year warranty period under Section 11.2.

(J) **Contractor's Records.** Contractor must maintain all of its records relating to the Project in any form, including paper documents, photos, videos, electronic records, approved samples, and the construction records required pursuant to paragraph (G), above. Project records subject to this provision include, but are not limited to, complete Project cost records and records relating to preparation of Contractor's bid, including estimates, take-offs, and price quotes or bids.

- (1) Contractor's cost records must include all supporting documentation, including original receipts, invoices, and payroll records, evidencing its direct costs to perform the Work, including, but not limited to, costs for labor, materials, and equipment. Each cost record should include, at a minimum, a description of the expenditure with references to the applicable requirements of the Contract Documents, the amount actually paid, the date of payment, and whether the expenditure is part of the original Contract Price, related to an executed Change Order, or otherwise categorized by Contractor as Extra Work. Contractor's failure to comply with this provision as to any claimed cost operates as a waiver of any rights to recover the claimed cost.
- (2) Contractor must continue to maintain its Project-related records in an organized manner for a period of five years after City's acceptance of the Project or following Contract termination, whichever occurs first. Subject to prior notice to Contractor, City is entitled to inspect or audit any of Contractor's records relating to the Project or to investigate Contractor's plant or equipment during Contractor's normal business hours. Contractor's records may also be subject to examination and audit by the California State Auditor, pursuant to Government Code § 8546.7. The

record-keeping requirements set forth in this subsection 2.2(J) will survive expiration or termination of the Contract.

(K) **Copies of Project Documents.** Contractor and its Subcontractors must keep copies, at the Project site, of all Work-related documents, including the Contract, permit(s), Plans, Specifications, Addenda, Contract amendments, Change Orders, RFIs and RFI responses, Shop Drawings, as-built drawings, schedules, daily records, testing and inspection reports or results, and any related written interpretations. These documents must be available to City for reference at all times during construction of the Project.

2.3 Subcontractors.

(A) **General.** All Work which is not performed by Contractor with its own forces must be performed by Subcontractors, subject to the 50% limitation set forth in the Instructions to Bidders. City reserves the right to approve or reject any and all Subcontractors proposed to perform the Work, for reasons including the Subcontractor's poor reputation, lack of relevant experience, financial instability, and lack of technical ability or adequately trained workforce. Each Subcontractor must obtain a City business license before performing any Work.

(B) **Contractual Obligations.** Contractor must require each Subcontractor to comply with the provisions of the Contract Documents as they apply to the Subcontractor's portion(s) of the Work, including the generally applicable terms of the Contract Documents, and to likewise bind their subcontractors. Contractor will provide that the rights that each Subcontractor may have against any manufacturer or supplier for breach of warranty or guarantee relating to items provided by the Subcontractor for the Project, will be assigned to City. Nothing in these Contract Documents creates a contractual relationship between a Subcontractor and City, but City is deemed to be a third-party beneficiary of the contract between Contractor and each Subcontractor. Copies of subcontracts must be available to the Engineer upon request. Before a Subcontractor commences Work on the Project, Contractor must provide the Engineer a written statement with the name of the Subcontractor, a description of each portion of the Work performed by the Subcontractor, and the percentage of the overall Work to be performed by the Subcontractor.

(C) **Termination.** If the Contract is terminated, each Subcontractor's agreement must be assigned by Contractor to City, subject to the prior rights of any surety, but only if and to the extent that City accepts, in writing, the assignment by written notification, and assumes all rights and obligations of Contractor pursuant to each such subcontract agreement.

(D) **Substitution of Subcontractor.** If Contractor requests substitution of a listed Subcontractor under Public Contract Code Section 4107, Contractor is solely responsible for all costs City incurs in responding to the request, including legal fees and costs to conduct a hearing, and any increased subcontract cost to perform the Work that was to be performed by the listed Subcontractor. If City determines that a Subcontractor is unacceptable to City based on the Subcontractor's failure to satisfactorily perform its Work, or for any of the grounds for substitution listed in Public Contract Code Section 4107(a), City may request removal of the Subcontractor from the Project. Upon receipt of a written request from City to remove a Subcontractor pursuant to this paragraph, Contractor will immediately remove the Subcontractor from the Project and, at no further cost to City, will either (1) self-perform the remaining Work to the extent that Contractor is duly licensed and qualified to do so, or (2) substitute a Subcontractor that is acceptable to City, in compliance with Public Contract Code Section 4107, as applicable.

2.4 Coordination of Work.

(A) **Concurrent Work.** City reserves the right to perform have performed, or permit performance of other work on or adjacent to the Project site while the Work is being performed for the Project. Contractor is responsible for coordinating its Work with other work being performed on or adjacent to the Project site, including by any utility companies or agencies, and must avoid hindering, delaying, or interfering with the work of other contractors, individuals, or entities, and must ensure safe and reasonable site access and use as required or authorized by City. To the full extent permitted by law, Contractor must hold harmless and indemnify City against any and all claims arising from or related to Contractor's avoidable, negligent, or willful hindrance of, delay to, or interference with the work of any utility company or agency or another contractor or subcontractor.

(B) **Coordination.** If Contractor's Work will connect or interface with work performed by others, Contractor is responsible for independently measuring and visually inspecting such work to ensure a correct connection and interface. Contractor is responsible for any failure by Contractor or its Subcontractors to confirm measurements before proceeding with connecting Work. Before proceeding with any portion of the Work affected by the construction or operations of others, Contractor must give the Project Manager prompt written notification of any defects Contractor discovers which will prevent the proper execution of the Work. Failure to give notice of any known or reasonably discoverable defects will be deemed acknowledgement by Contractor that the work of others is not defective and will not prevent the proper execution of the Work. Contractor must also promptly notify City if work performed by others, including work

or activities performed by City's own forces, is operating to hinder, delay, or interfere with Contractor's timely performance of the Work. City reserves the right to backcharge Contractor for any additional costs incurred due to Contractor's failure to comply with the requirements in this Section 2.4.

2.5 Submittals. Unless otherwise specified, Contractor must submit to Engineer for review and acceptance, all schedules, Shop Drawings, samples, product data and similar submittals required by the Contract Documents, or upon request by Engineer. Unless otherwise specified, all submittals, including Requests for Information (RFIs) are subject to the provisions of this Section, as well as specific submittal requirements that may be included elsewhere in the Contract Documents, including the Special Conditions or Specifications. The Engineer may require submission of a submittal schedule at or before a pre-construction conference, as may be specified in the Notice to Proceed.

(A) **General.** Contractor is responsible for ensuring that its submittals are accurate and conform to the Contract Documents.

(B) **Time and Manner of Submission.** Contractor must ensure that its submittals are prepared and delivered in a manner consistent with the current City-accepted schedule for the Work and within the applicable time specified elsewhere in the Contract Documents, or if no time is specified, in such time and sequence so as not to delay the performance of the Work or completion of the Project.

(C) **Required Contents.** Each submittal must include the Project name and contract number, Contractor's name and address, the name and address of any Subcontractor or supplier involved with the submittal, the date, and references to applicable Specification section(s) and/or drawing and detail number(s).

(D) **Required Corrections.** If corrections are required, Contractor must promptly make and submit any required corrections as specified in full conformance with the requirements of this Section, or other requirements that apply to that submittal.

(E) **Effect of Review and Acceptance.** Review and acceptance of a submittal by City will not relieve Contractor from complying with the requirements of the Contract Documents. Contractor is responsible for any errors in any submittal, and review or acceptance of a submittal by City is not an assumption of risk or liability by City.

(F) **Enforcement.** Any Work performed or any material furnished, installed, fabricated, or used without City's prior acceptance of a required

submittal is performed or provided at Contractor's risk, and Contractor may be required to bear the costs incident thereto, including the cost of removing and replacing such Work or material, repairs to other affected portions of the Work, and the cost of additional time or services required of City, including costs for the Design Professional, Project Manager, or Inspector.

(G) **Excessive RFIs.** An RFI will be considered excessive or unnecessary if the City determines that the explanation or response to the RFI is clearly and unambiguously discernable from the Contract Documents. City's costs to review and respond to excessive or unnecessary RFIs may be deducted from payments otherwise due to Contractor.

2.6 Shop Drawings. When Shop Drawings are required by the Specifications or requested by the Engineer, they must be prepared according to best practices at Contractor's expense. The Shop Drawings must be of a size and scale to clearly show all necessary details. Unless otherwise specified by City, Shop Drawings must be provided to the Engineer for review and acceptance at least 30 days before the Work will be performed. If City requires changes, the corrected Shop Drawings must be resubmitted to the Engineer for review within the time specified by the Engineer. For all Project components requiring Shop Drawings, Contractor will not furnish materials or perform any Work until the Shop Drawings for those components are accepted by City. Contractor is responsible for any errors or omissions in the Shop Drawings, shop fits and field corrections; any deviations from the Contract Documents; and for the results obtained by the use of Shop Drawings. Acceptance of Shop Drawings by City does not relieve Contractor of Contractor's responsibility.

2.7 Access to Work. Contractor must afford prompt and safe access to any Worksite by City and its employees, agents, or consultants authorized by City; and upon request by City, Contractor must promptly arrange for City representatives to visit or inspect manufacturing sites or fabrication facilities for items to be incorporated into the Work.

2.8 Personnel. Contractor and its Subcontractors must employ only competent and skillful personnel to perform the Work. Contractor and its Subcontractor's supervisors, security or safety personnel, and employees who have unescorted access to the Project site must possess proficiency in English sufficient to read, understand, receive, and implement oral or written communications or instructions relating to their respective job functions, including safety and security requirements. Upon written notification from the Engineer, Contractor and its Subcontractors must immediately discharge any personnel who are incompetent, disorderly, disruptive, threatening, abusive, or profane, or otherwise refuse or fail to comply with the requirements of the Contract Documents or Laws, including Laws pertaining to health and safety. Any such

discharged personnel may not be re-employed or permitted on the Project in any capacity without City's prior written consent.

Article 3 - Contract Documents

3.1 Interpretation of Contract Documents.

(A) ***Plans and Specifications.*** The Plans and Specifications included in the Contract Documents are complementary. If Work is shown on one but not on the other, Contractor must perform the Work as though fully described on both, consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the indicated results. The Plans and Specifications are deemed to include and require everything necessary and reasonably incidental to completion of the Work, whether or not particularly mentioned or shown. Contractor must perform all Work and services and supply all things reasonably related to and inferable from the Contract Documents. In the event of a conflict between the Plans and Specifications, the Specifications will control, unless the Plan(s) at issue are dated later than the Specification(s) at issue. Detailed drawings take precedence over general drawings, and large-scale drawings take precedence over smaller scale drawings. Any arrangement or division of the Plans and Specifications into sections is for convenience and is not intended to limit the Work required by separate trades. A conclusion presented in the Plans or Specifications is only a recommendation. Actual locations and depths must be determined by Contractor's field investigation. Contractor may request access to underlying or background information in City's possession that is necessary for Contractor to form its own conclusions.

(B) ***Duty to Notify and Seek Direction.*** If Contractor becomes aware of a changed condition in the Project, or of any ambiguity, conflict, inconsistency, discrepancy, omission, or error in the Contract Documents, including the Plans or Specifications, Contractor must promptly submit a Request for Information to the Engineer and wait for a response from City before proceeding further with the related Work. The RFI must notify the City of the issue and request clarification, interpretation, or direction. The Engineer's clarification, interpretation, or direction will be final and binding on Contractor. If Contractor proceeds with the related Work before obtaining City's response, Contractor will be responsible for any resulting costs, including the cost of correcting any incorrect or defective Work that results. Timely submission of a clear and complete RFI is essential to avoiding delay. Delay resulting from Contractor's failure to submit a timely and complete RFI to the Engineer is Non-Excusable Delay. If Contractor believes that City's response to an RFI justifies a change to the Contract Price or Contract Time, Contractor must perform the Work as directed, but

may submit a timely Change Order request in accordance with the Contract Documents. (See Articles 5 and 6.)

(C) **Figures and Dimensions.** Figures control over scaled dimensions.

(D) **Technical or Trade Terms.** Any terms that have well-known technical or trade meanings will be interpreted in accordance with those meanings, unless otherwise specifically defined in the Contract Documents.

(E) **Measurements.** Contractor must verify all relevant measurements in the Contract Documents and at the Project site before ordering any material or performing any Work, and will be responsible for the correctness of those measurements or for costs that could have been avoided by independently verifying measurements.

(F) **Compliance with Laws.** The Contract Documents are intended to comply with Laws and will be interpreted to comply with Laws.

3.2 Order of Precedence. Information included in one Contract Document but not in another will not be considered a conflict or inconsistency. Unless otherwise specified in the Special Conditions, in case of any conflict or inconsistency among the Contract Documents, the following order of precedence will apply, beginning from highest to lowest, with the most recent version taking precedent over an earlier version:

- (A) Change Orders;
- (B) Addenda;
- (C) Contract;
- (D) Notice to Proceed;
- (E) Appendix B- Federal Contract Requirements (only if used);
- (F) Special Conditions;
- (G) General Conditions;
- (H) Payment and Performance Bonds;
- (I) Specifications;
- (J) Plans;
- (K) Notice of Award
- (L) Notice Inviting Bids;
- (M) Appendix A – Federal Bidding Requirements (only if used);
- (N) Instructions to Bidders;
- (O) Contractor's Bid Proposal and attachments;
- (P) The City's standard specifications, as applicable; and
- (Q) Any generic documents prepared by and on behalf of a third party, that were not prepared specifically for this Project, such as Caltrans Standard Specifications or Caltrans Special Provisions.

3.3 Caltrans Standard Specifications. Any reference to or incorporation of the Standard Specifications of the State of California, Department of Transportation (“Caltrans”), including “Standard Specifications,” “Caltrans Specifications,” “State Specifications,” or “CSS,” means the most current edition of Caltrans’ Standard Specifications, unless otherwise specified (“Caltrans Standard Specifications”), including the most current amendments as of the date that Contractor’s bid was submitted for this Project. The following provisions apply to use of or reference to the Caltrans Standard Specifications or Special Provisions:

- (A) **Limitations.** None of the “General Provisions” of the Caltrans Standard Specifications, i.e., Sections 1 through 9, applies to these Contract Documents with the exception of any specific provisions, if any, which are expressly stated to apply to these Contract Documents.
- (B) **Conflicts or Inconsistencies.** If there is a conflict or inconsistency between any provision in the Caltrans Standard Specifications or Special Provisions and a provision of these Contract Documents, as determined by City, the provision in the Contract Documents will govern.
- (C) **Meanings.** Terms used in the Caltrans Standard Specifications or Special Provisions are to be interpreted as follows:
 - (1) Any reference to the “Engineer” is deemed to mean the City Engineer.
 - (2) Any reference to the “Special Provisions” is deemed to mean the Special Conditions, unless the Caltrans Special Provisions are expressly included in the Contract Documents listed in Section 2 of the Contract.
 - (3) Any reference to the “Department” or “State” is deemed to mean City.

3.4 For Reference Only. Contractor is responsible for the careful review of any document, study, or report provided by the City or appended to the Contract Documents solely for informational purposes and identified as “For Reference Only.” Nothing in any document, study, or report so appended and identified is intended to supplement, alter, or void any provision of the Contract Documents. Contractor is advised that City or its representatives may be guided by information or recommendations included in such reference documents, particularly when making determinations as to the acceptability of proposed materials, methods, or changes in the Work. Any record drawings or similar final or accepted drawings or maps that are not part of the Contract Documents are deemed to be For Reference Only. The provisions of the Contract Documents

are not modified by any perceived or actual conflict with provisions in any document that is provided For Reference Only.

3.5 Current Versions. Unless otherwise specified by City, any reference to standard specifications, technical specifications, or any City or state codes or regulations means the latest specification, code, or regulation in effect at the time the Contract is signed.

3.6 Conformed Copies. If City prepares a conformed set of the Contract Documents following award of the Contract, it will provide Contractor with two hard copy (paper) sets and one copy of the electronic file in PDF format. It is Contractor's responsibility to ensure that all Subcontractors, including fabricators, are provided with the conformed set of the Contract Documents at Contractor's sole expense.

3.7 Ownership. No portion of the Contract Documents may be used for any purpose other than construction of the Project, without prior written consent from City. Contractor is deemed to have conveyed the copyright in any designs, drawings, specifications, Shop Drawings, or other documents (in paper or electronic form) developed by Contractor for the Project, and City will retain all rights to such works, including the right to possession.

Article 4 - Bonds, Indemnity, and Insurance

4.1 Payment and Performance Bonds. Within ten days following issuance of the Notice of Award, Contractor is required to provide a payment bond and a performance bond, each in the penal sum of not less than 100 percent of the Contract Price, and each executed by Contractor and its surety using the bond forms included with the Contract Documents.

(A) **Surety.** Each bond must be issued and executed by a surety admitted in California. If an issuing surety cancels the bond or becomes insolvent, within seven days following written notice from City, Contractor must substitute a surety acceptable to City. If Contractor fails to substitute an acceptable surety within the specified time, City may, at its sole discretion, withhold payment from Contractor until the surety is replaced to City's satisfaction, or terminate the Contract for default.

(B) **Supplemental Bonds for Increase in Contract Price.** If the Contract Price increases during construction by five percent or more over the original Contract Price, Contractor must provide supplemental or replacement bonds within ten days of written notice from City pursuant to this Section, covering 100% of the increased Contract Price and using the bond forms included with the Contract Documents.

4.2 Indemnity. To the fullest extent permitted by law, Contractor must indemnify, defend, and hold harmless City, its Council, officers, officials, employees, agents, volunteers, and consultants, (individually, an "Indemnitee," and collectively the "Indemnitees") from and against any and all liability, loss, damage, claims, causes of action, demands, charges, fines, costs, and expenses (including, without limitation, attorney fees, expert witness fees, paralegal fees, and fees and costs of litigation or arbitration) (collectively, "Liability") of every nature arising out of or in connection with the acts or omissions of Contractor, its employees, Subcontractors, representatives, or agents, in bidding or performing the Work or in failing to comply with any obligation of Contractor under the Contract, except such Liability caused by the active negligence, sole negligence, or willful misconduct of an Indemnitee. This indemnity requirement applies to any Liability arising from alleged defects in the content or manner of submission of Contractor's bid for the Contract. Contractor's failure or refusal to timely accept a tender of defense pursuant to this Contract will be deemed a material breach of this Contract. City will timely notify Contractor upon receipt of any third-party claim relating to the Contract, as required by Public Contract Code Section 9201. Contractor waives any right to express or implied indemnity against any Indemnitee. Contractor's indemnity obligations under this Contract will survive the expiration or any early termination of the Contract.

4.3 Insurance. No later than ten days following issuance of the Notice of Award, Contractor must procure and provide proof of the insurance coverage required by this Section in the form of certificates and endorsements acceptable to City. The required insurance must cover the activities of Contractor and its Subcontractors relating to or arising from the performance of the Work, and must remain in full force and effect at all times during the period covered by the Contract through the date of City's acceptance of the Project. The coverages may be arranged under a single policy for the full limits required or by a combination of underlying policies with the balance provided by excess or "umbrella" policies, provided each such policy complies with the requirements set forth herein. If Contractor fails to provide any of the required coverage in full compliance with the requirements of the Contract Documents, City may, at its sole discretion, purchase such coverage at Contractor's expense and deduct the cost from payments due to Contractor, or terminate the Contract for default. Contractor further understands that City reserves the right to modify the insurance requirements set forth herein, with thirty (30) days' notice provided to Contractor, at any time as deemed necessary to protect the interests of City. The procurement of the required insurance will not be construed to limit Contractor's liability under this Contract or to fulfill Contractor's indemnification obligations under this Contract.

(A) **Deductibles and Self-Insured Retentions.** Any deductibles or self-insured retentions must be declared to and approved by City. If the City's Risk Manager determines that the deductibles and/or self-insured retentions are unacceptably high, at City's option, Contractor must either

reduce or eliminate the deductibles and/or self-insured retentions as they apply to City and all required Additional Insured; or must provide a financial guarantee, to City's satisfaction, guaranteeing payment of losses and related investigation, claim administration, and legal expenses.

(B) **Policies and Limits.** The following insurance policies and limits are required for this Contract unless otherwise specified in the Special Conditions:

- (1) **Commercial General Liability Insurance ("CGL").** Contractor shall maintain CGL and must include coverage for liability arising from Contractor's or its Subcontractor's acts or omissions in the performance of the Work against claims and liabilities for personal injury, death, or property damage providing protection in the minimum amount of: (i) five million dollars (\$5,000,000.00) combined single limit each occurrence and either a general aggregate limit of ten million dollars (\$10,000,000.00) or a general aggregate limit of five million dollars (\$5,000,000.00) as applied on a "per project" or "per location" basis, or (ii) the maximum amount of such insurance available to Contractor under Contractor's combined insurance policies (including any excess or "umbrella" policies), whichever is greater.
 - a. CGL policy may not exclude explosion, collapse, underground excavation hazard, or removal of lateral support.
 - b. CGL policy must include contractor's protected coverage, blanket contractual, and completed operations.
- (2) **Builder's Risk Insurance:** The Builder's Risk Insurance policy must be issued on occurrence basis, for all-risk coverage (including Flood and Earthquake) on a one hundred percent (100%) completed value basis on the insurable portion of the Project for the benefit of City.
- (3) **Workers' Compensation Insurance and Employer's Liability:** Contractor shall maintain Workers Compensation coverage, as required by law. The policy must comply with the requirements of the California Workers' Compensation Insurance and Safety Act and provide protection in the minimum amount of: (i) One Million Dollars (\$1,000,000.00) for any one accident or occurrence, or (ii) the maximum amount of such insurance available to Contractor under Contractor's combined insurance policies (including any excess or "umbrella"

policies), whichever is greater. If Contractor is self-insured, Contractor must provide its Certificate of Permission to Self-Insure, duly authorized by the Department of Industrial Relations.

- (4) **Automobile Liability:** Contractor shall maintain Automobile Liability covering all owned, non-owned and hired automobiles (if Contractor does not own automobiles, then Contractor shall maintain Hired/Non-owned Automobile Liability) against claims and liabilities for personal injury, death, or property damage providing protection in the minimum amount of: (i) Five Million Dollars (\$5,000,000.00) combined single limit, or (ii) the maximum amount of such insurance available to Contractor under Contractor's combined insurance policies (including any excess or "umbrella" policies), whichever is greater.
- (5) **Pollution (Environmental) Liability:** If the performance of Contractor's work or service under this Contract involves hazardous materials, contaminated soil disposal, and/or a risk of accidental release of fuel oil, chemicals or other toxic gases or hazardous materials, Contractor shall procure and maintain Pollution Liability covering Contractor's liability for bodily injury, property damage and environmental damage resulting from pollution and related cleanup costs arising out of the work or services to be performed under this Contract. Coverage shall be provided for both work performed on site, as well as during the transport of hazardous materials. Such coverage shall be in the minimum amount of: (i) One Million Dollars (\$1,000,000.00) for any one accident or occurrence, or (ii) the maximum amount of such insurance available to Contractor under Contractor's combined insurance policies (including any excess or "umbrella" policies), whichever is greater.
- (6) **Professional Liability:**
 - a. If the performance of Contractor's work or service under this Contract involves professional and/or technical services (examples include, but are not limited to, architects, engineers, land surveyors, legal services, and appraisers), Contractor shall procure and maintain either a claims made or occurrence Errors and Omission liability insurance in the minimum amount of: (i) One Million Dollars (\$1,000,000.00) each claim, or (ii) the maximum amount of such insurance available to Contractor under Contractor's combined insurance policies (including any excess or "umbrella" policies), whichever is greater. Further, if Contractor

maintains a claims-made policy, Contractor shall provide written evidence of such insurance to City for at least five (5) years after the completion of work performed under this Contract.

- b. If the performance of Contractor's work or service under this Contract relates to Information Technology or related services (examples include, but are not limited to computer programmers, hardware engineers, or other systems consultants), Contractor shall procure and maintain a claims made Errors and Omission liability insurance, including Cyber Liability and Data Breach, in the minimum amount of: (i) One Million Dollars (\$1,000,000.00) each claim, or (ii) the maximum amount of such insurance available to Contractor under Contractor's combined insurance policies (including any excess or "umbrella" policies), whichever is greater.

(C) **Required Endorsements.** Contractor must provide proof of the following endorsements, listed for each policy for which endorsements are required, as outlined below:

- (1) For all Policies except Builder's Risk and Professional Liability:
 - a. "Waiver of Subrogation" endorsements providing that the carrier agrees to waive any right of subrogation it may have against the City of Morgan Hill and the City's elected or appointed officials, boards, agencies, officers, agents, employees, and volunteers.
- (2) General Liability, Automobile, and Pollution Liability:
 - a. "Additionally Insured" - The City of Morgan Hill, its elected or appointed officials, boards, agencies, officers, agents, employees, and volunteers are named as additional insureds on a form at least as broad as ISO Form CG 20 10 for ongoing operations and at least as broad as ISO Form CG 20 37 for completed operations.
 - b. "Primary and Non-Contributing" - Insurance shall be endorsed to be primary and non-contributory and will not seek contribution from the City's insurance or self-insurance and shall be at least as broad as ISO Form CG 20 01.
- (3) General Liability:

- a. “Separation of Insureds” endorsements stating that the inclusion of more than one insured will not operate to impair the rights of one insured against another, and the coverages afforded will apply as though separate policies have been issued to each insured.

(D) **Subcontractors.** Contractor must ensure that each Subcontractor is required to maintain the same insurance coverage required under this Section 4.3, with respect to its performance of Work on the Project, including those requirements related to the additional insureds and waiver of subrogation. Contractor must confirm that each Subcontractor has complied with requirements as outlined herein. The insurance requirements for Subcontractors do not replace or limit the Contractor’s insurance obligations.

(E) **Qualification of Insurers.** All insurance required pursuant to this Contract must be issued by a company licensed and admitted, or otherwise legally authorized to carry out insurance business in the State of California, and each insurer must have a current A.M. Best's financial strength rating of “A” or better and a financial size rating of “VIII” or better.

(F) **Certificates.** Contractor must furnish City with copies of all certificates as outlined herein, whether new or modified, promptly upon receipt. In the event of a claim or legal action, CONSULTANT shall promptly furnish CITY of Morgan Hill with copies of all policies outlined herein. No policy subject to Contractor’s Contract with City shall be reduced, canceled, allowed to expire, or materially changed except after thirty (30) days' notice by the insurer to City, unless due to non-payment of premiums, in which case ten (10) days written notice must be made to City. Certificates, including renewal certificates, may be mailed electronically to riskmgmt@morganhill.ca.gov or delivered to the Certificate Holder address as follows:

City of Morgan Hill
Attn: Risk Management
17575 Peak Avenue
Morgan Hill, CA 95037

(G) **Contractor’s Responsibilities.** This Section 4.3 establishes the minimum requirements for Contractor’s insurance coverage in relation to this Project, but is not intended to limit Contractor’s ability to procure additional or greater coverage. Contractor is responsible for its own risk assessment and needs and is encouraged to consult its insurance provider to determine what coverage it may wish to carry beyond the minimum requirements of this Section. Contractor is solely responsible for the cost of its insurance coverage, including premium payments,

deductibles, or self-insured retentions, and no Additional Insured will be responsible or liable for any of the cost of Contractor's insurance coverage.

Article 5 - Contract Time

5.1 Time is of the Essence. Time is of the essence in Contractor's performance and completion of the Work, and Contractor must diligently prosecute the Work and complete it within the Contract Time.

(A) **General.** Contractor must commence the Work on the date indicated in the Notice to Proceed, and must fully complete the Work in strict compliance with all requirements of the Contract Documents and within the Contract Time. Contractor may not begin performing the Work before the date specified in the Notice to Proceed.

(B) **Authorization.** Contractor is not entitled to compensation or credit for any Work performed before the date specified in the Notice to Proceed, with the exception of any schedules, submittals, or other requirements, if any, that must be provided or performed before issuance of the Notice to Proceed

(C) **Rate of Progress.** Contractor and its Subcontractors must, at all times, provide workers, materials, and equipment sufficient to maintain the rate of progress necessary to ensure full completion of the Work within the Contract Time. If City determines that Contractor is failing to prosecute the Work at a sufficient rate of progress, City may, in its sole discretion, direct Contractor to provide additional workers, materials, or equipment, or to work additional hours or days without additional cost to City, in order to achieve a rate of progress satisfactory to City. If Contractor fails to comply with City's directive in this regard, City may, at Contractor's expense, separately contract for additional workers, materials, or equipment or use City's own forces to achieve the necessary rate of progress. Alternatively, City may terminate the Contract based on Contractor's default.

5.2 Schedule Requirements. Contractor must prepare all schedules using standard, commercial scheduling software acceptable to Engineer, and must provide the schedules in electronic and paper form as requested by the Engineer. In addition to the general scheduling requirements set forth below, Contractor must also comply with any scheduling requirements included in the Special Conditions or in the Technical Specifications.

(A) **Baseline (As-Planned) Schedule.** Within ten calendar days following City's issuance of the Notice to Proceed (or as otherwise specified in the Notice to Proceed), Contractor must submit to City for review and acceptance a baseline as-planned schedule using critical path

methodology showing in detail how Contractor plans to perform and fully complete the Work within the Contract Time including labor, equipment, materials, and fabricated items. The baseline schedule must show the order of the major items of Work and the dates of start and completion of each item, including when the materials and equipment will be procured. The schedule must also include the work of all trades reflecting anticipated labor or crew hours and equipment loading for the construction activities, and must be sufficiently comprehensive and detailed to enable progress to be monitored on a day-by-day basis. For each activity, the baseline schedule must be dated, provided in the format specified in the Contract Documents or as required by City, and must include, at a minimum, a description of the activity, the start and completion dates of the activity, and the duration of the activity.

(1) ***Specialized Materials Ordering.*** Within five calendar days following issuance of the Notice to Proceed, Contractor must order any specialized material or equipment for the Work that is not readily available from material suppliers. Contractor must also retain documentation of the purchase order date(s).

(B) ***City's Review of Schedules.*** City will review and may note exceptions to the baseline schedule, and to the progress schedules submitted as required below, to assure completion of the Work within the Contract Time. Contractor is solely responsible for resolving any exceptions noted in a schedule and, within seven days, must correct the schedule to address the exceptions. City's review or acceptance of Contractor's schedules will not operate to waive or limit Contractor's duty to complete the Project within the Contract Time, nor to waive or limit City's right to assess liquidated damages for Contractor's unexcused failure to do so.

(C) ***Progress Schedules.*** After City accepts the final baseline schedule with no exceptions, Contractor must submit an updated progress schedule and three week look-ahead schedule, in the format specified by City, for review and acceptance with each application for a progress payment or when otherwise specified by City, until completion of the Work. The updated progress schedule must show: how the actual progress of the Work as constructed to date compares to the baseline schedule; reflect any proposed changes in the construction schedule or method of operations, including to achieve Project milestones within the Contract Time; and identify any actual or potential impacts to the critical path. Contractor must also submit periodic reports to City of any changes in the projected material or equipment delivery dates for the Project.

(1) ***Float.*** The progress schedule must show early and late completion dates for each task. The number of days between those dates will be designated as the "float." Any float belongs to the

Project and may be allocated by the Engineer to best serve timely completion of the Project.

(2) ***Failure to Submit Schedule.*** Reliable, up-to-date schedules are essential to efficient and cost-effective administration of the Project and timely completion. If Contractor fails to submit a schedule within the time periods specified in this Section, or submits a schedule to which City has noted exceptions that are not corrected, City may withhold up to five percent from payment(s) otherwise due to Contractor until the exceptions are resolved, the schedule is corrected and resubmitted, and City has accepted the schedule. In addition, Contractor's failure to comply with the schedule requirements in this Section 5.2 will be deemed a material default and a waiver of any claims for Excusable Delay or loss of productivity arising during any period when Contractor is out of compliance, subject only to the limits of Public Contract Code Section 7102.

(D) ***Recovery Schedule.*** If City determines that the Work is more than one week behind schedule, within seven days following written notice of such determination, Contractor must submit a recovery schedule, showing how Contractor intends to perform and complete the Work within the Contract Time, based on actual progress to date.

(E) ***Effect of Acceptance.*** Contractor and its Subcontractors must perform the Work in accordance with the most current City-accepted schedule unless otherwise directed by City. City's acceptance of a schedule does not operate to extend the time for completion of the Work or any component of the Work, and will not affect City's right to assess liquidated damages for Contractor's unexcused delay in completing the Work within the Contract Time.

(F) ***Posting.*** Contractor must at all times prominently post a copy of the most current City-accepted progress or recovery schedule in its on-site office.

(G) ***Reservation of Rights.*** City reserves the right to direct the sequence in which the Work must be performed or to make changes in the sequence of the Work in order to facilitate the performance of work by City or others, or to facilitate City's use of its property. The Contract Time or Contract Price may be adjusted to the extent such changes in sequence actually increase or decrease Contractor's time or cost to perform the Work.

(H) ***Authorized Working Days and Times.*** Contractor is limited to working Monday through Friday, excluding City of Morgan Hill-observed

holidays, during City's normal business hours, except as expressly provided in the Special Conditions, or as authorized in writing by City. City reserves the right to charge Contractor for additional costs incurred by City due to Work performed on days or during hours not expressly authorized in the Contract Documents, including reimbursement of costs incurred for inspection, testing, and construction management services.

5.3 Delay and Extensions of Contract Time.

(A) **Notice of Delay.** If Contractor becomes aware of any actual or potential delay affecting the critical path, Contractor must promptly notify the Engineer in writing, regardless of the nature or cause of the delay, so that City has a reasonable opportunity to mitigate or avoid the delay.

(B) **Excusable Delay.** The Contract Time may be extended if Contractor encounters "Excusable Delay," which is an unavoidable delay in completing the Work within the Contract Time due to causes completely beyond Contractor's control, and which Contractor could not have avoided or mitigated through reasonable care, planning, foresight, and diligence, provided that Contractor is otherwise fully performing its obligations under the Contract Documents. Grounds for Excusable Delay may include fire, natural disasters, including earthquake or unusually severe weather, acts of terror or vandalism, epidemic, unforeseeable adverse government actions, unforeseeable actions of third parties, encountering unforeseeable hazardous materials, unforeseeable site conditions, or suspension for convenience under Article 13. The Contract Time will not be extended based on circumstances which will not unavoidably delay completing the Work within the Contract Time based on critical path analysis.

(C) **Weather Delays.** A "Weather Delay Day" is a Working Day during which Contractor and its forces, including Subcontractors, are unable to perform more than 40% of the critical path Work scheduled for that day due to adverse weather conditions which impair the ability to safely or effectively perform the scheduled critical path Work that day. Adverse weather conditions may include rain, saturated soil, and Project site clean-up required due to adverse weather. Determination of what constitutes critical path Work scheduled for that day will be based on the most current, City-approved schedule. Contractor will be entitled to a non-compensable extension of the Contract Time for each Weather Delay Day in excess of the normal Weather Delay Days within a given month as determined by reliable records, including monthly rainfall averages, for the preceding ten years (or as otherwise specified in the Special Conditions or Specifications).

(1) Contractor must fully comply with the applicable procedures in Articles 5 and 6 of the General Conditions regarding requests to modify the Contract Time.

(2) Contractor will not be entitled to an extension of time for a Weather Delay Day to the extent Contractor is responsible for concurrent delay on that day.

(3) Contractor must take reasonable steps to mitigate the consequences of Weather Delay Days, including prudent workforce management and protecting the Work, Project Site, materials, and equipment.

(D) **Non-Excusable Delay.** Delay which Contractor could have avoided or mitigated through reasonable care, planning, foresight, and diligence is "Non-Excusable Delay." Contractor is not entitled to an extension of Contract Time or any compensation for Non-Excusable Delay, or for Excusable Delay that is concurrent with Non-Excusable Delay. Non-Excusable Delay includes delay caused by:

(1) weather conditions which are normal for the location of the Project, as determined by reliable records, including monthly rainfall averages, for the preceding ten years;

(2) Contractor's failure to order equipment and materials sufficiently in advance of the time needed for completion of the Work within the Contract Time;

(3) Contractor's failure to provide adequate notification to utility companies or agencies for connections or services necessary for completion of the Work within the Contract Time;

(4) foreseeable conditions which Contractor could have ascertained from reasonably diligent inspection of the Project site or review of the Contract Documents or other information provided or available to the Contractor;

(5) Contractor's failure, refusal, or financial inability to perform the Work within the Contract Time, including insufficient funds to pay its Subcontractors or suppliers.

(6) performance or non-performance by Contractor's Subcontractors or suppliers;

(7) the time required to respond to excessive RFIs (see Section 2.5(G));

(8) delayed submission of required submittals, or the time required for correction and resubmission of defective submittals;

(9) time required for repair of, re-testing, or re-inspection of defective Work;

(10) enforcement of Laws by City, or outside agencies with jurisdiction over the Work; or

(11) City's exercise or enforcement of any of its rights or Contractor's duties pursuant to the Contract Documents, including correction of defective Work, extra inspections or testing due to non-compliance with Contract requirements, safety compliance, environmental compliance, or rejection and return of defective or deficient submittals.

(E) **Compensable Delay.** Pursuant to Public Contract Code Section 7102, in addition to entitlement to an extension of Contract Time, Contractor is entitled to compensation for costs incurred due to delay caused solely by City, when that delay is unreasonable under the circumstances involved and not within the contemplation of the parties ("Compensable Delay"). Contractor is not entitled to an extension of Contract Time or recovery of costs for Compensable Delay that is concurrent with Non-Excusable Delay. Delay due to causes that are beyond the control of either City or Contractor, including Weather Delay Days, discovery of Historic or Archeological Items pursuant to Section 7.18, or the actions or inactions of third parties or other agencies, is not Compensable Delay, and will only entitle Contractor to an extension of time commensurate with the time lost due to such delay.

(F) **Recoverable Costs.** Contractor is not entitled to compensation for Excusable Delay unless it is Compensable Delay, as defined above. Contractor is entitled to recover only the actual, direct, reasonable, and substantiated costs ("Recoverable Costs") for each working day that the Compensable Delay prevents Contractor from proceeding with more than 50% of the critical path Work scheduled for that day, based on the most recent progress schedule accepted by City. Recoverable Costs will not include home office overhead or lost profit.

(G) **Request for Extension of Contract Time or Recoverable Costs.** A request for an extension of Contract Time or any associated Recoverable Costs must be submitted in writing to City within ten calendar days of the date the delay is first encountered, even if the duration of the delay is not yet known at that time, or any entitlement to the Contract Time extension or to the Recoverable Costs will be deemed waived. In addition

to complying with the requirements of this Article 5, the request must be submitted in compliance with the Change Order request procedures in Article 6, below. Strict compliance with these requirements is necessary to ensure that any delay or consequences of delay may be mitigated as soon as possible, and to facilitate cost-efficient administration of the Project and timely performance of the Work. Any request for an extension of Contract Time or Recoverable Costs that does not strictly comply with all of the requirements of Article 5 and Article 6 will be deemed waived.

(1) *Required Contents.* The request must include a detailed description of the cause(s) of the delay, and must also describe the measures that Contractor has taken to mitigate the delay and/or its effects, including efforts to mitigate the cost impact of the delay, such as by workforce management, or by a change in sequencing. If the delay is still ongoing at the time the request is submitted, the request should also include Contractor's plan for continued mitigation of the delay or its effects.

(2) *Delay Days and Costs.* The request must specify the number of days of Excusable Delay claimed, or provide a realistic estimate if the duration of the delay is not yet known. If the Contractor believes it is entitled to Recoverable Costs for Compensable Delay, the request must specify the amount of and basis for the Recoverable Costs that are claimed or provide a realistic estimate if the amount is not yet known. Any estimate of delay duration or cost must be updated in writing and submitted with all required supporting documentation as soon as the actual time and cost is known. The maximum extension of Contract Time will be the number of days, if any, by which an Excusable Delay or a Compensable Delay exceeds any concurrent Non-Excusable Delay. Contractor is entitled to an extension of Contract Time, or compensation for Recoverable Costs, only if, and only to the extent that, such delay will unavoidably delay Final Completion.

(3) *Supporting Documentation.* The request must also include any and all supporting documentation necessary to evidence the delay and its actual impacts, including scheduling and cost impacts, with a time impact analysis using critical path methodology, and demonstrating the unavoidable delay to Final Completion. The time impact analysis must be submitted in a form or format acceptable to City.

(4) *Burden of Proof.* Contractor has the burden of proving that the delay was an Excusable or Compensable Delay, as defined above; Contractor has fully complied with its scheduling obligations in Section 5.2, Schedule Requirements; Contractor has made

reasonable efforts to mitigate the delay and its schedule and cost impacts; the delay will unavoidably result in delaying Final Completion, and any Recoverable Costs claimed by Contractor were actually incurred and were reasonable under the circumstances.

(5) *Legal Compliance.* Nothing in this Section 5.3 is intended to require the waiver, alteration, or limitation of the applicability of Public Contract Code Section 7102.

(6) *No Waiver.* Any grant of an extension of Contract Time or compensation for Recoverable Costs due to Compensable Delay will not operate as a waiver of City's right to assess liquidated damages for Non-Excusable Delay.

(7) *Dispute Resolution.* In the event of a dispute over entitlement to an extension of Contract Time or compensation for Recoverable Costs, Contractor may not stop Work pending resolution of the dispute, but must continue to comply with its duty to diligently prosecute the performance and timely completion of the Work. Contractor's sole recourse for an unresolved dispute based on City's rejection of a Change Order request for an extension of Contract Time or compensation for Recoverable Costs is to comply with the dispute resolution provisions set forth in Article 12, below.

5.4 Liquidated Damages. It is expressly understood that if Final Completion is not achieved within the Contract Time, City will suffer damages from the delay that are difficult to determine and accurately specify. Pursuant to Public Contract Code section 7203, if Contractor fails to achieve Final Completion within the Contract Time, City will charge Contractor in the amount specified in the Contract for each calendar day that Final Completion is delayed beyond the Contract Time, as liquidated damages and not as a penalty. Any waiver of accrued liquidated damages, in whole or in part, is subject to approval of the City Council or its authorized delegee.

(A) **Liquidated Damages.** Liquidated damages will not be assessed for any Excusable or Compensable Delay, as set forth above.

(B) **Milestones.** Liquidated damages may also be separately assessed for failure to meet milestones specified elsewhere in the Contract Documents.

(C) **Setoff.** City is entitled to deduct the amount of liquidated damages assessed against any payments otherwise due to Contractor, including progress payments, Final Payment, or unreleased retention. If there are

insufficient Contract funds remaining to cover the full amount of liquidated damages assessed, City is entitled to recover the balance from Contractor or its performance bond surety.

(D) **Occupancy or Use.** Occupancy or use of the Project in whole or in part prior to Final Completion does not constitute City's acceptance of the Project and will not operate as a waiver of City's right to assess liquidated damages for Contractor's Non-Excusable Delay in achieving Final Completion.

(E) **Other Remedies.** City's right to liquidated damages under this Section applies only to damages arising from Contractor's Non-Excusable Delay or failure to complete the Work within the Contract Time. City retains its right to pursue all other remedies under the Contract for other types of damage, including damage to property or persons, costs, or diminution in value from defective materials or workmanship, costs to repair or complete the Work, or other liability caused by Contractor.

Article 6 - Contract Modification

6.1 Contract Modification. Subject to the limited exception set forth in subsection (D) below, any change in the Work or the Contract Documents, including the Contract Price or Contract Time, will not be a valid and binding change to the Contract unless it is formalized in a Change Order, including a "no-cost" Change Order or a unilateral Change Order. Changes in Work will not operate to release, limit, or abridge Contractor's warranty obligations pursuant to Article 11 or any obligations of Contractor's bond sureties.

(A) **City-Directed Changes.** City may direct changes in the scope or sequence of Work or the requirements of the Contract Documents, without invalidating the Contract. Such changes may include Extra Work as set forth in subsection (C) below, or deletion or modification of portions of the Work. Contractor must promptly comply with City-directed changes in the Work in accordance with the intent of the original Contract Documents, even if Contractor and City have not yet reached agreement as to adjustments to the Contract Price or Contract Time for the change in the Work or for the Extra Work. Contractor is not entitled to extra compensation for cost savings resulting from "value engineering" pursuant to Public Contract Code Section 7101, except to the extent authorized in advance by City in writing, and subject to any applicable procedural requirements for submitting a proposal for value engineering cost savings.

(B) **Disputes.** In the event of a dispute over entitlement to or the amount of a change in Contract Time or a change in Contract Price related to extra City-directed change in the Work, Contractor must perform

the Work as directed and may not delay its Work or cease Work pending resolution of the dispute, but must continue to comply with its duty to diligently prosecute the performance and timely completion of the Work, including the Work in dispute. Likewise, in the event that City and Contractor dispute whether a portion or portions of the Work are already required by the Contract Documents or constitute Extra Work, or otherwise dispute the interpretation of any portion(s) of the Contract Documents, Contractor must perform the Work as directed and may not delay its Work or cease Work pending resolution of the dispute, but must continue to comply with its duty to diligently prosecute the performance and timely completion of the Work, including the Work in dispute, as directed by City. If Contractor refuses to perform the Work in dispute, City may, acting in its sole discretion, elect to delete the Work from the Contract and reduce the Contract Price accordingly, and self-perform the Work or direct that the Work be performed by others. Alternatively, City may elect to terminate the Contract for convenience or for cause. Contractor's sole recourse for an unresolved dispute related to changes in the Work or performance of any Extra Work is to comply with the dispute resolution provisions set forth in Article 12, below.

- (C) **Extra Work.** City may direct Contractor to perform Extra Work related to the Project. Contractor must promptly perform any Extra Work as directed or authorized by City in accordance with the original Contract Documents, even if Contractor and City have not yet reached agreement on adjustments to the Contract Price or Contract Time for such Extra Work. If Contractor believes it is necessary to perform Extra Work due to changed conditions, Contractor must promptly notify the Engineer in writing, specifically identifying the Extra Work and the reason(s) the Contractor believes it is Extra Work. This notification requirement does not constitute a Change Order request pursuant to Section 6.2, below. Contractor must maintain detailed daily records that itemize the cost of each element of Extra Work, and sufficiently distinguish the direct cost of the Extra Work from the cost of other Work performed. For each day that Contractor performs Extra Work, or Work that Contractor contends is Extra Work, Contractor must submit no later than the following Working Day, a daily report of the Extra Work performed that day and the related costs, together with copies of certified payroll, invoices, and other documentation substantiating the costs ("Extra Work Report"). The Engineer will make any adjustments to Contractor's Extra Work Report(s) based on the Engineer's records of the Work. When an Extra Work Report(s) is agreed on and signed by both City and Contractor, the Extra Work Report(s) will become the basis for payment under a duly authorized and signed Change Order. Failure to submit the required documentation by close of business on the next Working Day is

deemed a full and complete waiver for any change in the Contract Price or Contract Time for any Extra Work performed that day.

(D) **Minor Changes and RFIs.** Minor field changes, including RFI replies from City, that do not affect the Contract Price or Contract Time and that are approved by the Engineer acting within his or her scope of authority, do not require a Change Order. By executing an RFI reply from City, Contractor agrees that it will perform the Work as clarified therein, with no change to the Contract Price or Contract Time.

(E) **Remedy for Non-Compliance.** Contractor's failure to promptly comply with a City-directed change is deemed a material breach of the Contract, and in addition to all other remedies available to it, City may, at its sole discretion, hire another contractor or use its own forces to complete the disputed Work at Contractor's sole expense, and may deduct the cost from the Contract Price.

6.2 Contractor Change Order Requests. Contractor must submit a request or proposal for a change in the Work, compensation for Extra Work, or a change in the Contract Price or Contract Time as a written Change Order request or proposal.

(A) **Time for Submission.** Any request for a change in the Contract Price or the Contract Time must be submitted in writing to the Engineer within ten calendar days of the date that Contractor first encounters the circumstances, information or conditions giving rise to the Change Order request, even if the total amount of the requested change in the Contract Price or impact on the Contract Time is not yet known at that time. If City requests that Contractor propose the terms of a Change Order, unless otherwise specified in City's request, Contractor must provide the Engineer with a written proposal for the change in the Contract Price or Contract Time within five working days of receiving City's request, in a form satisfactory to the Engineer.

(B) **Required Contents.** Any Change Order request or proposal submitted by Contractor must include a complete breakdown of actual or estimated costs and credits, and must itemize labor, materials, equipment, taxes, insurance, subcontract amounts, and if applicable, Extra Work Reports. Any estimated cost must be updated in writing as soon as the actual amount is known.

(C) **Required Documentation.** All claimed costs must be fully documented, and any related request for an extension of time or delay-related costs must be included at that time and in compliance with the requirements of Article 5 of the General Conditions. Upon request, Contractor must permit City to inspect its original and unaltered bidding

records, subcontract agreements, subcontract change orders, purchase orders, invoices, or receipts associated with the claimed costs.

(D) **Required Form.** Contractor must use City's form(s) for submitting all Change Order requests or proposals, unless otherwise specified by City.

(E) **Certification.** All Change Order requests must be signed by Contractor and must include the following certification:

"The undersigned Contractor certifies under penalty of perjury that its statements and representations in this Change Order request are true and correct. Contractor warrants that this Change Order request is comprehensive and complete as to the Work or Changes referenced herein, and agrees that any costs, expenses, or time extension requests not included herein are deemed waived."

6.3 Adjustments to Contract Price. The amount of any increase or decrease in the Contract Price will be determined based on one of the following methods listed below, in the order listed with unit pricing taking precedence over the other methods. Markup applies only to City-authorized time and material Work, and does not apply to any other payments to Contractor. For Work items or components that are deleted in their entirety, Contractor will only be entitled to compensation only for those direct, actual, and documented costs (including restocking fees), reasonably incurred before Contractor was notified of the City's intent to delete the Work, with no markup for overhead, profit, or other indirect costs.

(A) **Unit Pricing.** Amounts previously provided by Contractor in the form of unit prices, either in a bid schedule or in a post-award schedule of values pursuant to Section 8.1 Schedule of Values, will apply to determine the price for the affected Work, to the extent applicable unit prices have previously been provided for that type of Work. No additional markup for overhead, profit, or other indirect costs. will be added to the calculation.

(B) **Lump Sum.** A mutually agreed upon, all-inclusive lump sum price for the affected Work with no additional markup for overhead, profit, or other indirect costs;

(C) **Time and Materials.** On a time and materials basis, if and only to the extent compensation on a time and materials basis is expressly authorized by City in advance of Contractor's performance of the Work and subject to any not-to-exceed limit. Time and materials compensation for increased costs or Extra Work (but not decreased costs or deleted

Work), will include allowed markup for overhead, profit, and other indirect costs, and which may include a not-to-exceed limit, calculated as the total of the following sums, the cumulative total of which may not exceed the maximum markup rate of 15%:

- (1) All direct labor costs provided by the Contractor, excluding superintendence, project management, or administrative costs plus 15 percent markup;
- (2) All direct material costs provided by the Contractor, including sales tax, plus 15 percent markup;
- (3) All direct plant and equipment rental costs provided by the Contractor, plus 15 percent markup;
- (4) All direct additional subcontract costs plus ten percent markup for Work performed by Subcontractors; and
- (5) Increased bond or insurance premium costs computed at 1.5% percent of total of the previous four sums.

6.4 Unilateral Change Order. If the parties dispute the terms of a proposed Change Order, including disputes over the amount of compensation or extension of time that Contractor has requested, the value of deleted or changed Work, what constitutes Extra Work, or quantities used, City may elect to issue a unilateral Change Order, directing performance of the Work, and authorizing a change in the Contract Price or Contract Time for the adjustment to compensation or time that the City believes is merited. Contractor's sole recourse to dispute the terms of a unilateral Change Order is to submit a timely Claim pursuant to Article 12, below.

6.5 Non-Compliance Deemed Waiver. Contractor waives its entitlement to any increase in the Contract Price or Contract Time if Contractor fails to fully comply with the provisions of this Article. Contractor will not be paid for unauthorized Extra Work.

Article 7 - General Construction Provisions

7.1 Permits, Fees, Business License, and Taxes.

(A) ***Permits, Fees, and City Business License.*** Contractor must obtain and pay for all permits, fees, and licenses required to perform the Work, including a City business license. Contractor must cooperate with and provide notifications to all government agencies with jurisdiction over the Project, as may be required. Contractor must provide City with copies

of all records of permits and permit applications, payment of required fees, and any licenses required for the Work.

- (7) **Taxes.** Contractor must pay for all taxes on labor, material, and equipment, except Federal Excise Tax to the extent that City is exempt from Federal Excise Tax.

7.2 Temporary Facilities. Contractor must provide, at Contractor's sole expense, any and all temporary facilities for the Project, including an onsite staging area for materials and equipment, a field office, sanitary facilities, utilities, storage, scaffolds, barricades, walkways, and any other temporary structure required to safely perform the Work along with any incidental utility services. The location of all temporary facilities must be approved by the City prior to installation. Temporary facilities must be safe and adequate for the intended use, and installed and maintained in accordance with Laws and the Contract Documents. Contractor must fence and screen the Project site and, if applicable, any separate Worksites, including the staging area, and its operation must minimize inconvenience to neighboring properties. Additional provisions pertaining to temporary facilities may be included in the Specifications or Special Conditions.

(A) **Utilities.** Contractor must install and maintain the power, water, sewer, and all other utilities required for the Project site, including the piping, wiring, internet and Wi-Fi connections, and any related equipment necessary to maintain the temporary facilities.

(B) **Removal and Repair.** Contractor must promptly remove all such temporary facilities when they are no longer needed or upon completion of the Work, whichever comes first. Contractor must promptly repair any damage to City's property or to other property caused by the installation, use, or removal of the temporary facilities, and must promptly restore the property to its original or intended condition.

7.3 Noninterference and Site Management. Contractor must avoid interfering with City's use of its property at or adjacent to the Project site, including use of roadways, entrances, parking areas, walkways, and structures. Contractor must also minimize disruption of access to private property in the Project vicinity. Contractor must coordinate with affected property owners, tenants, and businesses, and maintain some vehicle and pedestrian access to their residences or properties at all times. Temporary access ramps, fencing or other measures must be provided as needed. Before blocking access to a private driveway or parking lot, Contractor must provide effective notice to the affected parties at least 48 hours in advance of the pending closure and allow them to remove vehicles.

Private driveways, residences and parking lots must have access to a roadway during non-Work hours.

(A) **Offsite Acquisition.** Unless otherwise provided by City, Contractor must acquire, use, and dispose of, at its sole expense, any Worksites, licenses, easements, and temporary facilities necessary to access and perform the Work.

(B) **Offsite Staging Area and Field Office.** If additional space beyond the Project site is needed, such as for the staging area or the field office, Contractor may need to make arrangements with the nearby property owner(s) to secure the space. Before using or occupying any property owned by a third party, Contractor must provide City with a copy of the necessary license agreement, easement, or other written authorization from the property owner, together with a written release from the property owner holding City harmless from any related liability, in a form acceptable to the City Attorney.

(C) **Traffic Management.** Contractor must provide traffic management and traffic controls as specified in the Contract Documents, as required by Laws, and as otherwise required to ensure public and worker safety, and to avoid interference with public or private operations or the normal flow of vehicular, bicycle, or pedestrian traffic.

7.4 Signs. No signs may be displayed on or about City's property, except signage which is required by Laws or by the Contract Documents, without City's prior written approval as to size, design, and location.

7.5 Project Site and Nearby Property Protections.

(A) **General.** Contractor is responsible at all times, on a 24-hour basis and at its sole cost for protecting the Work, the Project site, and the materials and equipment to be incorporated into the Work until the City has accepted the Project, excluding any exceptions to acceptance, if any. Except as specifically authorized by City, Contractor must confine its operations to the area of the Project site indicated in the Plans and Specifications. Contractor is liable for any damage caused by Contractor or its Subcontractors to the Work, City's property, the property of adjacent or nearby property owners and the work or personal property of other contractors working for City, including damage related to Contractor's failure to adequately secure the Work or any Worksite.

(1) Subject to City's approval, Contractor will provide and install safeguards to protect the Work; any Worksite, including the Project site; City's real or personal property and the real or personal

property of adjacent or nearby property owners, including plant and tree protections.

(2) City wastewater systems may not be interrupted. If the Work disrupts existing sewer facilities, Contractor must immediately notify City and establish a plan, subject to City's approval, to convey the sewage in closed conduits back into the sanitary sewer system. Sewage must not be permitted to flow in trenches or be covered by backfill.

(3) Contractor must remove with due care, and store at City's request, any objects or material from the Project site that City will salvage or reuse at another location.

(4) If directed by Engineer, Contractor must promptly repair or replace any property damage, as specified by the Engineer. However, acting in its sole discretion, City may elect to have the property damage remedied otherwise, and may deduct the cost to repair or replace the damaged property from payment otherwise due to Contractor.

(5) Contractor will not permit any structure or infrastructure to be loaded in a manner that will damage or endanger the integrity of the structure or infrastructure.

(B) **Securing Project Site.** After completion of Work each day, Contractor must secure the Project site and, to the extent feasible, make the area reasonably accessible to the public unless City approves otherwise. All excess materials and equipment not protected by approved traffic control devices must be relocated to the staging area or demobilized. Trench spoils must be hauled off the Project site daily and open excavations must be protected with steel plates. Contractor and Subcontractor personnel may not occupy or use the Project site for any purpose during non-Work hours, except as may be provided in the Contract Documents or pursuant to prior written authorization from City.

(C) **Unforeseen Conditions.** If Contractor encounters facilities, utilities, or other unknown conditions not shown on or reasonably inferable from the Plans or apparent from inspection of the Project site, Contractor must immediately notify the City and promptly submit a Request for Information to obtain further directions from the Engineer. Contractor must avoid taking any action which could cause damage to the facilities or utilities pending further direction from Engineer. The Engineer's written response will be final and binding on Contractor. If Engineer's subsequent direction to Contractor affects Contractor's cost or time to perform the

Work, Contractor may submit a Change Order request as set forth in Article 6 above.

(D) **Support; Adjacent Properties.** Contractor must provide, install, and maintain all shoring, bracing, and underpinning necessary to provide support to City's property and adjacent properties and improvements thereon. Contractor must provide notifications to adjacent property owners as may be required by Laws. See also Section 7.15 Trenching of Five Feet or More.

(E) **Notification of Property Damage.** Contractor must immediately notify the City of damage to any real or personal property resulting from Work on the Project. Contractor must immediately provide a written report to City of any such property damage in excess of \$500 (based on estimated cost to repair or replace) within 24 hours of the occurrence. The written report must include: (1) the location and nature of the damage, and the owner of the property, if known; (2) the name and address of each employee of Contractor or any Subcontractor involved in the damage; (3) a detailed description of the incident, including precise location, time, and names and contact information for known witnesses; and (4) a police or first responder report, if applicable. If Contractor is required to file an accident report with another government agency, Contractor will provide a copy of the report to City.

7.6 Materials and Equipment.

(A) **General.** Unless otherwise specified, all materials and equipment required for the Work must be new, free from defects, and of the best grade for the intended purpose, and furnished in sufficient quantities to ensure the proper and expeditious performance of the Work. Contractor must employ measures to preserve the specified quality and fitness of the materials and equipment. Unless otherwise specified, all materials and equipment required for the Work are deemed to include all components required for complete installation and intended operation, and must be installed in accordance with the manufacturer's recommendations or instructions. Contractor is responsible for all shipping, handling, and storage costs associated with the materials and equipment required for the Work. Contractor is responsible for providing security and protecting the Work and all of the required materials, supplies, tools and equipment at Contractor's sole cost until City has formally accepted the Project as set forth in Section 11.1, Final Completion. Contractor will not assign, sell, mortgage, or hypothecate any materials or equipment for the Project, or remove any materials or equipment that have been installed or delivered.

(B) **City-Provided.** If the Work includes installation of materials or equipment to be provided by City, Contractor is solely responsible for the

proper examination, handling, storage, and installation in accordance with the Contract Documents. Contractor must notify City of any defects discovered in City-provided materials or equipment sufficiently in advance of scheduled use or installation to afford adequate time to procure replacement materials or equipment as needed. Contractor is solely responsible for any loss of or damage to such items which occurs while the items are in Contractor's custody and control, the cost of which may be offset from the Contract Price and deducted from any payment(s) due to Contractor.

(C) ***Intellectual Property Rights.*** Contractor must, at its sole expense, obtain any authorization or license required for use of patented or copyright-protected materials, equipment, devices, or processes that are incorporated into the Work. Contractor's indemnity obligations in Article 4 apply to any claimed violation of intellectual property rights in violation of this provision.

7.7 Substitutions.

(A) ***"Or Equal."*** Any Specification designating a material, product, or thing (collectively "item") or service by specific brand or trade name, followed by the words "or equal," is intended only to indicate the quality and type of item or service desired, and Contractor may request use of any equal item or service. Unless otherwise stated in the Specifications, any reference to a specific brand or trade name for an item or service that is used solely for the purpose of describing the type of item or service desired, will be deemed to be followed by the words "or equal." A substitution will only be approved if it is a true "equal" item or service in every aspect of design, function, and quality, as determined by City, including dimensions, weight, maintenance requirements, durability, fit with other elements, and schedule impacts.

(B) ***Request for Substitution.*** A post-award request for substitution of an item or service must be submitted in writing to the Engineer for approval in advance, within the applicable time period provided in the Contract Documents. If no time period is specified, the substitution request may be submitted any time within 35 days after the date of award of the Contract, or sufficiently in advance of the time needed to avoid delay of the Work, whichever is earlier.

(C) ***Substantiation.*** Any available data substantiating the proposed substitute as an equal item or service must be submitted with the written request for substitution. Contractor's failure to timely provide all necessary substantiation, including any required test results as soon as they are available, is grounds for rejection of the proposed substitution, without further review.

(D) **Burden of Proving Equality.** Contractor has the burden of proving, at Contractor's sole cost, the equality of the proposed substitution. City has sole discretion to determine whether a proposed substitution is equal, and City's determination is final.

(E) **Approval or Rejection.** If the proposed substitution is approved, Contractor is solely responsible for any additional costs or time associated with the substituted item or service. If the proposed substitution is rejected, Contractor must, without delay, install the item or use the service as specified by the City.

(F) **Contractor's Obligations.** City's approval of a proposed substitution will not relieve Contractor from any of its obligations under the Contract Documents. In the event Contractor makes an unauthorized substitution, Contractor will be solely responsible for all resulting cost impacts, including the cost of removal and replacement and the impact to other design elements.

7.8 Testing and Inspection.

(A) **General.** All materials, equipment, and workmanship used in the Work are subject to inspection and testing by City at all times and locations during construction and/or fabrication and at any Worksite, including at shops and yards as well as at the Project site. All manufacturers' application or installation instructions must be provided to the Inspector at least ten days prior to the first such application or installation. Contractor must, at all times, make the Work available for testing or inspection. Neither City's inspection or testing of Work, nor its failure to do so, operate to waive or limit Contractor's duty to complete the Work in accordance with the Contract Documents.

(B) **Scheduling and Notification.** Contractor must cooperate with City in coordinating the inspections and testing. Contractor must submit samples of materials, at Contractor's expense, and schedule all tests required by the Contract Documents in time to avoid any delay to the progress of the Work. Contractor must notify the Engineer no later than noon of the Working Day before any inspection or testing and must provide timely notice to the other necessary parties as specified in the Contract Documents. If Contractor schedules an inspection or test beyond regular Work hours, or on a Saturday, Sunday, or recognized City holiday, Contractor must notify the Engineer at least two Working Days in advance for approval. If approved, Contractor must reimburse City for the cost of the overtime inspection or testing. Such costs, including the City's hourly costs for required personnel, may be deducted from payments otherwise due to Contractor.

(C) **Responsibility for Costs.** City will bear the initial cost of inspection and testing to be performed by independent consultants retained by City, subject to the following exceptions:

(1) Contractor will be responsible for the costs of any subsequent inspections or tests which are required to substantiate compliance with the Contract Documents, and any associated remediation costs.

(2) Contractor will be responsible for inspection costs, at City's hourly rates, for inspection time lost because the Work is not ready, or Contractor fails to appear for a scheduled inspection.

(3) If any portion of the Work that is subject to inspection or testing is covered or concealed by Contractor prior to the inspection or testing, Contractor will bear the cost of making that portion of the Work available for the inspection or testing required by the Contract Documents, and any associated repair or remediation costs.

(4) Contractor is responsible for properly shoring all compaction test sites deeper than five feet below grade, as required under Section 7.15 below.

(5) Any Work or material that is defective or fails to comply with the requirements of the Contract Documents must be promptly repaired, removed, replaced, or corrected by Contractor, at Contractor's sole expense, even if that Work or material was previously inspected or included in a progress payment.

(D) **Contractor's Obligations.** Contractor is solely responsible for any delay occasioned by remediation of defective or of noncompliant Work or material. Inspection or testing of the Work does not in any way relieve Contractor of its obligations to perform the Work as specified. Any Work done without the inspection(s) or testing required by the Contract Documents will be subject to rejection by City.

(E) **Distant Locations.** If required off-site testing or inspection must be conducted at a location more than 100 miles from the Project site, Contractor is solely responsible for the additional travel costs required for testing and/or inspection at such locations.

(F) **Final Inspection.** The provisions of this Section 7.8 also apply to final inspection under Article 11, Completion and Warranty Provisions.

7.9 Project Site Conditions and Maintenance. Contractor must at all times, on a 24-hour basis and at its sole cost, maintain the Project site and staging and storage areas in clean, neat, and sanitary condition and in compliance with all Laws pertaining to safety, air quality, and dust control. Adequate toilets must be provided, and properly maintained and serviced for all workers on the Project site, located in a suitably secluded area, subject to City's prior approval. Contractor must also, on a daily basis and at its sole cost, remove and properly dispose of the debris and waste materials from the Project site.

(A) **Air Emissions Control.** Contractor must not discharge smoke or other air contaminants into the atmosphere in violation of any Laws. Contractor must comply with all Laws, including the California Air Resources Board's In-Use Off-Road Diesel-Fueled Fleets Regulation (13 CCR § 2449 et seq.).

(B) **Dust and Debris.** Contractor must minimize and confine dust and debris resulting from the Work. Contractor must abate dust nuisance by cleaning, sweeping, and immediately sprinkling with water excavated areas of dirt or other materials prone to cause dust, and within one hour after the Engineer notifies Contractor that an airborne nuisance exists. The Engineer may direct that Contractor provide an approved water-spraying truck for this purpose. If water is used for dust control, Contractor will only use the minimum necessary. Contractor must take all necessary steps to keep wastewater out of streets, gutters, or storm drains. See Section 7.19, Environmental Control. If City determines that the dust control is not adequate, City may have the work done by others and deduct the cost from the Contract Price. Contractor will immediately remove any excess excavated material from the Project site and any dirt deposited on public streets.

(C) **Clean up.** Before discontinuing Work in an area, Contractor must clean the area and remove all rubbish debris and waste along with the construction equipment, tools, machinery, waste, and surplus materials. Contractor must, at all times, minimize and confine dust and debris resulting from construction activities.

(1) Except as otherwise specified, all excess Project materials, and the materials removed from existing improvements on the Project site with no salvage value or intended reuse by City, will be Contractor's property.

(2) Hauling trucks and other vehicles leaving the Project site must be cleaned of exterior mud or dirt before traveling on City streets. Materials and loose debris must be delivered and loaded to prevent dropping materials or debris. Contractor must immediately remove

spillage from hauling on any publicly traveled way. Streets affected by Work on the Project must be kept clean by street sweeping.

(D) **Disposal.** Contractor must dispose of all Project debris and waste materials in a safe and legal manner. Contractor may not burn or bury waste materials on the Project site. Contractor will not allow any dirt, refuse, excavated material, surplus concrete or mortar, or any associated washings, to be disposed of onto streets, into manholes or into the storm drain system.

(E) **Completion.** At the completion of the Work, Contractor must remove from the Project site all of its equipment, tools, surplus materials, waste materials and debris., presenting a clean and neat appearance. Before demobilizing from the Project site, Contractor must ensure that all surfaces are cleaned, sealed, waxed, or finished as applicable, and that all marks, stains, paint splatters, and the like have been properly removed from the completed Work and the surrounding areas. Contractor must ensure that all parts of the construction are properly joined with the previously existing and adjacent improvements and conditions. Contractor must provide all cutting, fitting, and patching needed to accomplish that requirement. Contractor must also repair or replace all existing improvements that are damaged or removed during the Work, both on and off the Project site, including curbs, sidewalks, driveways, fences, signs, landscaping, utilities, street surfaces and structures. Repairs and replacements must be at least equal to the previously existing improvements, and the condition, finish and dimensions must match the previously existing improvements. Contractor must restore to original condition all property or items that are not designated for alteration under the Contract Documents and leave each Worksite clean and ready for occupancy or use by City.

(F) **Non-Compliance.** If Contractor fails to comply with its maintenance and cleanup obligations within two business days following written notification from any City or its representative clean up order, City may, acting in its sole discretion, elect to suspend the Work until the condition(s) is corrected with no increase in the Contract Time or Contract Price, or undertake appropriate cleanup measures without further notice and deduct the cost from any amounts due or to become due to Contractor.

7.10 Instructions and Manuals. Contractor must provide to City three copies each of all instructions and manuals required by the Contract Documents, unless otherwise specified. These must be complete as to drawings, details, parts lists, performance data, and other information that may be required for City to easily maintain and service the materials and equipment installed for this Project.

(A) **Submittal Requirements.** All manufacturers' application or installation instructions must be provided to the City at least ten days prior to the first such application. The instructions and manuals, along with any required guarantees, must be delivered to City for review.

(B) **Training.** Contractor or its Subcontractors must train City's personnel in the operation and maintenance of any complex equipment or systems as a condition precedent to Final Completion, if required in the Contract Documents.

7.11 As-built Drawings. Contractor and its Subcontractors must prepare and maintain at the Project site a detailed, complete, and accurate as-built set of the Plans which will be used solely for the purpose of recording changes made in any portion of the original Plans in order to create accurate record drawings at the end of the Project.

(A) **Duty to Update.** The as-built drawings must be updated as changes occur, on a daily basis if necessary. City may withhold the estimated cost for City to have the as-built drawings prepared from payments otherwise due to the Contractor, until the as-built drawings are brought up to date to the satisfaction of City. Actual locations to scale must be identified on the as-built drawings for all runs of mechanical and electrical work, including all site utilities, installed underground, in walls, floors, or otherwise concealed. Deviations from the original Plans must be shown in detail. The exact location of all main runs, whether piping, conduit, ductwork, or drain lines, must be shown by dimension and elevation. The location of all buried pipelines, appurtenances, or other improvements must be represented by coordinates and by the horizontal distance from visible above-ground improvements.

(B) **Final Completion.** Contractor must verify that all changes in the Work are depicted in the as-built drawings and must deliver the complete set of as-built drawings to City for review and acceptance as a condition precedent to Final Completion and Final Payment.

7.12 Existing Utilities.

(A) **General.** The Work may be performed in developed, urban areas with existing utilities, both above and below ground, including utilities identified in the Contract Documents or in other informational documents or records. Contractor must take due care to locate identified or reasonably identifiable utilities before proceeding with trenching, excavation, or any other activity that could damage or disrupt existing utilities. This may include excavation with small equipment, potholing, or hand excavation, and, if practical, using white paint or other suitable

markings to delineate the area to be excavated. Except as otherwise provided herein, Contractor will be responsible for costs resulting from damage to identified or reasonably identifiable utilities due to Contractor's negligence or failure to comply with the Contract Documents, including the requirements in this Article 7.

(B) **Unidentified Utilities.** Pursuant to Government Code Section 4215, if, during the performance of the Work, Contractor discovers utility facilities not identified by City in the Contract Documents, Contractor must immediately provide written notice to City and the utility. City assumes responsibility for the timely removal, relocation, or protection of existing main or trunkline utility facilities located on the Project site, if those utilities are not identified in the Contract Documents. Contractor will be compensated in accordance with the provisions of the Contract Documents for the costs of locating, repairing damage not due to Contractor's failure to exercise reasonable care, and removing or relocating such utility facilities not indicated in the Plans or Specifications with reasonable accuracy, and for equipment on the Project necessarily idled during such work. Contractor will not be assessed liquidated damages for delay in completion of the Work, to the extent such delay was caused by City's failure to provide for removal or relocation of the utility facilities.

7.13 Notice of Excavation. Contractor must comply with all applicable requirements in Government Code Section 4216 *et seq.*, which are incorporated by reference herein.

7.14 Trenching and Excavations of Four Feet or More. As required by Public Contract Code Section 7104, if the Work includes digging trenches or other excavations that extend deeper than four feet below the surface, the provisions in this Section apply to the Work and the Project.

(A) **Duty to Notify.** Contractor must promptly, and before the following conditions are disturbed, provide written notice to City if Contractor finds any of the following conditions:

(1) Material that Contractor believes may be a hazardous waste, as defined in Section 25117 of the Health and Safety Code, that is required to be removed to a Class I, Class II, or Class III disposal site in accordance with the provisions of existing Laws;

(2) Subsurface or latent physical conditions at the Project site differing from those indicated by information about the Project site made available to bidders prior to the deadline for submitting bids;
or

(3) Unknown physical conditions at the Project site of any unusual nature, materially different from those ordinarily encountered and generally recognized as inherent in work of the character required by the Contract Documents.

(B) **City Investigation.** City will promptly investigate the conditions and if City finds that the conditions materially differ from those indicated, apparent, or reasonably inferred from information about the Project site made available to bidders, or involve hazardous waste, and cause a decrease or increase in Contractor's cost of, or the time required for, performance of any part of the Work, City will issue a Change Order.

(C) **Disputes.** In the event that a dispute arises between City and Contractor regarding any of the conditions specified in subsection (B) above, or the terms of a Change Order issued by the City, Contractor will not be excused from completing the Work within the Contract Time, but must proceed with all Work to be performed under the Contract. Contractor will retain any and all rights provided either by the Contract or by Laws which pertain to the resolution of disputes between Contractor and City.

7.15 Trenching of Five Feet or More. As required by Labor Code Section 6705, if the Contract Price exceeds \$25,000.00 and the Work includes the excavation of any trench or trenches of five feet or more in depth, a detailed plan must be submitted to City for acceptance in advance of the excavation. The detailed plan must show the design of shoring, bracing, sloping, or other provisions to be made for worker protection from the hazard of caving ground during the excavation. If the plan varies from the shoring system standards, it must be prepared by a California registered civil or structural engineer. Use of a shoring, sloping, or protective system less effective than that required by the Construction Safety Orders is prohibited.

7.16 New Utility Connections. Except as otherwise specified, City will pay connection charges and meter costs for new permanent utilities required by the Contract Documents, if any. Contractor must notify City sufficiently in advance of the time needed to request service from each utility provider so that connections and services are initiated in accordance with the Project schedule.

7.17 Lines and Grades. Contractor is required to use any benchmark provided by the Engineer. Unless otherwise specified in the Contract Documents, Contractor must provide all lines and grades required to execute the Work. Contractor must also provide, preserve, and replace, if necessary, all construction stakes required for the Project. All stakes or marks must be set by a California licensed surveyor or a California registered civil

engineer. Contractor must notify the Engineer of any discrepancies found between Contractor's staking and grading and information provided by the Contract Documents. Upon completion, all Work must conform to the lines, elevations, and grades shown in the Plans, including any changes directed by a Change Order.

7.18 Historic or Archeological Items.

(A) **Contractor's Obligations.** Contractor must ensure that all persons performing Work at the Project site are required to immediately notify the Project Manager, upon discovery of any potential historic or archeological items, including historic or prehistoric ruins, a burial ground, archaeological or vertebrate paleontological site, including fossilized footprints or other archeological, paleontological, or historical feature on the Project site (collectively, "Historic or Archeological Items").

(B) **Discovery; Cessation of Work.** Upon discovery of any potential Historic or Archeological Items, Work must be stopped within an 85-foot radius of the find and may not resume until authorized in writing by City. If required by City, Contractor must assist in protecting or recovering the Historic or Archeological Items, with any such assistance to be compensated as Extra Work on a time and materials basis under Article 6, Contract Modification. At City's discretion, a suspension of Work required due to discovery of Historic or Archeological Items may be treated as Excusable Delay pursuant to Article 5 or as a suspension for convenience under Article 13.

7.19 Environmental Control. Contractor must not pollute any drainage course or its tributary inlets with fuels, oils, bitumens, acids, insecticides, herbicides, or other harmful materials. Contractor must prevent the release of any hazardous material or hazardous waste into the soil or groundwater, and prevent the unlawful discharge of pollutants into City's storm drain system and watercourses as required below. Contractor and its Subcontractors must at all times in the performance of the Work comply with all Laws concerning pollution of waterways.

(A) **Stormwater Permit.** Contractor must comply with all applicable conditions of the State Water Resources Control Board National Pollutant Discharge Elimination System General Permit for Waste Discharge Requirements for Discharges of Stormwater Runoff Associated with Construction Activity ("Stormwater Permit").

(B) **Contractor's Obligations.** If required for the Work, a copy of the Stormwater Permit is on file in City's principal administrative offices, and Contractor must comply with the same without adjustment of the Contract Price or the Contract Time. Contractor must timely and completely submit

required reports and monitoring information required by the conditions of the Stormwater Permit. Contractor must also comply with all other Laws governing discharge of stormwater, including applicable municipal stormwater management programs.

- 7.20 Noise Control.** Contractor must comply with all applicable noise control Laws. Noise control requirements apply to all equipment used for the Work or related to the Work, including trucks, transit mixers or transient equipment that may or may not be owned by Contractor.
- 7.21 Mined Materials.** Pursuant to the Surface Mining and Reclamation Act of 1975, Public Resources Code Section 2710 *et seq.*, any purchase of mined materials, such as construction aggregate, sand, gravel, crushed stone, road base, fill materials, and any other mineral materials must originate from a surface mining operation included on the AB 3098 List, which may be accessed online at:
<https://www.conservation.ca.gov/smgb/Pages/AB-3098-List.aspx>

Article 8 - Payment

- 8.1 Schedule of Values.** Prior to submitting its first application for payment, Contractor must prepare and submit to the Project Manager a schedule of values apportioned to the various divisions and phases of the Work, including mobilization and demobilization. If a Bid Schedule was submitted with Contractor's bid, the amounts in the schedule of values must be consistent with the Bid Schedule. Each line item contained in the schedule of values must be assigned a value such that the total of all items equals the Contract Price. The items must be sufficiently detailed to enable accurate evaluation of the percentage of completion claimed in each application for payment, and the assigned value consistent with any itemized or unit pricing submitted with Contractor's bid.
- (A) **Measurements for Unit Price Work.** Materials and items of Work to be paid for on the basis of unit pricing will be measured according to the methods specified in the Contract Documents.
- (B) **Deleted or Reduced Work.** Contractor will not be compensated for Work that City has deleted or reduced in scope, except for any labor, material, or equipment costs for such Work that Contractor reasonably incurred before Contractor learned that the Work could be deleted or reduced. Contractor will only be compensated for those actual, direct, and documented costs incurred, and will not be entitled to any mark up for overhead or lost profits.
- 8.2 Progress Payments.** Following the last day of each month, or as otherwise required by the Special Conditions or Specifications, Contractor

will submit to Project Manager a monthly application for payment for Work performed during the preceding month based on the estimated value of the Work performed during that preceding month.

(A) ***Application for Payment.*** Each application for payment must be itemized to include labor, materials, and equipment incorporated into the Work, and materials and equipment delivered to the Project site, as well as authorized and approved Change Orders. Each payment application must be supported by the unit prices submitted with Contractor's Bid Schedule and/or schedule of values and any other substantiating data required by the Contract Documents. **Each application for payment shall be accompanied by completed "Contract Balance Form," a copy of which is provided at the end of Article 8.**

(B) ***Payment of Undisputed Amounts.*** City will pay the undisputed amount due within thirty days after Contractor has submitted a complete and accurate payment application, subject to Public Contract Code Section 20104.50. City will deduct a percentage from each progress payment as retention, as set forth in Section 8.5, below, and may deduct or withhold additional amounts as set forth in Section 8.3, below.

8.3 Adjustment of Payment Application. City may adjust or reject the amount requested in a payment application, including application for Final Payment, in whole or in part, if the amount requested is disputed or unsubstantiated. Contractor will be notified in writing of the basis for the modification to the amount requested. City may also deduct or withhold from payment otherwise due based upon any of the circumstances and amounts listed below. Sums withheld from payment otherwise due will be released when the basis for that withholding has been remedied and no longer exists.

(A) For Contractor's unexcused failure to perform the Work as required by the Contract Documents, including correction or completion of punch list items. City may withhold or deduct an amount based on the City's estimated cost to correct or complete the Work.

(B) For loss or damage caused by Contractor or its Subcontractors arising out of or relating to performance of the Work, or any failure to protect the Project site, City may deduct an amount based on the estimated cost to repair or replace.

(C) For Contractor's failure to pay its Subcontractors and suppliers when payment is due. City may withhold an amount equal to the total of past due payments and may opt to pay that amount separately via joint check pursuant to Section 8.6(B), Joint Checks.

(D) For Contractor's failure to timely correct rejected, nonconforming, or defective Work. City may withhold or deduct an amount based on the City's estimated cost to correct or complete the Work.

(E) For any unreleased stop notice, City may withhold 125% of the amount claimed.

(F) For Contractor's failure to submit any required schedule or schedule update in the manner specified or within the time specified in the Contract Documents, City may withhold an amount equal to five percent of the total amount requested until Contractor complies with its schedule submittal obligations.

(G) For Contractor's failure to maintain or submit as-built documents in the manner specified or within the time specified in the Contract Documents, City may withhold or deduct an amount based on the City's cost to prepare the as-builts.

(H) For Work performed without Shop Drawings, that has been accepted by the City when accepted Shop Drawings are required before proceeding with the Work, City may deduct an amount based on the estimated cost to correct unsatisfactory Work or diminution in value.

(I) For fines, payments, or penalties assessed under the Labor Code, City may deduct from payments due to Contractor as required by Laws and as directed by the Division of Labor Standards Enforcement.

(J) For any other costs or charges that may be withheld or deducted from payments to Contractor, as provided in the Contract Documents, including liquidated damages, City may withhold or deduct such amounts from payment otherwise due to Contractor.

8.4 Early Occupancy. Neither City's payment of progress payments nor its partial or full use or occupancy of the Project constitutes acceptance of any part of the Work.

8.5 Retention. City will retain five percent of the full amount due on each progress payment (i.e., the amount due before any withholding or deductions pursuant to Section 8.3, Adjustment of Payment Application), or the percentage stated in the Notice Inviting Bids, whichever is greater, as retention to ensure full and satisfactory performance of the Work. Contractor is not entitled to any reduction in the rate of withholding at any time, nor to release of any retention before 35 days following City's acceptance of the Project.

(A) ***Substitution of Securities.*** As provided by Public Contract Code Section 22300, Contractor may request in writing that it be allowed, at its sole expense, to substitute securities for the retention withheld by City. Any escrow agreement entered into pursuant to this provision must fully comply with Public Contract Code Section 22300, and will be subject to approval as to form by City's legal counsel. If City exercises its right to draw upon such securities in the event of default pursuant to section (7) of the statutory Escrow Agreement for Security Deposits in Lieu of Retention, pursuant to subdivision (g) of Public Contract Code Section 22300 ("Escrow Agreement"), and if Contractor disputes that it is in default, its sole remedy is to comply with the dispute resolution procedures in Article 12 and the provisions therein. It is agreed that for purposes of this paragraph, an event of default includes City's rights pursuant to these Contract Documents to withhold or deduct sums from retention, including withholding or deduction for liquidated damages, incomplete or defective Work, stop payment notices, or backcharges. It is further agreed that if any individual authorized to give or receive written notice on behalf of a party pursuant to section (10) of the Escrow Agreement are unavailable to give or receive notice on behalf of that party due to separation from employment, retirement, death, or other circumstances, the successor or delegee of the named individual is deemed to be the individual authorized to give or receive notice pursuant to section (10) of the Escrow Agreement.

(B) ***Release of Undisputed Retention.*** All undisputed retention, less any amounts that may be assessed as liquidated damages, retained for stop notices, or otherwise withheld pursuant to Section 8.3 Adjustment of Payment Application will be released as Final Payment to Contractor no sooner than 35 days following recordation of the notice of completion, and no later than 60 days following acceptance of the Project by City's governing body or authorized designee pursuant to Section 11.1(C) Acceptance, or, if the Project has not been accepted, no later than 60 days after the Project is otherwise considered complete pursuant to Public Contract Code Section 7107(c).

8.6 Payment to Subcontractors and Suppliers. Each month, Contractor must promptly pay each Subcontractor and supplier the value of the portion of labor, materials, and equipment incorporated into the Work or delivered to the Project site by the Subcontractor or supplier during the preceding month. Such payments must be made in accordance with the requirements of Laws pertaining to such payments, and those of the Contract Documents and applicable subcontract or supplier contract.

(A) ***Withholding for Stop Notice.*** Pursuant to Civil Code Section 9358, City will withhold 125% of the amount claimed by an unreleased stop notice, a portion of which may be retained by City for the costs

incurred in handling the stop notice claim, including attorneys' fees and costs, as authorized by law.

(B) **Joint Checks.** City reserves the right, acting in its sole discretion, to issue joint checks made payable to Contractor and a Subcontractor or supplier, if City determines this is necessary to ensure fair and timely payment to Subcontractor or supplier who has provided services or goods for the Project. As a condition to release of payment by a joint check, the joint check payees may be required to execute a joint check agreement in a form provided or approved by the City Attorney's Office. The joint check payees will be jointly and severally responsible for the allocation and disbursement of funds paid by joint check. Payment by joint check will not be construed to create a contractual relationship between City and a Subcontractor or supplier of any tier beyond the scope of the joint check agreement.

8.7 Final Payment. Contractor's application for Final Payment must comply with the requirements for submitting an application for a progress payment as stated in Section 8.2, above. Corrections to previous progress payments, including adjustments to estimated quantities for unit priced items, may be included in the Final Payment. If Contractor fails to submit a timely application for Final Payment, City reserves the right to unilaterally process and issue Final Payment without an application from Contractor in order to close out the Project. For the purposes of determining the deadline for Claim submission pursuant to Article 12, the date of Final Payment is deemed to be the date that City acts to release undisputed retention as final payment to Contractor, or otherwise provides written notice to Contractor of Final Payment or that no undisputed funds remain available for Final Payment due to offsetting withholdings or deductions pursuant to Section 8.3, Adjustment of Payment Application. If the amount due from Contractor to City exceeds the amount of Final Payment, City retains the right to recover the balance from Contractor or its sureties.

8.8 Release of Claims. City may, at any time, require that payment of the undisputed portion of any progress payment or Final Payment be contingent upon Contractor furnishing City with a written waiver and release of all claims against City arising from or related to the portion of Work covered by those undisputed amounts, subject to the limitations of Public Contract Code Section 7100. Any disputed amounts may be specifically excluded from the release.

8.9 Warranty of Title. Contractor warrants that title to all work, materials, or equipment incorporated into the Work and included in a request for payment will pass over to City free of any claims, liens, or encumbrances upon payment to Contractor.

CONTRACT BALANCE FORM

East Dunne Hillside Water Reservoir Project

Note: A detailed invoice MUST be attached to this Contract Balance Form.

CONTRACTOR NAME: _____	DATE: _____
MAILING ADDRESS: _____	TELEPHONE NO.: _____
_____	FAX NO.: _____
_____	PROJECT NO.: _____
	INVOICE NO.: _____

1. ORIGINAL CONTRACT AMOUNT:	\$ _____	
2. APPROVED CHANGE ORDERS TOTAL:	\$ _____	
3. REVISED CONTRACT AMOUNT:		(1+2) \$ _____
4. PREVIOUS BALANCE PAID:	\$ _____	
5. REMAINING BALANCE:		(3-4) \$ _____
6. CURRENT PROGRESS PAYMENT DUE: (before retention)	\$ _____	
7. 5% RETENTION FROM WORK DONE:	(-)\$ _____	
8. CURRENT BALANCE DUE:		(6-7) \$ _____
9. REMAINING BALANCE OF REVISED CONTRACT AMOUNT: (including retention)		(5-8) \$ _____

Article 9 - Labor Provisions

9.1 Discrimination Prohibited. Discrimination against any prospective or present employee engaged in the Work on grounds of race, color, ancestry, national origin, ethnicity, religion, sex, sexual orientation, age, disability, or marital status is strictly prohibited. Contractor and its Subcontractors are required to comply with all applicable Laws prohibiting discrimination, including the California Fair Employment and Housing Act (Government Code Section 12900 *et seq.*), Government Code Section 11135, and Labor Code Sections 1735, 1777.5, 1777.6, and 3077.5.

9.2 Labor Code Requirements.

(A) ***Eight Hour Day.*** Pursuant to Labor Code Section 1810, eight hours of labor constitute a legal day's work under this Contract.

(B) ***Penalty.*** Pursuant to Labor Code Section 1813, Contractor will forfeit to City as a penalty, the sum of \$25.00 for each day during which a worker employed by Contractor or any Subcontractor is required or permitted to work more than eight hours in any one calendar day or more than 40 hours per calendar week, except if such workers are paid overtime under Labor Code Section 1815.

(C) ***Apprentices.*** Contractor is responsible for compliance with the requirements governing employment and payment of apprentices, as set forth in Labor Code Section 1777.5, which is fully incorporated by reference.

(D) ***Notices.*** Pursuant to Labor Code Section 1771.4, Contractor is required to post all job site notices prescribed by Laws.

9.3 Prevailing Wages. Each worker performing Work under this Contract that is covered under Labor Code Sections 1720, 1720.3, or 1720.9, including cleanup at the Project site, must be paid at a rate not less than the prevailing wage as defined in Sections 1771 and 1774 of the Labor Code. The prevailing wage rates are available online at <http://www.dir.ca.gov/dlsr>. Contractor must post a copy of the applicable prevailing rates at the Project site.

(A) ***Penalties.*** Pursuant to Labor Code Section 1775, Contractor and any Subcontractor will forfeit to City as a penalty up to \$200.00 for each calendar day, or portion of a day, for each worker paid less than the applicable prevailing wage rate. Contractor must also pay each worker the difference between the applicable prevailing wage rate and the amount actually paid to that worker.

(B) **Federal Requirements.** If this Project is subject to federal prevailing wage requirements in addition to California prevailing wage requirements, Contractor and its Subcontractors are required to pay the higher of the currently applicable state or federal prevailing wage rates.

9.4 Payroll Records. Contractor must comply with the provisions of Labor Code Sections 1771.4, 1776, and 1812 and all implementing regulations, which are fully incorporated by this reference, including requirements for electronic submission of payroll records to the DIR.

(A) **Contractor and Subcontractor Obligations.** Contractor and each Subcontractor must keep accurate payroll records, showing the name, address, social security number, work classification, straight time and overtime hours worked each day and week, and the actual per diem wages paid to each journeyman, apprentice, worker, or other employee employed in connection with the Work. Each payroll record must contain or be verified by a written declaration that it is made under penalty of perjury, stating both of the following:

(1) The information contained in the payroll record is true and correct.

(2) Contractor or Subcontractor has complied with the requirements of Labor Code Sections 1771, 1811, and 1815 for any Work performed by its employees on the Project.

(B) **Certified Record.** A certified copy of an employee's payroll record must be made available for inspection or furnished to the employee or his or her authorized representative on request, to City, or to the Division of Labor Standards Enforcement, to the Division of Apprenticeship Standards of the DIR, and as further required by the Labor Code.

(C) **Enforcement.** Upon notice of noncompliance with Labor Code Section 1776, Contractor or Subcontractor has ten days in which to comply with the requirements of this section. If Contractor or Subcontractor fails to do so within the ten-day period, Contractor or Subcontractor will forfeit a penalty of \$100.00 per day, or portion of a day, for each worker for whom compliance is required, until strict compliance is achieved. Upon request by the Division of Apprenticeship Standards, or the Division of Labor Standards Enforcement, these penalties will be withheld from payments then due to Contractor.

9.5 Labor Compliance. Pursuant to Labor Code Section 1771.4, the Contract for this Project is subject to compliance monitoring and enforcement by the DIR.

9.6 Wage Theft Prevention. Compliance with Wage and Hour Laws: Contractor, and any subcontractor it employs to complete work under this Agreement, shall comply with all applicable federal, state, and local wage and hour laws. Applicable laws may include, but are not limited to, the Federal Fair Labor Standards Act and the California Labor Code.

Final Judgments, Decisions, and Orders: For purposes of this Section, a “final judgment, decision, or order” refers to one for which all appeals have been exhausted or the time to appeal has expired. Relevant investigatory government agencies include: the federal Department of Labor, the California Division of Labor Standards Enforcement, or any other governmental entity or division tasked with the investigation and enforcement of wage and hour laws.

Prior Judgments against Contractor and/or its Subcontractors: BY SIGNING THIS AGREEMENT, CONTRACTOR AFFIRMS THAT IT HAS DISCLOSED ANY FINAL JUDGMENTS, DECISIONS OR ORDERS FROM A COURT OR INVESTIGATORY GOVERNMENT AGENCY FINDING – IN THE FIVE (5) YEARS PRIOR TO EXECUTING THIS AGREEMENT – THAT CONTRACTOR OR ITS SUBCONTRACTOR(S) HAS VIOLATED ANY APPLICABLE WAGE AND HOUR LAWS. CONTRACTOR FURTHER AFFIRMS THAT IT OR ITS SUBCONTRACTOR(S) HAS SATISFIED AND COMPLIED WITH – OR HAS REACHED AGREEMENT WITH THE CITY REGARDING THE MANNER IN WHICH IT WILL SATISFY – ANY SUCH JUDGMENTS, DECISIONS OR ORDERS.

Judgments or Decisions During Term of Contract: If at any time during the term of this Agreement, a court or investigatory government agency issues a final judgment, decision or order finding that Contractor or an subcontractor it employs to perform work under this Agreement has violated any applicable wage and hour law, or Contractor learns of such a judgment, decision, or order that was not previously disclosed, Contractor shall inform the City Attorney, no more than fifteen (15) days after the judgment, decision or order becomes final or of learning of the final judgment, decision or order. Contractor and its subcontractors shall promptly satisfy and comply with any such judgment, decision, or order, and shall provide the City Attorney with documentary evidence of compliance with the final judgment, decision, or order within five (5) days of satisfying the final judgment, decision, or order. The City reserves the right to require Contractor to enter into an agreement with the City regarding the manner in which any such final judgment, decision, or order will be satisfied.

City’s Right to Withhold Payment: Where Contractor or any subcontractor it employs to perform work under this Agreement has been found in

violation of any applicable wage and hour law by a final judgment, decision or order of a court or government agency, the City reserves the right to withhold payment to Contractor until such judgment, decision or order has been satisfied in full.

Material Breach: Failure to comply with any part of this Section constitutes a material breach of this Agreement. Such breach may serve as a basis for immediate termination of this Agreement and/or any other remedies available under this Agreement and/or law.

Notice to City Related to Wage Theft Prevention: Notice provided to the City Attorney as required under this Section shall be addressed to: City Attorney, City of Morgan Hill, 17575 Peak Avenue, Morgan Hill, CA 95037. The Notice provisions of this Section are separate from any other notice provisions in this Agreement and, accordingly, only notice provided to the above address satisfies the notice requirements in this Section.

Article 10 - Safety Provisions

10.1 Safety Precautions and Programs. Contractor and its Subcontractors are fully responsible for safety precautions and programs, and for the safety of persons and property in the performance of the Work. Contractor and its Subcontractors must at all times comply with all applicable health and safety Laws and seek to avoid injury, loss, or damage to persons or property by taking reasonable steps to protect its employees and other persons at any Worksite, materials and equipment stored on or off site, and property at or adjacent to any Worksite.

(A) **Reporting Requirements.** Contractor must immediately notify the City of any death, serious injury or illness resulting from Work on the Project. Contractor must immediately provide a written report to City of each recordable accident or injury occurring at any Worksite within 24 hours of the occurrence. The written report must include: (1) the name and address of the injured or deceased person; (2) the name and address of each employee of Contractor or of any Subcontractor involved in the incident; (3) a detailed description of the incident, including precise location, time, and names and contact information for known witnesses; and (4) a police or first responder report, if applicable. If Contractor is required to file an accident report with a government agency, Contractor will provide a copy of the report to City.

(B) **Legal Compliance.** Contractor's safety program must comply with the applicable legal and regulatory requirements. Contractor must provide City with copies of all notices required by Laws.

(C) **Contractor's Obligations.** Any damage or loss caused by Contractor arising from the Work which is not insured under property insurance must be promptly remedied by Contractor.

(D) **Remedies.** If City determines, in its sole discretion, that any part of the Work or Project site is unsafe, City may, without assuming responsibility for Contractor's safety program, require Contractor or its Subcontractor to cease performance of the Work or to take corrective measures to City's satisfaction. If Contractor fails to promptly take the required corrective measures, City may perform them and deduct the cost from the Contract Price. Contractor agrees it is not entitled to submit a Claim for damages, for an increase in Contract Price, or for a change in Contract Time based on Contractor's compliance with City's request for corrective measures pursuant to this provision.

10.2 Hazardous Materials. Unless otherwise specified in the Contract Documents, this Contract does not include the removal, handling, or disturbance of any asbestos or other Hazardous Materials. If Contractor encounters materials on the Project site that Contractor reasonably believes to be asbestos or other Hazardous Materials, and the asbestos or other Hazardous Materials have not been rendered harmless, Contractor may continue Work in unaffected areas reasonably believed to be safe, but must immediately cease work on the area affected and report the condition to City. No asbestos, asbestos-containing products or other Hazardous Materials may be used in performance of the Work.

10.3 Material Safety. Contractor is solely responsible for complying with Section 5194 of Title 8 of the California Code of Regulations, including by providing information to Contractor's employees about any hazardous chemicals to which they may be exposed in the course of the Work. A hazard communication program and other forms of warning and training about such exposure must be used. Contractor must also maintain Safety Data Sheets ("SDS") at the Project site, as required by Law, for materials or substances used or consumed in the performance of the Work. The SDS will be accessible and available to Contractor's employees, Subcontractors, and City.

(A) **Contractor Obligations.** Contractor is solely responsible for the proper delivery, handling, use, storage, removal, and disposal of all materials brought to the Project site and/or used in the performance of the Work. Contractor must notify the Engineer if a specified product or material cannot be used safely.

(B) **Labeling.** Contractor must ensure proper labeling on any material brought onto the Project site so that any persons working with or in the vicinity of the material may be informed as to the identity of the material,

any potential hazards, and requirements for proper handling, protections, and disposal.

10.4 Hazardous Condition. Contractor is solely responsible for determining whether a hazardous condition exists or is created during the course of the Work, involving a risk of bodily harm to any person or risk of damage to any property. If a hazardous condition exists or is created, Contractor must take all precautions necessary to address the condition and ensure that the Work progresses safely under the circumstances. Hazardous conditions may result from, but are not limited to, use of specified materials or equipment, the Work location, the Project site condition, the method of construction, or the way any Work must be performed.

10.5 Emergencies. In an emergency affecting the safety or protection of persons, Work, or property at or adjacent to any Worksite, Contractor must take reasonable and prompt actions to prevent damage, injury, or loss, without prior authorization from the City if, under the circumstances, there is inadequate time to seek prior authorization from the City.

Article 11 - Completion and Warranty Provisions

11.1 Final Completion.

(A) ***Final Inspection and Punch List.*** When the Work required by this Contract is fully performed, Contractor must provide written notification to City requesting final inspection. The Engineer will schedule the date and time for final inspection, which must include Contractor's primary representative for the Project and its superintendent. Based on that inspection, City will prepare a punch list of any items that are incomplete, missing, defective, incorrectly installed, or otherwise not compliant with the Contract Documents. The punch list to Contractor will specify the time by which all of the punch list items must be completed or corrected. The punch list may include City's estimated cost to complete each punch list item if Contractor fails to do so within the specified time. The omission of any non-compliant item from a punch list will not relieve Contractor from fulfilling all requirements of the Contract Documents. Contractor's failure to complete any punch list item within the time specified in the punch list will not waive or abridge its warranty obligations for any such items that must be completed by the City or by a third party retained by the City due to Contractor's failure to timely complete any such outstanding item.

(B) ***Requirements for Final Completion.*** Final Completion will be achieved upon completion or correction of all punch list items, as verified by City's further inspection, and upon satisfaction of all other Contract requirements, including any commissioning required under the Contract

Documents, and submission of all final submittals, including instructions and manuals as required under Section 7.10, and complete, final as-built drawings as required under Section 7.11, all to City's satisfaction.

(C) **Acceptance.** The Project will be considered accepted upon City Council action during a public meeting to accept the Project, unless the Engineer is authorized to accept the Project, in which case the Project will be considered accepted upon the date of the Engineer's issuance of a written notice of acceptance. In order to avoid delay of Project close out, the City may elect, acting in its sole discretion, to accept the Project as complete subject to exceptions for punch list items that are not completed within the time specified in the punch list.

(D) **Final Payment and Release of Retention.** Final Payment and release of retention, less any sums withheld pursuant to the provisions of the Contract Documents, will not be made sooner than 35 days after recordation of the notice of completion. If Contractor fails to complete all of the punch list items within the specified time, City may withhold up to 150% of City's estimated cost to complete each of the remaining items from Final Payment and may use the withheld retention to pay for the costs to self-perform the outstanding items or to retain a third party to complete any such outstanding punch list item.

11.2 Warranty.

(A) **General.** Contractor warrants that all materials and equipment will be new unless otherwise specified, of good quality, in conformance with the Contract Documents, and free from defective workmanship and materials. Contractor further warrants that the Work will be free from material defects not intrinsic in the design or materials required in the Contract Documents. Contractor warrants that materials or items incorporated into the Work comply with the requirements and standards in the Contract Documents, including compliance with Laws, and that any Hazardous Materials encountered or used were handled as required by Laws. At City's request, Contractor must furnish satisfactory evidence of the quality and type of materials and equipment furnished. Contractor's warranty does not extend to damage caused by normal wear and tear, or improper use or maintenance.

(B) **Warranty Period.** Contractor's warranty must guarantee its Work for a period of one year from the date of Project acceptance (the "Warranty Period"), except when a longer guarantee is provided by a supplier or manufacturer or is required by the Specifications or Special Conditions. Contractor must obtain from its Subcontractors, suppliers, and manufacturers any special or extended warranties required by the Contract Documents.

(C) **Warranty Documents.** As a condition precedent to Final Completion, Contractor must supply City with all warranty and guarantee documents relevant to equipment and materials incorporated into the Work and guaranteed by their suppliers or manufacturers.

(D) **Subcontractors.** The warranty obligations in the Contract Documents apply to Work performed by Contractor and its Subcontractors, and Contractor expressly agrees to be co-guarantor of such Work.

(E) **Contractor's Obligations.** Upon written notice from City to Contractor of any defect in the Work discovered during the Warranty Period, Contractor or its responsible Subcontractor must promptly correct the defective Work at its own cost. Contractor's obligation to correct defects discovered during the Warranty Period will continue past the expiration of the Warranty Period as to any defects in Work for which Contractor was notified prior to expiration of the Warranty Period. Work performed during the Warranty Period ("Warranty Work") will be subject to the warranty provisions in this Section 11.2 for a one-year period that begins upon completion of such Warranty Work to City's satisfaction.

(F) **City's Remedies.** If Contractor or its responsible Subcontractor fails to correct defective Work within ten days following notice by City, or sooner, if required by the circumstances, Contractor expressly agrees that City may correct the defects to conform with the Contract Documents at Contractor's sole expense. Contractor must reimburse City for its costs in accordance with subsection (H) below.

(G) **Emergency Repairs.** In cases of emergency where any delay in correcting defective Work could cause harm, loss or damage, City may immediately correct the defects to conform with the Contract Documents at Contractor's sole expense. Contractor or its surety must reimburse City for its costs in accordance with subsection (H), below.

(H) **Reimbursement.** Contractor must reimburse City for its costs to repair under subsections (F) or (G), above, within 30 days following City's submission of a demand for payment pursuant to this provision. If City is required to initiate legal action to compel Contractor's compliance with this provision, and City is the prevailing party in such action, Contractor and its surety are solely responsible for all of City's attorney's fees and legal costs expended to enforce Contractor's warranty obligations herein in addition to any and all costs City incurs to correct the defective Work.

11.3 Use Prior to Final Completion. City reserves the right to occupy or make use of the Project, or any portions of the Project, prior to Final Completion

if City has determined that the Project or portion of it is in a condition suitable for the proposed occupation or use, and that it is in its best interest to occupy or make use of the Project, or any portions of it, prior to Final Completion. City will notify Contractor in writing of its intent to occupy or make use of the Project or any portions of the Project, pursuant to this provision.

(A) **Non-Waiver.** Occupation or use of the Project, in whole or in part, prior to Final Completion will not operate as acceptance of the Work or any portion of it, nor will it operate as a waiver of any of City's rights or Contractor's duties pursuant to these Contract Documents, and will not affect nor bear on the determination of the time of substantial completion with respect to any statute of repose pertaining to the time for filing an action for construction defect.

(B) **City's Responsibility.** City will be responsible for the cost of maintenance and repairs due to normal wear and tear with respect to those portions of the Project that are being occupied or used before Final Completion. The Contract Price or the Contract Time may be adjusted pursuant to the applicable provisions of these Contract Documents if, and only to the extent that, any occupation or use under this Section actually adds to Contractor's cost or time to complete the Work within the Contract Time.

11.4 Substantial Completion. For purposes of determining "substantial completion" with respect to any statute of repose pertaining to the time for filing an action for construction defect, "substantial completion" is deemed to mean the last date that Contractor or any Subcontractor performs Work on the Project prior to City acceptance of the Project, except for warranty work performed under this Article.

Article 12 - Dispute Resolution

12.1 Claims. This Article applies to and provides the exclusive procedures for any Claim arising from or related to the Contract or performance of the Work.

(A) **Definition.** "Claim" means a separate demand by Contractor, submitted in writing by registered or certified mail with return receipt requested, for a change in the Contract Time, including a time extension or relief from liquidated damages, or a change in the Contract Price when the demand has previously been submitted to City in accordance with the requirements of the Contract Documents, and which has been rejected or disputed by City, in whole or in part. A Claim may also include that portion of a unilateral Change Order that is disputed by the Contractor.

(B) **Limitations.** A Claim may only include the portion of a previously rejected demand that remains in dispute between Contractor and City. With the exception of any dispute regarding the amount of money actually paid to Contractor as Final Payment, Contractor is not entitled to submit a Claim demanding a change in the Contract Time or the Contract Price, which has not previously been submitted to City in full compliance with Article 5 and Article 6, and subsequently rejected in whole or in part by City.

(C) **Scope of Article.** This Article is intended to provide the exclusive procedures for submission and resolution of Claims of any amount, and applies in addition to the provisions of Public Contract Code Section 9204 and Sections 20104 *et seq.*, which are incorporated herein by this reference.

(D) **No Work Delay.** Notwithstanding the submission of a Claim or any other dispute between the parties related to the Project or the Contract Documents, Contractor must perform the Work and may not delay or cease Work pending resolution of a Claim or other dispute, but must continue to diligently prosecute the performance and timely completion of the Work, including the Work pertaining to a Claim or other dispute.

(E) **Informal Resolution.** Contractor will make a good faith effort to informally resolve a dispute before initiating a Claim, preferably by face-to-face meeting between authorized representatives of Contractor and City.

12.2 Claims Submission. The following requirements apply to any Claim subject to this Article:

(A) **Substantiation.** The Claim must be submitted to City in writing, clearly identified as a "Claim" submitted pursuant to this Article 12, and must include all of the documents necessary to substantiate the Claim including the Change Order request that was rejected in whole or in part, and a copy of City's written rejection that is in dispute. The Claim must clearly identify and describe the dispute, including relevant references to applicable portions of the Contract Documents, and a chronology of relevant events. Any Claim for additional payment must include a complete, itemized breakdown of all known or estimated labor, materials, taxes, insurance, and subcontract, or other costs. Substantiating documentation such as payroll records, receipts, invoices, or the like, must be submitted in support of each component of claimed cost. Any Claim for an extension of time or delay costs must be substantiated with a schedule analysis and narrative depicting and explaining claimed time impacts. Contractor understands that submission of a Claim which has no basis in fact or which Contractor knows to be false may violate the False Claims Act (Government Code Section 12650 *et seq.*).

(B) ***Claim Format and Content.*** A Claim must be submitted in the following format:

(1) Provide a cover letter, specifically identifying the submission as a “Claim” submitted under this Article 12 and specifying the requested remedy (e.g., amount of proposed change to Contract Price and/or change to Contract Time).

(2) Provide a summary of each Claim, including underlying facts and the basis for entitlement, and identify each specific demand at issue, including the specific Change Order request (by number and submittal date), and the date of City's rejection of that demand, in whole or in part.

(3) Provide a detailed explanation of each issue in dispute. For multiple issues included within a single Claim or for multiple Claims submitted concurrently, separately number and identify each individual issue or Claim and include the following for each separate issue or Claim:

(a) A succinct statement of the matter in dispute, including Contractor's position and the basis for that position;

(b) Identify and attach all documents that substantiate the Claim, including relevant provisions of the Contract Documents, RFIs, calculations, and schedule analysis (see subsection (A), Substantiation above);

(c) A chronology of relevant events; and

(d) Analysis and basis for claimed changes to Contract Price, Contract Time, or any other remedy requested.

(4) Provide a summary of issues and corresponding claimed damages. If, by the time of the Claim submission deadline (below), the precise amount of the requested change in the Contract Price or Contract Time is not yet known, Contractor must provide a good faith estimate, including the basis for that estimate, and must identify the date by which it is anticipated that the Claim will be updated to provide final amounts.

(5) Include the following certification, executed by Contractor's authorized representative:

“The undersigned Contractor certifies under penalty of perjury that its statements and representations in this Claim submittal are true and correct. Contractor warrants that this Claim submittal is comprehensive and complete as to the matters in dispute, and agrees that any costs, expenses, or delay not included herein are deemed waived.

(C) ***Submission Deadlines.***

(1) A Claim disputing rejection of a request for a change in the Contract Time or Contract Price must be submitted within 15 days following the date that City notified Contractor in writing that a request for a change in the Contract Time or Contract Price, duly submitted in compliance with Article 5 and Article 6, has been rejected in whole or in part. A Claim disputing the terms of a unilateral Change Order must be submitted within 15 days following the date of issuance of the unilateral Change Order. These Claim deadlines apply even if Contractor cannot yet quantify the total amount of any requested change in the Contract Time or Contract Price. If the Contractor cannot quantify those amounts, it must submit an estimate of the amounts claimed pending final determination of the requested remedy by Contractor.

(2) With the exception of any dispute regarding the amount of Final Payment, any Claim must be filed on or before the date of Final Payment, or will be deemed waived.

(3) A Claim disputing the amount of Final Payment must be submitted within 15 days of the effective date of Final Payment, under Section 8.7, Final Payment, above.

(4) Strict compliance with these Claim submission deadlines is necessary to ensure that any dispute may be mitigated as soon as possible, and to facilitate cost-efficient administration of the Project. Any Claim that is not submitted within the specified deadlines will be deemed waived by Contractor.

12.3 City’s Response. City will respond within 45 days of receipt of the Claim with a written statement identifying which portion(s) of the Claim are disputed, unless the 45-day period is extended by mutual agreement of City and Contractor or as otherwise allowed under Public Contract Code Section 9204. However, if City determines that the Claim is not adequately substantiated pursuant to Section 12.2(A), Substantiation, City may first request, in writing, within 30 days of receipt of the Claim, any additional documentation supporting the Claim or relating to defenses to the Claim that City may have against the Claim.

(A) **Additional Information.** If additional information is thereafter required, it may be requested and provided upon mutual agreement of City and Contractor. If Contractor's Claim is based on estimated amounts, Contractor has a continuing duty to update its Claim as soon as possible with information on actual amounts in order to facilitate prompt and fair resolution of the Claim.

(B) **Non-Waiver.** Any failure by City to respond within the times specified above will not be construed as acceptance of the Claim in whole or in part, or as a waiver of any provision of these Contract Documents.

12.4 Meet and Confer. If Contractor disputes City's written response, or City fails to respond within the specified time, within 15 days of receipt of City's response, or within 15 days of City's failure to respond within the applicable 45-day time period, respectively, Contractor may notify City of the dispute in writing sent by registered or certified mail, return receipt requested and demand an informal conference to meet and confer for settlement of the issues in dispute. If Contractor fails to notify City in writing of the dispute, and demand an informal conference to meet and confer, within the specified time, Contractor's Claim will be deemed waived.

(A) **Schedule Meet and Confer.** Upon receipt of the demand to meet and confer, City will schedule the meet and confer conference to be held within 30 days, or later if needed to ensure the mutual availability of each of the individuals that each party requires to represent its interests at the meet and confer conference.

(B) **Location for Meet and Confer.** The meet and confer conference will be scheduled at a location at or near City's principal office.

(C) **Written Statement After Meet and Confer.** Within ten working days after the meet and confer has concluded, City will issue a written statement identifying which portion(s) of the Claim remain in dispute, if any.

(D) **Submission to Mediation.** If the Claim or any portion remains in dispute following the meet and confer conference, within ten working days after the City issues the written statement identifying any portion(s) of the Claim remaining in dispute, the Contractor may identify in writing disputed portion(s) of the Claim, which will be submitted for mediation, as set forth below.

12.5 Mediation and Government Code Claims.

(A) **Mediation.** Within ten working days after the City issues the written statement identifying any portion(s) of the Claim remaining in dispute, following the meet and confer, City and Contractor will mutually agree to a mediator, as provided under Public Contract Code Section 9204.

Mediation will be scheduled to ensure the mutual availability of the selected mediator and all of the individuals that each party requires to represent its interests. If there are multiple Claims in dispute, the parties may agree to schedule the mediation to address all outstanding Claims at the same time. The parties will share the costs of the mediator and mediation fees equally, but each party is otherwise solely and separately responsible for its own costs to prepare for and participate in the mediation, including costs for its legal counsel or any other consultants.

(B) **Government Code Claims.**

(1) Timely presentation of a Government Code Claim is a condition precedent to filing any legal action based on or arising from the Contract. Compliance with the Claim submission requirements in this Article 12 is a condition precedent to filing a Government Code Claim.

(2) The time for filing a Government Code Claim will be tolled from the time Contractor submits its written Claim pursuant to Section 12.2, above, until the time that Claim is denied in whole or in part at the conclusion of the meet and confer process, including any period of time used by the meet and confer process. However, if the Claim is submitted to mediation, the time for filing a Government Code Claim will be tolled until conclusion of the mediation, including any continuations, if the Claim is not fully resolved by mutual agreement of the parties during the mediation or any continuation of the mediation.

12.6 Tort Claims. This Article does not apply to tort claims and nothing in this Article is intended nor will be construed to change the time periods for filing tort-based Government Code Claims.

12.7 Arbitration. It is expressly agreed, under Code of Civil Procedure Section 1296, that in any arbitration to resolve a dispute relating to this Contract, the arbitrator's award must be supported by law and substantial evidence.

12.8 Burden of Proof and Limitations. Contractor bears the burden of proving entitlement to and the amount of any claimed damages. Contractor is not entitled to damages calculated on a total cost basis, but must prove actual damages. Contractor is not entitled to speculative, special, or consequential damages, including home office overhead or

any form of overhead not directly incurred at the Project site or any other Worksite; lost profits; loss of productivity; lost opportunity to work on other projects; diminished bonding capacity; increased cost of financing for the Project; extended capital costs; non-availability of labor, material or equipment due to delays; or any other indirect loss arising from the Contract. The Eichleay Formula or similar formula will not be used for any recovery under the Contract. The City will not be directly liable to any Subcontractor or supplier.

12.9 Legal Proceedings. In any legal proceeding that involves enforcement of any requirements of the Contract Documents, the finder of fact will receive detailed instructions on the meaning and operation of the Contract Documents, including conditions, limitations of liability, remedies, claim procedures, and other provisions bearing on the defenses and theories of liability. Detailed findings of fact will be requested to verify enforcement of the Contract Documents. All of the City's remedies under the Contract Documents will be construed as cumulative, and not exclusive, and the City reserves all rights to all remedies available under law or equity as to any dispute arising from or relating to the Contract Documents or performance of the Work.

12.10 Other Disputes. The procedures in this Article 12 will apply to any and all disputes or legal actions, in addition to Claims, arising from or related to this Contract, including disputes regarding suspension or early termination of the Contract, unless and only to the extent that compliance with a procedural requirement is expressly and specifically waived by City. Nothing in this Article is intended to delay suspension or termination under Article 13.

Article 13 - Suspension and Termination

13.1 Suspension for Cause. In addition to all other remedies available to City, if Contractor fails to perform or correct Work in accordance with the Contract Documents, including non-compliance with applicable environmental or health and safety Laws, City may immediately order the Work, or any portion of it, suspended until the circumstances giving rise to the suspension have been eliminated to City's satisfaction.

(A) **Notice of Suspension.** Upon receipt of City's written notice to suspend the Work, in whole or in part, except as otherwise specified in the notice of suspension, Contractor and its Subcontractors must promptly stop Work as specified in the notice of suspension; comply with directions for cleaning and securing the Worksite; and protect the completed and in-progress Work and materials. Contractor is solely responsible for any damages or loss resulting from its failure to adequately secure and protect the Project.

(B) **Resumption of Work.** Upon receipt of the City's written notice to resume the suspended Work, in whole or in part, except as otherwise specified in the notice to resume, Contractor and its Subcontractors must promptly re-mobilize and resume the Work as specified; and within ten days from the date of the notice to resume, Contractor must submit a recovery schedule, prepared in accordance with the Contract Documents, showing how Contractor will complete the Work within the Contract Time.

(C) **Failure to Comply.** Contractor will not be entitled to an increase in Contract Time or Contract Price for a suspension occasioned by Contractor's failure to comply with the Contract Documents.

(D) **No Duty to Suspend.** City's right to suspend the Work will not give rise to a duty to suspend the Work, and City's failure to suspend the Work will not constitute a defense to Contractor's failure to comply with the requirements of the Contract Documents.

13.2 Suspension for Convenience. City reserves the right to suspend, delay, or interrupt the performance of the Work in whole or in part, for a period of time determined to be appropriate for City's convenience. Upon notice by City pursuant to this provision, Contractor must immediately suspend, delay, or interrupt the Work and secure the Project site as directed by City, except for taking measures to protect completed or in progress Work as directed in the suspension notice, and subject to the provisions of Section 13.1(A) and (B), above. If Contractor submits a timely request for a Change Order in compliance with Articles 5 and 6, the Contract Price and the Contract Time will be equitably adjusted by Change Order pursuant to Articles 5 and 6 to reflect the cost and delay impact occasioned by such suspension for convenience except to the extent that any such impacts were caused by Contractor's failure to comply with the Contract Documents or the terms of the suspension notice or notice to resume. However, Contract Time will only be extended if the suspension causes or will cause unavoidable delay in Final Completion. If Contractor disputes the terms of a Change Order issued for such equitable adjustment due to suspension for convenience, its sole recourse is to comply with the Claim procedures in Article 12.

13.3 Termination for Default. City may declare that Contractor is in default of the Contract for a material breach of or inability to fully, promptly, or satisfactorily perform its obligations under the Contract.

(A) **Default.** Events giving rise to a declaration of default include Contractor's refusal or failure to supply sufficient skilled workers, proper materials, or equipment to perform the Work within the Contract Time; Contractor's refusal or failure to make prompt payment to its employees,

Subcontractors, or suppliers or to correct defective Work or damage; Contractor's failure to comply with the Laws, or orders of any public agency with jurisdiction over the Project; evidence of Contractor's bankruptcy, insolvency, or lack of financial capacity to complete the Work as required within the Contract Time; suspension, revocation, or expiration and nonrenewal of Contractor's license or DIR registration; dissolution, liquidation, reorganization, or other major change in Contractor's organization, ownership, structure or existence as a business entity; unauthorized assignment of Contractor's rights or duties under the Contract; or any material breach of the Contract requirements.

(B) **Notice of Default and Opportunity to Cure.** Upon City's declaration that Contractor is in default, due to a material breach of the Contract Documents, if City determines that the default is curable, City will afford Contractor the opportunity to cure the default within ten days of City's notice of default, or within a period of time reasonably necessary for such cure, including a shorter period of time if applicable.

(C) **Termination.** If Contractor fails to cure the default or fails to expediently take steps reasonably calculated to cure the default within the time period specified in the notice of default, City may issue written notice to Contractor and its performance bond surety of City's termination of the Contract for default.

(D) **Waiver.** Time being of the essence in the performance of the Work, if Contractor's surety fails to arrange for completion of the Work in accordance with the Performance Bond, within seven calendar days from the date of the notice of termination, pursuant to paragraph (C), City may immediately make arrangements for the completion of the Work through use of its own forces, by hiring a replacement contractor, or by any other means that City determines advisable under the circumstances. Contractor and its surety will be jointly and severally liable for any additional cost incurred by City to complete the Work following termination, where "additional cost" means all cost in excess of the cost City would have incurred if Contractor had timely completed Work without the default and termination. In addition, City will have the right to immediate possession and use of any materials, supplies, and equipment procured for the Project and located at the Project site or any Worksite on City property for the purposes of completing the remaining Work.

(E) **Compensation.** Within 30 days of receipt of updated as-builts, all warranties, manuals, instructions, or other required documents for Work installed to date, and delivery to City of all equipment and materials for the Project for which Contractor has already been compensated, Contractor will be compensated for the Work satisfactorily performed in compliance with the Contract Documents up to the effective date of the termination

pursuant to the terms of Article 8, Payment, subject to City's rights to withhold or deduct sums from payment otherwise due pursuant to Section 8.3, and excluding any costs Contractor incurs as a result of the termination, including any cancellation or restocking charges or fees due to third parties. If Contractor disputes the amount of compensation determined by City, its sole recourse is to comply with the Claim Procedures in Article 12, by submitting a Claim no later than 30 days following notice from City of the total compensation to be paid by City.

(F) ***Wrongful Termination.*** If Contractor disputes the termination, its sole recourse is to comply with the Claim procedures in Article 12. If a court of competent jurisdiction or an arbitrator later determines that the termination for default was wrongful, the termination will be deemed to be a termination for convenience, and Contractor's damages will be strictly limited to the compensation provided for termination for convenience, under Section 13.4, below. Contractor waives any claim for any other damages for wrongful termination including special or consequential damages, lost opportunity costs or lost profits, and any award of damages is subject to Section 12.8, Burden of Proof and Limitations.

13.4 Termination for Convenience. City reserves the right, acting in its sole discretion, to terminate all or part of the Contract for convenience upon written notice to Contractor.

(A) ***Compensation to Contractor.*** In the event of City's termination for convenience, Contractor waives any claim for damages, including for loss of anticipated profits from the Project. The following will constitute full and fair compensation to Contractor, and Contractor will not be entitled to any additional claim or compensation.

(1) ***Completed Work.*** The value of its Work satisfactorily performed as of the date notice of termination is received, based on Contractor's schedule of values and unpaid costs for items delivered to the Project site that were fabricated for incorporation in the Work;

(2) ***Demobilization.*** Demobilization costs specified in the schedule of values, or if demobilization costs were not provided in a schedule of values pursuant to Section 8.1, then based on actual, reasonable, and fully documented demobilization costs; and

(3) ***Termination Markup.*** Five percent of the total value of the Work performed as of the date of notice of termination including reasonable, actual, and documented costs to comply with the direction in the notice of termination for convenience, and

demobilization costs, which is deemed to cover all overhead and profit to date.

(B) **Disputes.** If Contractor disputes the amount of compensation determined by City pursuant to paragraph (A), above, its sole recourse is to comply with the Claim procedures in Article 12, by submitting a Claim no later than 30 days following notice from City of total compensation to be paid by City.

13.5 Actions Upon Termination for Default or Convenience. The following provisions apply to any termination under this Article, whether for default or convenience, and whether in whole or in part.

(A) **General.** Upon termination, City may immediately enter upon and take possession of the Project and the Work and all tools, equipment, appliances, materials, and supplies procured or fabricated for the Project. Contractor will transfer title to and deliver all completed Work and all Work in progress to City.

(B) **Submittals.** Unless otherwise specified in the notice of termination, Contractor must immediately submit to City all designs, drawings, as-built drawings, Project records, contracts with vendors and Subcontractors, manufacturer warranties, manuals, and other such submittals or Work-related documents required under the terms of the Contract Documents, including incomplete documents or drafts.

(C) **Close Out Requirements.** Except as otherwise specified in the notice of termination, Contractor must comply with all of the following:

(1) Immediately stop the Work, except for any Work that must be completed pursuant to the notice of termination and comply with City's instructions for cessation of labor and securing the Project and any other Worksite(s).

(2) Comply with City's instructions to protect the completed Work and materials, using best efforts to minimize further costs.

(3) Contractor must not place further orders or enter into new subcontracts for materials, equipment, services or facilities, except as may be necessary to complete any portion of the Work that is not terminated.

(4) As directed in the notice, Contractor must assign to City or cancel existing subcontracts that relate to performance of the terminated Work, subject to any prior rights, if any, of the surety for Contractor's performance bond, and settle all outstanding liabilities and claims, subject to City's approval.

(5) As directed in the notice, Contractor must use its best efforts to sell any materials, supplies, or equipment intended solely for the terminated Work in a manner and at market rate prices acceptable to City.

(D) **Payment Upon Termination.** Upon completion of all termination obligations, as specified herein and in the notice of termination, Contractor will submit its request for Final Payment, including any amounts due following termination pursuant to this Article 13. Payment will be made in accordance with the provisions of Article 8, based on the portion of the Work satisfactorily completed, including the close out requirements, and consistent with the previously submitted schedule of values and unit pricing, including demobilization costs. Adjustments to Final Payment may include deductions for the cost of materials, supplies, or equipment retained by Contractor; payments received for sale of any such materials, supplies, or equipment, less re-stocking fees charged; and as otherwise specified in Section 8.3, Adjustment of Payment Application.

(E) **Continuing Obligations.** Regardless of any Contract termination, Contractor's obligations for portions of the Work already performed will continue and the provisions of the Contract Documents will remain in effect as to any claim, indemnity obligation, warranties, guarantees, submittals of as-built drawings, instructions, or manuals, record maintenance, or other such rights and obligations arising prior to the termination date.

Article 14 - Miscellaneous Provisions

14.1 Assignment of Unfair Business Practice Claims. Under Public Contract Code Section 7103.5, Contractor and its Subcontractors agree to assign to City all rights, title, and interest in and to all causes of action it may have under Section 4 of the Clayton Act (15 U.S.C. Section 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 pursuant to the Contract or any subcontract. This assignment will be effective at the time City tenders Final Payment to Contractor, without further acknowledgement by the parties.

14.2 Provisions Deemed Inserted. Every provision of law required to be inserted in the Contract Documents is deemed to be inserted, and the Contract Documents will be construed and enforced as though such provision has been included. If it is discovered that through mistake or otherwise that any required provision was not inserted, or not correctly inserted, the Contract Documents will be deemed amended accordingly.

- 14.3 Waiver.** City's waiver of a breach, failure of any condition, or any right or remedy contained in or granted by the provisions of the Contract Documents will not be effective unless it is in writing and signed by City. City's waiver of any breach, failure, right, or remedy will not be deemed a waiver of any other breach, failure, right, or remedy, whether or not similar, nor will any waiver constitute a continuing waiver unless specified in writing by City.
- 14.4 Titles, Headings, and Groupings.** The titles and headings used and the groupings of provisions in the Contract Documents are for convenience only and may not be used in the construction or interpretation of the Contract Documents or relied upon for any other purpose.
- 14.5 Statutory and Regulatory References.** With respect to any amendments to any statutes or regulations referenced in these Contract Documents, the reference is deemed to be the version in effect on the date that bids were due.
- 14.6 Survival.** The provisions that survive termination or expiration of this Contract include Contract Section 11, Notice, and subsections 12.1, 12.2, 12.3, 12.4, 12.5, and 12.6 of Section 12, General Provisions; and the following provisions in these General Conditions: Section 2.2(J), Contractor's Records, Section 2.3(C), Termination, Section 3.7, Ownership, Section 4.2, Indemnity, Article 12, Dispute Resolution, and Section 11.2, Warranty.

END OF GENERAL CONDITIONS

SPECIAL CONDITIONS

1.0 Shop Drawings. Whenever Shop Drawings are required by the Contract Documents or by the Engineer, Contractor must submit five (5) prints of each shop drawing to the Engineer.

(A) If three (3) prints of the drawing are returned to Contractor marked "NO EXCEPTIONS TAKEN," further revision of the drawings will not be required. If one (1) print of the drawing is returned to Contractor marked "REVISE AND RESUBMIT," Contractor must revise the drawing and resubmit five (5) copies of the revised drawing to the Engineer. City reserves the right to withhold payment due Contractor to cover additional costs of the Engineer's review beyond the second submission.

(B) Fabrication of an item may not commence before the Engineer has reviewed the pertinent shop drawings and returned copies to Contractor marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."

(C) Revisions indicated on shop drawings are deemed necessary to meet the existing requirements of the Contract Documents and may not be taken as the basis of claims for extra Work. Contractor is not entitled to claim for damages or extension of time due to any delay resulting from making the required revisions to shop drawings. The Engineer's review of the shop drawings does not relieve Contractor of responsibility for any errors or omissions contained in the shop drawings nor will such review operate to waive or modify any provision contained in the Contract Documents.

2.0 Waste Water. City will provide water required for performance of the Work. Contractor is responsible for the appropriate disposal of waste water in coordination with City personnel. Contractor must provide a backflow preventer on all point of connections to City's Water System. All backflow preventers must be checked and approved by City's Public Works Water Division. Contractor must provide a deposit (refundable) and make necessary arrangements to pick up a hydrant meter at City's Public Works Office. At the completion of the Project, if the hydrant meter is not returned promptly or if it is damaged, Contractor shall forfeit its deposit.

3.0 Equipment. Contractor must provide and use equipment and plants suitable to produce the quality of Work and materials required by the Contract Documents. Contractor may be required to remove equipment which the Engineer deems unsuitable for the Work. Contractor must ensure that equipment is operated by trained, experienced operators, and at a speed or rate of production not to exceed that recommended by the manufacturer. Any vehicles

used to haul materials over existing streets and highways must be equipped with pneumatic tires.

4.0 Lines and Grades. The Contractor will set the stakes or marks necessary to establish the lines and grades required for the completion of the Work in accordance with the Contract Documents.

(A) **Measurements.** Distances and measurements shall be provided in a horizontal plane. Grades are given from the top of stakes or nail unless otherwise noted. Three (3) consecutive points shown on the same rate of slope must be used in common in order to detect any variation from a straight grade. Any variation from a straight grade, straight slope or line, must be reported to the Engineer. If such discrepancy is not reported to the Engineer, Contractor is responsible for any error in the finished work.

(B) **Stakes.** Contractor must preserve all stakes and points set for lines, grades, or measurements of the Work in their proper places until authorized by the Engineer to remove them. All expense incurred by replacing stakes that have been removed without proper authority may be deducted from any payment due to Contractor.

5.0 Disposal of Materials Outside of Street Right-of-Way. Unless otherwise specified in the Specifications or Special Conditions, Contractor is solely responsible for disposing of materials outside the street right-of-way and for all associated costs. Before disposing materials outside the street right-of-way, Contractor must 1) obtain a written release from the property owner releasing City from any and all responsibility in connection with the disposal of material on that property; and 2) obtain permission from the Engineer to dispose of the material at the permitted location.

6.0 Emergency Contact. Prior to the commencement of Work on the Project, Contractor must provide contact information to the Engineer for the person designated by Contractor to respond to any emergency that arises on the Worksite during the course of the Project. That person will be responsible for responding to the Worksite within thirty (30) minutes following notification of an emergency by City's Police or Fire Department, regardless of the time of day.

7.0 Right-of-Way. City will provide the right-of-way for performance of the Work. Contractor is solely responsible for any additional area required outside of the designated the right-of-way, unless otherwise provided in the Contract Documents.

(A) **Environmental Control.** Contractor must not pollute any drainage course or its tributary inlets with fuels, oils, bitumens, acids, insecticides, herbicides or other harmful materials. Contractor and its subcontractors shall at all times in the performance of the Work comply with all applicable

federal, state, and local laws and regulations concerning pollution of waterways.

8.0 Use of Explosives. When the use of explosives is necessary for the prosecution of the Work, Contractor must ensure that they are used with the utmost care to avoid endangering persons or property. All explosives must be used and stored in strict accordance with all applicable federal, state, and local laws and regulations.

9.0 Authorized Work Days and Hours.

(A) **Authorized Work Days.** Except as expressly authorized in writing by City, Contractor is limited to performing Work on the Project on the following days of the week, excluding holidays observed by City:

Monday through Friday

(B) **Authorized Work Hours.** Except as expressly authorized in writing by City, Contractor is limited to performing Work on the Project during the following hours: **8AM through 4:30PM**

10.0 Pre-Construction Conference. City will designate a date and time for a pre-construction conference with Contractor following Contract execution. Project administration procedures and coordination between City and Contractor will be discussed, and Contractor must present City with the following information or documents at the meeting for City's review and acceptance before the Work commences:

- 10.1** Name, 24-hour contact information, and qualifications of the proposed on-site superintendent;
- 10.2** List of all key Project personnel and their complete contact information, including email addresses and telephone numbers during regular hours and after hours;
- 10.3** Staging plans that identify the sequence of the Work, including any phases and alternative sequences or phases, with the goal of minimizing the impacts on residents, businesses, and other operations in the Project vicinity;
- 10.4** If required, traffic control plans associated with the staging plans that are signed and stamped by a licensed traffic engineer;
- 10.5** Draft baseline schedule for the Work as required under Section 5.2 of the General Conditions, to be finalized within ten days after City issues the Notice to Proceed;

- 10.6 Breakdown of lump sum bid items, to be used for determining the value of Work completed for future progress payments to Contractor;
- 10.7 Schedule with list of Project submittals that require City review, and list of the proposed material suppliers;
- 10.8 Plan for coordination with affected utility owner(s) and compliance with any related permit requirements;
- 10.9 Videotape and photographs recording the conditions throughout the pre-construction Project site, showing the existing improvements and current condition of the curbs, gutters, sidewalks, signs, landscaping, streetlights, structures near the Project such as building faces, canopies, shades and fences, and any other features within the Project area limits;
- 10.10 If requested by City, Contractor's cash flow projections; and
- 10.11 Any other documents specified in the Special Conditions or Notice of Award.

11.0 Weather Delay Days. This provision is intended to supplement the requirements of General Conditions Section 5.2 on Schedule Requirements and Section 5.3 on Delays and Extensions of Contract Time.

- (A) **Weather Delay Day.** A Weather Delay Day is a Working Day during which Contractor and its forces, including Subcontractors, are unable to perform more than forty percent (40%) of the critical path Work scheduled for that day due to adverse weather conditions which impair the ability to safely or effectively perform the scheduled critical path Work that day. Adverse weather conditions may include rain, saturated soil, and Worksite clean-up required due to adverse weather. Determination of what constitutes critical path Work scheduled for that day will be based on the most current, City-approved schedule.
- (B) **Normal Weather Delay Days.** Based on historic records for the Project location, Contractor's schedule should assume the following number of normal Weather Delay Days for each month:

Month	# Normal Weather Delay Days
January	11
February	11
March	10
April	06

May	04
June	02
July	01
August	01
September	01
October	04
November	07
December	10

Weather Delay Days which do not occur during a given month based on the number of days allocated for that month (above) do not carry over to another month.

12.0 Close Out Requirements. Contractor's close out requirements include the following, if applicable:

- 12.1** Contractor must replace, with thermoplastic, any existing striping within and adjacent to the Project site that is damaged during the Work. Partially damaged striping must be replaced in its entirety.
- 12.2** Contractor must replace any survey monuments that are damaged or removed during the Work, with a Record of Survey filed by a licensed land surveyor as required by California law.
- 12.3** Before removing any traffic control or street signs on the Project site, Contractor must take photographs showing their original locations. Upon completion of each phase of construction, Contractor must temporarily reset the signs at those locations. Contractor must then replace the signs permanently upon completion of the Work and the cost of their removal and replacement must be included in the Bid Proposal.
- 12.4** Contractor must maintain any rural mail boxes on the Project site and relocate them to their permanent locations as soon as possible in the course of the Work, to the satisfaction of the affected property owners and the postal service.

13.0 Value Engineering. The Contractor may be entitled to additional compensation for cost reduction changes made pursuant to a value engineering proposal submitted by the Contractor, subject to the limitations of Public Contract Code Section 7101, and in strict compliance with this Section 13. Contractor will not be entitled to any such additional compensation unless all of the following requirements have been met:

- 13.1** The Contractor must submit a written proposal for changes to the Plans or Specifications for the Project, in which it:

(A) Identifies the written proposal as a proposal for cost reduction changes with reference to this section;

(B) Clearly and specifically identifies the proposed cost reduction changes by describing in detail each of the changes proposed with specific references to each of the Specifications and Plans involved in the proposed changes, and providing proposed revised Specifications and Plans as applicable; and

(C) Estimates the net amount of the cost reduction and provides the basis for that estimate.

13.2 The proposed changes have been identified and developed solely by the Contractor, and not, in whole or in part, by the City.

13.3 The City accepts the proposed changes in whole or in part in a writing signed by the Engineer. The Contractor will only be entitled to additional compensation for those changes specifically accepted by the City. The Engineer will determine the net savings in construction costs from any such changes that are both accepted and implemented by the City. Contractor will not be entitled to more than 50% of the net savings as determined by the Engineer, acting in his or her sole discretion.

14.0 Covid-19 Requirements. The CONTRACTOR shall comply with all State or Local requirements regarding COVID-19 during the project duration and no separate payment shall be made for compliance. Requirements include all online forms, all jobsite postings, employee training, supplying masks or other required protection devices, and temperature testing.

15.0 Mitigation Monitoring and Reporting Program. Contractor to comply with the requirements listed in the East Dunne Hillside Water Reservoir Mitigation Monitoring and Reporting Program, see Appendix A. Payment shall be included in (Bid Item 2) SWPPP Preparation.

16.0 Permits. The Contractor to comply with the requirements listed in the Habitat Agency Permit, see Appendix B. Payment shall be included in (Bid Item 2) SWPPP Preparation.

17.0 Construction Sequencing. All work under this Contract shall be conducted in a manner which will minimize shutdowns, roadway closures, or traffic obstructions caused by the construction. Shutdowns causing damage to adjacent public right-of-way and private property shall not be permitted, and any damage resulting shall be the sole responsibility of the Contractor.

18.0 Construction Yard Staging. The Contractor shall be responsible for acquiring or leasing space for temporary construction material and equipment staging. Any staging on private property shall be arranged and agreed upon solely between the Contractor and Property Owner(s). The Contractor shall provide the City a copy of the executed project related staging agreement between the Contractor and Property Owner(s).

END OF SPECIAL CONDITIONS

BID ITEM DESCRIPTIONS

1.01 BID QUANTITIES

- A. Payment shall be made for only those items shown on the bid proposal sheet. Any item of work that is not shown on the bid sheet but is required by the Plans and these Specifications shall be considered as incidental and full compensation for same shall be made as considered included in the payment for the bid items shown on the bid proposal. The price paid for each bid item shown on the bid schedule sheet shall be made as specified herein. **All applicable work shall comply with the latest version of the City of Morgan Hill Design Standard Details. These can be found on the City's website.**
- B. The following subsections describe the measurement of and payment for the work to be done under the items listed in the bid. Each unit or lump sum price stated in the bid shall constitute full compensation as herein specified for each item of work completed in accordance with the Plans and Specifications.
- C. It is the intent of the Proposal and these Special Provisions that the bid for each item, as submitted, shall cover all work called for in the Specifications and other Contract Documents. All costs in connection with the work, including all labor, materials, equipment, taxes, and services to fully complete the work, shall be included in the unit and lump sum prices named in the Proposal. No item of work that is required by the Contract Documents for the proper and successful completion of the contract will be paid for in addition to prices set forth in the Proposal. All work not specifically set forth in the Proposal as a pay item shall be considered as a subsidiary obligation of the Contractor, and all costs in connection therewith shall be included in the prices shown in the Proposal.

Bid Item No. 1 - Mobilization

The lump sum bid price for this item shall constitute full compensation for mobilization and demobilization including but not limited to equipment shipping and delivery, equipment set up, materials shipping and delivery, utility coordination and permitting, site restoration and demobilization. Compensation for this bid item shall not be in excess of 10 percent of the total bid schedule. Payment for mobilization shall conform to Section 11-1.02 of the State Standard Specifications.

Bid Item No. 2 - SWPPP Preparation

The lump sum bid price for this item shall include preparation of permit documents, permit compliance, including preparing and submitting a Storm Water Pollution Prevention Plan for compliance with the Construction General Permit (CGP) (NPDES Order No. 2022-0057-DWQ).

Bid Item No. 3 – SWPPP Monitoring Activities

The lump sum bid price for monitoring activities for this item shall constitute full compensation for required SWPPP inspections (weekly and pre-storm, during, and post-storm for Qualifying Storm Events) of storm water prevention measures such as wattles, hydroseed, concrete washouts, sediment fences, slope wattles and other items and completion of forms as described in the SWPPP for compliance with the CGP.

Bid Item No. 4 – SWPPP Reporting

The unit bid price for each Annual Storm Water Report and the Notice of Termination (NOT) shall constitute full compensation for completing the Annual Storm Water Report and NOT and submitting forms to SMARTS for compliance with the CGP.

Bid Item No. 5 - Erosion Control, Hydroseed & Environmental Compliance

The lump sum bid price for this item shall constitute full compensation for providing and applying hydroseed on all exposed dirt surfaces after grading is complete per the Contractor's approved SWPPP, construction and maintaining construction entrances/access, street sweeping, concrete washouts, and environmental compliance with the Mitigated Monitoring and Reporting Plan, (attachment A) and includes nesting bird surveys, and avoidance measures, such as other items as specified and shown on the Contractor's SWPPP Plans, including implementation of permit documents for compliance with the CGP, and storm water sampling and analysis if required.

Bid Item No. 6 – Perimeter Silt Fencing

The lump sum bid price for this item shall constitute full compensation for furnishing, installing, and removing a perimeter sediment fence per the approved Contractor's SWPPP.

Bid Item No. 7 – Slope Wattles

The lump sum price for this item shall constitute full compensation for furnishing and installing slope wattles per the approved Contractor's SWPPP.

Bid Item No. 8 – Drain Inlet Protection

The unit bid price per each drain inlet protection installed shall constitute full compensation for furnishing, installing and removing drain inlets per the approved Contractor's SWPPP.

Bid Item No. 9 – Surveying & Construction Staking

The lump sum price for this item shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in land surveying, including but not limited to office work, CAD work, development of points, construction staking, earthwork staking to the lines and grades shown on the Plans and specified herein.

Bid Item No. 10 - Clearing, Demolition and Restoration

The lump sum bid price for this item shall constitute full compensation for site preparation including but not limited to: clearing, grubbing and stripping on-site as necessary to remove all interfering or objectionable material from work areas within which excavation and grading are to be conducted, or storage of excavated materials or fill is to be made; demolition of existing structures and features identified on the drawings, and removal and disposal of such material. Demolition shall include but not limited to removal of existing fencing and pavement. Payment of this item also constitutes full compensation for the protection of landscaping and trees, and permanent facilities within the construction site, and the replacement and/or restoration of ground surface, landscaping and trees, and any permanent facilities damaged during construction including sidewalks, driveways, and fencing.

Bid Item No. 11 - Site Excavation & Fill

The lump sum price for this item shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in excavating and filling at the tank site, including placing fill, excavation, and compaction for grading the access road and reservoir pad to the lines and grades shown on the Plans and specified herein.

Bid Item No. 12 - Soil Nail Retaining Walls

The lump sum price for the Soil Nail Retaining Walls shall include full compensation for furnishing all material, labor and equipment necessary to construct the retaining walls. Work includes but not limited to soil nails, drainage, backfill and compaction, foundations, shoring, framing, shotcrete, weep holes, reinforcement for a complete soil nailing wall per the Plans and Specifications.

Bid Item No. 13 - MSE Retaining Walls

The lump sum price for the MSE Retaining Walls shall include full compensation for furnishing all material, labor and equipment necessary to construct the retaining walls, including but not limited to geogrid, geotextile, forming, foundations, shoring, backfill, compaction, drainage rock and pipe, leveling pad and MSE wall facing, concrete, reinforcement, and guardrail per the Plans and Specifications.

Bid Item No. 14 - Tank Foundation and Pad

The lump sum price for the tank foundation and pad shall include full compensation for furnishing all material, labor and equipment necessary to construct the tank foundation, including submittals, shop drawings, design calcs, placing of concrete, furnishing and placing reinforcement in the tank ring, center and column foundations, forming and placement and compaction of aggregate base and ac concrete.

Bid Item No. 15 - Steel Tank (Specialty Work)

A 850,000 gallon welded steel tank shall be furnished and installed as specified and shown on the plans for a complete operable system, including; shop drawings, design calculations, certificates, coatings and disinfection and testing. The lump sum price bid for this item includes tank appurtenances such as inlet and outlet nozzle, drain, overflow, manways, ladders, disinfection, platforms and guardrails, roof access, vent, sampling port, leak testing, and coatings as specified herein.

Bid Item No. 16- Tank Cathodic Protection System

Provide an impressed current Cathodic Protection System, and furnish all labor, materials, equipment, supervision and testing, and perform all operations required to install a complete system of cathodic protection to protect the interior of the welded steel protectively coated water storage reservoir.

Bid Item No. 17 - 16" Tank Connections

The unit price per linear foot for this item shall include full compensation for all material, labor, equipment, tools, and services necessary to furnish, and install 16" tank connections from Tank nozzles to the inlet and outlet waterline connections. Work includes but not limited to concrete pad support, pipe , fittings, valves, flexible connections, pipe supports, pressure testing, disinfection and testing.

Bid Item No. 18 - 16" Inlet Waterline

The unit price per linear foot for this item shall include full compensation for all material, labor, equipment, tools, and services necessary to furnish, and install a 16" ductile iron waterline to the tank site from E Dunne Road. Work includes but not limited to trenching, bedding, backfill, compaction, pipe, fittings, thrust restraint, pressure testing, disinfection and testing.

Bid Item No. 19 - 10" Outlet Waterline

The unit price per linear foot for this item shall include full compensation for all material, labor, equipment, tools, and services necessary to furnish, and install a 10" ductile iron waterline from the tank site to E Dunne Road. Work includes but not limited to trenching, bedding, backfill, compaction,

pipe, fittings, valves , thrust restraint, pressure testing, disinfection and testing.

Bid Item No. 20 - 12" Outlet Waterline

The unit price per linear foot for this item shall include full compensation for all material, labor, equipment, tools, and services necessary to furnish, and install a 10" ductile iron waterline from the tank site to E Dunne Road. Work includes but not limited to trenching, bedding, backfill, compaction, pipe, fittings, valves thrust restraint, pressure testing, disinfection and testing.

Bid Item No. 21 - Storm Drainage System

The unit price per linear foot for this item shall include full compensation for all material, labor, equipment, tools, and services necessary to furnish, and install complete storm drain system including all storm drain piping, catch basins, inlet structures, unction boxes, manholes from and around the tank site to the Biofiltration Vault. Work includes but not limited to trenching, shoring, bedding, backfill, and compaction.

Bid Item No. 22 – Storm Biofiltration System & Outlet Piping

The lump sum price shall constitute full compensation for all material, labor, equipment, tools and services necessary to furnish, and install a biofiltration vault system and retention piping including internal components, outlet piping, retention piping and headwall and rip rap discharge structure and all appurtenances as shown on the Plans.

Bid Item No. 23 - V Ditch,

The unit price per linear foot for this item shall include full compensation for all material, labor and equipment necessary to furnished and cast-in-place a concrete V ditch as specified and shown on the Plans.

Bid Item No. 24 - Valley Gutter

The unit price per linear foot for this item shall include full compensation for all material, labor and equipment necessary to furnished and cast-in-place a concrete valley gutter as specified and shown on the Plans.

Bid Item No. 25 - Asphalt Concrete Paving

Paving including asphaltic concrete and aggregate base as detailed on the Plans shall be paid for under the lump sum price bid for this item. This bid item includes all materials and labor for a complete installation.

Bid Item No. 26 – 6' Tall Chain Link Fencing and Gates

Barbed wire chain link fence shall be furnished and installed as specified and detailed on the Plans. The unit price bid per lineal foot includes full compensation for furnishing fencing and posts, excavation of footings,

placing posts and concrete, installing fabric and barbed wire and standard fabric gates as shown on the Plans.

Bid Item No. 27 – 4' Tall Chain Link Fencing

Chain link fence shall be furnished and installed as specified and detailed on the Plans. The unit price bid per lineal foot includes full compensation for furnishing fence fabric and posts, excavation of footings, placing posts and concrete, and installing fabric.

Bid Item No. 28 - Bollards

The unit price for Each bollard installed shall include full compensation for all material, labor, equipment, tools, and services necessary to furnish, and install all bollards as shown and detailed on the Plans.

Bid Item No. 29 - Landscaping & Irrigation

The lump sum price shall constitute full compensation for all material, labor and equipment necessary to furnish and placed landscaping and irrigation, including Irrigation Pump Station as specified and shown on the Plans.

Bid Item No. 30 - Electrical, Controls and Communications

The lump sum price shall constitute full compensation for all material, labor, and equipment necessary to furnish and install electrical cabinets, conduit, conductors, batteries, breakers, instruments, controls and miscellaneous other equipment as specified and shown on the Plans.

Bid Item No. 31 – Booster Pump Station Mechanical Modifications

The lump sum price shall constitute full compensation for all material, labor, and equipment necessary to modify pumps and piping at the Booster Pump Station including demolition, furnish and install pumps, piping connections, equipment pad modifications and miscellaneous other work to complete the booster pump replacement. equipment as specified and shown on the Plans.

Bid Item No. 32 - Booster Pump Station Electrical, Controls Modification

The lump sum price shall constitute full compensation for all material, labor, and equipment necessary to furnish and install electrical including demolition, modifications to MCC buckets with RVSS, conduit, conductors, breakers, instruments, controls and miscellaneous other equipment as specified and shown on the Plans.

Bid Item No. 33 – Initial Start-up and Contract Close Out

The lump sum price shall constitute full compensation for all material, labor, and equipment necessary to fill and start-up the reservoir system, including start up plan, demonstration, disinfection, testing, training, record

drawings, tank filling, operation manuals, warranties, site clean-up, punch list corrections, and miscellaneous other equipment as specified and shown on the Plans.

Bid Item No. 34 -Supplemental

Supplemental work shall include any new or unforeseen work not specified/included in the plans and specifications. The lump sum dollar amount listed in the bid schedule will be included in each bidder's proposal. Supplemental work shall be performed only upon direct written authorization from the Project Engineer. An agreed price may be used as an alternate method of payment, if directed by the Project Engineer.

**** END OF SECTION**

APPENDIX A-MITIGATION AND MONITORING REQUIREMENTS

**MITIGATION MONITORING AND REPORTING PROGRAM
EAST DUNNE HILLSIDE WATER RESERVOIR PROJECT
MORGAN HILL, CALIFORNIA**

Prepared for the:



Public Works Department
17575 Peak Avenue
Morgan Hill, CA 95037
408.778.6480

Prepared by:

Raney Planning & Management, Inc.
1501 Sports Drive, Suite A
Sacramento, CA 95834

May 2024

MITIGATION MONITORING AND REPORTING PROGRAM

INTRODUCTION

The City of Morgan Hill, as Lead Agency under the California Environmental Quality Act (CEQA) and State CEQA Guidelines, has prepared the Final Mitigated Negative Declaration (MND) for the East Dunne Hillside Water Reservoir Project (proposed project). When a lead agency makes findings on significant effects identified in an MND, it must also adopt a program for reporting or monitoring mitigation measures that were adopted or made conditions of project approval (Public Resources Code [PRC] Section 21081.6[a]; State CEQA Guidelines Sections 15091[d], 15097).

This document represents the mitigation monitoring and reporting program (MMRP) prepared by the City of Morgan Hill for the proposed project. This MMRP includes all measures required to reduce potentially significant environmental impacts to a less-than-significant level. In addition, the MMRP identifies the timing of implementation; the agency responsible for implementing the mitigation; and the agency responsible for monitoring the mitigation. The mitigation measures, timing, and responsibility are summarized in Table 1, and the full text of the mitigation measures follows. The implementation and monitoring of the mitigation measures, in conjunction with the implementation of the City's Standard Measures required for such projects, will ensure the reduction of potentially significant environmental effects to less-than-significant levels.

This MMRP has been prepared by the City of Morgan Hill, with technical assistance from Raney Planning & Management, Inc., an environmental consulting firm. Questions should be directed to David Gittleston, Associate Engineer, at the City of Morgan Hill.

Contact Information:

City of Morgan Hill
Public Works Department
17575 Peak Avenue
Morgan Hill, CA 95037
408.310.4642

TABLE 1. MITIGATION MONITORING AND REPORTING PROGRAM – SUMMARY OF MITIGATION MEASURES

Mitigation Measure	Implementation Responsibility	Monitoring Responsibility¹	Timing of Implementation
Prior to Construction			
BIO-1: The following avoidance measures shall be required to avoid the project's potential effects on Swainson's hawk, grasshopper sparrow, golden eagle, white- tailed kite, or any other special-status or migratory bird species. a. If land clearing and grading are to be conducted outside of the breeding season (i.e., September 1 through January 31), a preconstruction survey for nesting migratory birds is not warranted. b. If land clearing and grading are to be conducted during the breeding season (i.e., February 1 through August 31), a preconstruction nesting bird survey shall be conducted. The survey shall be performed by a qualified biologist no more than seven days prior to the initiation of work. If no nesting or breeding activity is observed, work may proceed without restrictions. To the extent allowed by access, all active nests identified within 76 m (250 ft) for raptors and 15 m (50 ft) for passerines shall be mapped. c. For any active nests found near the construction limits (76 m [250 ft] for raptors and 15 m [50 ft] for passerines) the Project Biologist shall make a determination as to whether or not construction activities are likely to disrupt reproductive behavior. If it is determined that construction is unlikely to disrupt breeding behavior, construction may proceed. If it is determined that construction may disrupt breeding, the no-	Project Applicant with a Qualified Biologist	City of Morgan Hill Development Services Department	No more than seven days prior to the start of construction, if construction is proposed during the breeding season (February 1 to August 31)

TABLE 1. MITIGATION MONITORING AND REPORTING PROGRAM – SUMMARY OF MITIGATION MEASURES

Mitigation Measure	Implementation Responsibility	Monitoring Responsibility ¹	Timing of Implementation
construction buffer zone shall be expanded; avoidance is the only mitigation available. The ultimate size of the no-construction buffer zone may be adjusted by the Project Biologist based on the species involved, topography, lines of site between the work area and the nest, physical barriers, and the ambient level of human activity. d. If it is determined that construction activities are likely to disrupt raptor breeding, construction activities within the no-construction buffer zone may not proceed until the project biologist determines that the nest is long longer occupied. e. If maintenance of a no-construction buffer zone is not feasible, the Project Biologist shall monitor the nest(s) to document breeding and rearing behavior of the adult birds. If it is determined that construction-related activities are likely to cause nest abandonment, work shall cease immediately and the CDFW shall be contacted for guidance. Work may not resume until an agreement has been reached with the authorities specifying the conditions under which work may proceed.			
GEO-1: Prior to grading permit issuance, the applicant shall submit a final design-level geotechnical report of the project site that provides final design recommendations for the tank foundation and surface drainage controls to ensure slope stability hazards are minimized. The geotechnical report shall be reviewed and approved by the City Engineer, Chief Building Official, and a qualified Geotechnical Engineer to ensure that all geotechnical recommendations specified in the geotechnical report are properly	Project Applicant with a Qualified Geotechnical Engineer	City Engineer and Chief Building Official	Prior to grading permit issuance

TABLE 1. MITIGATION MONITORING AND REPORTING PROGRAM – SUMMARY OF MITIGATION MEASURES

Mitigation Measure	Implementation Responsibility	Monitoring Responsibility¹	Timing of Implementation
incorporated and utilized in the project design in order to adhere to all geotechnical requirements contained in the California Building Code.			
¹ The City of Morgan Hill may hire a qualified contractor to conduct mitigation monitoring.			

BIOLOGICAL RESOURCES

The project's construction-related activities could have potentially significant effects on special-status bird species, including nesting migratory birds and raptors protected by the Migratory Bird Treaty Act (MBTA). Implementation of the following measure would reduce the potentially significant impact to a less-than-significant level.

MM BIO-1: Special-Status and Migratory Bird Species

The following avoidance measures shall be required to avoid the project's potential effects on Swainson's hawk, grasshopper sparrow, golden eagle, white-tailed kite, or any other special-status or migratory bird species.

- a. If land clearing and grading are to be conducted outside of the breeding season (i.e., September 1 through January 31), a preconstruction survey for nesting migratory birds is not warranted.
- b. If land clearing and grading are to be conducted during the breeding season (i.e., February 1 through August 31), a preconstruction nesting bird survey shall be conducted. The survey shall be performed by a qualified biologist no more than seven days prior to the initiation of work. If no nesting or breeding activity is observed, work may proceed without restrictions. To the extent allowed by access, all active nests identified within 76 m (250 ft) for raptors and 15 m (50 ft) for passerines shall be mapped.
- c. For any active nests found near the construction limits (76 m [250 ft] for raptors and 15 m [50 ft] for passerines) the Project Biologist shall make a determination as to whether or not construction activities are likely to disrupt reproductive behavior. If it is determined that construction is unlikely to disrupt breeding behavior, construction may proceed. If it is determined that construction may disrupt breeding, the no-construction buffer zone shall be expanded; avoidance is the only mitigation available. The ultimate size of the no-construction buffer zone may be adjusted by the Project Biologist based on the species involved, topography, lines of site between the work area and the nest, physical barriers, and the ambient level of human activity.
- d. If it is determined that construction activities are likely to disrupt raptor breeding, construction activities within the no-construction buffer zone may not proceed until the project biologist determines that the nest is long longer occupied.
- e. If maintenance of a no-construction buffer zone is not feasible, the Project Biologist shall monitor the nest(s) to document breeding and rearing behavior of the adult birds. If it is determined that construction-related activities are likely to cause nest abandonment, work shall cease immediately and the CDFW shall be contacted for guidance. Work may not resume until an

agreement has been reached with the authorities specifying the conditions under which work may proceed.

GEOLOGY AND SOILS

Due to the soils underlying the project site, project development could result in impacts related to erosion and landslide hazards. Implementation of the following measure would reduce the potentially significant impact to a less-than-significant level.

MM GEO-1: Erosion and Landslide Hazards

Prior to grading permit issuance, the applicant shall submit a final design-level geotechnical report of the project site that provides final design recommendations for tank foundation and surface drainage controls to ensure slope stability hazards are minimized. The geotechnical report shall be reviewed and approved by the City Engineer, Chief Building Official, and a qualified Geotechnical Engineer to ensure that all geotechnical recommendations specified in the geotechnical report are properly incorporated and utilized in the project design in order to adhere to all geotechnical requirements contained in the California Building Code.

FINDING

The City of Morgan Hill Development Services Director hereby finds that the proposed project could have a significant effect on the environment; however, there would not be a significant effect in this case because mitigation measures summarized above and described in the MND are included in the project.

Jennifer Carman
Development Services Director

Date: _____

END ATTACHMENT A –

Attachment B – Habitat Agency Permit Conditions

The Contractor shall comply with the following Habitat Agency Permit Conditions:



Santa Clara Valley Habitat Plan Implementation
Certificate of Approval – Compliance Determination

March 8, 2024

Dave Gittleson
Associate Engineer
City of Morgan Hill Utilities & Engineering Department
17575 Peak Avenue
Morgan Hill, CA 95037

Project Name/Number: MH-PUB-2023-0368 East Dunne Hillside Reservoir Project

Dear Mr. Dave Gittleson:

The City of Morgan Hill has thoroughly evaluated your Santa Clara Valley Habitat Plan (Habitat Plan) Application MH-PUB-2023-0368 East Dunne Hillside Reservoir Project and has determined that the proposed project is consistent with the applicable terms and conditions established under the Habitat Plan. The City of Morgan Hill concludes that take associated with the implementation of the proposed project is properly authorized through the Permits. The City of Morgan Hill confirms that the impact of 2.1 acres meets the requirements established under the Habitat Plan and has received sufficient payment of \$17,706.75 for these impacts.

Under the Permits and Implementing Agreement, the project applicants may become authorized to perform certain activities covered in the Habitat Plan resulting in "take" of certain species, provided all applicable terms and conditions of the Permits, the Habitat Plan, the associated Implementing Agreement, and City of Morgan Hill's habitat conservation plan ordinance are met.

As proposed, the project is approved for construction so long as the following checked conditions, as established under the Habitat Plan, are met.

- ☒ Condition 1. Avoid Direct Impacts on Legally Protected Plant and Wildlife Species
- ☐ Condition 2. Incorporate Urban-Reserve System Interface Design Requirements
- ☒ Condition 3. Maintain Hydrologic Conditions and Protect Water Quality
- ☐ Condition 4. Avoidance and Minimization for In-Stream Projects
- ☐ Condition 5. Avoidance and Minimization Measures for In-Stream Operations and Maintenance
- ☐ Condition 6. Design and Construction Requirements for Covered Transportation Projects
- ☐ Condition 7. Rural Development Design and Construction Requirements

- ☒ Condition 8. Implement Avoidance and Minimization Measures for Rural Road Maintenance
- ☐ Condition 9. Prepare and Implement a Recreation Plan
- ☐ Condition 10. Fuel Buffer
- ☐ Condition 11. Stream and Riparian Setbacks
- ☐ Condition 12. Wetland and Pond Avoidance and Minimization
- ☐ Condition 13. Serpentine and Associated Covered Species Avoidance and Minimization
- ☐ Condition 14. Valley Oak and Blue Oak Woodland Avoidance and Minimization
- ☐ Condition 15. Western Burrowing Owl
- ☒ Condition 16. Least Bell's Vireo
- ☒ Condition 17. Tricolored Blackbird
- ☐ Condition 18. San Joaquin Kit Fox
- ☐ Condition 19. Plant Salvage when Impacts are Unavoidable
- ☐ Condition 20. Avoid and Minimize Impacts to Covered Plant Occurrences

Coverage under the Permits will become effective upon receipt of this Certificate of Approval executed by City of Morgan Hill and Dave Gittleson and the City of Morgan Hill Utilities & Engineering Department.

	03/08/2024		
Co-Permittee Signature	Date	Applicant Signature	Date

- ☒ **Condition 1. Avoid Direct Impacts on Legally Protected Plant and Wildlife Species.** This condition applies to all projects covered under the Habitat Plan and helps to protect species for which environmental permits cannot be granted: Contra Costa goldfields, bald eagle, American peregrine falcon, southern bald eagle, white-tailed kite, California condor, and Ring-tailed cat (= ringtail); also requires compliance with the Migratory Bird Treaty Act and Bald and Golden Eagle Protection Act. For detailed information, see Habitat Plan pages 6-7 to 6-8.
- ☒ **Condition 8. Implement Avoidance and Minimization Measures for Rural Road Maintenance.** This condition applies to projects that involve operations and maintenance activities (e.g., utility line maintenance, vegetation management, road maintenance) on or along rural roads and helps minimize sediment discharge, disturbance of nesting covered bird species, and the spread of nonnative invasive species. For detailed information, see Habitat Plan pages 6-35 to 6-37.
- ☒ **Condition 3. Maintain Hydrologic Conditions and Protect Water Quality.** This condition applies to all projects covered by the Habitat Plan and helps protect watershed health, primarily through reducing stormwater discharge and pollutant runoff from project sites. Work with the Habitat Plan lead to determine if NPDES compliance is sufficient for the project or if additional measures are required. For detailed information, see Habitat Plan pages 6-12 to 6-13 and Table 6-2.
- ☒ **Condition 16. Least Bell's Vireo.** This condition applies to projects that are located within any riparian forest and scrub land cover type and within Wildlife Survey Area and helps protect least Bell's vireos by prescribing preconstruction surveys, construction buffer zones, biological monitoring, and other requirements. For detailed information, see Habitat Plan pages 6-68 to 6-69.
- ☒ **Condition 17. Tricolored Blackbird.** This condition applies to projects that are located within 250 feet of any riparian, coastal and valley freshwater marsh and helps to protect tricolored blackbirds by prescribing preconstruction surveys, construction buffer zones, biological monitoring, and other requirements. For detailed information, see Habitat Plan pages 6-69 to 6-71.

Attachment C – Soil Sampling Results



Engeo (San Ramon)
2010 Crow Canyon Place, #250
San Ramon, California 94583
Tel: (925) 866-9000
Fax: (925) 866-0199
RE: City of Morgan Hill-E Dunne Ave

Work Order No.: 2404183 Rev: 1

Dear Nadine Periat:

Torrent Laboratory, Inc. received 5 sample(s) on April 17, 2024 for the analyses presented in the following Report.

All data for associated QC met EPA or laboratory specification(s) except where noted in the case narrative.

Torrent Laboratory, Inc. is certified by the State of California, ELAP #1991. If you have any questions regarding these test results, please feel free to contact the Project Management Team at (408)263-5258; ext 204.

Kathie Evans
Project Manager

April 22, 2024

Date



Date: 4/22/2024

Client: Engeo (San Ramon)

Project: City of Morgan Hill-E Dunne Ave

Work Order: 2404183

CASE NARRATIVE

Unless otherwise indicated in the following narrative, no issues encountered with the receiving, preparation, analysis or reporting of the results associated with this work order.

Unless otherwise indicated in the following narrative, no results have been method and/or field blank corrected.

Reported results relate only to the items/samples tested by the laboratory.

This report shall not be reproduced, except in full, without the written approval of Torrent Laboratory, Inc.

REVISIONS

Report revised to include STLC data

STLC

Note: Extraction of 50 g sample / 500g 0.2M Sodium Citrate Solution was performed according to wet extraction procedure (WET) which was rotated in a rotary shaker for 48 hours (+/- 4 hours).

Date Prepared: 4/23/24 at 4:00 PM to 4/25/24 at 12:20 PM

Rev. 1 (4/26/24)



Sample Result Summary

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date Received: 04/17/24

Date Reported: 04/22/24

SB-1@5'

2404183-001

<u>Parameters:</u>	<u>Analysis Method</u>	<u>DF</u>	<u>MDL</u>	<u>PQL</u>	<u>Results</u>	<u>Unit</u>
Arsenic	SW6010B	1	0.15	1.30	5.10	mg/Kg
Barium	SW6010B	1	0.055	5.00	226	mg/Kg
Beryllium	SW6010B	1	0.055	5.00	0.570	mg/Kg
Chromium	SW6010B	1	0.075	5.00	183	mg/Kg
Cobalt	SW6010B	1	0.070	5.00	22.2	mg/Kg
Copper	SW6010B	1	0.20	5.00	28.2	mg/Kg
Lead	SW6010B	1	0.10	3.00	6.45	mg/Kg
Molybdenum	SW6010B	1	0.050	5.00	0.250	mg/Kg
Nickel	SW6010B	1	0.50	5.00	261	mg/Kg
Vanadium	SW6010B	1	0.10	5.00	67.0	mg/Kg
Zinc	SW6010B	1	0.30	5.00	46.0	mg/Kg
Chromium (STLC)	SW6010B-STLC	1	0.010	0.20	0.232	mg/L
Nickel (STLC)	SW6010B-STLC	1	0.010	0.20	2.09	mg/L
TPH as Diesel	SW8015B	1	0.66	2.0	2.18	mg/Kg
TPH as Motor Oil	SW8015B	1	0.76	5.0	7.03	mg/Kg

SB-2@3'

2404183-002

<u>Parameters:</u>	<u>Analysis Method</u>	<u>DF</u>	<u>MDL</u>	<u>PQL</u>	<u>Results</u>	<u>Unit</u>
Arsenic	SW6010B	1	0.15	1.30	6.60	mg/Kg
Barium	SW6010B	1	0.055	5.00	195	mg/Kg
Beryllium	SW6010B	1	0.055	5.00	0.540	mg/Kg
Chromium	SW6010B	1	0.075	5.00	122	mg/Kg
Cobalt	SW6010B	1	0.070	5.00	17.9	mg/Kg
Copper	SW6010B	1	0.20	5.00	30.9	mg/Kg
Lead	SW6010B	1	0.10	3.00	7.55	mg/Kg
Molybdenum	SW6010B	1	0.050	5.00	0.295	mg/Kg
Nickel	SW6010B	1	0.50	5.00	191	mg/Kg
Vanadium	SW6010B	1	0.10	5.00	53.0	mg/Kg
Zinc	SW6010B	1	0.30	5.00	50.5	mg/Kg
TPH as Diesel	SW8015B	1	0.66	2.0	2.01	mg/Kg
TPH as Motor Oil	SW8015B	1	0.76	5.0	10.2	mg/Kg



Sample Result Summary

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date Received: 04/17/24

Date Reported: 04/22/24

SB-3@1'

2404183-003

<u>Parameters:</u>	<u>Analysis Method</u>	<u>DF</u>	<u>MDL</u>	<u>PQL</u>	<u>Results</u>	<u>Unit</u>
Arsenic	SW6010B	1	0.15	1.30	4.83	mg/Kg
Barium	SW6010B	1	0.055	5.00	310	mg/Kg
Beryllium	SW6010B	1	0.055	5.00	0.610	mg/Kg
Chromium	SW6010B	1	0.075	5.00	92.0	mg/Kg
Cobalt	SW6010B	1	0.070	5.00	17.3	mg/Kg
Copper	SW6010B	1	0.20	5.00	33.7	mg/Kg
Lead	SW6010B	1	0.10	3.00	7.85	mg/Kg
Molybdenum	SW6010B	1	0.050	5.00	0.310	mg/Kg
Nickel	SW6010B	1	0.50	5.00	158	mg/Kg
Vanadium	SW6010B	1	0.10	5.00	52.5	mg/Kg
Zinc	SW6010B	1	0.30	5.00	53.0	mg/Kg
TPH as Diesel	SW8015B	1	0.66	2.0	4.05	mg/Kg
TPH as Motor Oil	SW8015B	1	0.76	5.0	19.4	mg/Kg

SB-4@3'

2404183-004

<u>Parameters:</u>	<u>Analysis Method</u>	<u>DF</u>	<u>MDL</u>	<u>PQL</u>	<u>Results</u>	<u>Unit</u>
Arsenic	SW6010B	1	0.15	1.30	4.96	mg/Kg
Barium	SW6010B	1	0.055	5.00	265	mg/Kg
Beryllium	SW6010B	1	0.055	5.00	0.640	mg/Kg
Chromium	SW6010B	1	0.075	5.00	128	mg/Kg
Cobalt	SW6010B	1	0.070	5.00	19.3	mg/Kg
Copper	SW6010B	1	0.20	5.00	30.3	mg/Kg
Lead	SW6010B	1	0.10	3.00	9.60	mg/Kg
Molybdenum	SW6010B	1	0.050	5.00	0.295	mg/Kg
Nickel	SW6010B	1	0.50	5.00	177	mg/Kg
Vanadium	SW6010B	1	0.10	5.00	64.5	mg/Kg
Zinc	SW6010B	1	0.30	5.00	47.9	mg/Kg
Chromium (STLC)	SW6010B-STLC	1	0.010	0.20	0.212	mg/L
TPH as Diesel	SW8015B	1	0.66	2.0	3.31	mg/Kg
TPH as Motor Oil	SW8015B	1	0.76	5.0	12.4	mg/Kg



Sample Result Summary

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date Received: 04/17/24

Date Reported: 04/22/24

SB-5@1'

2404183-005

<u>Parameters:</u>	<u>Analysis Method</u>	<u>DF</u>	<u>MDL</u>	<u>PQL</u>	<u>Results</u>	<u>Unit</u>
Antimony	SW6010B	1	0.050	5.00	0.0800	mg/Kg
Arsenic	SW6010B	1	0.15	1.30	4.08	mg/Kg
Barium	SW6010B	1	0.055	5.00	230	mg/Kg
Beryllium	SW6010B	1	0.055	5.00	0.615	mg/Kg
Chromium	SW6010B	1	0.075	5.00	138	mg/Kg
Cobalt	SW6010B	1	0.070	5.00	18.1	mg/Kg
Copper	SW6010B	1	0.20	5.00	26.3	mg/Kg
Lead	SW6010B	1	0.10	3.00	8.20	mg/Kg
Molybdenum	SW6010B	1	0.050	5.00	0.160	mg/Kg
Nickel	SW6010B	1	0.50	5.00	210	mg/Kg
Vanadium	SW6010B	1	0.10	5.00	58.5	mg/Kg
Zinc	SW6010B	1	0.30	5.00	40.7	mg/Kg
Chromium (STLC)	SW6010B-STLC	1	0.010	0.20	0.262	mg/L
Nickel (STLC)	SW6010B-STLC	1	0.010	0.20	3.41	mg/L
TPH as Diesel	SW8015B	1	0.66	2.0	4.58	mg/Kg
TPH as Motor Oil	SW8015B	1	0.76	5.0	23.8	mg/Kg



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-1@5'	Lab Sample ID:	2404183-001A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 11:55		
SDG:			

Prep Method: 7471BP	Prep Batch Date/Time: 4/18/24 7:15:00PM
Prep Batch ID: 1159988	Prep Analyst: TNGO

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Mercury	SW7471B	1	0.083	0.50	ND		mg/Kg	04/19/24	11:39	BJAY	483311



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-1@5'	Lab Sample ID:	2404183-001A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 11:55		
SDG:			

Prep Method:	3050B	Prep Batch Date/Time:	4/18/24	7:00:00PM
Prep Batch ID:	1159990	Prep Analyst:	TNGO	

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Antimony	SW6010B	1	0.050	5.00	ND		mg/Kg	04/19/24	11:38	GS	483322
Arsenic	SW6010B	1	0.15	1.30	5.10		mg/Kg	04/19/24	11:38	GS	483322
Barium	SW6010B	1	0.055	5.00	226		mg/Kg	04/19/24	11:38	GS	483322
Beryllium	SW6010B	1	0.055	5.00	0.570	J	mg/Kg	04/19/24	11:38	GS	483322
Cadmium	SW6010B	1	0.10	0.750	ND		mg/Kg	04/19/24	11:38	GS	483322
Chromium	SW6010B	1	0.075	5.00	183		mg/Kg	04/19/24	11:38	GS	483322
Cobalt	SW6010B	1	0.070	5.00	22.2		mg/Kg	04/19/24	11:38	GS	483322
Copper	SW6010B	1	0.20	5.00	28.2		mg/Kg	04/19/24	11:38	GS	483322
Lead	SW6010B	1	0.10	3.00	6.45		mg/Kg	04/19/24	11:38	GS	483322
Molybdenum	SW6010B	1	0.050	5.00	0.250	J	mg/Kg	04/19/24	11:38	GS	483322
Nickel	SW6010B	1	0.50	5.00	261		mg/Kg	04/19/24	11:38	GS	483322
Selenium	SW6010B	1	0.35	1.10	ND		mg/Kg	04/19/24	11:38	GS	483322
Silver	SW6010B	1	0.15	0.500	ND		mg/Kg	04/19/24	11:38	GS	483322
Thallium	SW6010B	1	0.20	5.00	ND		mg/Kg	04/19/24	11:38	GS	483322
Vanadium	SW6010B	1	0.10	5.00	67.0		mg/Kg	04/19/24	11:38	GS	483322
Zinc	SW6010B	1	0.30	5.00	46.0		mg/Kg	04/19/24	11:38	GS	483322



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-1@5'	Lab Sample ID:	2404183-001A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 11:55		
SDG:			

Prep Method:	WET/3010B	Prep Batch Date/Time:	4/25/24 12:50:00PM
Prep Batch ID:	1160173	Prep Analyst:	ROME

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch
Chromium (STLC)	SW6010B-STL C	1	0.010	0.20	0.232		mg/L	04/25/24	14:09	GS	483469
Nickel (STLC)	SW6010B-STL C	1	0.010	0.20	2.09		mg/L	04/25/24	14:09	GS	483469



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-1@5'	Lab Sample ID:	2404183-001A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 11:55		
SDG:			

Prep Method:	3546_TPH	Prep Batch Date/Time:	4/17/24	2:26:00PM
Prep Batch ID:	1159947	Prep Analyst:	AKIZ	

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch
TPH as Diesel	SW8015B	1	0.66	2.0	2.18	x	mg/Kg	04/18/24	21:46	SN	483342
TPH as Motor Oil	SW8015B	1	0.76	5.0	7.03		mg/Kg	04/18/24	21:46	SN	483342
Acceptance Limits											
Pentacosane (S)	SW8015B		45 - 130		94.1		%	04/18/24	21:46	SN	483342

NOTE: x-not typical of Diesel ref. std: peaks within Diesel range quantified as diesel



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-1@5'	Lab Sample ID:	2404183-001A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 11:55		
SDG:			

Prep Method: 5035	Prep Batch Date/Time: 4/18/24 10:44:00AM
Prep Batch ID: 1160007	Prep Analyst: JZHAO

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Dichlorodifluoromethane	SW8260B	1	0.0012	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Chloromethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Vinyl Chloride	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Bromomethane	SW8260B	1	0.0027	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Chloroethane	SW8260B	1	0.0030	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Trichlorofluoromethane	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,1-Dichloroethene	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Freon 113	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Methylene Chloride	SW8260B	1	0.0071	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
trans-1,2-Dichloroethene	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
MTBE	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
TBA	SW8260B	1	0.012	0.050	ND		mg/Kg	04/18/24	15:00	JZ	483324
Diisopropyl ether	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,1-Dichloroethane	SW8260B	1	0.0022	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Ethyl tert-Butyl ether	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
cis-1,2-Dichloroethene	SW8260B	1	0.0022	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
2,2-Dichloropropane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Bromochloromethane	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Chloroform	SW8260B	1	0.0024	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Carbon Tetrachloride	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,1,1-Trichloroethane	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,1-Dichloropropene	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Benzene	SW8260B	1	0.0022	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
TAME	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,2-Dichloroethane	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Trichloroethene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Dibromomethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,2-Dichloropropane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Bromodichloromethane	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
cis-1,3-Dichloropropene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Toluene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Tetrachloroethene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
trans-1,3-Dichloropropene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,1,2-Trichloroethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Dibromochloromethane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,3-Dichloropropane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,2-Dibromoethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Chlorobenzene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-1@5'	Lab Sample ID:	2404183-001A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 11:55		
SDG:			

Prep Method: 5035	Prep Batch Date/Time: 4/18/24 10:44:00AM
Prep Batch ID: 1160007	Prep Analyst: JZHAO

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Ethylbenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,1,1,2-Tetrachloroethane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
m,p-Xylene	SW8260B	1	0.0032	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
o-Xylene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Styrene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Bromoform	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Isopropyl Benzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
n-Propylbenzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Bromobenzene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,1,2,2-Tetrachloroethane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
2-Chlorotoluene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,3,5-Trimethylbenzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,2,3-Trichloropropane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
4-Chlorotoluene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
tert-Butylbenzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,2,4-Trimethylbenzene	SW8260B	1	0.0014	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
sec-Butyl Benzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
p-Isopropyltoluene	SW8260B	1	0.0015	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,3-Dichlorobenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,4-Dichlorobenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
n-Butylbenzene	SW8260B	1	0.0015	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,2-Dichlorobenzene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,2-Dibromo-3-Chloropropane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Hexachlorobutadiene	SW8260B	1	0.0014	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,2,4-Trichlorobenzene	SW8260B	1	0.0015	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
Naphthalene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
1,2,3-Trichlorobenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	15:00	JZ	483324
2-Butanone	SW8260B	1	0.0023	0.0100	ND		mg/Kg	04/18/24	15:00	JZ	483324
(S) Dibromofluoromethane	SW8260B		59.8 - 148		106		%	04/18/24	15:00	JZ	483324
(S) Toluene-d8	SW8260B		55.2 - 133		107		%	04/18/24	15:00	JZ	483324
(S) 4-Bromofluorobenzene	SW8260B		55.8 - 141		114		%	04/18/24	15:00	JZ	483324



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-1@5'	Lab Sample ID:	2404183-001A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 11:55		
SDG:			

Prep Method:	5035GRO	Prep Batch Date/Time:	4/18/24	10:44:00AM
Prep Batch ID:	1160009	Prep Analyst:	JZHAO	

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch
TPH as Gasoline	SW8260B(TPH)	1	0.043	0.10	ND		mg/Kg	04/18/24	15:00	JZ	483324
(S) 4-Bromofluorobenzene	SW8260B(TPH)		43.9 - 127		88.5		%	04/18/24	15:00	JZ	483324



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-2@3'	Lab Sample ID:	2404183-002A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 10:35		
SDG:			

Prep Method:	7471BP	Prep Batch Date/Time:	4/18/24	7:15:00PM
Prep Batch ID:	1159988	Prep Analyst:	TNGO	

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Mercury	SW7471B	1	0.083	0.50	ND		mg/Kg	04/19/24	11:41	BJAY	483311



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-2@3'	Lab Sample ID:	2404183-002A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 10:35		
SDG:			

Prep Method:	3050B	Prep Batch Date/Time:	4/18/24	7:00:00PM
Prep Batch ID:	1159990	Prep Analyst:	TNGO	

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Antimony	SW6010B	1	0.050	5.00	ND		mg/Kg	04/19/24	11:39	GS	483322
Arsenic	SW6010B	1	0.15	1.30	6.60		mg/Kg	04/19/24	11:39	GS	483322
Barium	SW6010B	1	0.055	5.00	195		mg/Kg	04/19/24	11:39	GS	483322
Beryllium	SW6010B	1	0.055	5.00	0.540	J	mg/Kg	04/19/24	11:39	GS	483322
Cadmium	SW6010B	1	0.10	0.750	ND		mg/Kg	04/19/24	11:39	GS	483322
Chromium	SW6010B	1	0.075	5.00	122		mg/Kg	04/19/24	11:39	GS	483322
Cobalt	SW6010B	1	0.070	5.00	17.9		mg/Kg	04/19/24	11:39	GS	483322
Copper	SW6010B	1	0.20	5.00	30.9		mg/Kg	04/19/24	11:39	GS	483322
Lead	SW6010B	1	0.10	3.00	7.55		mg/Kg	04/19/24	11:39	GS	483322
Molybdenum	SW6010B	1	0.050	5.00	0.295	J	mg/Kg	04/19/24	11:39	GS	483322
Nickel	SW6010B	1	0.50	5.00	191		mg/Kg	04/19/24	11:39	GS	483322
Selenium	SW6010B	1	0.35	1.10	ND		mg/Kg	04/19/24	11:39	GS	483322
Silver	SW6010B	1	0.15	0.500	ND		mg/Kg	04/19/24	11:39	GS	483322
Thallium	SW6010B	1	0.20	5.00	ND		mg/Kg	04/19/24	11:39	GS	483322
Vanadium	SW6010B	1	0.10	5.00	53.0		mg/Kg	04/19/24	11:39	GS	483322
Zinc	SW6010B	1	0.30	5.00	50.5		mg/Kg	04/19/24	11:39	GS	483322



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-2@3'	Lab Sample ID:	2404183-002A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 10:35		
SDG:			

Prep Method: WET/3010B	Prep Batch Date/Time: 4/25/24 12:50:00PM
Prep Batch ID: 1160173	Prep Analyst: ROME

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch
Chromium (STLC)	SW6010B-STL C	1	0.010	0.20	ND		mg/L	04/25/24	14:14	GS	483469



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-2@3'	Lab Sample ID:	2404183-002A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 10:35		
SDG:			

Prep Method:	3546_TPH	Prep Batch Date/Time:	4/17/24	2:26:00PM
Prep Batch ID:	1159947	Prep Analyst:	AKIZ	

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch
TPH as Diesel	SW8015B	1	0.66	2.0	2.01	x	mg/Kg	04/18/24	22:08	SN	483342
TPH as Motor Oil	SW8015B	1	0.76	5.0	10.2		mg/Kg	04/18/24	22:08	SN	483342
Acceptance Limits											
Pentacosane (S)	SW8015B		45 - 130		81.4		%	04/18/24	22:08	SN	483342

NOTE: x-not typical of Diesel ref. std: peaks within Diesel range quantified as diesel



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-2@3'	Lab Sample ID:	2404183-002A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 10:35		
SDG:			

Prep Method: 5035	Prep Batch Date/Time: 4/18/24 10:44:00AM
Prep Batch ID: 1160007	Prep Analyst: JZHAO

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Dichlorodifluoromethane	SW8260B	1	0.0012	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Chloromethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Vinyl Chloride	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Bromomethane	SW8260B	1	0.0027	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Chloroethane	SW8260B	1	0.0030	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Trichlorofluoromethane	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,1-Dichloroethene	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Freon 113	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Methylene Chloride	SW8260B	1	0.0071	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
trans-1,2-Dichloroethene	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
MTBE	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
TBA	SW8260B	1	0.012	0.050	ND		mg/Kg	04/18/24	15:36	JZ	483324
Diisopropyl ether	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,1-Dichloroethane	SW8260B	1	0.0022	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Ethyl tert-Butyl ether	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
cis-1,2-Dichloroethene	SW8260B	1	0.0022	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
2,2-Dichloropropane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Bromochloromethane	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Chloroform	SW8260B	1	0.0024	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Carbon Tetrachloride	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,1,1-Trichloroethane	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,1-Dichloropropene	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Benzene	SW8260B	1	0.0022	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
TAME	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,2-Dichloroethane	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Trichloroethene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Dibromomethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,2-Dichloropropane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Bromodichloromethane	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
cis-1,3-Dichloropropene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Toluene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Tetrachloroethene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
trans-1,3-Dichloropropene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,1,2-Trichloroethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Dibromochloromethane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,3-Dichloropropane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,2-Dibromoethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Chlorobenzene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-2@3'	Lab Sample ID:	2404183-002A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 10:35		
SDG:			

Prep Method: 5035	Prep Batch Date/Time: 4/18/24 10:44:00AM
Prep Batch ID: 1160007	Prep Analyst: JZHAO

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Ethylbenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,1,1,2-Tetrachloroethane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
m,p-Xylene	SW8260B	1	0.0032	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
o-Xylene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Styrene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Bromoform	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Isopropyl Benzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
n-Propylbenzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Bromobenzene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,1,2,2-Tetrachloroethane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
2-Chlorotoluene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,3,5-Trimethylbenzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,2,3-Trichloropropane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
4-Chlorotoluene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
tert-Butylbenzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,2,4-Trimethylbenzene	SW8260B	1	0.0014	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
sec-Butyl Benzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
p-Isopropyltoluene	SW8260B	1	0.0015	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,3-Dichlorobenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,4-Dichlorobenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
n-Butylbenzene	SW8260B	1	0.0015	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,2-Dichlorobenzene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,2-Dibromo-3-Chloropropane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Hexachlorobutadiene	SW8260B	1	0.0014	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,2,4-Trichlorobenzene	SW8260B	1	0.0015	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
Naphthalene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
1,2,3-Trichlorobenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	15:36	JZ	483324
2-Butanone	SW8260B	1	0.0023	0.0100	ND		mg/Kg	04/18/24	15:36	JZ	483324
(S) Dibromofluoromethane	SW8260B		59.8 - 148		110		%	04/18/24	15:36	JZ	483324
(S) Toluene-d8	SW8260B		55.2 - 133		106		%	04/18/24	15:36	JZ	483324
(S) 4-Bromofluorobenzene	SW8260B		55.8 - 141		115		%	04/18/24	15:36	JZ	483324



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-2@3'	Lab Sample ID:	2404183-002A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 10:35		
SDG:			

Prep Method:	5035GRO	Prep Batch Date/Time:	4/18/24	10:44:00AM
Prep Batch ID:	1160009	Prep Analyst:	JZHAO	

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch
TPH as Gasoline	SW8260B(TPH)	1	0.043	0.10	ND		mg/Kg	04/18/24	15:36	JZ	483324
(S) 4-Bromofluorobenzene	SW8260B(TPH)		43.9 - 127		112		%	04/18/24	15:36	JZ	483324



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-3@1'	Lab Sample ID:	2404183-003A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 9:50		
SDG:			

Prep Method:	7471BP	Prep Batch Date/Time:	4/18/24	7:15:00PM
Prep Batch ID:	1159988	Prep Analyst:	TNGO	

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Mercury	SW7471B	1	0.083	0.50	ND		mg/Kg	04/19/24	11:48	BJAY	483311



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-3@1'	Lab Sample ID:	2404183-003A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 9:50		
SDG:			

Prep Method: 3050B	Prep Batch Date/Time: 4/18/24 7:00:00PM
Prep Batch ID: 1159990	Prep Analyst: TNGO

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch
<i>The results shown below are reported using their MDL.</i>											
Antimony	SW6010B	1	0.050	5.00	ND		mg/Kg	04/19/24	11:45	GS	483322
Arsenic	SW6010B	1	0.15	1.30	4.83		mg/Kg	04/19/24	11:45	GS	483322
Barium	SW6010B	1	0.055	5.00	310		mg/Kg	04/19/24	11:45	GS	483322
Beryllium	SW6010B	1	0.055	5.00	0.610	J	mg/Kg	04/19/24	11:45	GS	483322
Cadmium	SW6010B	1	0.10	0.750	ND		mg/Kg	04/19/24	11:45	GS	483322
Chromium	SW6010B	1	0.075	5.00	92.0		mg/Kg	04/19/24	11:45	GS	483322
Cobalt	SW6010B	1	0.070	5.00	17.3		mg/Kg	04/19/24	11:45	GS	483322
Copper	SW6010B	1	0.20	5.00	33.7		mg/Kg	04/19/24	11:45	GS	483322
Lead	SW6010B	1	0.10	3.00	7.85		mg/Kg	04/19/24	11:45	GS	483322
Molybdenum	SW6010B	1	0.050	5.00	0.310	J	mg/Kg	04/19/24	11:45	GS	483322
Nickel	SW6010B	1	0.50	5.00	158		mg/Kg	04/19/24	11:45	GS	483322
Selenium	SW6010B	1	0.35	1.10	ND		mg/Kg	04/19/24	11:45	GS	483322
Silver	SW6010B	1	0.15	0.500	ND		mg/Kg	04/19/24	11:45	GS	483322
Thallium	SW6010B	1	0.20	5.00	ND		mg/Kg	04/19/24	11:45	GS	483322
Vanadium	SW6010B	1	0.10	5.00	52.5		mg/Kg	04/19/24	11:45	GS	483322
Zinc	SW6010B	1	0.30	5.00	53.0		mg/Kg	04/19/24	11:45	GS	483322



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-3@1'	Lab Sample ID:	2404183-003A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 9:50		
SDG:			

Prep Method: WET/3010B	Prep Batch Date/Time: 4/25/24 12:50:00PM
Prep Batch ID: 1160173	Prep Analyst: ROME

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch
Chromium (STLC)	SW6010B-STL C	1	0.010	0.20	ND		mg/L	04/25/24	14:15	GS	483469



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-3@1'	Lab Sample ID:	2404183-003A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 9:50		
SDG:			

Prep Method:	3546_TPH	Prep Batch Date/Time:	4/17/24	2:26:00PM
Prep Batch ID:	1159947	Prep Analyst:	AKIZ	

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch
TPH as Diesel	SW8015B	1	0.66	2.0	4.05	x	mg/Kg	04/18/24	22:31	SN	483342
TPH as Motor Oil	SW8015B	1	0.76	5.0	19.4		mg/Kg	04/18/24	22:31	SN	483342
Acceptance Limits											
Pentacosane (S)	SW8015B		45 - 130		79.6		%	04/18/24	22:31	SN	483342

NOTE: x-not typical of Diesel ref. std: peaks within Diesel range quantified as diesel



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID: SB-3@1'
Project Name/Location: City of Morgan Hill-E Dunne Ave
Project Number: 9158.003.009
Date/Time Sampled: 04/17/24 / 9:50
SDG:

Lab Sample ID: 2404183-003A
Sample Matrix: Soil

Prep Method: 5035
Prep Batch ID: 1160007

Prep Batch Date/Time: 4/18/24 10:44:00AM
Prep Analyst: JZHAO

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Dichlorodifluoromethane	SW8260B	1	0.0012	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Chloromethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Vinyl Chloride	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Bromomethane	SW8260B	1	0.0027	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Chloroethane	SW8260B	1	0.0030	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Trichlorofluoromethane	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,1-Dichloroethene	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Freon 113	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Methylene Chloride	SW8260B	1	0.0071	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
trans-1,2-Dichloroethene	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
MTBE	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
TBA	SW8260B	1	0.012	0.050	ND		mg/Kg	04/18/24	16:09	JZ	483324
Diisopropyl ether	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,1-Dichloroethane	SW8260B	1	0.0022	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Ethyl tert-Butyl ether	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
cis-1,2-Dichloroethene	SW8260B	1	0.0022	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
2,2-Dichloropropane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Bromochloromethane	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Chloroform	SW8260B	1	0.0024	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Carbon Tetrachloride	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,1,1-Trichloroethane	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,1-Dichloropropene	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Benzene	SW8260B	1	0.0022	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
TAME	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,2-Dichloroethane	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Trichloroethene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Dibromomethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,2-Dichloropropane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Bromodichloromethane	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
cis-1,3-Dichloropropene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Toluene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Tetrachloroethene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
trans-1,3-Dichloropropene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,1,2-Trichloroethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Dibromochloromethane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,3-Dichloropropane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,2-Dibromoethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Chlorobenzene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-3@1'	Lab Sample ID:	2404183-003A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 9:50		
SDG:			

Prep Method: 5035	Prep Batch Date/Time: 4/18/24 10:44:00AM
Prep Batch ID: 1160007	Prep Analyst: JZHAO

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Ethylbenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,1,1,2-Tetrachloroethane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
m,p-Xylene	SW8260B	1	0.0032	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
o-Xylene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Styrene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Bromoform	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Isopropyl Benzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
n-Propylbenzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Bromobenzene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,1,2,2-Tetrachloroethane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
2-Chlorotoluene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,3,5-Trimethylbenzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,2,3-Trichloropropane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
4-Chlorotoluene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
tert-Butylbenzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,2,4-Trimethylbenzene	SW8260B	1	0.0014	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
sec-Butyl Benzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
p-Isopropyltoluene	SW8260B	1	0.0015	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,3-Dichlorobenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,4-Dichlorobenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
n-Butylbenzene	SW8260B	1	0.0015	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,2-Dichlorobenzene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,2-Dibromo-3-Chloropropane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Hexachlorobutadiene	SW8260B	1	0.0014	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,2,4-Trichlorobenzene	SW8260B	1	0.0015	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
Naphthalene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
1,2,3-Trichlorobenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	16:09	JZ	483324
2-Butanone	SW8260B	1	0.0023	0.0100	ND		mg/Kg	04/18/24	16:09	JZ	483324
(S) Dibromofluoromethane	SW8260B		59.8 - 148		109		%	04/18/24	16:09	JZ	483324
(S) Toluene-d8	SW8260B		55.2 - 133		110		%	04/18/24	16:09	JZ	483324
(S) 4-Bromofluorobenzene	SW8260B		55.8 - 141		125		%	04/18/24	16:09	JZ	483324



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-3@1'	Lab Sample ID:	2404183-003A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 9:50		
SDG:			

Prep Method:	5035GRO	Prep Batch Date/Time:	4/18/24	10:44:00AM
Prep Batch ID:	1160009	Prep Analyst:	JZHAO	

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch
TPH as Gasoline	SW8260B(TPH)	1	0.043	0.10	ND		mg/Kg	04/18/24	16:09	JZ	483324
(S) 4-Bromofluorobenzene	SW8260B(TPH)		43.9 - 127		92.3		%	04/18/24	16:09	JZ	483324



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-4@3'	Lab Sample ID:	2404183-004A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 9:15		
SDG:			

Prep Method: 7471BP	Prep Batch Date/Time: 4/18/24 7:15:00PM
Prep Batch ID: 1159988	Prep Analyst: TNGO

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Mercury	SW7471B	1	0.083	0.50	ND		mg/Kg	04/19/24	11:50	BJAY	483311



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-4@3'	Lab Sample ID:	2404183-004A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 9:15		
SDG:			

Prep Method:	3050B	Prep Batch Date/Time:	4/18/24	7:00:00PM
Prep Batch ID:	1159990	Prep Analyst:	TNGO	

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Antimony	SW6010B	1	0.050	5.00	ND		mg/Kg	04/19/24	11:46	GS	483322
Arsenic	SW6010B	1	0.15	1.30	4.96		mg/Kg	04/19/24	11:46	GS	483322
Barium	SW6010B	1	0.055	5.00	265		mg/Kg	04/19/24	11:46	GS	483322
Beryllium	SW6010B	1	0.055	5.00	0.640	J	mg/Kg	04/19/24	11:46	GS	483322
Cadmium	SW6010B	1	0.10	0.750	ND		mg/Kg	04/19/24	11:46	GS	483322
Chromium	SW6010B	1	0.075	5.00	128		mg/Kg	04/19/24	11:46	GS	483322
Cobalt	SW6010B	1	0.070	5.00	19.3		mg/Kg	04/19/24	11:46	GS	483322
Copper	SW6010B	1	0.20	5.00	30.3		mg/Kg	04/19/24	11:46	GS	483322
Lead	SW6010B	1	0.10	3.00	9.60		mg/Kg	04/19/24	11:46	GS	483322
Molybdenum	SW6010B	1	0.050	5.00	0.295	J	mg/Kg	04/19/24	11:46	GS	483322
Nickel	SW6010B	1	0.50	5.00	177		mg/Kg	04/19/24	11:46	GS	483322
Selenium	SW6010B	1	0.35	1.10	ND		mg/Kg	04/19/24	11:46	GS	483322
Silver	SW6010B	1	0.15	0.500	ND		mg/Kg	04/19/24	11:46	GS	483322
Thallium	SW6010B	1	0.20	5.00	ND		mg/Kg	04/19/24	11:46	GS	483322
Vanadium	SW6010B	1	0.10	5.00	64.5		mg/Kg	04/19/24	11:46	GS	483322
Zinc	SW6010B	1	0.30	5.00	47.9		mg/Kg	04/19/24	11:46	GS	483322



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-4@3'	Lab Sample ID:	2404183-004A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 9:15		
SDG:			

Prep Method:	WET/3010B	Prep Batch Date/Time:	4/25/24	12:50:00PM
Prep Batch ID:	1160173	Prep Analyst:	ROME	

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch
Chromium (STLC)	SW6010B-STL C	1	0.010	0.20	0.212		mg/L	04/25/24	14:17	GS	483469



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-4@3'	Lab Sample ID:	2404183-004A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 9:15		
SDG:			

Prep Method:	3546_TPH	Prep Batch Date/Time:	4/17/24	2:26:00PM
Prep Batch ID:	1159947	Prep Analyst:	AKIZ	

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch
TPH as Diesel	SW8015B	1	0.66	2.0	3.31	x	mg/Kg	04/18/24	22:54	SN	483342
TPH as Motor Oil	SW8015B	1	0.76	5.0	12.4		mg/Kg	04/18/24	22:54	SN	483342
Acceptance Limits											
Pentacosane (S)	SW8015B		45 - 130		44.6	S	%	04/18/24	22:54	SN	483342

NOTE: S-surrogate outside of control limits due to possible matrix interference
x-not typical of Diesel ref. std: peaks within Diesel range quantified as diesel



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-4@3'	Lab Sample ID:	2404183-004A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 9:15		
SDG:			

Prep Method: 5035	Prep Batch Date/Time: 4/18/24 10:44:00AM
Prep Batch ID: 1160007	Prep Analyst: JZHAO

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Dichlorodifluoromethane	SW8260B	1	0.0012	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Chloromethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Vinyl Chloride	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Bromomethane	SW8260B	1	0.0027	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Chloroethane	SW8260B	1	0.0030	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Trichlorofluoromethane	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,1-Dichloroethene	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Freon 113	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Methylene Chloride	SW8260B	1	0.0071	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
trans-1,2-Dichloroethene	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
MTBE	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
TBA	SW8260B	1	0.012	0.050	ND		mg/Kg	04/18/24	16:42	JZ	483324
Diisopropyl ether	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,1-Dichloroethane	SW8260B	1	0.0022	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Ethyl tert-Butyl ether	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
cis-1,2-Dichloroethene	SW8260B	1	0.0022	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
2,2-Dichloropropane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Bromochloromethane	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Chloroform	SW8260B	1	0.0024	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Carbon Tetrachloride	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,1,1-Trichloroethane	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,1-Dichloropropene	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Benzene	SW8260B	1	0.0022	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
TAME	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,2-Dichloroethane	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Trichloroethene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Dibromomethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,2-Dichloropropane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Bromodichloromethane	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
cis-1,3-Dichloropropene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Toluene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Tetrachloroethene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
trans-1,3-Dichloropropene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,1,2-Trichloroethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Dibromochloromethane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,3-Dichloropropane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,2-Dibromoethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Chlorobenzene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-4@3'	Lab Sample ID:	2404183-004A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 9:15		
SDG:			

Prep Method: 5035	Prep Batch Date/Time: 4/18/24 10:44:00AM
Prep Batch ID: 1160007	Prep Analyst: JZHAO

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Ethylbenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,1,1,2-Tetrachloroethane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
m,p-Xylene	SW8260B	1	0.0032	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
o-Xylene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Styrene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Bromoform	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Isopropyl Benzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
n-Propylbenzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Bromobenzene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,1,2,2-Tetrachloroethane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
2-Chlorotoluene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,3,5-Trimethylbenzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,2,3-Trichloropropane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
4-Chlorotoluene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
tert-Butylbenzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,2,4-Trimethylbenzene	SW8260B	1	0.0014	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
sec-Butyl Benzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
p-Isopropyltoluene	SW8260B	1	0.0015	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,3-Dichlorobenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,4-Dichlorobenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
n-Butylbenzene	SW8260B	1	0.0015	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,2-Dichlorobenzene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,2-Dibromo-3-Chloropropane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Hexachlorobutadiene	SW8260B	1	0.0014	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,2,4-Trichlorobenzene	SW8260B	1	0.0015	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
Naphthalene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
1,2,3-Trichlorobenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	16:42	JZ	483324
2-Butanone	SW8260B	1	0.0023	0.0100	ND		mg/Kg	04/18/24	16:42	JZ	483324
(S) Dibromofluoromethane	SW8260B		59.8 - 148		110		%	04/18/24	16:42	JZ	483324
(S) Toluene-d8	SW8260B		55.2 - 133		111		%	04/18/24	16:42	JZ	483324
(S) 4-Bromofluorobenzene	SW8260B		55.8 - 141		121		%	04/18/24	16:42	JZ	483324



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-4@3'	Lab Sample ID:	2404183-004A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 9:15		
SDG:			

Prep Method:	5035GRO	Prep Batch Date/Time:	4/18/24	10:44:00AM
Prep Batch ID:	1160009	Prep Analyst:	JZHAO	

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch
TPH as Gasoline	SW8260B(TPH)	1	0.043	0.10	ND		mg/Kg	04/18/24	16:42	JZ	483324
(S) 4-Bromofluorobenzene	SW8260B(TPH)		43.9 - 127		87.0		%	04/18/24	16:42	JZ	483324



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-5@1'	Lab Sample ID:	2404183-005A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 8:45		
SDG:			

Prep Method: 7471BP	Prep Batch Date/Time: 4/18/24 7:15:00PM
Prep Batch ID: 1159988	Prep Analyst: TNGO

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Mercury	SW7471B	1	0.083	0.50	ND		mg/Kg	04/19/24	11:57	BJAY	483311



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-5@1'	Lab Sample ID:	2404183-005A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 8:45		
SDG:			

Prep Method:	3050B	Prep Batch Date/Time:	4/18/24	7:00:00PM
Prep Batch ID:	1159990	Prep Analyst:	TNGO	

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Antimony	SW6010B	1	0.050	5.00	0.0800	J	mg/Kg	04/19/24	11:48	GS	483322
Arsenic	SW6010B	1	0.15	1.30	4.08		mg/Kg	04/19/24	11:48	GS	483322
Barium	SW6010B	1	0.055	5.00	230		mg/Kg	04/19/24	11:48	GS	483322
Beryllium	SW6010B	1	0.055	5.00	0.615	J	mg/Kg	04/19/24	11:48	GS	483322
Cadmium	SW6010B	1	0.10	0.750	ND		mg/Kg	04/19/24	11:48	GS	483322
Chromium	SW6010B	1	0.075	5.00	138		mg/Kg	04/19/24	11:48	GS	483322
Cobalt	SW6010B	1	0.070	5.00	18.1		mg/Kg	04/19/24	11:48	GS	483322
Copper	SW6010B	1	0.20	5.00	26.3		mg/Kg	04/19/24	11:48	GS	483322
Lead	SW6010B	1	0.10	3.00	8.20		mg/Kg	04/19/24	11:48	GS	483322
Molybdenum	SW6010B	1	0.050	5.00	0.160	J	mg/Kg	04/19/24	11:48	GS	483322
Nickel	SW6010B	1	0.50	5.00	210		mg/Kg	04/19/24	11:48	GS	483322
Selenium	SW6010B	1	0.35	1.10	ND		mg/Kg	04/19/24	11:48	GS	483322
Silver	SW6010B	1	0.15	0.500	ND		mg/Kg	04/19/24	11:48	GS	483322
Thallium	SW6010B	1	0.20	5.00	ND		mg/Kg	04/19/24	11:48	GS	483322
Vanadium	SW6010B	1	0.10	5.00	58.5		mg/Kg	04/19/24	11:48	GS	483322
Zinc	SW6010B	1	0.30	5.00	40.7		mg/Kg	04/19/24	11:48	GS	483322



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-5@1'	Lab Sample ID:	2404183-005A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 8:45		
SDG:			

Prep Method: WET/3010B	Prep Batch Date/Time: 4/25/24 12:50:00PM
Prep Batch ID: 1160173	Prep Analyst: ROME

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch
Chromium (STLC)	SW6010B-STL C	1	0.010	0.20	0.262		mg/L	04/25/24	14:19	GS	483469
Nickel (STLC)	SW6010B-STL C	1	0.010	0.20	3.41		mg/L	04/25/24	14:19	GS	483469



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-5@1'	Lab Sample ID:	2404183-005A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 8:45		
SDG:			

Prep Method:	3546_TPH	Prep Batch Date/Time:	4/17/24	2:26:00PM
Prep Batch ID:	1159947	Prep Analyst:	AKIZ	

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch
TPH as Diesel	SW8015B	1	0.66	2.0	4.58	x	mg/Kg	04/18/24	23:16	SN	483342
TPH as Motor Oil	SW8015B	1	0.76	5.0	23.8		mg/Kg	04/18/24	23:16	SN	483342
Acceptance Limits					68.8		%	04/18/24	23:16	SN	483342
Pentacosane (S)	SW8015B		45 - 130								

NOTE: x-Diesel value the result of overlap of Oil range into Diesel range



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-5@1'	Lab Sample ID:	2404183-005A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 8:45		
SDG:			

Prep Method: 5035	Prep Batch Date/Time: 4/18/24 10:44:00AM
Prep Batch ID: 1160007	Prep Analyst: JZHAO

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Dichlorodifluoromethane	SW8260B	1	0.0012	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Chloromethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Vinyl Chloride	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Bromomethane	SW8260B	1	0.0027	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Chloroethane	SW8260B	1	0.0030	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Trichlorofluoromethane	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,1-Dichloroethene	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Freon 113	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Methylene Chloride	SW8260B	1	0.0071	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
trans-1,2-Dichloroethene	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
MTBE	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
TBA	SW8260B	1	0.012	0.050	ND		mg/Kg	04/18/24	20:29	JZ	483324
Diisopropyl ether	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,1-Dichloroethane	SW8260B	1	0.0022	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Ethyl tert-Butyl ether	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
cis-1,2-Dichloroethene	SW8260B	1	0.0022	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
2,2-Dichloropropane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Bromochloromethane	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Chloroform	SW8260B	1	0.0024	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Carbon Tetrachloride	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,1,1-Trichloroethane	SW8260B	1	0.0021	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,1-Dichloropropene	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Benzene	SW8260B	1	0.0022	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
TAME	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,2-Dichloroethane	SW8260B	1	0.0023	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Trichloroethene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Dibromomethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,2-Dichloropropane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Bromodichloromethane	SW8260B	1	0.0020	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
cis-1,3-Dichloropropene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Toluene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Tetrachloroethene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
trans-1,3-Dichloropropene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,1,2-Trichloroethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Dibromochloromethane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,3-Dichloropropane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,2-Dibromoethane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Chlorobenzene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-5@1'	Lab Sample ID:	2404183-005A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 8:45		
SDG:			

Prep Method: 5035	Prep Batch Date/Time: 4/18/24 10:44:00AM
Prep Batch ID: 1160007	Prep Analyst: JZHAO

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch

The results shown below are reported using their MDL.

Ethylbenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,1,1,2-Tetrachloroethane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
m,p-Xylene	SW8260B	1	0.0032	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
o-Xylene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Styrene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Bromoform	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Isopropyl Benzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
n-Propylbenzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Bromobenzene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,1,2,2-Tetrachloroethane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
2-Chlorotoluene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,3,5-Trimethylbenzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,2,3-Trichloropropane	SW8260B	1	0.0019	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
4-Chlorotoluene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
tert-Butylbenzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,2,4-Trimethylbenzene	SW8260B	1	0.0014	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
sec-Butyl Benzene	SW8260B	1	0.0016	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
p-Isopropyltoluene	SW8260B	1	0.0015	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,3-Dichlorobenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,4-Dichlorobenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
n-Butylbenzene	SW8260B	1	0.0015	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,2-Dichlorobenzene	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,2-Dibromo-3-Chloropropane	SW8260B	1	0.0018	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Hexachlorobutadiene	SW8260B	1	0.0014	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,2,4-Trichlorobenzene	SW8260B	1	0.0015	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
Naphthalene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
1,2,3-Trichlorobenzene	SW8260B	1	0.0017	0.010	ND		mg/Kg	04/18/24	20:29	JZ	483324
2-Butanone	SW8260B	1	0.0023	0.0100	ND		mg/Kg	04/18/24	20:29	JZ	483324
(S) Dibromofluoromethane	SW8260B		59.8 - 148		109		%	04/18/24	20:29	JZ	483324
(S) Toluene-d8	SW8260B		55.2 - 133		113		%	04/18/24	20:29	JZ	483324
(S) 4-Bromofluorobenzene	SW8260B		55.8 - 141		133		%	04/18/24	20:29	JZ	483324



SAMPLE RESULTS

Report prepared for: Nadine Periat
Engeo (San Ramon)

Date/Time Received: 04/17/24, 12:58 pm
Date Reported: 04/22/24

Client Sample ID:	SB-5@1'	Lab Sample ID:	2404183-005A
Project Name/Location:	City of Morgan Hill-E Dunne Ave	Sample Matrix:	Soil
Project Number:	9158.003.009		
Date/Time Sampled:	04/17/24 / 8:45		
SDG:			

Prep Method: 5035GRO	Prep Batch Date/Time: 4/18/24 10:44:00AM
Prep Batch ID: 1160009	Prep Analyst: JZHAO

Parameters:	Analysis Method	DF	MDL	PQL	Results	Q	Units	Analyzed	Time	By	Analytical Batch
TPH as Gasoline	SW8260B(TPH)	1	0.043	0.10	ND		mg/Kg	04/18/24	20:29	JZ	483324
(S) 4-Bromofluorobenzene	SW8260B(TPH)		43.9 - 127		76.3		%	04/18/24	20:29	JZ	483324



MB Summary Report

Work Order:	2404183	Prep Method:	3546_TPH	Prep Date:	04/17/24	Prep Batch:	1159947
Matrix:	Soil	Analytical Method:	SW8015B	Analyzed Date:	4/17/2024	Analytical Batch:	483294
Units:	mg/Kg						

Parameters	MDL	PQL	Method Blank Conc.	Lab Qualifier	
TPH as Diesel	0.66	2.0	ND		
TPH as Motor Oil	0.76	5.0	2.10		
Pentacosane (S)			89.6		

Work Order:	2404183	Prep Method:	7471BP	Prep Date:	04/18/24	Prep Batch:	1159988
Matrix:	Soil	Analytical Method:	SW7471B	Analyzed Date:	4/19/2024	Analytical Batch:	483311
Units:	mg/Kg						

Parameters	MDL	PQL	Method Blank Conc.	Lab Qualifier	
Mercury	0.083	0.50	ND		

Work Order:	2404183	Prep Method:	3050B	Prep Date:	04/18/24	Prep Batch:	1159990
Matrix:	Soil	Analytical Method:	SW6010B	Analyzed Date:	4/19/2024	Analytical Batch:	483322
Units:	mg/Kg						

Parameters	MDL	PQL	Method Blank Conc.	Lab Qualifier	
Antimony	0.050	5.00	0.13	J	
Arsenic	0.15	1.30	ND		
Barium	0.055	5.00	0.055	J	
Beryllium	0.055	5.00	ND		
Cadmium	0.10	0.750	ND		
Chromium	0.075	5.00	ND		
Cobalt	0.070	5.00	ND		
Copper	0.20	5.00	ND		
Lead	0.10	3.00	0.13	J	
Molybdenum	0.050	5.00	ND		
Nickel	0.50	5.00	ND		
Selenium	0.35	1.10	ND		
Silver	0.15	0.500	ND		
Thallium	0.55	5.00	ND		
Vanadium	0.10	5.00	ND		
Zinc	0.30	5.00	ND		



MB Summary Report

Work Order:	2404183	Prep Method:	5035	Prep Date:	04/18/24	Prep Batch:	1160007
Matrix:	Soil	Analytical Method:	SW8260B	Analyzed Date:	4/18/2024	Analytical Batch:	483324
Units:	ug/Kg						

Parameters	MDL	PQL	Method Blank Conc.	Lab Qualifier	
Dichlorodifluoromethane	1.2	10	ND		
Chloromethane	1.8	10	ND		
Vinyl Chloride	2.0	10	ND		
Bromomethane	2.7	10	ND		
Chloroethane	3.0	10	ND		
Trichlorofluoromethane	2.1	10	ND		
1,1-Dichloroethene	2.0	10	ND		
Freon 113	1.9	10	ND		
Methylene Chloride	7.1	10	ND		
trans-1,2-Dichloroethene	2.1	10	ND		
MTBE	2.3	10	ND		
TBA	12	50	ND		
Diisopropyl ether	2.3	10	ND		
1,1-Dichloroethane	2.2	10	ND		
Ethyl tert-Butyl ether	2.3	10	ND		
cis-1,2-Dichloroethene	2.2	10	ND		
2,2-Dichloropropane	1.9	10	ND		
Bromochloromethane	2.3	10	ND		
Chloroform	2.4	10	ND		
Carbon Tetrachloride	2.1	10	ND		
1,1,1-Trichloroethane	2.1	10	ND		
1,1-Dichloropropene	2.0	10	ND		
Benzene	2.2	10	ND		
TAME	2.3	10	ND		
1,2-Dichloroethane	2.3	10	ND		
Trichloroethene	1.8	10	ND		
Dibromomethane	1.8	10	ND		
1,2-Dichloropropane	1.9	10	ND		
Bromodichloromethane	2.0	10	ND		
cis-1,3-Dichloropropene	1.6	10	ND		
Toluene	1.8	10	ND		
Tetrachloroethene	1.7	10	ND		
trans-1,3-Dichloropropene	1.6	10	ND		
1,1,2-Trichloroethane	1.8	10	ND		
Dibromochloromethane	1.9	10	ND		
1,3-Dichloropropane	1.8	10	ND		
1,2-Dibromoethane	1.8	10	ND		
Chlorobenzene	1.8	10	ND		
Ethylbenzene	1.7	10	ND		
1,1,1,2-Tetrachloroethane	1.9	10	ND		
m,p-Xylene	3.2	10	ND		
o-Xylene	1.7	10	ND		
Styrene	1.6	10	ND		
Bromoform	1.7	10	ND		
Isopropyl Benzene	1.6	10	ND		



MB Summary Report

Work Order:	2404183	Prep Method:	5035	Prep Date:	04/18/24	Prep Batch:	1160007
Matrix:	Soil	Analytical Method:	SW8260B	Analyzed Date:	4/18/2024	Analytical Batch:	483324
Units:	ug/Kg						

Parameters	MDL	PQL	Method Blank Conc.	Lab Qualifier	
n-Propylbenzene	1.6	10	ND		
Bromobenzene	1.8	10	ND		
1,1,2,2-Tetrachloroethane	1.9	10	ND		
2-Chlorotoluene	1.8	10	ND		
1,3,5-Trimethylbenzene	1.6	10	ND		
1,2,3-Trichloropropane	1.9	10	ND		
4-Chlorotoluene	1.6	10	ND		
tert-Butylbenzene	1.6	10	ND		
1,2,4-Trimethylbenzene	1.4	10	ND		
sec-Butyl Benzene	1.6	10	ND		
p-Isopropyltoluene	1.5	10	ND		
1,3-Dichlorobenzene	1.7	10	ND		
1,4-Dichlorobenzene	1.7	10	ND		
n-Butylbenzene	1.5	10	ND		
1,2-Dichlorobenzene	1.8	10	ND		
1,2-Dibromo-3-Chloropropane	1.8	10	ND		
Hexachlorobutadiene	1.4	10	ND		
1,2,4-Trichlorobenzene	1.5	10	5.2		
Naphthalene	1.7	10	6.5		
1,2,3-Trichlorobenzene	1.7	10	6.1		
2-Butanone	2.3	10	ND		
(S) Dibromofluoromethane			107		
(S) Toluene-d8			105		
(S) 4-Bromofluorobenzene			118		

Work Order:	2404183	Prep Method:	5035GRO	Prep Date:	04/18/24	Prep Batch:	1160009
Matrix:	Soil	Analytical Method:	SW8260B(TPH)	Analyzed Date:	4/18/2024	Analytical Batch:	483324
Units:	ug/Kg						

Parameters	MDL	PQL	Method Blank Conc.	Lab Qualifier	
TPH as Gasoline	43	100	ND		
(S) 4-Bromofluorobenzene			92.6		

Work Order:	2404183	Prep Method:	WET/3010B	Prep Date:	04/25/24	Prep Batch:	1160173
Matrix:	Soil	Analytical Method:	SW6010B-STLC	Analyzed Date:	4/25/2024	Analytical Batch:	483469
Units:	mg/L						

Parameters	MDL	PQL	Method Blank Conc.	Lab Qualifier	
Chromium (STLC)	0.010	0.20	0.018		
Nickel (STLC)	0.010	0.20	ND		



LCS/LCSD Summary Report

Raw values are used in quality control assessment.

Work Order:	2404183	Prep Method:	3546_TPH	Prep Date:	04/17/24	Prep Batch:	1159947
Matrix:	Soil	Analytical Method:	SW8015B	Analyzed Date:	4/17/2024	Analytical Batch:	483294
Units:	mg/Kg						

Parameters	MDL	PQL	Method Blank Conc.	Spike Conc.	LCS % Recovery	LCSD % Recovery	LCS/LCSD % RPD	% Recovery Limits	% RPD Limits	Lab Qualifier
TPH as Diesel	0.66	2.0	ND	25.0	66.7	71.3	6.38	52 - 115	30	
Pentacosane (S)				200	93.1	91.4		45 - 130		

Work Order:	2404183	Prep Method:	7471BP	Prep Date:	04/18/24	Prep Batch:	1159988
Matrix:	Soil	Analytical Method:	SW7471B	Analyzed Date:	4/19/2024	Analytical Batch:	483311
Units:	mg/Kg						

Parameters	MDL	PQL	Method Blank Conc.	Spike Conc.	LCS % Recovery	LCSD % Recovery	LCS/LCSD % RPD	% Recovery Limits	% RPD Limits	Lab Qualifier
Mercury	0.047	0.50	ND	1.25	97.2	95.7	1.65	80 - 120	20	

Work Order:	2404183	Prep Method:	3050B	Prep Date:	04/18/24	Prep Batch:	1159990
Matrix:	Soil	Analytical Method:	SW6010B	Analyzed Date:	4/19/2024	Analytical Batch:	483322
Units:	mg/Kg						

Parameters	MDL	PQL	Method Blank Conc.	Spike Conc.	LCS % Recovery	LCSD % Recovery	LCS/LCSD % RPD	% Recovery Limits	% RPD Limits	Lab Qualifier
Antimony	0.050	5.00	0.13	50	102	104	1.94	80 - 120	30	
Arsenic	0.15	1.30	ND	50	101	103	1.96	80 - 120	30	
Barium	0.055	5.00	0.055	50	107	109	1.85	80 - 120	30	
Beryllium	0.055	5.00	ND	50	106	108	1.87	80 - 120	30	
Cadmium	0.10	0.750	ND	50	104	106	1.90	80 - 120	30	
Chromium	0.075	5.00	ND	50	107	109	1.85	80 - 120	30	
Cobalt	0.070	5.00	ND	50	106	108	1.87	80 - 120	30	
Copper	0.20	5.00	ND	50	108	110	1.83	80 - 120	30	
Lead	0.10	3.00	0.13	50	106	107	0.939	80 - 120	30	
Molybdenum	0.050	5.00	ND	50	107	109	1.85	80 - 120	30	
Nickel	0.50	5.00	ND	50	106	107	0.939	80 - 120	30	
Selenium	0.22	5.00	ND	50	94.9	96.1	1.26	80 - 120	30	
Silver	0.15	5.00	ND	50	104	106	1.90	80 - 120	30	
Thallium	0.20	5.00	ND	50	105	107	1.89	80 - 120	30	
Vanadium	0.10	5.00	ND	50	107	109	1.85	80 - 120	30	
Zinc	0.30	5.00	ND	50	103	104	0.966	80 - 120	30	



LCS/LCSD Summary Report

Raw values are used in quality control assessment.

Work Order:	2404183	Prep Method:	5035	Prep Date:	04/18/24	Prep Batch:	1160007
Matrix:	Soil	Analytical Method:	SW8260B	Analyzed Date:	4/18/2024	Analytical Batch:	483324
Units:	ug/Kg						

Parameters	MDL	PQL	Method Blank Conc.	Spike Conc.	LCS % Recovery	LCSD % Recovery	LCS/LCSD % RPD	% Recovery Limits	% RPD Limits	Lab Qualifier
1,1-Dichloroethene	2.0	10	ND	50.0	80.9	84.6	4.59	53.7 - 139	30	
Benzene	2.2	10	ND	50.0	99.6	102	2.58	66.5 - 135	30	
Trichloroethene	1.8	10	ND	50.0	96.9	101	4.25	57.5 - 150	30	
Toluene	1.8	10	ND	50.0	98.5	102	3.40	56.8 - 134	30	
Chlorobenzene	1.8	10	ND	50.0	100	103	2.75	57.4 - 134	30	
(S) Dibromofluoromethane				50.0	91.5	93.8		59.8 - 148		
(S) Toluene-d8				50.0	97.4	98.5		55.2 - 133		
(S) 4-Bromofluorobenzene				50.0	106	110		55.8 - 141		

Work Order:	2404183	Prep Method:	5035GRO	Prep Date:	04/18/24	Prep Batch:	1160009
Matrix:	Soil	Analytical Method:	SW8260B(TPH)	Analyzed Date:	4/18/2024	Analytical Batch:	483324
Units:	ug/Kg						

Parameters	MDL	PQL	Method Blank Conc.	Spike Conc.	LCS % Recovery	LCSD % Recovery	LCS/LCSD % RPD	% Recovery Limits	% RPD Limits	Lab Qualifier
TPH as Gasoline	43	100	ND	1000	97.3	104	6.66	48.2 - 132	30	
(S) 4-Bromofluorobenzene				50	98.2	103		43.9 - 127		

Work Order:	2404183	Prep Method:	WET/3010B	Prep Date:	04/25/24	Prep Batch:	1160173
Matrix:	Soil	Analytical Method:	SW6010B-STLC	Analyzed Date:	4/25/2024	Analytical Batch:	483469
Units:	mg/L						

Parameters	MDL	PQL	Method Blank Conc.	Spike Conc.	LCS % Recovery	LCSD % Recovery	LCS/LCSD % RPD	% Recovery Limits	% RPD Limits	Lab Qualifier
Chromium (STLC)	0.010	0.20	0.018	10	100	99.3	0.702	80 - 120	20	
Nickel (STLC)	0.010	0.20	ND	10	99.2	98.4	0.810	80 - 120	20	



MS/MSD Summary Report

Raw values are used in quality control assessment.

Work Order:	2404183	Prep Method:	7471BP	Prep Date:	04/18/24	Prep Batch:	1159988
Matrix:	Soil	Analytical Method:	SW7471B	Analyzed Date:	4/19/2024	Analytical Batch:	483311
Spiked Sample:	2404183-002A						
Units:	mg/Kg						

Parameters	MDL	PQL	Sample Conc.	Spike Conc.	MS % Recovery	MSD % Recovery	MS/MSD % RPD	% Recovery Limits	% RPD Limits	Lab Qualifier
Mercury	0.047	0.50	ND	1.25	104	107	2.20	80 - 120	30	

Work Order:	2404183	Prep Method:	3050B	Prep Date:	04/18/24	Prep Batch:	1159990
Matrix:	Soil	Analytical Method:	SW6010B	Analyzed Date:	4/19/2024	Analytical Batch:	483322
Spiked Sample:	2404183-002A						
Units:	mg/Kg						

Parameters	MDL	PQL	Sample Conc.	Spike Conc.	MS % Recovery	MSD % Recovery	MS/MSD % RPD	% Recovery Limits	% RPD Limits	Lab Qualifier
Antimony	0.050	5.00	ND	50	84.8	80.5	5.08	30.7 - 130	30	
Arsenic	0.15	1.30	6.60	50	97.8	94.8	2.74	71.0 - 121	30	
Barium	0.055	5.00	195	50	104	99.0	0.813	70.2 - 130	30	
Beryllium	0.055	5.00	ND	50	102	99.9	1.96	73.3 - 115	30	
Cadmium	0.10	0.750	ND	50	95.3	93.7	1.69	80.0 - 110	30	
Chromium	0.075	5.00	122	50	96.0	97.0	0.587	76.0 - 116	30	
Cobalt	0.070	5.00	17.9	50	97.2	93.2	3.05	57.4 - 122	30	
Copper	0.20	5.00	30.9	50	112	107	2.92	74.8 - 119	30	
Lead	0.10	3.00	7.55	50	96.9	93.9	2.71	57.9 - 118	30	
Molybdenum	0.050	5.00	ND	50	98.3	95.6	2.87	62.9 - 123	30	
Nickel	0.50	5.00	191	50	101	67.0	7.28	61.5 - 122	30	
Selenium	0.22	5.00	ND	50	85.1	83.5	1.90	62.0 - 111	30	
Silver	0.15	5.00	ND	50	108	105	2.82	75 - 125	30	
Thallium	0.20	5.00	ND	50	93.0	91.1	1.95	39.2 - 125	30	
Vanadium	0.10	5.00	53.0	50	111	104	3.74	65.8 - 122	30	
Zinc	0.30	5.00	50.5	50	96.0	89.0	3.62	59.9 - 122	30	

Work Order:	2404183	Prep Method:	WET/3010B	Prep Date:	04/25/24	Prep Batch:	1160173
Matrix:	Soil	Analytical Method:	SW6010B-STLC	Analyzed Date:	4/25/2024	Analytical Batch:	483469
Spiked Sample:	2404183-001A						
Units:	mg/L						

Parameters	MDL	PQL	Sample Conc.	Spike Conc.	MS % Recovery	MSD % Recovery	MS/MSD % RPD	% Recovery Limits	% RPD Limits	Lab Qualifier
Chromium (STLC)	0.0100	0.200	0.232	10	101	99.7	0.976	75 - 125	20	
Nickel (STLC)	0.0100	0.200	2.09	10	98.1	97.1	0.844	75 - 125	20	



Laboratory Qualifiers and Definitions

DEFINITIONS:

Accuracy/Bias (% Recovery) - The closeness of agreement between an observed value and an accepted reference value.
Blank (Method/Preparation Blank) -MB/PB - An analyte-free matrix to which all reagents are added in the same volumes/proportions as used in sample processing. The method blank is used to document contamination resulting from the analytical process.
Duplicate - a field sample and/or laboratory QC sample prepared in duplicate following all of the same processes and procedures used on the original sample (sample duplicate, LCSD, MSD)
Laboratory Control Sample (LCS ad LCSD) - A known matrix spiked with compounds representative of the target analyte(s). This is used to document laboratory performance.
Matrix - the component or substrate that contains the analyte of interest (e.g., - groundwater, sediment, soil, waste water, etc)
Matrix Spike (MS/MSD) - Client sample spiked with identical concentrations of target analyte (s). The spiking occurs prior to the sample preparation and analysis. They are used to document the precision and bias of a method in a given sample matrix.
Method Detection Limit (MDL) - the minimum concentration of a substance that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero
Practical Quantitation Limit/Reporting Limit/Limit of Quantitation (PQL/RL/LOQ) - a laboratory determined value at 2 to 5 times above the MDL that can be reproduced in a manner that results in a 99% confidence level that the result is both accurate and precise. PQLs/RLs/LODs reflect all preparation factors and/or dilution factors that have been applied to the sample during the preparation and/or analytical processes.
Precision (%RPD) - The agreement among a set of replicate/duplicate measurements without regard to known value of the replicates
Surrogate (S) or (Surr) - An organic compound which is similar to the target analyte(s) in chemical composition and behavior in the analytical process, but which is not normally found in environmental samples. Surrogates are used in most organic analysis to demonstrate matrix compatibility with the chosen method of analysis
Tentatively Identified Compound (TIC) - A compound not contained within the analytical calibration standards but present in the GCMS library of defined compounds. When the library is searched for an unknown compound, it can frequently give a tentative identification to the compound based on retention time and primary and secondary ion match. TICs are reported as estimates and are candidates for further investigation.
Units: the unit of measure used to express the reported result - mg/L and mg/Kg (equivalent to PPM - parts per million in liquid and solid), ug/L and ug/Kg (equivalent to PPB - parts per billion in liquid and solid), ug/m3 , mg/m3 , ppbv and ppmv (all units of measure for reporting concentrations in air), % (equivalent to 10000 ppm or 1,000,000 ppb), ug/Wipe (concentration found on the surface of a single Wipe usually taken over a 100cm2 surface)

LABORATORY QUALIFIERS

B - Indicates when the analyte is found in the associated method or preparation blank
D - Surrogate is not recoverable due to the necessary dilution of the sample
E - Indicates the reportable value is outside of the calibration range of the instrument but within the linear range of the instrument (unless otherwise noted) Values reported with an E qualifier should be considered as estimated.
H - Indicates that the recommended holding time for the analyte or compound has been exceeded
J - Indicates a value between the method MDL and PQL and that the reported concentration should be considered as estimated rather the quantitative
NA - Not Analyzed
N/A - Not Applicable
ND - Not Detected at a concentration greater than the PQL/RL or, if reported to the MDL, at greater than the MDL.
NR - Not recoverable - a matrix spike concentration is not recoverable due to a concentration within the original sample that is greater than four times the spike concentration added
R - The % RPD between a duplicate set of samples is outside of the absolute values established by laboratory control charts
S - Spike recovery is outside of established method and/or laboratory control limits. Further explanation of the use of this qualifier should be included within a case narrative
X -Used to indicate that a value based on pattern identification is within the pattern range but not typical of the pattern found in standards. Further explanation may or may not be provided within the sample footnote and/or the case narrative.



Sample Receipt Checklist

Client Name: Engeo (San Ramon)

Date and Time Received: 4/17/2024 12:58:00PM

Project Name: City of Morgan Hill-E Dunne Ave

Received By: Claudia Moreno

Work Order No.: 2404183

Physically Logged By: Claudia Moreno

Checklist Completed By: Claudia Moreno

Carrier Name: Client Drop Off

Chain of Custody (COC) Information

Chain of custody present? Yes

Chain of custody signed when relinquished and received? Yes

Chain of custody agrees with sample labels? Yes

Custody seals intact on sample bottles? Not Present

Sample Receipt Information

Custody seals intact on shipping container/cooler? Not Present

Shipping Container/Cooler In Good Condition? Yes

Samples in proper container/bottle? Yes

Samples containers intact? Yes

Sufficient sample volume for indicated test? Yes

Sample Preservation and Hold Time (HT) Information

All samples received within holding time? Yes

Container/Temp Blank temperature in compliance? Temperature: 8.0 °C

Water-VOA vials have zero headspace? No VOA vials submitted

Water-pH acceptable upon receipt? N/A

pH Checked by: N/A

pH Adjusted by: N/A

Comments:

SAMPLE 1 IS LABELED AS SB-1@4.5' NOT SB-1@5'



Login Summary Report

Client ID: TL5123 Engeo (San Ramon)

QC Level: II

Project Name: City of Morgan Hill-E Dunne Ave

TAT Requested: 3 Day Std:3

Project # : 9158.003.009

Date Received: 4/17/2024

Report Due Date: 4/26/2024

Time Received: 12:58 pm

Comments:

Work Order # : **2404183**

<u>WO Sample ID</u>	<u>Client Sample ID</u>	<u>Collection Date/Time</u>	<u>Matrix</u>	<u>Scheduled Disposal</u>	<u>Sample On Hold</u>	<u>Test On Hold</u>	<u>Requested Tests</u>	<u>Subbed</u>
2404183-001A	SB-1@5'	04/17/24 11:55	Soil	10/14/24			TPHDO_S_8015(Mod) Met_S_CAM17STLC VOC_S_8260B mg/Kg VOC_S_GRO mg/Kg Met_S_6010B CAM17 Hg_S_7471B	
Sample Note: Pls report to MDL								
2404183-002A	SB-2@3'	04/17/24 10:35	Soil	10/14/24			TPHDO_S_8015(Mod) Met_S_CAM17STLC VOC_S_8260B mg/Kg VOC_S_GRO mg/Kg Met_S_6010B CAM17 Hg_S_7471B	
2404183-003A	SB-3@1'	04/17/24 9:50	Soil	10/14/24			TPHDO_S_8015(Mod) Met_S_CAM17STLC VOC_S_8260B mg/Kg VOC_S_GRO mg/Kg Met_S_6010B CAM17 Hg_S_7471B	
2404183-004A	SB-4@3'	04/17/24 9:15	Soil	10/14/24			TPHDO_S_8015(Mod) Met_S_CAM17STLC VOC_S_8260B mg/Kg VOC_S_GRO mg/Kg Met_S_6010B CAM17 Hg_S_7471B	
2404183-005A	SB-5@1'	04/17/24 8:45	Soil	10/14/24			TPHDO_S_8015(Mod) Hg_S_7471B Met_S_6010B CAM17	



Login Summary Report

Client ID:

TL5123

Engeo (San Ramon)

Project Name:

City of Morgan Hill-E Dunne Ave

Project # :

9158.003.009

Report Due Date:

4/26/2024

Comments:

Work Order # :

2404183

QC Level:

II

TAT Requested:

3 Day Std:3

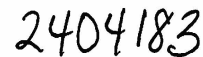
Date Received:

4/17/2024

Time Received:

12:58 pm

<u>WO Sample ID</u>	<u>Client Sample ID</u>	<u>Collection Date/Time</u>	<u>Matrix</u>	<u>Scheduled Disposal</u>	<u>Sample On Hold</u>	<u>Test On Hold</u>	<u>Requested Tests</u>	<u>Subbed</u>
							VOC_S_GRO mg/Kg VOC_S_8260B mg/Kg Met_S_CAM17STLC	

[illegible]

D/O 7.8#3

Technical Specification

PROJECT MANUAL
INCLUDING SPECIFICATIONS
FOR
EAST DUNNE HILLSIDE WATER RESERVOIR

CITY OF MORGAN HILL
SANTA CLARA COUNTY, CALIFORNIA
PROJECT NO. 603G1#

CONSTRUCTION DOCUMENTS
APRIL 2024

KENNEDY/JENKS CONSULTANTS
2350 Mission College Boulevard, Suite 525
Santa Clara, California 95054
650-852-2800

Job No. 2368021*00
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SECTION 01000

PROFESSIONAL RESPONSIBILITIES AND SEALS

**City of Morgan Hill Public Works Department
Morgan Hill, CA
East Dunne Hillside Water Reservoir**

The following Technical Specification Division(s) and/or Section(s) of this Project Manual: Divisions 1, 3, 5, 9, 13 were prepared under the direction and supervision of (whose seal and signature appear to the right): Donald Lee Barraza License No. C45483 Kennedy Jenks 275 Battery Street, Suite 550 San Francisco, CA 94111	
The following Technical Specification Division(s) and/or Section(s) of this Project Manual: Sections 02200, 02301, 02370, 02700, 02820 were prepared under the direction and supervision of (whose seal and signature appear to the right): Patrick Tran License No. 92907 Kennedy Jenks 35 N Lake Avenue, Suite 550 Pasadena, CA 91101	

The following Technical Specification Division(s) and/or Section(s) of this Project Manual: Sections 02065, 02085, 02510, 02630 were prepared under the direction and supervision of (whose seal and signature appear to the right): Jomel Bautista License No. C93806 Kennedy Jenks 2121 N California Boulevard, Suite 810 Walnut Creek, CA 94596	 04/29/24
The following Technical Specification Division(s) and/or Section(s) of this Project Manual: Sections 02100, 02810, 02900 were prepared under the direction and supervision of (whose seal and signature appear to the right): Barbara Lundburg License No. 1591 RHAA 225 Miller Ave Mill Valley, CA 94942	 04/29/24

The following Technical Specification Division(s) and/or Section(s) of this Project Manual: Sections 02480, 02485 were prepared under the direction and supervision of (whose seal and signature appear to the right): Jake Darin Salter License No. C75464 Kennedy Jenks 275 Battery Street, Suite 550 San Francisco, CA 94111	
The following Technical Specification Division(s) and/or Section(s) of this Project Manual: Divisions 11, 15 were prepared under the direction and supervision of (whose seal and signature appear to the right): Zachary D Harris License No. M28906 Kennedy Jenks 275 Battery Street, Suite 550 San Francisco, CA 94111	

The following Technical Specification Division(s) and/or Section(s) of this Project Manual: Division 16 were prepared under the direction and supervision of (whose seal and signature appear to the right): Sandy Schuler License No. E15453 Kennedy Jenks 2882 Prospect Park Drive, Suite 240 Rancho Cordova, CA 95670	
The following Technical Specification Division(s) and/or Section(s) of this Project Manual: Division 17 were prepared under the direction and supervision of (whose seal and signature appear to the right): Stephan Koweluk License No. E23895 Kennedy Jenks 1500 NE Irving St, Suite 200 Portland, OR, 97234	

The Engineer's/Architect's seals and signatures above do not apply to the documents that comprise Division 00, Bidding and Contracting Requirements unless specifically designated.

It is a violation of applicable laws and regulations governing professional licensing and registration for any person, unless acting under the direction of the licensed and registered design professional(s) indicated above, to alter in any way the Specifications in this Project Manual.

END OF PROFESSIONAL RESPONSIBILITIES AND SEALS

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SECTION 01010

SUMMARY OF WORK AND CONTRACT CONSIDERATIONS

1.01 WORK COVERED BY CONTRACT DOCUMENTS

- A. The project includes: site preparation and grading for the tank, access road, and future pump station; construction of access road; construction of new welded steel water storage tank including excavation of the tank pad, construction of ringwall footing and tank foundation, fabrication and erection of the welded steel tank, tank appurtenances, impressed current cathodic protection system, protective coatings, disinfection and testing; retaining walls for tank pad and access roadway; site utilities for water, sewer, storm drainage, and electrical service; connections to existing water system; site drainage and erosion control improvements; landscaping including planting and irrigation; new electric service including power feed, metering, distribution, tank lighting and receptacles, instrumentation and controls; together with associated site work, fencing, paving and demolition. Project earthwork is unbalanced and requires disposal of unsuitable material and importation of suitable material for engineered fill.

1.02 PROVISIONS FOR FUTURE WORK

- A. The Owner intends to build a water booster pump station on the southeast side of water storage tank pad in the near future. The Contractor shall not locate any conduits, pipes, equipment or other items in such a way that they will have to be relocated when the pump station is constructed.

1.03 CONTRACTOR'S USE OF SITE AND OWNER'S CONTINUED OPERATIONS

- A. The Contractor shall confine its use of the site for work and storage to the Work Area Limits shown on the contract drawings. The Contractor's use of adjacent lands and roads for access to move onto and off of the site and for daily access of workers, material and equipment shall be arranged and scheduled to minimize interference with the Owner's continued operations.

1.04 DOCUMENTING EXISTING

- A. Prior to commencing the Work, tour the site with the Owner and the Engineer. Examine and document photographically and in writing the condition of existing buildings, improvements, and landscape planting on or adjacent to the site. This record shall serve as a basis for determination of subsequent damage due to the Contractor's operations and shall be signed by all parties making the tour. Record existing conditions on a Video Tape or by making color photographs.

1.05 SHUTDOWN OF EXISTING UTILITIES, SERVICES OR OPERATIONS

- A. Obtain the Engineer's approval at least seven (7) days prior to the shutdown of any utility, service or operation of any existing facility. Give required notice and make appropriate arrangements with utility owners and other affected parties prior to shutdown of any utility service. The Contractor's Bid shall include the cost of

premium time to perform work requiring utility shutdowns on weekends or outside of normal working hours.

- B. Schedule utility service or operations shutdowns for periods of minimum use and at the Owner's convenience. Have all required material, equipment and workers on site prior to beginning any work involving a possible shutdown. Perform work as required to reduce shutdown time to the minimum. In some cases, this may require increased numbers of workers and/or premium time night or weekend work.
- C. The Contract Price shall include the cost of additional workers and premium time work required to minimize the impact of utility service or operations shutdowns.
Connections requiring shutdown of the water system shall be done between the hours of 12:00 midnight and 6:00 a.m..

1.06 SCHEDULE OF VALUES

- A. Specific provisions are described in the General Conditions.
- B. The Contractor's Schedule of Values shall be in a form acceptable to the Engineer and have at least the following level of detail: a separate line item for each technical specification section, for site mobilization, for Construction Scheduling, for bonds and insurance, for final cleanup and for final deliverables. Subdivide final deliverables into: Record Drawings; Operation and Maintenance Manuals with Parts Lists; and Special Guarantees. Include the appropriate specification section and paragraph number for each line item. Subdivide major trades or portions of the work into multiple line items that relate to observable milestones to aid monthly progress evaluations in accordance with the following example:

Concrete Work
 Foundations
 Slab on grade
 First floor walls and columns
 Second floor beams and slabs
 Second floor walls and columns, etc.

1.07 UNIT PRICE WORK (OPTIONAL)

- A. When the Contract Documents include Unit Price Work, the Contract Price shall include an amount equal to the sum of Unit Prices bid for each item times the estimated quantity for that item listed on the Bid Form.
- B. The estimated quantities listed on the Bid Form are not guaranteed to be accurate but are intended solely to determine a Contract Price. If actual quantities differ from estimated quantities by more than plus or minus 25% the unit prices may be adjusted by negotiation. Payment to the Contractor shall be based on actual quantities for each type of work as determined by the Engineer from certified quantity surveys or measurements submitted by the Contractor.
- C. For the purpose of determining quantities for payment, the Contractor shall submit certified surveys by a licensed surveyor or other certified measurements of quantities to the Engineer with each application for payment. The Engineer will

determine the quantities for payment based on data submitted by the Contractor and the Engineer's written determination shall be final unless appealed within 14 days under General Conditions.

- D. Unit Prices shall include all of the Contractor's cost including overhead and profit.

1.08 REGULATORY REQUIREMENTS

- A. The codes and regulations together with local amendments when applicable adopted by the State and other governmental authorities having jurisdiction shall establish minimum requirements for this project. This project shall comply with the following:
1. California Building Code (CBC) 2016 edition
 2. California Plumbing Code (CPC) 2016 edition
 3. California Electric Code (CEC) 2016 edition
 4. California Green Building Standards
 5. California Energy Commission
 6. California Code of Regulations
 - a. Title 8, Industrial Relations: Especially CAL-OSHA.
 - b. Title 19, Public Safety: Portions of the work regulated by the State Fire Marshal.
 - c. Title 24, Building Standards: Regulations applicable to Essential Service Facilities, Energy Conservation, Public Assembly and Handicapped Access.
- B. The latest edition of the requirements in effect at the date of submission of bids shall apply.
- C. General Conditions cover the Contractor's responsibility to comply with laws and codes applicable to Means and Methods for performing the Work.
- D. General Conditions cover the Contractor's responsibility to report code deficiencies in the design to the Engineer prior to proceeding with the Work.
- E. Paragraphs addressing Pre-Engineered Systems and Performance Specifications in other Sections cover the Contractor's responsibility to comply with code requirements when (1) performance specifications are used to describe all or portions of Work or items and (2) when pre-engineered (contractor designed) systems are specified.
- F. In cases where the Contract Documents are more restrictive than applicable codes, the Contractor shall comply with the Contract Documents.

1.9 REFERENCE STANDARDS

- A. When these specifications state that Work or tests shall conform to specific provisions in a referenced standard, specification, code, recommendation or manual published by an association, organization, society or agency the referenced provisions, as they apply to the Work of the Contractor only shall be considered a part of these specifications as fully as if included in total. When these specifications or applicable codes contain higher or more restrictive requirements than those

contained in reference standards these specifications or applicable codes shall govern.

- B. The latest edition of a referenced standard published at the time of submission of bids shall apply unless a specific date for the referenced standard is cited in these specifications.
- C. General provisions in referenced standards, specifications, manuals or codes shall not change the specific duties and responsibilities between any of the parties involved in this work from those described in the General Conditions. Provisions in referenced standards with regard to measurement and payment shall not apply to this Work unless specifically cited. See General Conditions.

1.10 SPECIFICATION LANGUAGE AND STYLE

- A. Many parts of the Specifications as well as notes on the Drawings are written in the active voice and are addressed to the Contractor.
 - 1. When words or phrases requiring an action or performance of a task are used, it means that the Contractor shall provide the action or perform the task. For example: provide, perform, install, furnish, erect, connect, test, operate, adjust or similar words mean that the Contractor shall perform the action or task referred to.
 - 2. When words or phrases requiring selection, acceptance, approval, review, direction, designation or similar actions are referred to, it means that such actions are the Owner's or the Engineer's prerogative and that the Contractor must obtain such action before proceeding.
- B. Requirements in the Specifications and Drawings apply to all work of a similar type, kind or class even though the word "all" or "typical" may not be stated.

1.11 DEFINITIONS

- A. The following terms, when used in the Contract Documents, shall have the meanings listed:

ACCEPTABLE	"acceptable to the Engineer"
PERFORM	"perform all operations required to complete the work referred to in accordance with the intent of the Contract Documents"
PROVIDE	"furnish and install the work referred to including proper anchorage, connection to required utilities or other work, testing, adjustment and startup ready to put in service and perform the intended function"
REQUIRED	"required by the Contract Documents or required to complete the Work and produce the intended results"
SATISFACTORY	"acceptable to the Engineer"
SHOWN	"as indicated on the Drawings"
SITE	"geographical location of the Project and land within the work area shown on the contract drawings and within which the Work will be installed or built"

SPECIFIED	"as written in the Contract Documents including the Specifications and the Drawings"
SUBMIT	"submit to the Engineer"

1.12 ABBREVIATIONS

- A. The following acronyms or abbreviations are used in these specifications for the organizations listed.

<u>Abbreviation</u>	<u>Stands for</u>
AASHTO	American Association of State Highway and Transportation Officials
AAMA	Architectural Aluminum Manufacturers Association
ABMA	American Boiler Manufacturers Association
ACI	American Concrete Institute
ADC	Air Diffusion Council
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AI	Asphalt Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standard Institute (formerly United States of America Standards Institute)
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
AREA	American Railway Engineering Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWPA	American Wood-Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
CAGI	Compressed Air and Gas Institute
CAL/OSHA	State of California Department of Industrial Relations, Division of Industrial Safety
CAL TRANS	California Department of Transportation
CBC	California Building Code
CBM	Certified Ballast Manufacturers
CBR	California Bearing Ratio
CDFW	California Department of Fish and Wildlife
CI	Chlorine Institute
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers Association of America
CPSC	Consumer Products Safety Commission
CRA	California Redwood Association
CRSI	Concrete Reinforcing Steel Institute

<u>Abbreviation</u>	<u>Stands for</u>
CS	Commercial Standards for the U.S. Department of Commerce
CTI	Cooling Tower Institute
DFPA	Douglas Fir Plywood Association
EIA	Electronic Industries Association
EPA	U.S. Environmental Protection Agency
ETL	Electronic Testing Laboratory
FM	Factory Mutual Insurance Company
FPS	Fluid Power Society
FS	Federal Specifications
GO 95	General Order No. 95, California Public Utilities Commission Rules for Overhead Electric Line Construction
GO 128	General Order No. 128, California Public Utilities Commission Rules for Underground Electrical Construction
HI	Hydraulic Institute
HMI	Hoist Manufacturers Institute
IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
IGCC	Insulating Glass Certification Council
IPCE	International Power Cable Engineers Association
ISA	Instrument Society of America
NAAMM	National Association of Architectural Metal Manufacturers
NBS	National Bureau of Standards
NCPI	National Clay Pipe Institute
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
NGVD	National Geodetic Vertical Datum
NSF	National Sanitation Foundation
NWMA	National Woodwork Manufacturers Association
OSHA	Occupational Safety and Health Act
PCA	Portland Cement Association
REA	Rural Electrification Administration
SAMA	Scientific Apparatus Makers Association
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Structural Steel Painting Council
TCA	Tile Council of America
UBC	Uniform Building Code
UFC	Uniform Fire Code
UMC	Uniform Mechanical Code
UPC	Uniform Plumbing Code
USDC	U.S. Department of Commerce
USFWS	U.S. Fish and Wildlife Service
UL	Underwriters Laboratories
WCLIB	West Coast Lumber Inspection Bureau
WIC	Woodwork Institute of California
WQCB	Water Quality Control Board (Regional)

Abbreviation

Stands for

WRCB

Water Resources Control Board

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SECTION 01040

COORDINATION AND PROJECT REQUIREMENTS

1.01 PROJECT COORDINATION

- A. Coordinate scheduling, submittals and work of various Sections of the Specifications and subcontractors to assure efficient and orderly sequence of interdependent construction. Provide accommodations for items to be furnished and installed by Owner and labeled "NIC" (not in contract) on the Drawings and for Owner Furnished Contractor Installed items.

1.02 MECHANICAL AND ELECTRICAL COORDINATION

- A. The Contractor's superintendent or a specially assigned assistant shall be designated the mechanical/electrical coordinator and shall coordinate the exact location, space priorities and sequence of installation of all mechanical and electrical work with each other and with all other trades. The mechanical/electrical coordinator shall assure compliance with the requirements of this paragraph 1.02.
- B. The location of mechanical and electrical work may be indicated diagrammatically on the Drawings. Actual locations shall follow locations shown on the Drawings as closely as practicable but shall be altered or adjusted in the field by the mechanical/electrical coordinator as required by the following:
 - 1. In finished spaces install mechanical and electrical work concealed within the space available.
 - 2. Organize mechanical and electrical work to make efficient use of space. Combine similar items into groups; make all runs parallel to or at right angles with building lines.
 - 3. Layout and install work to provide adequate space and access for adjustment, servicing, and maintenance and maximize space available for future installation of additional services or replacement of existing services.
 - 4. Assure that all access doors required by code or required for adjustment, servicing or maintenance are provided. Locate access doors to provide convenient access and to coordinate with finished visual elements.
 - 5. Coordinate location of fixtures, registers, grills, outlets, switches, panelboards, pullboxes, access doors, and other exposed mechanical and electrical items with functional and visual elements. Verify location of questionable items with Engineer before proceeding.
- C. Prepare large scale coordinated detailed installation drawings showing the work of all affected trades to coordinate the actual installed location of all equipment and of all mechanical and electrical work. Review coordination drawings with Engineer and all affected trades before proceeding.
- D. Review Shop Drawings and Product Data prior to submission for the Engineer's Review to assure that physical characteristics and service requirements are compatible with contract requirements, field conditions, and other items submitted.
- E. Verify that required services such as electrical power characteristics, control wiring, and utility requirements of items and equipment submitted and furnished are

compatible with services provided. Notify Engineer of potential problems prior to ordering items or equipment and prior to installing services or completing construction in areas where services would have to be installed.

- F. Schedule installation sequence of various elements of mechanical and electrical work to achieve optimum compliance with requirements under Mechanical and Electrical Coordination in this Section.

1.03 CUTTING, FITTING, AND PATCHING

- A. Provide cutting, fitting, or patching required to complete the Work and to make all of its parts fit together properly. Include cutting, fitting, and patching required to:
 - 1. Fit the several parts together and to integrate with other work.
 - 2. Uncover work to install or correct ill-timed work.
 - 3. Provide openings in elements of work for penetrations of mechanical and electrical work.
 - 4. Remove and replace defective and non-conforming work.
 - 5. Remove samples of installed work for testing.
- B. Request guidance from the Engineer prior to beginning cutting or altering construction, which affects:
 - 1. Structural integrity of any element.
 - 2. Functional performance of any element.
 - 3. Integrity of weather-exposed or moisture-resistant elements.
 - 4. Efficiency, maintenance, or safety of elements.
 - 5. Visual qualities of sight-exposed elements.
 - 6. Work by Owner or separate contractor.
- C. Execute cutting and patching using workers that specialize in and are skilled in installing the type of work being cut or patched.
- D. Perform work in accordance with the Contract Documents or in the absence of specific requirements comply with best trade practice for the work involved.
 - 1. Execute work by methods that will avoid damage to other work.
 - 2. Provide proper support and substrates to receive patching and finishing materials.
 - 3. Cut concrete materials using masonry saw or core drill. Locate all reinforcing steel, conduits and pipes with electronic detecting devices prior to cutting or core drilling existing concrete.
 - 4. Replace or patch work with new materials meeting the requirements of these specifications or if not specified matching materials and finishes of existing or adjacent work.
 - 5. Cut wall, ceiling and floor finishes to fit snugly around pipes, sleeves, ducts, conduit, and other penetrations. Provide fire and/or acoustical caulking as required by code or conditions of use.
 - 6. Maintain integrity of wall, ceiling, or floor construction; completely seal voids against smoke, fire and water.
 - 7. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.
 - 8. Report any hazardous or unsatisfactory conditions to the Engineer.

1.04 ALTERATION PROJECT PROCEDURES

- A. Plan, schedule and perform alteration work as required to minimize impacting the Owner's continued operations. See Section 01010 paragraph titled "Contractor's Use of Site and Owner's Continued Operations."
- B. The existing E. Dunne Avenue Booster Pump Station must remain in operation during construction. Schedule utility interruptions, piping connections, and interruption of existing operations as required to permit continued compliance with regulatory requirements and to meet Owner's flow requirements.
- C. Perform cutting fitting and patching in accordance with provisions in other paragraphs of this Section. Where new work abuts or aligns with existing work perform a smooth even transition. When a smooth unnoticeable transition is not feasible cut existing surfaces along a straight line at a natural dividing point and provide a groove or cover plate as recommended by the Engineer.
- D. Provide new construction in accordance with the technical specifications or if not specified provide new construction matching adjacent or similar existing work in material and finish.

1.05 CONNECTIONS TO UNDERGROUND UTILITIES, CONDUITS, OR PROCESS PIPING

- A. Obtain best available current information on location, identification and marking of existing utilities, piping and conduits and other underground facilities before beginning any excavation. In areas where utilities that participate in Underground Service Alert may occur, call 800-227-2600 in Northern California for information at least 48 hours in advance of beginning work. Give Engineer 24 hours notice before beginning work.
- B. The location of existing utilities and underground facilities known to the Design Engineer are shown in their approximate location based on information available at the time of preparing the Drawings. The actual location, size type and number of utilities and underground facilities may differ from that shown and utilities or underground facilities may be present that are not shown. See General Conditions for the Contractor's responsibilities and for differing conditions that warrant a change in Contract Price.
- C. Use extreme care when excavating or working in areas that may contain existing utilities, process piping, conduits or other underground facilities. Use careful potholing, hand digging and probing to determine the exact location of underground installation. Some locations contain multiple pipes or conduits. Prior to performing any subsurface work, investigate, determine and prepare a plan to turn off or disconnect each utility believed to be in the within 100 feet of the subsurface work in the event of an accidental breach of a utility conduit.
- D. Where connections to existing utilities or other underground facilities is required or where new piping or conduits may cross or interfere with existing utilities or underground facilities carefully excavate and uncover existing installations to a point 1 foot below the pipe or conduit to determine the actual elevation and alignment. Call the Engineer's attention to differing existing conditions that may require a clarification or change.

- E. Shutdown of existing utilities, services or operations shall be done in accordance with Section 01010. **Connections requiring shutdown of the water system shall be done between the hours of 12:00 midnight and 6:00 a.m..**

1.06 FIELD ENGINEERING AND LAYOUT

- A. See General Conditions regarding reference points provided by Owner.
- B. General Conditions require the Contractor to accurately layout the Work including the corners of buildings and other structures and the elevation of every tank bottom and pipeline.
- C. Employ a Surveyor or Civil Engineer to layout all detailed dimensions and elevations from reference points. Use recognized engineering survey methods and documentation techniques.

1.07 PRECONSTRUCTION MEETINGS

- A. Prior to beginning the Work, the Contractor and its key personnel and Subcontractors including the Contractor's Superintendent, Project Manager, and Field Engineer shall attend a meeting with the Owner and the Engineer to discuss the following:
 - 1. Name, Authority, and Responsibilities of Parties Involved
 - 2. Project Procedures:
 - a. Progress meetings
 - b. Correspondence
 - c. Notification
 - d. Submittal of Product Data, Shop Drawing Samples, and Proposed Equivalents
 - e. Requests for Information
 - f. Response to Requests for Information
 - g. Requests for Quotation
 - h. Work Directive Change
 - i. Change Orders
 - j. Engineer's "Items of Concern List"
 - 3. Temporary Schedule and Contractor's Construction Schedule
 - 4. Temporary Facilities and Control
 - 5. Testing During Construction
 - 6. Contractors Coordination
 - 7. Civil/Structural/Mechanical/Electrical Coordination
 - 8. Maintenance of Record Drawings
 - 9. Owner Provided Items or Work and Owner Furnished Contractor Installed items
 - 10. Early Beneficial or Partial Occupancy
 - 11. Final Testing, Startup, and Balancing
 - 12. Punch Lists and Project Closeout Procedures
 - 13. Final Deliverables including Record Drawings, Operation and Maintenance Manuals, and Special Guarantees.

1.08 PROGRESS MEETINGS

- A. The Engineer will conduct weekly progress meetings with Contractor and Owner at

job site. Attendance required by Contractor's project manager, superintendent and affected Subcontractors and suppliers. The Engineer will prepare, maintain and distribute agenda and dated record of: (1) actions required and taken and (2) decisions needed and made.

B. Agenda:

1. Review critical items/action list.
2. Review work progress. Compare actual progress with planned progress shown on Contractors rolling three-week Schedule. Discuss Corrective action required. Compare actual and projected progress with Contractor's Construction Schedule, propose methods to correct deficiencies.
3. Review status of Submittals; review delivery dates and date of need for critical items.
4. Review coordination problems.
5. Schedule needed testing and critical inspections.
6. Review critical requirements for each trade or major piece of equipment prior to beginning work or installation.
7. Discuss Contractor Quality Control.
8. Discuss open items on Engineers "Items of Concern List."
9. Discuss impact of proposed changes on progress Schedule.
10. Other business.

1.09 PERFORMANCE SPECIFICATIONS AND CONTRACTOR DESIGNED WORK

- A. Work under this Contract may be specified by a combination of descriptive, performance, reference standard and proprietary specifications. In the event of conflict between any of the various specification methods used to specify a single item the order of precedence shall be the order in which the methods are listed in the preceding sentence. The terms used to describe types of Specifications are taken from the Construction Specification Institute (CSI) Handbook of Practice.
- B. Where Specifications are used to define the characteristics of Contractor designed systems, items or components, the Contractor shall be fully responsible to design, engineer, manufacture, and install the systems, items and components to meet the specified functional requirements, performance requirements, quality standards, durability standards and conditions of use as well as all applicable codes, regulations and referenced trade or industry standards. The Contractor shall perform such design by employing engineers licensed in the State in which the Work is being constructed. The Contractor's design submittals shall include calculations and assumptions on which the design is based and shall be stamped and signed by appropriately licensed engineers.
- C. In accordance with General Conditions, the Owner and the Engineer shall have the right to rely on the expertise and professional competence of the Contractor's design. Favorable review of the Contractor's design submittal shall not relieve the Contractor from full responsibility for the adequacy of the Contractor design.

1.10 MATERIAL AND EQUIPMENT

A. General:

1. Verify that products delivered meet requirements of Contract Documents and the requirements for Favorably Reviewed submittals.

- B. Compatibility of Equipment and Material:
1. Similar items, equipment, devices or products furnished under a single specification section shall all be made by the same maker and have interchangeable parts.
 2. In addition, but only if so stated in each affected Specification Section, similar items furnished under two or more Specification Sections shall be made by the same maker and have interchangeable parts.
 3. All similar materials or products that are interrelated or used together in an assembly shall be compatible with each other.
- C. Transportation and Handling:
1. Transport and handle products in accordance with manufacturer's instructions.
 2. Promptly inspect shipments to assure that products comply with requirements, quantities are correct, and products are undamaged.
 3. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.
- D. Storage and Protection:
1. Store and protect products in accordance with manufacturer's instructions. Seals and labels shall be intact and legible.
 2. Store moisture sensitive products including finish woodwork, gypsum products, acoustical products, motors, electrical equipment, instruments and controls in weathertight, humidity and temperature controlled enclosures.
 3. For exterior storage of fabricated products, place items on sloped supports, aboveground.
 4. Cover products subject to deterioration from moisture, dust, or sunlight with opaque watertight but breathable sheet covering. Provide ventilation to avoid condensation.
 5. Provide offsite storage and protection including insurance coverage when site does not permit onsite storage or protection.
 6. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
 7. Provide facilities, equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
 8. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.
- E. Installation Standards and Manufacturers' Recommendations:
1. Install all products and materials in strict compliance with the most restrictive of the following:
 - a. The manufacturer's or provider's written instructions or recommendations. Follow step-by-step installation procedures.
 - b. Recommendations of referenced trade associations or standards.
 - c. These specifications and drawings.
 2. Where conflicts exist present alternatives with advantages and disadvantages to Engineer for decision.
- F. If reference standards or manufacturer's instructions contain provisions that would alter or are at variance with relationships between the parties to the Contract set forth in the Contract Documents, the provisions in the Contract Documents shall

take precedence. See General Conditions.

1.11 BACKING, SUPPORTS AND FASTENERS

- A. Provide backing, supports, bracing, fasteners and other provisions required for the proper support and attachment of all work. Backing, supports, bracing and fasteners shall be sized to resist vertical and horizontal loads including seismic and wind loads required by codes listed under Regulatory Requirements in Section 01010 and in accordance with Seismic Design Requirements in this Section. Where finishes in existing facilities must be removed to install backing or where finishes are installed in new construction prior to installing backing the Contractor shall remove finishes, install backing and reinstall finishes.
- B. Low velocity pneumatic type power-driven fasteners may be used only:
 - 1. Where specifically shown, specified or approved.
 - 2. Where they meet the structural requirements for a particular assembly with a safety factor of at least 400 percent.
 - 3. Power-driven fasteners may not be used for electrical or mechanical installations or to attach any items loaded in withdrawal or subject to vibration.
 - 4. Non-load bearing metal stud tracks fastened to concrete. Powder-driven fasteners shall not be used within 3 inches of the edge or corners of concrete surfaces

1.12 SEISMIC REQUIREMENTS

- A. See Section 01190, Seismic Requirements.

1.13 SAFETY

- A. In accordance with generally accepted construction practice, applicable law and the General Conditions, the Contractor shall be solely and exclusively responsible for:
 - 1. Construction means and methods.
 - 2. Safety of employees engaged in the work while on and off the site.
 - 3. Safety of the Owner, the Engineer, the Design Engineer, and others who may visit or be affected by the work.
 - 4. Safety of the work itself including material and equipment to be incorporated therein.
 - 5. Safety of other property at the site or adjacent thereto.
 - 6. Safety programs, equipment and protective devices required to assure the safety of persons and property for whom/which the Contractor is responsible.
- B. The duties of the Engineer in conducting review of the Contractor's performance is not intended to include review of the adequacy of the Contractor's work methods, equipment, bracing, scaffolding or safety measures in, on, or near the construction site. See General Conditions.
- C. The Contractor is hereby informed that work on this project could be hazardous. The Contractor shall carefully instruct all personnel working in potentially hazardous work areas as to potential dangers and shall provide such necessary safety equipment and instructions as required to prevent injury to personnel and damage to property, and to comply with all applicable laws and regulations including State OSHA, Federal OSHA, and other regulations referenced in these Contract

Documents.

- D. The Contractor shall, at all times, maintain the job in a condition that is safe for the Owner, the Engineer and their Consultants to make site visits and to conduct construction reviews. If the Owner or the Engineer cannot allow personnel to visit the job because it is not safe, the Contractor is not providing required safe access to the Work as required by General Conditions.
- E. The Contractor shall prepare a Safety Plan meeting the requirements of applicable regulations. As a minimum, the Contractors Safety Plan shall set forth definite procedures for informing workers about safety, for instructing workers in safe practices, for assuring that workers are using appropriate safety equipment and safe work practices and for reporting accidents.

1.14 EXCAVATION AND TRENCHING; WORK WITHIN CONFINED SPACES

- A. Submit specific plans to the Owner showing details of provisions for worker protection from caving ground in accordance with Section 6705 of the California State Labor Code. The detailed plans shall show the design of shoring, bracing, sloping banks or other provisions and shall be prepared, signed and stamped by a Civil or Structural Engineer licensed in the State in which the Work is performed and retained by the Contractor. The Owner's acceptance of the detailed plans submitted is only an acknowledgment of the submission and does not constitute review or approval of the designs, design assumptions, criteria, completeness, applicability to areas of intended use, or implementation of the plans, which are solely the responsibility of the Contractor and his Registered Engineer.
- B. Work Within Confined Spaces: Work within confined spaces is subject to applicable laws, regulations and safety orders including applicable California regulations.
- C. The foregoing provisions do NOT reduce the requirement for the Contractor to maintain safety in ALL operations performed by the Contractor or its Subcontractors.

1.15 CONTRACTOR'S QUALITY CONTROL

- A. The Contractor shall be fully responsible for inspecting the work of its suppliers and Subcontractors to assure that the work when completed will comply with the standards for materials and workmanship required by the Contract Documents. See General Conditions.
- B. Inspections, periodic observations and testing performed by the Owner or the Engineer are for the Owner's benefit and information only and shall not be construed as partial or incremental acceptance of the work and shall not be deemed to establish any duty on the part of the Owner or the Engineer to the Contractor, its subcontractors or suppliers. See General Conditions.
- C. The Contractor shall:
 - 1. Monitor quality control over suppliers, manufacturer, products, services, site conditions, and workmanship, to produce work of specified quality.
 - 2. Comply fully with manufacturer's installation instructions, including performing each step in sequence as recommended by the manufacturer.
 - 3. Submit a Request for Information to Engineer before proceeding with work

when manufacturers' instructions or reference standards conflict with Contract Documents.

4. Comply with specified standards as a minimum quality for the work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
5. Perform work by persons specializing in the specific trade and class of work required and qualified to produce workmanship of specified quality.
6. Secure products in place with positive anchorage devices designed and sized to withstand seismic, static and dynamic loading, vibration, and physical distortion or disfigurement.

- D. If reference standards or manufacturers' instructions contain provisions that would alter or are at variance with relationships between the parties to the Contract set forth in the Contract Documents, the provisions in the Contract Documents shall take precedence.
- E. The Contractor shall provide assistance required by the Engineer to adequately inspect the Work including ladders, scaffolding, lighting, ventilation and other aids to facilitate access and provide a safe working environment.

1.16 TESTING LABORATORY SERVICES AND CERTIFIED LABORATORY REPORTS

- A. Provide testing service in accordance with General Conditions and specific requirements contained in each technical specification section. Submit Certified Laboratory Reports required by technical specification sections.

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SECTION 01140

ENVIRONMENTAL PROTECTION

1.01 SCOPE

- A. During the progress of the work, keep the work areas occupied by the Contractor in a neat and clean condition and protect the environment both onsite and offsite, throughout and upon completion of the construction project.
- B. Work necessary by the Contractor to allow the Owner to comply with the California State Water Resources Control Board Construction Activities Storm Water General Permit No. 2009-0009-DWQ (NPDES No. CAS000002) (Permit) for discharge of storm water associated with construction activities pertaining to linear underground/overhead projects (LUP) and 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 Permit. Definitions of abbreviations pertaining to SWPPP are provided in Section 1.05.B.

1.02 SUBMITTALS

- A. Develop an Environmental Protection Plan in detail and submit to the Engineer in the Product Review category within thirty (30) days from the date of the Notice to Proceed. Distribute the favorably reviewed plan to all employees and to all subcontractors and their employees. The Environmental Protection Plan shall include, but not be limited to, the following items:
 - 1. Copies of required permits.
 - 2. Proposed sanitary landfill site.
 - 3. Other proposed disposal sites.
 - 4. Copies of any agreements with public or private landowners regarding equipment, materials storage, borrow sites, fill sites, or disposal sites. Any such agreement made by the Contractor shall be invalid if its execution causes violation of local or regional grading or land use regulations.
 - 5. Identify compliance with local and/or State regulations for discharges related to, but not limited to, the following Surface Water Discharges:
 - a. Dewatering Water
 - b. Flushing Water
 - c. Disinfection Water
 - 6. Storm Water Pollution Plan.
- B. Submit the SWPPP in electronic format and in hard copy and as follows:

1. Submit in accordance with Section 01300.
 2. Submit Risk Type information that will be basis for SWPPP, including supportive information for determination, within fifteen (15) calendar days of Award.
 3. Submit name and qualifications of the Qualified SWPPP Developer (QSD) responsible for preparing the SWPPP.
 4. Submit Draft SWPPP.
 5. Upon Favorable Review, coordinate with Owner to ensure SWPPP is submitted to the Stormwater Multiple Application and Report Tracking System (SMARTS).
 6. If, with Owner approval, Contractor performed SWPPP upload into SMARTS, submit QSD notification of SMARTS upload with request for the Owner's Legally Responsible Person (LRP) to certify the SWPPP SMARTS upload as authorized to proceed.
 7. Submit Final SWPPP with Waste Discharge Identification (WDID) number.
- C. Distribute the favorably reviewed plans to all employees and to all subcontractors and their employees.

1.03 MITIGATION OF CONSTRUCTION IMPACTS

- A. Requirements: All operations shall comply with all federal, state and local regulations pertaining to water, air, solid waste and noise pollution.
- B. Definitions of Contaminants:
1. Sediment: Soil and other debris that have been eroded and transported by runoff water.
 2. Solid Waste: Rubbish, debris, garbage and other discarded solid materials resulting from construction activities, including a variety of combustible and non-combustible wastes, such as ashes, waste materials that result from construction or maintenance and repair work, leaves and tree trimmings.
 3. Chemical Waste: Includes petroleum products, bituminous materials, salts, acids, alkalies, herbicides, pesticides, disinfectants, organic chemicals and inorganic wastes. Some of the above may be classified as "hazardous."
 4. Sanitary Wastes:
 - a. Sewage: That which is considered as domestic sanitary sewage.
 - b. Garbage: Refuse and scraps resulting from preparation, cooking, dispensing and consumption of food.
 5. Hazardous Materials: As defined by applicable laws and regulations. Undisclosed hazardous material contamination, if encountered will constitute a changed site condition. The Owner may retain a separate contractor to dispose of undisclosed hazardous material encountered.
- C. Protection of Natural Resources:
1. General: It is intended that the natural resources within the project boundaries and outside the limits of permanent work performed under this Contract be preserved in their existing condition or be restored to an equivalent or improved condition upon completion of the work. Confine construction activities to areas defined by the public roads, easements, and work area limits shown on the Drawings. Return construction areas to their pre-construction elevations except where surface elevations are otherwise noted to be changed. Maintain natural

drainage patterns. Conduct construction activities to avoid ponding stagnant water conducive to mosquito breeding.

2. Land Resources: **Do not remove or prune the valley oaks and coast live oak tree on the project site.** Do not remove, cut, deface, injure or destroy trees or shrubs outside the work area limits. Do not remove, deface, injure or destroy trees within the work area without permission from the Engineer.
 - a. Protection: Protect trees that are located near the limits of the Contractor's work areas which may possibly be defaced, bruised or injured or otherwise damaged by the Contractor's operations. No ropes, cables or guys shall be fastened to or attached to any existing nearby trees or shrubs for anchorages unless specifically authorized. Where such special emergency use is permitted, the Contractor shall be responsible for any damage resulting from such use.
 - b. Trimming: Trim and seal tree limbs overhanging the line of the work and in danger of being damaged by the Contractor's operations in accordance with recognized standards for such work. Remove other tree limbs under the direction of the Engineer, so that the tree will present a balanced appearance.
 - c. Treatment of Roots: Do not cut roots unnecessarily during excavating or trenching operations. Expose major roots encountered in the course of excavation and do not sever. Wrap them in burlap as a protective measure while exposed. Neatly trim all other roots larger than 1 inch in diameter that are severed in the course of excavation at the edge of the excavation or trench and paint them with a heavy coat of an approved tree seal.
 - d. Repair or Restoration: Repair or replace any trees or other landscape features scarred or damaged by equipment or construction operations as specified below. The repair and/or restoration plan shall be favorably reviewed prior to its initiation.
 - e. Temporary Construction: Obliterate all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, or any other vestiges of construction as directed by the Engineer. Level all temporary roads, parking areas and any other areas that have become compacted or shaped. Any unpaved areas where vehicles are operated shall receive a suitable surface treatment or shall be periodically wetted down to prevent construction operations from producing dust damage and nuisance to persons and property, at no additional cost to the Owner. Keep haul roads clear at all times of any object that creates an unsafe condition. Promptly remove any contaminants or construction material dropped from construction vehicles. Do not drop mud and debris from construction equipment on public streets. Sweep clean turning areas and pavement entrances as necessary.
3. Water Resources: Investigate and comply with all applicable federal, state and local regulations concerning the discharge (directly or indirectly) of pollutants to the underground and natural waters. This project is required to be covered under the CA Construction General Permit. Refer to Section 1.05 for SWPPP requirements for implementation of Best Management Practices (BMPs) that shall be considered and implemented to minimize the potential for impacts to water resources. Perform all work under this Contract in such a manner that any adverse environmental impacts are reduced to a level that is acceptable to the Engineer and regulatory agencies. Refer to the paragraph on control of

water in Section 02301, Earthwork, for "dewatering" water disposal requirements.

- a. Oily Substances: At all times, special measures shall be taken to prevent oily or other hazardous substances from entering the ground, drainage areas or local bodies of water in such quantities as to affect normal use, aesthetics or produce a measurable impact upon the area. Any soil or water that is contaminated with oily substances due to the Contractor's operations shall be disposed of in accordance with applicable regulations. Exercise every reasonable precaution to protect ground, drainage areas or local bodies of water from pollution with fuels, oils, bitumens, calcium chloride and other harmful materials and conduct and schedule operations so as to avoid or minimize muddying and silting of said streams or local bodies of water. Water pollution control work is intended to provide prevention control and abatement of water pollution to streams, waterways and other bodies of water, and shall consist of constructing those facilities that may be shown on the Drawings, specified herein or in the Special Provisions, or directed by the Engineer. The Contractor shall provide temporary water pollution control measures, including but not limited to, dikes, basins, and ditches, and shall apply straw and seed, which become necessary as a result of his operations. The Contractor shall coordinate water pollution control work with all other work done on the Contract.
- b. Submit a plan to control water pollution effectively during construction of the Work. Such program shall show the schedule for the erosion control work included in the Contract and for all water pollution control measures, which the Contractor proposes to take in connection with construction of the project to minimize the effects of his operations upon adjacent streams and other bodies of water. The Contractor shall not perform any clearing and grubbing or earthwork on the project, other than that specifically authorized in writing by the Engineer, until such plan has been accepted. The Owner will not be liable to the Contractor for failure to accept all or any portion of an originally submitted or revised water pollution control plan, nor for any delays to the work due to the Contractor's failure to submit an acceptable water pollution control plan. The Contractor may request the Engineer to waive the requirement for submission of a written plan for control of water pollution when the nature of the Contractor's operation is such that erosion is not likely to occur. Waiver of this requirement will not relieve the Contractor from responsibility for compliance with the other provisions of this Section. Waiver of the requirement for a written plan for control of water pollution will not preclude requiring submittal of a written plan at a later time if the Engineer deems it necessary because of the effect of the Contractor's operations.
- c. If the measures being taken by the Contractor are inadequate to control water pollution effectively, the Engineer may direct the Contractor to revise his operations and his water pollution control program. Such directions will be in writing and will specify the items of work for which the Contractor's water pollution control measures are inadequate. No further work shall be performed on said items until the water pollution control measures are adequate; and if also required, a revised water pollution control plan has been accepted.
- d. Where erosion which will cause water pollution is probable due to the nature of the material or the season of the year, the Contractor's operations

- shall be so scheduled that permanent erosion control features will be installed concurrently with or immediately following grading operations.
- e. Nothing in the terms of the Contract nor in the provisions in this Section shall relieve the Contractor of the responsibility for compliance with Sections 5650 and 12015 of the California Fish and Game Code, or other applicable statutes relating to prevention or abatement of water pollution.
 - f. The Contractor shall also conform to the following provisions:
 - 1) Where working areas encroach on live streams, barriers adequate to prevent the flow of muddy water into streams shall be constructed and maintained between working areas and streams and during construction of such barriers, muddying of streams shall be held to a minimum.
 - 2) Removal of material from beneath a flowing stream shall not be commenced until adequate means, such as a bypass channel, are provided to carry the stream free from mud or silt around the removal operations.
 - 3) Should the Contractor's operations require transportation of materials across live streams, such operations shall be conducted without muddying the stream. Mechanized equipment shall not be operated in the stream channels of such live streams except as may be necessary to construct crossings or barriers and fills at channel changes.
 - 4) Water containing mud or silt from aggregate washing or other operations shall be treated by filtration, or retention in a settling pond, or ponds, adequate to prevent muddy water from entering live streams.
 - 5) Oily or greasy substances originating from the Contractor's operations shall not be allowed to enter or be placed where they will later enter a live stream.
 - 6) Portland cement or fresh portland cement concrete shall not be allowed to enter flowing water of streams.
 - 7) When operations are completed, the flow of streams shall be returned as nearly as possible to a meandering thread without creating possible future bank erosion and settling; pond sites shall be graded so they will drain and will blend in with the surrounding terrain.
 - 8) Material derived from roadway work shall not be deposited in a live stream channel where it could be washed away by high stream flows.
 - 9) Where there is possible migration of anadromous fish in streams affected by construction on the project, the Contractor shall conduct his operations so as to allow free passage of such migratory fish.
 - g. Chlorinated Water: Take special measures to prevent chlorinated water from entering the ground or surface waters. Dechlorinate chlorinated water prior to discharge.
4. Fish and Wildlife Resources: Perform all work and take such steps required to prevent any interference or disturbance to fish and wildlife. The Contractor will not be permitted to alter water flows or otherwise significantly disturb native habitat adjacent to the project area which are critical to fish and wildlife except as may be indicated or specified. **The following avoidance measures shall be required to avoid the project's potential effects on white-tailed kite, Lawrence's goldfinch, Lewis' woodpecker, Nuttall's woodpecker, oak titmouse, olive-sided flycatcher or any other special-status or migratory bird species.**

- a. If land clearing and grading are to be conducted outside of the breeding season (i.e., September 1 through January 31), a preconstruction survey for nesting migratory birds is not warranted.
 - b. If land clearing and grading are to be conducted during the breeding season (i.e., February 1 through August 31), a preconstruction nesting bird survey shall be conducted. The survey shall be performed by a qualified biologist no more than two weeks prior to the initiation of work. If no nesting or breeding activity is observed, work may proceed without restrictions. To the extent allowed by access, all active nests identified within 76 m (250 ft) for raptors and 15 m (50 ft) for passerines shall be mapped.
 - c. For any active nests found near the construction limits (76 m [250 ft] for raptors and 15 m [50 ft] for passerines) the Project Biologist shall make a determination as to whether or not construction activities are likely to disrupt reproductive behavior. If it is determined that construction is unlikely to disrupt breeding behavior, construction may proceed. If it is determined that construction may disrupt breeding, the no-construction buffer zone shall be expanded; avoidance is the only mitigation available. The ultimate size of the no-construction buffer zone may be adjusted by the Project Biologist based on the species involved, topography, lines of site between the work area and the nest, physical barriers, and the ambient level of human activity.
 - d. If it is determined that construction activities are likely to disrupt raptor breeding, construction activities within the no-construction buffer zone may not proceed until the project biologist determines that the nest is long longer occupied.
 - e. If maintenance of a no-construction buffer zone is not feasible, the Project Biologist shall monitor the nest(s) to document breeding and rearing behavior of the adult birds. If it is determined that construction-related activities are likely to cause nest abandonment, work shall cease immediately and the CDFW and/or the USFWS Division of Migratory Bird Management shall be contacted for guidance. Work may not resume until an agreement has been reached with the authorities specifying the conditions under which work may proceed.
5. **Cultural Resources: Monitoring of ground-disturbing activities for archaeological resources and the reporting of appropriate treatment and disposition of such resources that may be uncovered is required. In the event that undocumented human remains or unknown significant historic or archaeological resources are discovered, the Owner will provide a specific protocol for the treatment of the uncovered human remains and/or resources. The protocol entails the process of identifying the human remains and the contact of appropriate parties such as the Native American Heritage Commission and the Amah Mutsun Tribal Band to determine Most Likely Descendant for further consultation on the disposition of the remains.** The project does not pass through any known archaeological sites. However, it is conceivable that unrecorded archaeological sites could be discovered during the construction. In the event that artifacts, human remains, or other cultural resources are discovered during excavations at locations of the Work, the Contractor shall protect the discovered items,

notify the Engineer, and comply with applicable law. **The potential for encountering paleontological resources at the project site is considered to be low due to the distance to the closest resource, there remains the potential to unearth unknown paleontological resources at the project site. In the event that such resources are uncovered, the standard conditions of approval for the mitigation of archaeological resource discovery will be applied to paleontological resources.**

6. Noise Control: The following noise control procedures shall be employed:
 - a. Maximum Noise Levels within 1,000 Feet of any Residence, Business, or Other Populated Area: Noise levels for trenchers, pavers, graders and trucks shall not exceed 90 dBA at 50 feet as measured under the noisiest operating conditions. For all other equipment, noise levels shall not exceed 85 dBA at 50 feet.
 - b. Equipment: Jack hammers shall be equipped with exhaust mufflers and steel muffling sleeves. Air compressors should be of a quiet type such as a "whisperized" compressor.
 - c. Operations: Keep noisy equipment as far as possible from noise-sensitive site boundaries. Machines should not be left idling. Use electric power in lieu of internal combustion engine power wherever possible. Maintain equipment properly to reduce noise from excessive vibration, faulty mufflers, or other sources. All engines shall have mufflers.
 - d. Scheduling: Schedule noisy operations so as to minimize their duration at any given location. **Construction activities shall be limited to the hours between 7:00 a.m. and 8:00 p.m., Monday through Friday, and between the hours of 9:00 a.m. and 6:00 p.m. on Saturdays. No construction activities shall occur on Sundays or Federal Holidays. Connections requiring shutdown of the water system shall be done between the hours of 12:00 midnight and 6:00 a.m..**
 - e. Monitoring: To determine whether the above noise limits are being met and whether noise barriers are needed, the Contractor shall use a portable sound level meter meeting the requirements of American National Standards Institute Specification S1.4 for Type 2 sound level meters. If non-complying noise levels are found, the Contractor shall be responsible for monitoring and correction of excessive noise levels.
7. Dust Control, Air Pollution, Air Quality and Odor Control: Employ measures to prevent the creation of dust, air pollution and odors. **To limit the project's construction-related dust and criteria pollutant emissions, the following BAAQMD-recommended Basic Construction Mitigation Measures shall be included**
 - a. **All exposed surfaces (e.g., parking areas, staging areas, soil piles, graded areas, and unpaved access roads) shall be watered two times per day.**
 - b. **All haul trucks transporting soil, sand, or other loose material off-site shall be covered.**
 - c. **All visible mud or dirt track-out onto adjacent public roads shall be removed using wet power vacuum street sweepers at least once per day. The use of dry power sweeping is prohibited.**
 - d. **All vehicle speeds on unpaved roads shall be limited to 15 mph.**
 - e. **All roadways, driveways, and sidewalks to be paved shall be completed as soon as possible.**

- f. Idling times shall be minimized either by shutting equipment off when not in use or reducing the maximum idling time to five minutes (as required by the California airborne toxics control measure Title 13, Section 2485 of California Code of Regulations [CCR]). Clear signage shall be provided for construction workers at all access points.
 - g. All construction equipment shall be maintained and properly tuned in accordance with manufacturer's specifications. All equipment shall be checked by a certified mechanic and determined to be running in proper condition prior to operation.
 - h. Post a publicly visible sign with the telephone number and person to contact at the City regarding dust complaints. This person shall respond and take corrective action within 48 hours. The BAAQMD's phone number shall also be visible to ensure compliance with applicable regulations.
 - i. Unpaved areas where vehicles are operated shall be periodically wetted down or given an equivalent form of treatment, to eliminate dust formation.
 - j. Store all volatile liquids, including fuels or solvents, in closed containers.
 - k. No open burning of debris, lumber or other scrap will be permitted.
 - l. Properly maintain equipment to reduce gaseous pollutant emissions.
8. Construction Storage Areas: Storage of construction equipment and materials shall be limited to the designated Contractor's storage area.
- a. Store and service equipment at the designated Contractor's storage area where oil wastes shall be collected in containers. Oil wastes shall not be allowed to flow onto the ground or into surface waters. Containers shall be required at the construction site for the disposal of materials such as paint, paint thinner, solvents, motor oil, fuels, resins and other environmentally deleterious substances. No dumping of surplus concrete or grout on the site will be permitted.
9. Sanitation: During the construction period, provide adequate and conveniently located chemical sanitation facilities, properly screened, for use of construction crews, the Engineer and visitors to the site. Facilities shall be regularly maintained.
10. Fire Prevention: Take steps to prevent fires including, but not limited to the following:
- a. Provide spark arrestors on all internal combustion engines.
 - b. Store and handle flammable liquids in accordance with the Flammable and Combustible Liquids Code, NFPA 30.
 - c. Provide fire extinguishers at hazardous locations or operations, such as welding.
11. Erosion and Sediment Transport Control: **For the disturbance of areas one acre or more, Chapter 13.30 of the City of Morgan Hill Municipal Code (Urban Storm Water Quality Management and Discharge Control), requires projects to comply with the requirements of the General Permit for Storm Water Discharges Associated with Construction and Land Disturbance Activities, Order No. 2009-0009-DWQ (Construction General Stormwater Permit) to control erosion during construction.** Prepare a SWPPP that identifies pollutant sources that could affect the quality of stormwater discharges from the construction site. Include control practices that effectively target pollutants in stormwater discharges and comply with the requirements of the revised California Construction Stormwater Permit when it becomes effective in 1 July 2010. **The SWPPP prepared in accordance with this**

permit shall include at least the minimum BMPs related to housekeeping (storage of construction materials (including hazardous materials), waste management, vehicle storage and maintenance, landscape materials, pollutant control); non-stormwater management; erosion control; sediment control; run-on and run-off control. Additional BMPs shall be specified as needed to protect water quality from construction-related stormwater and non-stormwater discharges. As part of the SWPPP, the Contractor shall implement a construction site monitoring program to demonstrate compliance with the discharge prohibitions of the General Permit; demonstrate whether non-visible pollutants are present and could contribute to an exceedance of water quality objectives; identify the need for correction actions, additional BMPs, or SWPPP revisions; and evaluate the effectiveness of the existing BMPs. The SWPPP must also be submitted to the City of Morgan Hill Engineering Division for review and approval. To protect receiving water quality, the SWPPP shall include, but is not limited to, the following elements:

- a. Discharge construction runoff into small drainages at frequent intervals to avoid buildup of large potentially erosive flows.
- b. Prevent runoff from flowing over unprotected slopes.
- c. Keep disturbed areas to the minimum necessary for construction.
- d. Keep runoff away from disturbed areas during construction.
- e. Direct flows over vegetated areas prior to discharge into public storm drainage systems.
- f. Trap sediment before it leaves the site, using such techniques as check dams, sediment ponds, or siltation fences.
- g. Remove and dispose of all project construction-generated siltation that occurs in offsite retention ponds.
- h. Confine construction to the dry season, whenever possible. If construction needs to be scheduled for the wet season, ensure that erosion and sediment transport control measures are ready for implementation prior to the onset of the first major storm of the season.
- i. Stabilize disturbed areas as quickly as possible.

D. Execution: Training.

1. Provide pre-construction training to ensure staff is aware of project specific environmental impacts
2. Provide weekly training to review staff awareness of environmental factors
3. Ensure photo and ongoing compliance documentation is acquired and properly kept.

1.04 DISPOSAL OPERATIONS

- A. Solid Waste Management: **For demolition and construction waste disposal, a minimum of 50 percent of non-hazardous construction and demolition debris must be recycled or salvaged. Submit a waste management plan for on-site sorting of construction debris.**
1. **Identify the materials to be diverted from disposal by recycling, reuse on the project, or salvage for future use or sale.**
 2. **Specify if materials will be sorted on-site or mixed for transportation to a diversion facility.**
 3. **Identify the diversion facility where the material collected will be taken.**

4. **Identify construction methods employed to reduce the amount of waste generated.**
 5. **Specify that the amount of materials diverted shall be calculated by weight or volume, but not by both.**
 6. Supply solid waste transfer containers. Daily remove all debris such as spent air filters, oil cartridges, cans, bottles, combustibles and litter. Take care to prevent trash and papers from blowing onto adjacent property. Encourage personnel to use refuse containers. Convey contents to a sanitary landfill.
 7. Washing of concrete containers where wastewater may reach adjacent property or natural water courses will not be permitted. Remove any excess concrete to the sanitary landfill.
- B. Chemical Waste and Hazardous Materials Management: Furnish containers for storage of spent chemicals used during construction operations. Dispose of chemicals and hazardous materials in accordance with applicable regulations.
- C. Garbage: Store garbage in covered containers, pick up daily and dispose of in a sanitary landfill.
- D. Dispose of vegetation, weeds, rubble, and other materials removed by the clearing, stripping and grubbing operations off site at a suitable disposal site in accordance with applicable regulations.
- E. Excavated Materials:
1. Native soil complying with the requirements of Section 02301, Earthwork, may be used for backfill, fill and embankments as allowed by that section.
 2. Spoil Material:
 - a. Remove all material which is excavated in excess of that required for backfill, and such excavated material which is unsuitable for backfill, from the site and dispose of off site in accordance with applicable regulations at the disposal site indicated in the Environmental Protection Plan. No additional compensation will be paid to the Contractor for such disposal. Include all such costs in the lump sum prices bid for the project. Remove rubbish and materials unsuitable for backfill immediately following excavation. Remove material in excess of that required for backfill immediately following backfill operations.
 - b. Rubbish shall consist of all materials not classified as suitable materials or rubble and shall include shrubbery, trees, timber, trash and garbage.

1.05 STORMWATER POLLUTION PREVENTION PLAN REQUIREMENTS

- A. The Contractor shall prepare and submit a Draft SWPPP before work shall begin on the site. The SWPPP shall be prepared in accordance with the NPDES construction permit procedures and requirements in effect at the time of Bidding. Contractor shall provide a QSD to prepare the Risk Level Assessment, prepare the SWPPP and, upon favorable review by the Engineer and the Owner, ensure the submittal of the SWPPP to the SMARTS database. If, with Owner approval, Contractor performed SWPPP upload into SMARTS, Contractor shall submit QSD notification of SMARTS upload with request for the Owner's LRP to certify the SWPPP SMARTS upload. Contractor shall be provided the WDID number to finalize the SWPPP.

The Draft SWPPP shall identify and mitigate pollutant sources that could affect the quality of stormwater discharges from the construction site. Control practices shall include those that effectively target pollutants in stormwater discharges and shall comply with requirements of the Permit. Within fifteen (15) calendar days of Bid Selection, submit Risk Type information that will be basis for SWPPP, including supportive information for determination.

B. Definitions and Abbreviations for SWPPP:

1. Approved Signatory – A person designated by the Owner who has legal authority to sign, certify, and electronically submit Permit Registration Documents and Notices of Termination on behalf of the Legally Responsible Person.
2. BMP – Best Management Practice
3. CSMP – Construction Site Monitoring Program
4. Contractor – The person or persons, firm, partnership, corporation or combination thereof, private or municipal, who enters into the Contract with the Owner to construct the project.
5. Discharger – The Legally Responsible Person or entity subject to the General Permit.
6. Permit – National Pollutant Discharge Elimination System General Permit for Stormwater Discharges Associated with Construction and Land Disturbance Activities, Order No. 2009-0009-DWQ (as amended by 2010-0014-DWQ and 2012-0006-DWQ), NPDES No. CAS000002 adopted and made effective on 17 July 2012.
7. Legally Responsible Person (LRP) – The person designated by the Owner who possesses the title of the land or the leasehold interest of a mineral estate upon which the construction activities will occur for the regulated site.
8. LUP – Linear Underground Projects
9. PRDs – Permit Registration Documents
10. Qualified SWPPP Developer (QSD) – The Contractor's employee or individual(s) retained by the Contractor who is authorized to develop and revise SWPPPs.
11. Qualified SWPPP Practitioner (QSP) – The Contractor's employee or individual(s) retained by the Contractor who is/are assigned responsibility for non-stormwater and stormwater visual observations, sampling and analysis, and responsibility to ensure full compliance with the General Permit and implementation of all elements of the SWPPP, including the preparation of the annual compliance evaluation and elimination of all unauthorized discharges.
12. SWPPP – Stormwater Pollution Prevention Plan

- C. The Contractor shall incorporate the actual construction means and methods to be employed to be in compliance with the SWPPP. The Contractor shall submit an updated SWPPP when significant changes occur for the project and in accordance with the requirements of the NPDES General Permit. Submittal shall also include submittal to the Owner in accordance Section 01300.

- D. The Contractor shall have a Designated SWPPP Manager prepare updates to the SWPPP during construction as required by the Permit and be on site to oversee the implementation, respond to changed conditions, and monitor the SWPPP.
- E. The Contractor will be responsible for amending, implementing, and maintaining the SWPPP, as necessary.

END OF SECTION

SECTION 01190

STRUCTURAL DESIGN REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section is applicable to the following secondary structural system elements, non-structural components, and/or equipment supported by structures.
 - 1. Mechanical, electrical, and plumbing equipment and appurtenances, including, but not limited to:
 - a. Enclosures and panels.
 - 2. Conduit, piping, cable trays, raceways, ducts and similar systems.
 - 3. Tanks and vessels (include contents), including support systems.
 - 4. All equipment specifically listed in this specification.
 - 5. Light fixtures, architectural features and other non-structural components.

1.02 REFERENCES

- A. American Society of Civil Engineers Standard ASCE 7-16, Minimum Design Loads and Associated Criteria for Buildings and Other Structures
- B. California Building Code, 2022 Edition.

1.03 DEFINITIONS

- A. Engineer of Record: The Design Engineer responsible for the preparation of Contract Documents.
- B. Specialty Engineer: Structural or Civil Engineer licensed in California responsible for specific elements of the primary structural system, the secondary structural system, non-structural elements and/or equipment supported by structures. The Specialty Engineer shall be provided by the Contractor.

1.04 GENERAL DESIGN REQUIREMENTS

- A. The Contractor and Specialty Engineer are responsible for producing structural designs that resist applicable loads including: Dead, Live, Wind, Seismic, Fluid, Snow, Rain, Earth, operational, or other special loads applicable to the component being designed.
- B. Minimum design loads shall be based on guidelines given in this Section, the Drawings, ASCE 7-16, CBC Chapter 16, equipment manufacturer's recommendations and/or other industry accepted design standard for the component being designed (i.e. AWWA D100, API 650, ANSI MH16.1).

1.05 SEISMIC DESIGN REQUIREMENTS

- A. The Contractor is responsible for producing designs that resist the total seismic forces in accordance with the seismic design criteria. The Contractor is responsible for coordinating between the Engineer of Record and the Specialty Engineer. The Contractor is responsible to coordinate the favorably reviewed design in the field, and shall provide the proposed design, including any modifications required to the primary structure, at no additional cost to the owner.

- B. The seismic design for non-structural components and equipment shall be in accordance with the IBC Chapter 16, and the required coefficients and factors for determining the total design seismic forces are shown on the Drawings.
- C. Coordinate the layout so that adequate space is provided between items for relative motion. Provide additional supports and restraints between items of different systems when necessary to prevent seismic impacts or interaction.
- D. Design non-building structures in accordance with Chapter 15 of ASCE 7-16; all designs utilizing Chapter 15 shall include the design and anchorage of the entire non-building structure.
- E. Design anchorages of all elements of structures, nonstructural components, and equipment supported by structures, to resist static and dynamic operational loads, plus total seismic loads specified in ASCE 7-16 Section 13.3.1 and as follows:
 - 1. For suspended equipment, multiply dead load by 1.2 and add $0.2S_{DS}$ to account for vertical seismic effects in the downward direction.
 - 2. For anchorage uplift, multiply dead load by 0.9 and subtract $0.2S_{DS}$ if used to reduce vertical seismic effects.
 - 3. Post-installed anchors installed in concrete shall be prequalified for seismic application in accordance with ACI 355.2.
- F. Design Basis and Coordination: Contractor shall note that the layout of the structure and equipment pads is based on the first named manufacturer and model for the equipment to be anchored.
 - 1. Contractor shall coordinate all attachments and related work and shall provide connections as noted in the favorably reviewed shop drawings.
 - 2. For all suppliers, if the dimensions required by the Contractor's submitted anchorage calculations deviate from those provided on the Contract Drawings, Contractor shall note the deviation in the submittal for review and provide the favorably reviewed pad at no additional cost to the Owner.
 - 3. If a model or manufacturer other than the first name supplier is submitted for use by the Contractor, Contractor shall coordinate all related work and deviations from the Contract Drawings.
 - 4. Where Contractor's specialty engineer proposes a deviation from the contract drawings for any manufacturer, and that deviation is favorably reviewed by the Engineer, Contractor shall provide that modification to the structure at no additional cost.

1.06 DESIGN REQUIREMENTS FOR PIPING, CONDUIT, AND DUCTS

- A. The Contractor is responsible for producing designs for support of piping, conduit, duct or other systems to resist total seismic forces based on the seismic design criteria coefficients specified above, unless shown on the Contract Documents. Except where the technical specifications give specific exemption from resistance of seismic forces, all supports shall be designed to meet seismic criteria. Support systems for piping, conduit, duct or other systems greater than 5 inches in diameter are shown on the Contract Documents.
- B. Where possible, pipes, conduit, and their connections shall be constructed of ductile materials (e.g., copper, ductile iron, steel or aluminum and brazed, welded or screwed connections). Pipes, conduits and their connections, constructed of nonductile materials (e.g., cast iron, no-hub pipe and plastic), shall have the brace spacing reduced to one-half of the spacing allowed for ductile material.

- C. Seismic restraints may be omitted for the following conditions, where flexible connections are provided between components and the associated ductwork, piping and conduit:
1. Fuel piping less than 1-inch nominal pipe size.
 2. All other piping suspended by individual hangers 12 inches or less in length from the top of the pipe to the bottom of the structural support for the hanger, where the hangers are detailed to avoid bending of the hangers and their connections.
 3. Electrical conduit less than 2.5 inches trade size or raceways supported by individual hangers 12 inches or less in length from raceway support point to the bottom of the structural support for the hanger, where the hangers are detailed to avoid bending of the hangers and their connections.
 4. Air-handling ducts not carrying hazardous gases or used for smoke control with less than 6 square feet in cross-sectional area or weighing less than 17 pounds/foot, or ducts suspended by individual hangers 12 inches or less in length from the duct support point to the bottom of the structural support for the hanger, where the hangers are detailed to avoid bending of the hangers and their connections.
- D. All trapeze assemblies supporting pipes, ducts and conduit shall be braced to resist the total seismic forces considering the weight of the elements on the trapeze. Pipes, ducts and conduit supported by a trapeze where none of those elements would individually be braced need not be braced if connections from the pipe/conduit/ductwork to component or directional changes do not restrict the movement of the trapeze. If this flexibility is not provided, bracing will be required when the aggregate weight of the pipes and conduit exceed 10 pounds/foot or ducting exceeds 17 pounds/foot. The weight shall be determined assuming all pipes and conduit are filled with water.
- E. As an alternative to designing the supports and anchorage, where an approved national standard provides a basis for the earthquake-resistant design, submit standard, data, and details for piping, conduit, duct or other systems:
1. For ductwork, mechanical piping, process piping and electrical conduits, follow Guidelines for Seismic Restraints of Mechanical Systems by SMACNA modified as follows:
 - a. Seismically brace piping regardless of size or location. Provide transverse braces at all changes in direction and at the end of all pipe runs. Space transverse braces not more than 20 feet apart. Provide longitudinal braces at 40-foot centers.
 - b. Seismically brace all ductwork regardless of size or location. Provide transverse braces at all changes in direction and at each end of run. Space braces not over 20 feet apart. Provide longitudinal braces at 40-foot centers.
 2. For fire protection systems, follow NFPA 13 modified as in paragraph 1.b above. Ensure that no seismic interaction occurs with items of other systems.

1.07 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Shop Drawings for non-building structures and contractor designed components: Submit signed and sealed structural calculations and detailed drawings for the following listed elements and where required in Divisions 2 through 17 of the primary structural system and their attachments, the secondary structural system

and their attachments, permanent non-structural components and their attachments, and the attachments and anchorage for permanent equipment supported by the structure:

1. Welded Steel Tank
2. Soil Nail Walls
3. MSE Wall
4. Pipe Supports (T8S and T10S)
5. Any components or equipment where Contractor's Specialty Engineer has designed using Chapter 15 of ASCE 7-16 (i.e. which are non-building structures rather than equipment)

C. Seismic Certification of Equipment.

1. Certification is required for the following elements or components:
 - a. Any components or equipment where the component importance factor I_p is designated as greater than 1.0.
2. Certification may consist of one of the following methods:
 - a. Project-specific component design and documentation determined to be acceptable by the Engineer and the authority having jurisdiction.
 - b. Written certification from the manufacturer that the equipment is capable of resisting the internal seismic loads due to the loading conditions noted herein and meeting the requirements based on one of the following:
 - 1) Analysis, where section 13.2.2 allows, or
 - 2) Testing meeting ASCE 7-16 section 13.2.5, or
 - 3) Experience Data meeting ASCE 7-16 section 13.2.6.
3. Level 2 Certification shall consist of a written certification from the manufacturer, and accompanying test results or experiential evidence, indicating compliance with ASCE 7-16 Chapter 13.2.2.
4. For elements designed using Chapter 15, Contractor shall submit complete calculations for the element or non-building structure in lieu of seismic certification.

D. Shop Drawings for Anchorage Calculations: Where required in the equipment specifications in Divisions 2 through 17 or listed below, submit signed and sealed structural calculations and detailed drawings from the Contractor's Specialty Engineer.

1. Pipe Supports (T8S and T10S)
2. Control Panels
3. Pumps

E. Structural calculations and detailed drawings shall be prepared by the Contractor's Specialty Engineer.

F. Structural calculations and detailed drawings shall clearly show the total design seismic forces which will be transferred from the elements of the structural system, non-structural components, and/or equipment and their attachments to the primary structure. Calculations must be reviewed by Engineer of Record for general conformance with the design criteria and building code and therefore calculations shall include:

1. Seismic and wind load criteria used to determine design lateral and uplift forces. For external equipment, a statement should be made as to whether wind controls for all equipment.
2. Derivation of forces used, including at least one complete sample calculation, showing the process used so that Engineer of Record may determine general

compliance. Printouts of spreadsheets without explanation of calculations used to determine values are not acceptable.

3. Adequacy of anchorage to concrete and masonry or attachment to the primary structure to transfer the design forces from the element.
 4. Detail drawings shall note:
 - a. Required concrete strength,
 - b. Anchor type, dimensions, and materials.
 - c. Edge distance, spacing, embedment depth, substrate thickness and any supplementary reinforcing required for anchors installed in concrete.
 - d. Required dimensions of equipment pads based on equipment size and edge distance. The Contractor shall coordinate dimensions of equipment pads, including any revisions required to meet the requirements of the favorably reviewed submittal by the Specialty Engineer at no additional cost to the Owner.
- G. The Engineer of Record's review of items within a Specification Section cannot be completed until all related items have been coordinated and submitted for review.
- H. Quality Assurance Submittals
1. Test Reports: Submit test reports for tension testing of anchors.

1.08 QUALITY ASSURANCE

- A. Qualifications: The Contractor is responsible for submitting signed and sealed structural calculations and detailed drawings from a Specialty Structural or Civil Engineer licensed in the State where the project is being built.
- B. Regulatory Requirements: Comply with the adopted and amended versions of the California Building Code Section 1613, the referenced sections of ASCE 7-16 plus clarifications and additions specified in this Section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

PART 4 - FIELD QUALITY CONTROL

- A. Site Tests: Tension testing of expansion or adhesive anchors utilized for anchorage shall be done in the presence of the Owner's Representative and a report of the test results shall be submitted. See
- B. Inspection: Special Inspection shall be provided for high strength bolting or bolts installed in concrete.

END OF SECTION

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SECTION 01300

SUBMITTALS

1.01 SUBMITTAL PROCEDURES

- A. Accompany each submittal with a Submittal form, General Conditions Exhibit GC-2, which contains the following information:
 - 1. Contractor's name and the name of Subcontractor or supplier who prepared the submittal.
 - 2. The project name and identifying number.
 - 3. Description of the submittal and reference to the Contract requirement or technical specification section and paragraph number being addressed.
- B. Unless otherwise specified, provide submittals in electronic PDF searchable format.
- C. Submittals which include more than one item or piece of equipment shall include a Table of Contents following the standard submittal form and cover sheets
- D. Each submittal shall include a copy of the specification section and all referenced and applicable sections with addendum updates included. For each specification section, check-mark each paragraph to indicate specification compliance with the full paragraph as a whole or marked to indicate requested deviations from specification requirements. Each deviation from the specifications requested by the Contractor shall be underlined and referenced by a unique number in the margin to the right of the identified paragraph. The submittal shall include a detailed written explanation of the reasons for requesting the deviation that is clearly labeled to correspond with the unique number provided in the margin. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal on the basis that the submittal is incomplete and will be returned to the Contractor REJECTED – RESUBMIT with no further consideration.
- E. Project Initiation Submittals. At a minimum, provide the following project initiation submittals prior to mobilization.
 - 1. Designation of Superintendent: Include name, address, home telephone number and a brief resume.
 - 2. List of Subcontractors and Major Suppliers: Include address, telephone number and name of responsible party.
 - 3. Schedule of Values, in a form acceptable to the Engineer: See General Conditions.

1.02 SCHEDULE OF SUBMITTALS

- A. See General Conditions. Within 15 days after the Notice to Proceed, submit a Schedule of Submittals showing the date by which each submittal required for Product Review or Product Information will be made. Identify the items that will be included in each submittal by listing the item or group of items and the Specification

Section and paragraph number under which they are specified. Indicate whether the submittal is required for Product Review of Proposed Equivalents, Shop Drawings, Product Data or Samples or required for Product Information only.

1.03 PLAN OF OPERATIONS

- A. Before beginning on site work, submit a plan showing Contractor's intended use of the site assigned to it. Show location of enclosing fence, access points and gates. Show location for Contractor's, Subcontractor's, and Engineer's field office and parking. Show location of Contractor's and Subcontractor's work areas and storage areas.

1.04 CONSTRUCTION SCHEDULE

- A. See General Conditions.
- B. The Contractor's Construction Schedule shall be in the form of a computer generated network analyses diagram and supporting mathematical analysis using the Critical Path Method (CPM) under concepts and methods outlined in the Associated General Contractor's publication, "The Use of CPM's Construction - A Manual for General Contractors and the Construction Industry." Provide a copy of the software used to the Engineer.
 - 1. Draw network diagram to scale using actual calendar dates. Show work subdivided into identifiable activities within each trade such that no activity has a duration longer than five (5) working days. Show order and interdependencies of each activity.
 - 2. Use actual calendar dates to show planned and actual performance and show:
 - a. Preceding and following event numbers.
 - b. Activity description.
 - c. Estimated duration of activity.
 - d. Earliest start date.
 - e. Earliest finish date.
 - f. Actual start date.
 - g. Actual finish date.
 - h. Latest start date.
 - i. Latest finish date.
 - j. Total and free float.
 - k. Monetary value of activity, keyed to Schedule of Values.
 - l. Percentage of activity completed.
 - m. Dates for making submittals of Proposed Equivalents, Product Data and Shop Drawings.
- C. If the Construction Schedule does not reflect the CPM format requirements, the specified work, or the Contract Time, it will be returned to the Contractor for modification.
- D. Revise the Construction Schedule and resubmit within seven (7) days following any monthly meeting to review Contractor's Application for Payment when Contractor's work is fifteen (15) days or more behind schedule.
- E. Accelerated Work if Required to Meet Schedule: See General Conditions. Give Engineer 3 days prior notice of construction that will take place outside of normal

work hours or work days. Compensate Owner for extra inspection cost caused by Accelerated Work required to meet Schedule.

- F. Give Engineer 3 days prior notice of normal work days on which construction will not take place or of scheduled construction that will not take place. Compensate Owner for extra inspection cost resulting from failure to give notice.

1.05 SHOP DRAWING, PRODUCT DATA AND SAMPLES SUBMITTED FOR PRODUCT REVIEW

- A. This paragraph covers submittal of Shop Drawings, Product Data and Samples required for the Engineer's review referred to as Product Review submittals in the Technical Specifications (Division 2 through 17). Submittals required for information only are referred to as Product Information submittals in the Technical Specifications and are covered in this Section. Also see General Conditions.
- B. The Contractor shall make all Product Review submittals early enough to allow adequate time for the Engineer's review, for manufacture and for delivery at the construction site without causing delay to the Work. Submittals shall be made early enough to allow for unforeseen delays such as:
 - 1. Failure to obtain Favorable Review because of inadequate or incomplete submittal or because the item submitted does not meet the requirements of the Contract Documents.
 - 2. Delays in manufacture.
 - 3. Delays in delivery.
- C. Content of Submittals:
 - 1. Each submittal shall include all of the items and material required for a complete assembly, system or Specification Section.
 - 2. Submittals shall contain all of the physical, technical and performance data required by the specifications or necessary to demonstrate conclusively that the items comply with the requirements of the Contract Documents.
 - 3. Include information on characteristics of electrical or utility service required and verification that requirements have been coordinated with services provided by the Work and by other interconnected elements of the Work.
 - 4. Provide verification that the physical characteristics of items submitted, including size, configuration, clearances, mounting points, utility connection points and service access points, are suitable for the space provided and are compatible with other interrelated items that are existing or have or will be submitted.
 - 5. Label each Product Data Submittal, Shop Drawing and Sample with the information required in paragraph 1.01A of this Section. Highlight or mark every page of every copy of all Product Data submittals to show the specific items being submitted and all options included or choices offered.
 - 6. Additional requirements for Product Review submittals are contained in the Technical Specification sections.
 - 7. Designation of work as "NIC" or "by others," shown on Shop Drawings, shall mean that the work will be the responsibility of the Contractor rather than the subcontractor or supplier who has prepared the Shop Drawings.
- D. Compatibility of Equipment and Material: Verify that items contained in the same or in different submittals meet the requirements in the paragraph titled "Material and

Equipment in Section 01040 especially the subparagraphs titled "Compatibility of Material and Equipment."

- E. Requirements for Contractor Designed Items and for First Specified (Named) Items: Verify that items meet the requirements in the paragraph titled "Performance Specifications and Contractor Designed Items" in Section 01040.
- F. Requirements for the Contractor's review and stamping of submittals prepared by the Contractor or by Subcontractors or suppliers prior to submitting them to the Engineer are covered in General Conditions.
- G. Submittals that contain deviations from the requirements of the Contract Documents shall be accompanied by a separate letter explaining the deviations. See General Conditions. The Contractor's letter shall:
 - 1. Cite the specific Contract requirement including the Specification Section and paragraph number for which approval of a deviation is sought.
 - 2. Describe the proposed alternate material, item or construction and explain its advantages and/or disadvantages to the Owner.
 - 3. State the reduction in Contract Price if any that is offered to the Owner.
- H. Engineer's Review Procedure and Meaning:
 - 1. The Engineer will stamp and mark each Product Review submittal prior to returning it to the Contractor. The stamp will indicate whether or not the review was favorable and what action is required of the Contractor. Review categories "No Exceptions Taken" and "Make Corrections Noted" both indicate Favorable Review.
 - 2. At a minimum, Favorable Review is contingent on:
 - a. The compatibility of items included in a submittal with other related or interdependent items included in previous or future submittals.
 - b. Future submittal of items related to or required to be part of this submittal that were not included with this submittal.
 - 3. Favorable Review of a submittal does not constitute approval or deletion of items required as part of the submittal but not included with the submittal. Favorable Review of items included in the submittal does not constitute deletion of specified features, options or accessories that were not included in the submittal.
 - 4. The action required by the Contractor for each category of review is as follows:
 - a. **NO EXCEPTIONS TAKEN.** NO RESUBMITTAL REQUIRED.
 - b. **MAKE CORRECTIONS NOTED:**
 - (1) **NO RESUBMITTAL REQUIRED.** The Contractor shall make corrections noted prior to manufacture.
 - (2) **PARTIAL RESUBMITTALS REQUIRED.** The Contractor shall submit related accessory or optional items as noted which are required but were not included with the submittal and/or shall resubmit unsatisfactory portions or attributes of items as noted. The Contractor may proceed to manufacture those portions of the submittal that will be unaffected by required resubmittals.
 - c. **AMEND AND RESUBMIT.** The Contractor shall amend and resubmit the submittal as noted or required to comply with the Contract Documents.
 - d. **REJECTED - RESUBMIT.** The item submitted does not comply with the Contract Documents. Resubmit items that comply with the requirements of the Contract Documents.

- e. **NOT REVIEWED**. The item submitted is incomplete or does not comply with the Contract Documents. The item has not been reviewed and is returned to the Contractor for correction.
 - f. **RECEIPT ACKNOWLEDGED**. Receipt of a submittal that is not subject to the Owner's review and approval is acknowledged; and, is being filed for information purposes only. Generally used in acknowledging receipt of Product Information. No further submittal activity is required by the Contractor.
5. The letter of transmittal accompanying the returned Product Review submittal may contain numbered notes. Marking a corresponding number on a Shop Drawing or Product Data submittal shall have the same affect as applying the entire note to the submittal.
- J. Re-submittals that contain changes that were not requested by the Engineer on the previous submittal shall be accompanied by a letter explaining the change.
- K. Favorable Review Required Prior to Proceeding: Do not proceed with manufacture, fabrication, delivery or installation of items prior to obtaining the Engineers Favorable Review of Product Review submittals. See General Conditions.
- L. Intent and Limitation on Engineer's Review:
- 1. See General Conditions.
 - 2. The Contractor has primary responsibility for submitting and providing work that complies with the requirements of the Contract Documents. That responsibility cannot be delegated in whole or in part to subcontractors or suppliers. Neither the Engineer's Favorable Review nor the Engineer's failure to notice or comment on deficiencies in the Contractor's submittals shall relieve the Contractor from the duty to provide work, which complies with the requirements of the Contract Documents.

1.06 PROPOSED EQUIVALENTS

- A. Submit Proposed Equivalent submittal form, General Conditions Exhibit GC-3 and comply with the submittal requirements for Shop Drawings, Product Data, and Samples submitted for Product Review in another paragraph of this Section.
- B. See General Conditions.
- C. Time of Submittal:
 - 1. General Conditions requires submittal of Proposed Equivalents within 35 days of the Notice to Proceed. The Engineer may agree to a later submittal date if requested in writing within 35 days of the Notice to Proceed. The request shall identify the item; give the Specification reference, and proposed manufacturer and model number of the item that will be submitted and the proposed submittal date.
 - 2. The Engineer's agreement to a later submittal date shall be in writing and shall not be construed as Favorable Review or acceptance of the manufacturer or item proposed.
- D. Content of submittals shall be the same as that required for Product Data, Shop Drawings and Samples submitted for Product Review in another paragraph of this Section. In addition, the Contractor shall provide information on several recent

similar installations of the item to verify its suitability. The information shall include the project name and location, the Owner's name, address, telephone number and name of a knowledgeable person to contact for information on performance of the product.

- E. When the Contractor has listed specific maker's products submitted with its Bid no changes will be permitted without submittal of acceptable evidence justifying the change and the Engineer's written approval.
- F. If a non-equivalent substitute is submitted for review, it shall be accompanied by a proposed reduction in Contract Price which shall include the increased cost of Engineering service required to evaluate the proposed substitute (which shall be paid to the Owner whether or not the substitute is accepted) plus the greater of
1) the difference in price between the first specified item and the item submitted and
2) the difference in value to the Owner between the two items.

1.07 PRODUCT INFORMATION SUBMITTALS

- A. See General Conditions. Submittal for Informational Purpose Only is an item required for the Owner's permanent records relating, in part, to future maintenance, repair, modification, replacement of work or as otherwise required. Submittals for Informational Purpose Only will only be received and logged to document that the required submittals have been made. Neither the Owner nor Engineer will respond to a Submittal for Informational Purpose Only.
- B. The Contractor shall clearly separate information for Product Review from information for Product Information in submittals that include both.
- C. Make Product Information submittals prior to delivering material, products or items for which Product Information submittals are required.
- D. The Contractor has the sole and exclusive responsibility for furnishing products and work that meets the requirements of the Contract Documents.
- E. The Engineer reserves the right to comment on any submittal and to reject any product or work delivered, installed or otherwise at any time that the Engineer become aware that it is defective or does not meet the requirements of the Contract Document. See General Conditions.

1.08 OPERATION AND MAINTENANCE MANUALS AND PARTS LISTS

- A. Operation and maintenance information shall be submitted in a format best suited for the type of manual to be provided to the owner. Unless otherwise specified, provide information in electronic PDF searchable format.
- B. Provide operation and maintenance manuals and parts list for all equipment furnished under this contract. Comply with the detailed requirements in Technical Specification sections. Include instructions for delivery, storage, assembly, installation, lubrication, adjusting, startup, operation and maintenance.
 - 1. For all equipment include:
 - a. Startup instructions
 - b. Normal operation instructions.

- c. Trouble shooting instructions.
 - d. Lubrication instructions.
 - e. Maintenance and reinstallation instructions.
 - f. Parts identification.
 - g. List of spare parts recommended to have on hand.
 - h. Operator safety instructions.
 - 2. For all Electrical Equipment, provide the following additional information:
 - a. Equipment ratings.
 - b. Calibration curves and rating tables if appropriate.
 - 3. For Complex Equipment provide in addition:
 - a. Alternate specified operating modes.
 - b. Emergency shutdown instructions.
 - c. Normal shutdown instructions.
 - d. Long-term shutdown instructions.
 - 4. Operation and maintenance manuals for systems composed of separate pieces of equipment shall include a system explanation of items 1, a, b, and c, and 3a through c, as well as the instructions for each separate piece of equipment.
- C. Submit at least 15 days prior to Facility Startup and Training specified in Section 01650.
- D. When standard manufacturer's literature is used highlight or mark all copies to shop specific items and options provided.

1.09 MANUFACTURER'S CERTIFICATES

- A. When specified in Technical Specification section, submit manufacturers' certificate to Engineer for review. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate. Certificates may be recent or previous test results on material or Product, but must be acceptable to the Engineer.

1.10 CONSTRUCTION PHOTOGRAPHS

- A. Submit digital photographs in electronic JPEG format each month to Engineer with Application for Payment.
- B. Take site photographs from different directions and photographs to show progress of the Work. Make photographs within 5 days of the Application for Payment Date.
- C. Identify photographs with date, time, orientation and project identification.

1.11 LIST OF SUBMITTALS FOR DIVISIONS 0 AND 1

A. Submittals required with the Bid are not listed.

Description	Required by	Time of Submittal
1. Performance & Payment Bonds	GC Article 4	Prior to signing Agreement
2. Liability Insurance Certificates	GC Article 4	Prior to beginning Construction
3. Property Insurance Certificates	GC Article 4	Prior to beginning Construction
4. List of Subcontractors	Doc 00430, GC Article 5	Prior to beginning Construction
5. Plan of Operations	01300	Prior to beginning work on the site
6. Temporary Construction Schedule	GC Article 5	Within 10 days of the date in the Notice to Proceed
7. Schedule of Submittals	01300	Within 15 days of Notice to Proceed
8. Schedule of Values	GC Article 13, 01010	20 days prior to the first Application for Payment
9. Application for Payment	GC Article 13, 01010	5 days prior to each Application for Payment date
10. Construction Schedule	GC Article 5, 01300	Within 30 days of Notice to Proceed.
11. Environmental Protection Plan	01300 01140	Submit within 30 days from the date of the Notice to Proceed
12. Submittal of All Proposed Equivalent Items	GC Article 8, 01300 and Technical Sections	Within 35 days of the Notice to Proceed unless Engineer has agreed to a later submittal date in writing
13. Manufacturer's Certificates	01300, and Technical Specifications	Prior to delivering material or equipment and in accordance with Technical Specifications
14. Construction Photographs	01300	Submit monthly
15. Operations and Maintenance Manuals and Parts Lists	01300 01650	Submit 15 days prior to Facility Startup and Training
16. Manufacturer's Affidavits	01300 01650	During equipment startup. For equipment for which affidavits are called for in the Technical Specifications
17. Record Drawings	GC Article 5	Prior to Final Acceptance
18. Extra Materials	01700, and Technical Specifications	Prior to Final Acceptance
19. Special Guarantees	01700, and Technical Specifications	Prior to Final Acceptance
20. Maintenance Contracts	01700, and Technical Specifications	Prior to Final Acceptance
21. Release of Liens	GC Article 13	With Progress Payments Prior to Final Payment
22. Contractor's Waiver of Claims	GC Article 13	Prior to Final Payment
23. Insurance Certificate for insurance coverage beyond Final Payment including completed operations coverage and liability coverage when the Contractor is correcting defective work under the Guarantee.	GC Article 4	Prior to Final Payment

1.13 LIST OF SUBMITTALS FOR TECHNICAL SPECIFICATIONS

- A. A list of submittals required in Technical Specification Sections is included in this Section. This list may not be all-inclusive; refer to Technical Specification Sections for detailed submittal requirements.

LIST OF SUBMITTALS

SECTION	PARA-GRAPH	PRODUCT REVIEW	PRODUCT INFOR.	SAMPLES	FACTORY TEST PLAN OR LAB	FACTORY OR MATERIALS TEST REPORT	FIELD TEST PLAN	FIELD(3) TEST REPORT	O&M MANUAL & PARTS LIST	AFFIDAVIT
02301		S		M	M					
02700			S							
02810		S							S	
03200		M	M	M		M				
03300		S	S	M	S(1)	M				
03350		S		M						
09960		S		S	(S)(1)					S
10401		S								
11001		(4)	(4)			(4)		(4)	(4)	
11003		S					S (1)	M		
13200		S							S	S
15050	1.03 A.2.	M						M		
	1.03 A.3.a		s	s				M		
	1.03 A.3.b	S								
	1.03 A.3.c		S							
	1.03 A.3.d	M	S			M			M	M
	1.03 A.3.e		S							
	1.03 A.4					M				
	1.03 A.5	S								
16010		(4)	(4)			(4)		(4)	(4) (5)	
16110			S (7)							
16130			S (7)							
16140			S (7)							
16402		S				S				
16406		S				M		S	S	
16450			S (7)					M		
16500		S								
17010		(4)	(4)			(4)	(4)	(4)	(4) (5)	
17140		S							S	
17150		S							S	

LEGEND AND NOTES:

- S Indicates a single and separate submittal package each within its own transmittal letter from Contractor. This submittal shall be complete for all items in the Section (or portion of Section as designated in table).
- M Indicates multiple submittals are acceptable to facilitate project progress.
- (1) Include this item with Product Review Submittal Package.
- (2) Include documentation of required special warranty or guarantee.
- (3) There are certain requirements under various sections for testing, for which submission of a report is not required. Such situations are not included in this listing.
- (4) This Section includes submittal requirements for items described in other sections.
- (5) Include record/as-built drawings and/or special as-built data as specified.
- (6) For Product Review submittals, submit single, complete submittal packages for all items specified within the following Specification groups (i.e., no more than one submittal per group of specification sections):
- Sections 16100 through 16199.
 - Sections 16200 through 16299.
 - Sections 16900 through 16999.
- (7) Submit Division 16 Product Information submittals together in a single package.

END OF SECTION

SECTION 01500

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

1.01 TEMPORARY UTILITIES

- A. Sanitary Facilities: Provide and maintain self-contained portable sanitary facilities for the Contractor's, subcontractor's, Engineer's, and Owner's use. Facilities shall comply with applicable regulations and shall be serviced, cleaned and disinfected frequently.
- B. Temporary Power and Telephone Service: Provide all temporary utility service required for the project. Pay all utility service connection and use charges.
- C. Temporary Water Service:
 - 1. Water: Limited water service will be available at the project site for the Contractor's use. No charge will be made for this use provided utilities are not wasted. The Contractor shall provide temporary connection and distribution systems and remove them at the end of its work. That Contractor shall coordinate with Owner regarding connection location and metering.
- D. Temporary Lighting: Provide and maintain lighting for construction operations to achieve a minimum lighting level of 20-foot candles for rough work and 60-foot candles for finish work.
- E. Temporary Fire Protection:
 - 1. Provide and maintain fire protection equipment, including extinguishers, fire hoses, and other equipment required by law, insurance carriers, or necessary for proper fire protection during the course of the work.
 - 2. Use fire protection equipment only for fighting fires.
 - 3. Locate fire extinguishers in field offices, storage sheds, tool houses, temporary buildings, and throughout the construction site.

1.02 TEMPORARY CONSTRUCTION

- A. The Contractor is solely and exclusively responsible for the design, construction and maintenance of all temporary construction including forms, falsework, shoring, scaffolding, stairs, ladders and all other similar items. See General Conditions.
- B. Construct adequate and safe forms and falsework, to rigidly support partially completed structures. Provide temporary bridges and decking to maintain vehicular and pedestrian access. Design and construct temporary forms, falsework, bridges and decking in accordance with applicable regulations and codes.

1.03 BARRICADES, FENCES AND ENCLOSURES

- A. See General Conditions.

- B. Barricades: Provide temporary guard rails, ladders, stairs, guards, and barricades to protect persons in accordance with applicable regulations, including California Code of Regulations Title 8 and Cal/OSHA.
- C. Fences:
 - 1. Provide a temporary 6-foot-high chain-link fence completely around the site to exclude unauthorized persons from construction areas.

1.04 PROTECTION OF INSTALLED WORK

- A. Provide temporary and removable protection for installed products. Control activity in immediate work area to minimize damage.
- B. Provide heavy planking to protect curbs, gutters, culverts, paving and similar surfaces from damage by heavy equipment or vehicles.

1.05 SECURITY

- A. Provide security and facilities to protect the Work, and existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.

1.06 ACCESS ROADS AND PARKING AREAS

- A. Access Roads: Construct and maintain temporary access roads to serve the construction area.
- B. Parking:
 - 1. Construct temporary gravel surfaced parking areas for construction personnel where shown on the Drawings or in the Contractor's storage areas.
 - 2. Park workers' vehicles offsite.
 - 3. Construct temporary graveled surface parking for 3 vehicles adjacent to the Engineer's site office.

1.07 TRAFFIC REGULATION

- A. Notify the Public Works Department 48 hours prior to commencement of any work in the public right-of-way at that time an "INSPECTION REQUEST FORM" shall be completed to ensure proper scheduling of an inspection with the Engineer.
- B. Submit a Traffic Control Plan for approval to the Public Works Department a minimum of 5 days prior to any work within an existing public street. The Plan shall be signed by a licensed Traffic Engineer when it involves an arterial street. Provide all necessary traffic control in accordance with the latest edition of a CALTRANS "MANUAL OF WARNING SIGNS, LIGHTS, AND DEVICES FOR USE IN PERFORMANCE OF WORK UPON HIGHWAYS", while working within the public right-of-way. Two traffic lanes (10' min.) shall be open to vehicular traffic during all hours, weekends, and holidays. One lane one way traffic, may be permitted under the control of not less than two (2) competent flagmen during construction operations. Street closures and detours shall only take place upon engineer approval and police department coordination.

- C. Conduct operations so as to offer the least possible obstruction and inconvenience to public traffic. Do not overload or damage paved or improved surfaces, sidewalks, curbs or gutters.
- D. Provide temporary barricades, lights, flag persons and other means to safely control pedestrian and vehicular traffic entering and leaving the project site and on the project site.

1.08 PROJECT SIGN

- A. Provide an 8-foot-wide by 6-foot-high project sign using 3/4-inch exterior grade plywood and braced wood frame construction. Paint all surfaces with two coats of exterior house paint. Employ a professional sign painter to letter sign in accordance with Engineer's small scale design and color selection (two colors).
 - 1. List project title and names of Owner, Engineer, and Contractor.
 - 2. Erect the sign where directed by the Engineer. Locate bottom edge of the sign 8 feet above the ground. Maintain sign in good condition and remove it on project completion.

1.09 FIELD OFFICES

- A. Contractor's Office at the Site: Maintain a suitable office at the site for the Contractor's Superintendent who shall be authorized to receive submittals, drawings, instructions, or other communications from the Engineer or the Owner.
- B. Engineer's Office at the Site:
 - 1. Office: Provide a trailer-type temporary structure for the Engineer's use as an office with the following features:
 - a. All-metal frame, exterior, sides and roof.
 - b. Size: 300 square feet minimum.
 - c. Number of Rooms: Two minimum and a toilet room.
 - d. Windows: Two minimum per office room with security guard screens.
 - e. Lighting: Interior fluorescent ceiling lights with 70-foot candles of uniform lighting at desk level. Outside lights above each door.
 - f. Heating, Ventilation and Air Conditioning: Provide at least six air changes per hour in all rooms and provide air conditioning equipment capable of maintaining at least 70°F for heating and 78°F maximum for cooling.
 - g. Toilet room with chemical toilet - Monogram Industries Jetomatic; Pyrolet; or equal, wash basin, mirror, toilet paper and paper towel dispensers.
 - h. Doors equipped with automatic retracting deadbolt locks. Provide four keys.
 - i. Provide staircase with stair handrail and landing with guardrail at entrances.
 - j. Electrical service, disconnect switch and a circuit breaker panel. Provide ground fault protected outlets.
 - k. One hundred fifteen (115) volt, 15 amp receptacles, spaced no more than 8 feet apart.
 - 2. Equipment and Furnishings: Provide the following:
 - a. Two desks each with two drawer pedestals.
 - b. Two swivel chairs.

- c. One 4-drawer filing cabinet.
 - d. One 12-stick plan holder.
 - e. Two desk lamps.
 - f. Two drafting tables and stools.
 - g. One paper towel dispenser.
 - h. One paper cup dispenser.
 - i. One bookcase, 4 feet wide and 3 feet high.
 - j. Two wastepaper baskets.
 - k. One first-aid kit
 - l. Two telephones, one with speaker.
 - m. One telephone answering machine.
 - n. One 14A 60 BC dry chemical fire extinguishers
 - o. Water chiller fountain with hot water accessory and refrigerated compartment, EBCO Manufacturing Co. Model ODP8AH Oasis; equivalent by Hawes; or equal.
- 3. Utilities: Install potable water service. Arrange and pay for telephone and electrical service. The Contractor shall pay for periodic water, sewer, and electrical charges.
 - 4. Installation and Removal: Install the Engineer's office at the location directed by the Engineer within 15 days after the Notice to Proceed. Provide rigid level supports and seismic and wind tie downs. Remove the Engineer's office no later than 30 days after recording of the Notice of Completion, but no earlier than the Notice of Completion.
 - 5. Maintenance: Maintain the Engineer's office in good repair. Provide daily cleaning and maintenance service. Replenish paper towels, paper cups, soap, toilet paper, and bottled water daily. Service, pump and clean chemical toilets at least twice weekly.

END OF SECTION

SECTION 01650

FACILITY STARTUP

1.01 FACILITY STARTUP

- A. Commission all systems and equipment to verify performance, function, and correct operation by performing procedures to activate, startup, adjust, test, and demonstrate that the work is in operating order in accordance with these general requirements of this Section and the detailed requirements of the technical sections under the system or equipment specified. To ensure that the work is ready for full-time operation the procedures include verification, balancing, calibration, witness testing, documentation, inspection by equipment manufacturers and operator training where specified.
- B. Notification: Notify the Engineer five days prior to starting each system or piece of equipment.
- C. Coordination: During the startup period, coordinate the operation of the equipment with Engineer, subcontractors, Owner's operators, and manufacturer's representatives.
- D. Furnish test equipment, measuring devices and supplies required to conduct tests.
- E. Maintain the equipment until acceptance. Provide all lubricants, chemicals, and electricity necessary until acceptance.
- F. Furnish all expendable supplies, gas, water, etc., required for startup, demonstration and testing and dispose of all waste or used supplies, water, etc.

1.02 SUBMITTALS

- A. Startup Plan, Forms, and Schedule: Prepare a facility startup plan and schedule. The plan shall include test methods and procedures and sample forms for recording test data.
- B. Affidavit.
- C. Submit documentation of tests, balancing reports, and the like.

1.03 INITIAL STARTUP AND OPERATION OF FACILITIES

- A. See Step 17 below for requirements before placing the reservoir into operation. The following listing is a general sequence of startup activity steps to be used in placing facility systems into operation:
1. Perform initial lubrication of equipment and have manufacturers check and adjust equipment. Provide all subsequent lubrication and maintenance, and such staff as required for test operation until the Owner assumes equipment maintenance responsibility after Step 14 below.
 2. Perform satisfactory testing of electrical work required prior to energizing of the electrical system.
 3. After completion of Step 2, perform satisfactory electrical testing required after energizing of the electrical system.
 4. Complete calibration of instruments.
 5. Satisfactorily complete system verification of instrumentation work.
 6. After completion of Steps 1 and 3, perform a rotational test of equipment and correct backward rotating drives.
 7. After completion of Steps 5 and 6, test operate the equipment by manually initiating the operation. Where manual operation bypasses alarm or safety monitoring, provide continuous supervision of such parameters. Perform this step using water in lieu of chemicals or other process liquids. Use dry air or nitrogen in lieu of hazardous gases.
 8. Concurrent with Step 7, perform instrumentation and control testing and adjustments as related to the equipment being tested.
 9. Concurrent with Step 7 and where possible at this stage of startup, complete the performance testing specified for the equipment.
 10. Concurrent with Step 7, perform adjustments of the electrical work as related to the equipment being tested.
 11. Repeat Steps 1 through 10 as required for other equipment items and plant systems until all plant process components and utility systems are ready for total plant operation. It may be necessary for the Contractor to put portions of the newly constructed facility in service before constructing other portions of the facility or completing the Work as a whole.
 12. Notify the Owner and the Engineer 45 days before total plant operation is to occur so that the Owner may order chemicals and make other arrangements for full time operation. This notification shall have an accuracy of plus or minus 7 days. Notify the Owner and Engineer again, exactly 7 days before total plant operation is to begin.
 13. Upon completion of all the above steps, the facility shall be started up and operated on a complete full-time basis beginning on the indicated date. The Owner will provide operating personnel, chemicals and untreated water. For five consecutive days beginning with the start-up day, the Contractor shall have at the plant site, during the day shift, a mechanic, an electrician and an instrument engineer. Representatives of manufacturers of critical equipment shall also be present for these five days as needed or as required elsewhere in the specifications. The Contractor shall also provide these personnel, on a 24-hour per day, "on call" basis, if necessary, to adjust, repair, and correct deficiencies as required to keep the facilities in continuous operation for a period of 30 days. The Contractor shall train the operators in the proper operation and the control of the new facilities. The Contractor shall also furnish all such mechanical and electrical workers as required to make adjustments to

- and perform all required maintenance for the operating equipment until the end of the 30-day initial operation period. Maintenance of operating equipment shall include lubrication, adjustments, replacements, and modifications as required.
14. After successful completion of the 30-day initial operation period, the Owner will take over maintenance duties as well as operation and will begin to provide and pay for lubricants. If continuous process operation is interrupted for a period of four consecutive hours or more due to a failure of the equipment or work provided by the Contractor, then the counting of the 5-day and/or 30-day periods, described in Step 13 above, shall be restarted at day one if these periods have not reached satisfactory completion.
 15. Following the commencement of Step 13, satisfactorily complete equipment performance testing, electrical testing and adjustments, and instrumentation/control testing and adjustments to the extent that such testing and adjustments could not be made prior to full plant operation.
 16. Complete the documentation of test, balancing reports, and the like commissioning for submittal during the startup process and before acceptance.
 17. Before placing the reservoir into operation high performance coatings in accordance with Section 09960, disinfection in accordance with Section 11003, impressed current cathodic protection systems in accordance with Section 11003, and level measurement devices in accordance with Section 17140 shall have been completed, tested, and documented. Before placing the reservoir into operation all of the following requirements of the State of California State Water Resources Control Board Division of Drinking Water (DDW) shall be met:
 - a. Evidence that all material in contact with water is certified as meeting NSF Standard 61 shall have been submitted.
 - b. A disinfection plan to place a new tank in service and the bacteriological test results shall have been submitted.
 - c. Photos of the storage facility (reservoir) features including but not limited to the roof (underside and top), roof hatch with lock (top and underside), screened vents (exterior and interior), interior of tank, inlet (interior and exterior), outlet (interior and exterior), overflow (interior weir and exterior discharge), drain (interior and exterior), and sample tap (interior and exterior) shall be submitted.
 - d. Where documentation is required to be submitted to the DDW the documentation shall be submitted, received, and accepted by the DDW prior to placing the reservoir into operation.

1.04 MANUFACTURER'S FIELD SERVICE AND AFFIDAVITS

- A. Field Service: Where specified, manufacturers of equipment shall provide field service. Field service shall be provided by an authorized factory-trained and qualified manufacturer's representative for the specific equipment. Equipment shall not be considered ready for full-time operation until after the manufacturer's representative has checked and adjusted the equipment, and certified by written affidavit that the equipment has been properly installed, tested, adjusted, lubricated, and calibrated, and is ready for full-time operation.
- B. Affidavits: Acceptable affidavits shall be submitted prior to completion of the work.
 1. Affidavits shall contain the following specific wording:

"The *[Name of Equipment]* has been properly installed, tested, adjusted, lubricated, and calibrated, and is ready for full-time operation. The installation has been inspected and has been found to be in conformance with our (the manufacturer's) standards and requirements."

2. No amplification, dilution, or modification of this specific wording will be permitted.

1.05 TRAINING

- A. Submit Operation and Maintenance Manuals and Parts Lists specified in Section 01300 at least 15 days prior to the first training session.
- B. Demonstrate the operation, maintenance and safety procedures for all systems and equipment to personnel designated by the Owner.
- C. Provide training and onsite demonstration of systems and equipment.
 1. Illustrate training with diagrams, checklists, photographs and other visual aids as appropriate. Use video to present visual materials.
 2. Prepare a summary illustrated with copies of visual materials. Distribute one copy to each course attendee, four copies to the Owner and two copies to the Engineer.
- D. In addition to overall training specified above, provide special demonstration and training for specific pieces of equipment specified in the Technical Specification Sections.

END OF SECTION

SECTION 01700

CONTRACT CLOSEOUT

1.01 FINAL CLEANUP

- A. Prior to Final Inspection clean the entire construction area and all other areas affected by the performance of work under this Contract. Perform cleaning using personnel specializing in and skilled in cleaning and maintenance work. Perform repair work using personnel skilled in executing the type of work being repaired. Perform all work to the highest trade standards applicable to that type of work.
 - 1. Remove all temporary construction, signs, tools, equipment, excess material and debris.
 - 2. Remove all lumps, splatters, spots and stains caused by paint, adhesive, asphalt, concrete, mortar, sealant or other foreign material from exposed or finished surfaces. Remove all temporary labels.
 - 3. Repair, patch or replace new or existing work including pavement, sidewalks, curbs, gutters, catch basins, gratings, manholes, covers, landscaping, plant materials and other items that have been damaged, broken, cracked or chipped as a result of performing this Work.
 - 4. Sweep clean and wash down all exterior pavement. Remove all hazardous material and material that may cause sediment in drainage systems prior to washdown. Remove all grease and oil stains on pavement caused by Contractor's equipment.

1.02 CONTRACTOR'S ACTION LIST OF ITEMS TO BE CORRECTED AND/OR COMPLETED

- A. During construction, the Contractor shall maintain an action list of items to be corrected and/or completed. The Contractor shall regularly add items and update the list as information becomes available or as requested by the Engineer. The Contractor shall deliver a current copy of the list to the Engineer at each progress meeting.

1.03 SEMIFINAL INSPECTION/SUBSTANTIAL COMPLETION

- A. See General Conditions. When the Contractor considers the Work nearly complete, the Contractor shall review the Contract Documents, inspect the Work, and use the Contractor's action list to prepare a Contractor's Punch List of all deficient or uncompleted items. The Contractor shall complete or correct items on the Punch List. When the Work is Substantially Complete in accordance with General Conditions, the Contractor shall notify the Engineer in writing that the Contractor has reviewed the Contract Documents, inspected the Work and believes that the Work is Substantially Complete and ready for Semifinal Inspection.
- B. See General Conditions. On receipt of the Contractor's Punch List and notice that the work is ready for Semifinal Inspection, the Engineer will inspect the Work. The Engineer may add additional items to the Contractor's Punch List, may find that the work is not ready for inspection, is ready for inspection but not Substantially Complete or that the Work is Substantially Complete. When the Engineer finds the

Work is Substantially Complete, it will prepare a Final Punch List and a notice of Substantial Complete, which will state the date of Substantial Completion and the time agreed to by the Owner and the Contractor (not to exceed 30 days) in which the Work shall be fully complete and ready for Final Inspection.

1.04 FINAL INSPECTION, FINAL COMPLETION AND FINAL PAYMENT

- A. See General Conditions. When the Contractor has completed or corrected all the items on the Engineer's Final Punch List, the Contractor shall give the Engineer written notice that the Work is ready for Final Inspection. When the Engineer finds the Work acceptable and fully complete in accordance with the Contract Documents, and upon receipt of a final Application for Payment and all final submittals, the Engineer will recommend that the Owner issue a Notice of Final Completion, make Final Payment and Accept the Work stating that to the best of the Engineer's knowledge, information and belief, and on the basis of the Engineer's observations and inspection, the Work has been fully completed in accordance with the terms and conditions of the Contract Documents.
- B. Final Submittals include:
 - 1. Operation and Maintenance Manuals and Parts Lists
 - 2. Record Drawings
 - 3. Extra Materials
 - 4. Special Guarantees
 - 5. Insurance Certificate showing required continuation of coverage beyond Final Payment. See General Conditions.
 - 6. Release of Liens. See General Conditions.
 - 7. Waiver of Claims by Contractor. See General Conditions.
 - 8. And any other submittals required by the Contract Documents and not previously received.
- C. The Owner will accept the Work as complete and record the Notice of Final Completion at the County Records Office.
- D. The Owner will make Final Payment to the Contractor 35 days after recording the Notice of Final Completion.

1.05 RECORD DRAWINGS

- A. The Contractor shall maintain on the jobsite, a complete set of Contract Documents and a complete file of all addenda, contract modifications and favorably reviewed submittals. The Contractor shall prepare a set of Record Drawings concurrently with the construction of the Work and in accordance with General Conditions and the following:
 - 1. Show the invert elevation of all gravity piping and the top of pipe, top of conduit or top of protective concrete encasement for other utilities. Elevations shall be related to a permanent visible elevation benchmark set at the site by the Contractor.
 - 2. Show the horizontal location of underground utilities measured from permanent visible physical features such as face of building, face of tank, or centerline of manhole.
 - 3. Comply with detailed requirements in technical specification sections describing the type of information required on Record Drawings. The Contractor's copy of

Contract Documents, Contract modifications and Record Drawings shall be available to the Engineer for weekly verification that the records are being currently updated.

- B. Submit Record Drawings and obtain acceptance prior to completion.

1.06 EXTRA MATERIALS

- A. Deliver specified extra materials and parts to Owner. Itemize all items on a transmittal letter in duplicate and obtain signature of receiving party. Submit copies of signed transmittals for all specified extra materials and parts prior to completion.

1.07 SPECIAL GUARANTEES

- A. The General Conditions covers the Contractor's responsibility to remedy defects due to faulty workmanship and materials, which appear within one year from the date of Final Completion and acceptance by the Owner.
- B. Guarantees for more than one year when called for in various sections of the Specifications shall be evidenced by the Contract Documents and in the form of a special guarantee written on the letterhead of the Contractor, Subcontractor, or Supplier doing the work and/or supplying the item to be guaranteed, and countersigned by the Contractor as follows. Failure to provide the special guarantee on the letterhead shall not relieve the Contractor, Subcontractor, or Supplier from its obligations for the special guarantees.

- C. Special Guarantee:

We hereby guarantee that the _____ which we have provided in the _____, Project, was done in accordance with the Drawings and Specifications, and that the work, as installed, will fulfill the requirements of the guarantee included in Specification Section _____. We agree to repair or replace any or all of our work, together with any other adjacent work which may be damaged or displaced by so doing, that may prove to be defective in workmanship or material (with the exception of defects due to ordinary wear and tear, and unusual abuse or neglect) within a period of _____ years from the date of acceptance of the abovenamed facility, without any expense whatsoever to the Owner. In the event of our failure to comply with the above-mentioned conditions within the period set forth in the General Conditions after being notified in writing by the Owner, we, collectively or separately, do hereby authorize the Owner to proceed to have said defects repaired and made good at our expense, and we will honor and pay the costs and charges therefor upon demand. We understand that the provisions of General Conditions apply to this Special Guarantee.

Signed _____
(Subcontractor or Supplier)

Company _____

Address _____

Telephone Number _____

Countersigned _____
(Contractor)

- D. Submit two notarized original signed copies of each required Special Guarantee prior to completion.

1.08 TWELVE-MONTH INSPECTION

- A. Thirty (30) days prior to the expiration of the one-year guarantee period described in General Conditions, the Contractor shall tour the project with the Engineer and/or the Owner to prepare a list of corrective work required under the 12-month guarantee. The Contractor shall correct all items found to be defective within 20 days of receipt of the list of items to be corrected.

END OF SECTION

SECTION 02065

CONTROLLED LOW STRENGTH MATERIAL

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: This Section covers the work necessary for backfilling in confined areas around pipelines or trenches, where specified or where access for compaction equipment is limited.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM) Standard Specification or Test Method:
 - 1. ASTM C33 Concrete Aggregates
 - 2. ASTM C94 Ready-Mixed Concrete
 - 3. ASTM C143 Slump of Hydraulic-Cement Concrete
 - 4. ASTM C150 Portland Cement
 - 5. ASTM C260 Air-Entraining Admixtures for Concrete
 - 6. ASTM C618 Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
 - 7. ASTM C685 Concrete Made by Volumetric Batching and Continuous Mixing
 - 8. ASTM D4318 Liquid Limit, Plastic Limit, and Plasticity Index of Soils
 - 9. ASTM D4832 Preparation and Testing of Soil-Cement Slurry Test Cylinders
- B. American Concrete Institute (ACI):
 - 1. ACI 229 Controlled Low Strength Materials (CLSM)
 - 2. ACI 304 Guide for Measuring, Mixing, Transporting and Placing Concrete
- C. State of California, Department of Transportation (CALTRANS):
 - 1. Section 19-3.062 Slurry Cement Backfill
 - 2. Section 19-3.025 Soil Cement Bedding

1.03 DEFINITIONS

- A. Controlled Low Strength Material (CLSM): A mixture of portland cement, fly ash, aggregates and admixtures proportioned to provide a nonsegregating, self-consolidating, free-flowing and hand-excavatable material, which will result in a hardened, dense, nonsettling fill.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Product Data:
 - 1. Concrete mix product certification: Submit certified laboratory test results that the mix proportions and materials comply with these Specifications. Submit certification on cementitious products and aggregates performed within the past 6 months.
 - a. Cementitious materials.
 - b. Coarse and fine aggregates.

- c. Admixtures.
 - d. Water.
- C. Quality Assurance/Control Submittals:
 1. Design Data: Submit a mix design for the material to be used.
 2. Test Reports: Submit trial laboratory and testing data with cylinder breaks performed at 7, 14, and 28 days.
 3. Certificates: Ready-mix plant certification.

1.05 QUALITY ASSURANCE

- A. Certifications:
 1. Products and Materials Tests: Certified by independent commercial testing laboratories.
 2. Mix Designs: By an independent commercial testing laboratory, complying with ASTM C1077 and favorably reviewed by the Engineer. Mix design proportions shall be established on the basis of field experience and trial mixtures with the materials to be employed in accordance with UBC Section 1905.
 3. Mix Test Results.
 - a. Submit result statistics of satisfactory mix designs if available from prior projects. Comply with UBC Section 1905.3.
 - b. Submit test results of trial batches prepared for this project. Comply with UBC Section 1905.3.
 - c. Allow adequate time for review of submittals and adjustments to comply with the Specifications.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials shall conform to the following:
 1. Portland Cement: ASTM C150, Type II or V.
 2. Aggregate: Comply with ASTM C33. Aggregate shall consist of fine aggregate, with or without coarse aggregate, with a minimum size of 1-inch, free of clay, organics, and other deleterious materials. Less than 10 percent by weight shall pass the No. 200 sieve, and material passing the No. 40 sieve shall be nonplastic as determined in accordance with ASTM D4318.
 3. Water: Potable.
 4. Fly Ash: ASTM C618, Class F unless otherwise approved.
 5. Admixtures: Air entraining; ASTM C260. Air content limited to 6% unless demonstrated to avoid segregation. Provide a liquid admixture such as DaraFill manufactured by W.R. Grace when air contents from 15-35% are required.

2.02 MIXES

- A. Performance Requirements: The CLSM shall be proportioned to be a nonsegregating, free-flowing, self-consolidating, low-shrink slurry.
- B. Mix Design Requirements: The Contractor and its supplier shall determine the materials and proportions used to meet the requirements of the Specifications. The mix design shall be prepared for a range of aggregate gradations that are expected to be used.

- C. Strength: The unconfined compressive strength at 28 days shall be 100 psi (± 50 psi) as per ASTM D4832.
- D. Flowability: The slump shall be 7 inches (± 1 inch) as per ASTM C143.
- E. Density: The density shall be between 115-145 lb/ft³.
- F. Minimum Cement Content: For compliance with Caltrans 185 lb/cy (110 kg/m³) for slurry cement backfill, 295 lb/cy (175 kg/m³) for soil cement bedding.

2.03 SOURCE QUALITY CONTROL

- A. Mix, transport, and place CLSM in accordance with the methods and procedures in ACI 304 and ASTM C94.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Site Verification of Conditions: CLSM batching, mixing, and placing may be started if the weather conditions are favorably and when the air temperature is 34 F and rising. At the time of placement, the CLSM must have a temperature of at least 40 F. Mixing and placing shall stop when the air temperature is 38 F or less and falling.
- B. Subgrade on which CLSM is to be placed shall be free of disturbed or softened materials, debris, and water.

3.02 PREPARATION

- A. Protection: Take appropriate precautions to prevent pipe displacement and/or flotation.

3.03 CONSTRUCTION

- A. Special Techniques: Contain CLSM in trench sections using bulkheads or fill materials to confine the flow of material.
- B. CLSM shall be placed in lifts not exceeding 6 feet in height, with a time interval of not less than 1 hour between lifts.

3.04 FIELD QUALITY CONTROL

- A. Field Control Testing: Performed by the Contractor:
 - 1. After completion of the trial mix work, and prior to CLSM placement operations, the Contractor shall prepare field trial mixes. The initial mix shall be based on the design mix. Additional trial mixes may be made by varying the proportions as may be required to produce a dense, homogenous material with good workability.
 - 2. Manufacture of the field trial mixes shall be accomplished utilizing the equipment that will be used on the job.
 - 3. Compressive strength: A set of six standard 6 inch x 12 inch cylinders will be cast for each mix.
 - a. Making, storing and initial cure of cylinders: ASTM C94 or C685. Provide site storage and initial cure, 16 hours minimum and 24 hours maximum.
 - b. Testing laboratory: Provided by Contractor.

- c. Final cure and tests of cylinders: ASTM D4832. Testing laboratory will transport cylinders from site, cure, test and provide report. Test one specimen at 7 days, one at 14 days, one at 21 days, and two at 28 days. One specimen shall be held as a "spare" and may be used in the event of questionable results from one of the scheduled tests.
- B. Site Tests: Performed by the Engineer:
 - 1. Test frequency: Each mix type placed, each day placed.
 - 2. Compressive strength: A set of four standard 6-inch x 12-inch cylinders will be cast for each mix and for 100 cubic yards or fraction thereof.
 - a. Making, storing and initial cure of cylinders: ASTM C94 or C685. Provide site storage and initial cure, 16 hours minimum and 24 hours maximum.
 - b. Testing laboratory: Provided by Owner.
 - c. Final cure and tests of cylinders: ASTM D4832. Testing laboratory will transport cylinders from site, cure, test and provide report. Test one specimen at 7 days, and two at 28 days. One specimen shall be held as a "spare" and may be used in the event of questionable results from one of the scheduled tests.
 - 3. Slump: Test will be performed on each 50 cubic yards or fraction thereof. Test each sample used for strength tests.
 - a. Testing: ASTM C143.
 - b. Results outside the limits indicate possible cause for rejection of concrete. The Engineer shall be the sole judge.

3.05 PROTECTION

- A. When backfilling against retaining walls or other below grade structures, protection shall be provided to the wall or structure from the lateral pressures exerted by the material.
- B. Protect facilities from bleed water. Make provisions for runoff of bleed water.
- C. Provide steel plates to span trenches and prevent traffic contact if necessary. No traffic or construction equipment shall be allowed on CLSM for at least 24 hours after placement, or until the material is hard enough to prevent rutting or damage.

END OF SECTION

SECTION 02085

PRECAST CONCRETE UTILITY VAULTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Precast reinforced concrete box structures for utility service, complete with openings, inserts, and hardware.
 - 2. Manhole covers and frames.
 - 3. Precast concrete headwall with energy dissipater.
- B. Related Sections:
 - 1. Section 02301: Earthwork
 - 2. Section 03300: Cast-In-Place Concrete

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM), Standard Specifications:
 - 1. A36 Carbon Structural Steel
 - 2. A48 Gray Iron Castings
 - 3. A615 Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 - 4. A1064 Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
 - 5. C150 Portland Cement
 - 6. C478 Circular Precast Reinforced Concrete Manhole Sections
 - 7. C857 Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
 - 8. C858 Underground Precast Concrete Utility Structures
 - 9. C891 Installation of Underground Precast Concrete Utility Structures
 - 10. C990 Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
- B. American Association of State Highway and Transportation Officials (AASHTO), Standard Specifications for Highway Bridges.
- C. Federal Specification: SS-S-210: Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints.
- D. American Iron and Steel Institute (AISI).

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Product Data:
 - 1. Descriptive details of the manufacturer's proposed standard products, including:
 - a. Precast sections.
 - b. Precast roof slab or cone section.

- c. Minimum concrete 28-day compressive strength.
 - d. Cement, aggregate and reinforcing certifications.
 - e. Sealant product data and safety handling sheets
 - f. Manhole covers and frames.
 - g. Steps and/or ladder rungs.
 - h. Access hatches.
 - i. Gratings, covers and frames.
 - j. Any other prefabricated inserts and integrally cast hardware.
2. Shop drawings, including:
- a. Design criteria.
 - b. Layout:
 - 1) Plan:
 - a) Orientation of eccentric manholes, junction structures, vaults, catch basins with laterals shown
 - b) Inserts, attachments, and openings
 - 2) Section:
 - a) Finished grade of manhole/junction structures/vaults/catch basins lid/cover/grate
 - b) Elevations of bottom of manhole/junction structures/vaults/Catch basins and pipe invert(s)
 - c) Inserts, attachments, and openings
 - d) Joint types and number of risers
 - c. Reinforcing steel location and concrete cover.
 - d. Location and type of joints.

1.04 QUALITY ASSURANCE

- A. Provide products of a manufacturer who has been regularly engaged in the design and manufacture of the product for at least 5 years.
- B. Demonstrate to the satisfaction of the Engineer that the quality is equal to the product made by those manufacturers specifically named herein, if an alternate product manufacturer is proposed.

PART 2 - PRODUCTS

2.01 DESIGN CRITERIA

- A. General: ASTM C857, ASTM C913, and also:
 - 1. Structure live load: AASHTO Loading Class HS 20-44.
 - 2. Backfill material: Engineered Fill.

2.02 PRECAST SECTIONS

- A. General:
 - 1. Concrete: Minimum 28-day compressive strength 5000 psi.
 - 2. Cement: ASTM C150, Type II, low alkali.
 - 3. Manhole roof slab opening: Size to support the manhole cover frame.
 - 3. Aggregate: ASTM C33 and non-reactive in accordance with ASTM C1293.
 - 4. Reinforcing: Deformed bars conforming to ASTM A615 Grade 60. Wire mesh conforming to ASTM A1064.

5. Openings: Size as shown on the Drawings. Reinforce rectangular openings with additional diagonal reinforcing at the corners. Reinforce roof openings to support manhole cover frames or access hatches called for on the Drawings.
 6. Lifting eyes: Provide for each section.
- B. Manufacturer: Jensen Precast, Martinez, CA; Oldcastle Infrastructure, Pleasanton, CA; Associated Concrete Products, Inc., Santa Ana, CA; Brooks Products, Inc., El Monte, CA; or equal.
 - C. Biofiltration Vault: Jensen Precast Model SVBF-UV 8x16 NJCAT, or approved equal.
 - D. Precast Concrete Headwall with Energy Dissipater: Oldcastle Model 382STM4HDWLDIS with Toe, or approved equal.

2.03 VAULT/CATCH BASIN SEALANT GASKETS

- A. Type: Preformed, continuous rope form plastic material, protected by removable two-piece wrapper.
- B. Sealing Compound: Reinforced hydrocarbon resins blended with plasticizing compounds and reinforced with inert mineral filler. No solvents, irritating fumes or obnoxious odors.
- C. Adhesive and Cohesive Strength: Not dependent on oxidizing, evaporating, or chemical action.
- D. Conform to Federal Specification SS-S-210.
- E. Provide: QUIKSEAL as supplied by Associated Concrete Products, Santa Ana, CA; RAM-NEK as manufactured by K. T. Snyder Company, Inc., Houston, TX; or equal.

2.04 MANHOLE JOINTS AND SEALANT

- A. Tongue and Groove Joint General: Joint shall conform to ASTM C990.
 1. Sealant: Preformed, continuous rope gasket, protected by removable two-piece wrapper constructed from bitumen or butyl resins, blended with hydrocarbons and plasticizing compounds, and reinforced with inert mineral filler. Provide recommendation to Engineer of cross-sectional dimensions that will produce an ASTM C990 compliant joint. Suggested products include RAM-NEK by Henry Co.; KENT Seal by Hamilton-Kent; or equal. No solvents, irritating fumes, or obnoxious odors.

2.05 VAULT/CATCH BASIN FRAMES AND COVERS

- A. Grating Support Frames:
 1. Material: Galvanized steel.
 2. Provide grating support angles for all gratings. Fabricate grating support angles in complete, closed frames that will lie completely flat in a true plane. Install

grating frames so they will support the grating with even, uniform, non-rattling bearing.

3. Design and fabricate grating frames as required to prevent twisting due to any large ratio of length to width. Restrict the length of each closed section of long narrow grating frames to 10 feet maximum.
4. Hot-dip galvanize grating support frames after fabrication. Grind welds smooth on the bearing surface before galvanizing.
5. Coat upper surfaces of steel grating support frames with bituminous mastic. Hot-dip galvanize ferrous grating support frames.

B. Grating Covers:

1. Provide gratings that comply with requirements in the NAAMM Metal Bar Grating Manual.
2. Steel grating:
 - a. Welded steel grating: Hot-dip galvanized steel grating except where noted otherwise.
 - b. Cross bars: Spaced not more than 4 inches on centers. Main bars: Not less than 1-1/4-inch high and 3/16-inch in thickness and spaced 1-3/16 inches on center. Fabricate with top surface of all bars flush. Install grating flush with adjacent concrete or other walking surfaces.
 - c. Size steel grating and support members rated for 150 pounds per square foot superimposed load with a grating deflection not to exceed 1/4 of an inch.
 - d. Field measure installed grating frames before fabricating gratings.
 - e. Provide grating panels that are absolutely flat, correctly sized, and fabricated to lie in their frames with uniform, non-rattling bearing on all supporting surfaces.
 - h. Band: Ends of all fixed and removable grating sections. Weld banding bars of the same thickness but 1/4-inch less in depth than as the main bearing bars to the ends of all bearing and cross bars. Weld the banding bars flush with the bearing bars at each panel corner and grind the weld smooth and flush. Round all edges and corners to 1/8-inch radius.
 - i. Band all shop and field cutouts and openings. Weld the banding bars to all cut bearing and cross bars.
 - j. Leave "split" openings in the gratings when required for the passage of pipes, valve stems or other devices.
 - k. Provide "fixed" grating for all operating grating platforms. Bolt "fixed" grating to support members with saddle clips and stud bolts welded to support members.
 - l. Where required for access or where noted, provide removable grating sections sized to limit the weight of any one section to 90 pounds.
 - m. Bolt removable sections in place by the same method used for fixed grating. Mark removable sections by painting the banding bars red after galvanizing.

2.06 MANHOLE FRAMES AND COVERS

- A. Material: Cast iron; ASTM A48, Class 30B.
- B. Marking: In raised letters, as specified, on manhole cover.
- C. Coating: Bituminous paint, black.

- D. Size: 24-inch-diameter cover.
- E. Pick Hole: Two on side, and one curved pick hole (1-1/8" wide) blind for pressure type castings, per City of Morgan Hills Drawing S-6.
- F. Manufacturer: South Bay Foundry, Hayward, CA.; Alhambra Foundry Company Ltd., Alhambra, CA; Olympic Foundry, Seattle, WA; or equal.

2.07 LADDER RUNGS

- A. Cast-in Steps: Copolymer polypropylene plastic molded on ASTM A615 Grade 60 steel bar. Rungs shall provide at least 12-inch-wide tread with non-slip surface and shall meet ASTM C478 load standards.

2.08 SOURCE QUALITY CONTROL

- A. Precast Sections:
 - 1. Verify concrete compressive strength test results are satisfactory for the sections supplied.
 - 2. State the curing method. Identify the start and end dates for the sections supplied.
- B. Frames and Covers:
 - 1. Verify cast test bar tensile strengths are satisfactory.

2.09 OPENINGS AND EMBEDMENTS

- A. The contractor and precaster shall be responsible for the integration of embedded items in the quantity, materials, elevations, and locations required.
- B. Embedded pipes, conduits, sleeves, and other items intended to pass through walls and slabs shall be installed perpendicular to the surface unless noted otherwise.
- C. Embedded plates, grates, hatches, angle frames, and other items intended to provide a working surface shall be installed flush to the surface unless noted otherwise.
- D. Openings in the structure shall be placed integrally at the time of casting. Unreinforced knockouts may be provided for post installed opening if approved by the Engineer. Openings shall not be placed by coring or cutting through reinforced concrete after the item has been cast.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: Vaults and Catch basing in accordance with ASTM C891. Manholes in accordance with ASTM C1821 and also:
 - 1. Excavate and support excavations for manholes in accordance with Section 02300
 - 2. Compact subgrade in accordance with Section 02301.
 - 3. Provide a 6-inch gravel layer under the base slab and compact in accordance with Section 02301.

4. Apply primer to joint surfaces in accordance with manufacturer's instructions. Make all joints watertight with sealant gaskets.
5. Backfill around the vaults and manholes with Engineered Fill material,. Compact the backfill material in accordance with Section 02301 from the base up to final finish grade, over an area defined as being within a distance of 4 feet from the exterior walls of the vault.
6. Accurately locate and place the manhole frames to within 1/8-inch vertical elevation in paved areas and to 1/2-inch in other areas. Coordinate the activities of all trades so that this tolerance is achieved.
7. Install the manhole cover in the frame. Machine the cover if necessary to obtain a solid fit, without rattling under load.
8. Accurately locate conduits, pipes, spools and knock-outs for mechanical and connections through the manhole.
9. Eccentric manhole placement shall be approved by the Engineer prior to backfill. Locate eccentric manhole lids outside of the path of travel. Identify where this may not be achievable to the Engineer prior to excavating for the manhole.

3.02 FIELD QUALITY CONTROL

- A. Verify all precast sections are continuously sealed with gaskets.
 1. Contractor shall receive favorable review of initial section and seals from the Owner or Engineer prior to placing subsequent sections.
- B. Verify all covers fit quietly in the frames.

3.03 TEST FOR MANHOLES

- A. Furnish and dispose of water used for testing in accordance with Section 01140.
- B. Hydraulically test all manholes installed with the presence of the Owner or Engineer.
- C. After all pipe has been laid, backfilling completed, and pipes pass requirements, plug the end of pipe stubs in each manhole with flexible-joint caps, or acceptable alternate, fastened securely.
- D. Fill the manhole with water and measure leakage over a period of not less than 1 hour.
- E. Allowable Leakage: Less than one (1) gallon per hour per 10-foot depth of manhole.
- F. When leakage from the vault exceeds the above amount, determine the source or sources of the leakage, and repair or replace defective materials and workmanship. A second test shall not start until after the repaired/replaced defective materials have set. If the manhole does not pass the second test, Contractor shall remove and install new materials at no cost to the Owner.
- G. The completed pipe and vault installation shall pass this test before the project can be accepted.

END OF SECTION

SECTION 02100

SITE PREPARATION & PLANT PROTECTION

PART 1 - SUMMARY

1.01 DESCRIPTION

- A. Preserve and protect all improvements to remain, including existing trees, shrubs, utilities, pavements, structures, and improvements on adjoining properties during removal work, site preparation work and construction.
- B. Layout and review of utility and irrigation trenches that occur in the Tree Protection Root Zone is required as part of this Site Prep and Plant Protection work as described below in PART 3 EXECUTION.

1.02 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. Ordinances and Regulations: All local, municipal and state laws, codes and regulations governing or relating to all portions of this work are hereby incorporated into and made a part of these Specifications. Anything contained in these Specifications shall not be construed to conflict with any of the above codes, regulations, or requirements of the same. However, when these Specifications and Drawings call for or describe materials, workmanship or construction of a better quality, higher standard than is required by the above mentioned codes and regulations, the provisions of these Specifications and Drawings shall take precedence. Furnish without extra charge additional materials and labor required to comply with above rules and regulations.
 - 2. International Society of Arboriculture, Guide for Plant Appraisal, latest version.

1.03 DEFINITIONS

- A. Diameter at Breast Height of tree trunk (DBH)
 - 1. Location 54 inches from the ground as measured on the high side of the tree trunk.
- B. Tree Protection Zone (TPZ)
 - 1. Root Area around tree that is 5 times the DBH, or the tree Dripline, whichever is greater.
- C. Structural Root Zone (Radius of Three)
 - 1. The Structural Root Zone is a circular area with the tree trunk at the center and a radius equal to 3 times the diameter of the tree trunk measured at breast height (4.5 feet above ground line). This zone, where most of the structural roots exist, is based upon tree failure research conducted by E.T. Smiley at the Bartlett Tree Research Laboratory. Any structural (buttress) root, which has been severed or is rotten within this zone, can no longer provide adequate support to the tree and must be considered missing.

D. Dripline

1. The area of the ground directly beneath the vertical projection (shadow) of the trees foliage canopy.

1.04 QUALITY ASSURANCE

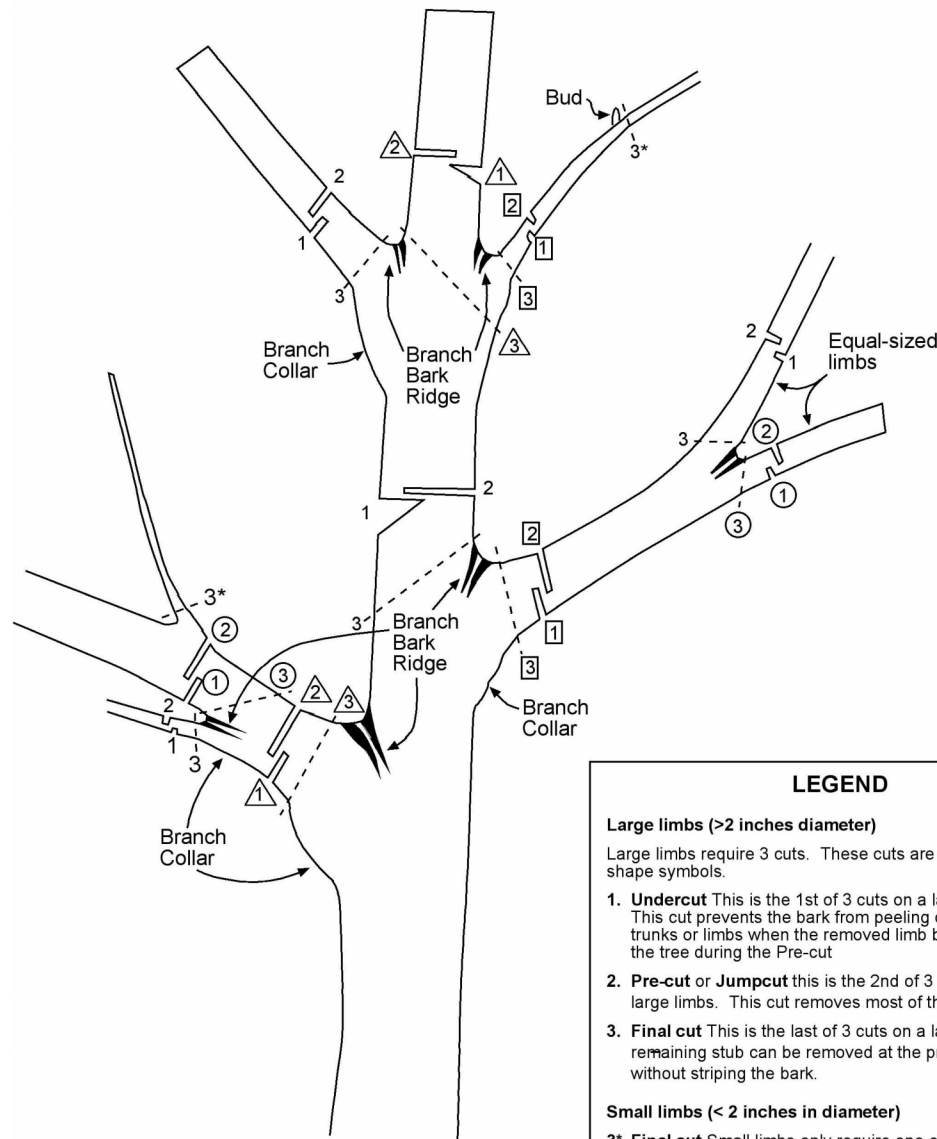
A. Review:

1. Contractor shall review and identify with the Owner's Representative the limits of Work and extent of plant materials and other improvements to be protected. Notify Owner's Representative of discrepancies between existing conditions and Drawings before proceeding with Work.
2. At the Owner's discretion, an Arborist may represent the Owner to review the work of the Contractor in regards to plant protection.
3. Pre-demolition Conference: Conduct conference at Project Site to review methods and procedures related to selective demolition including, but not limited to, the following:
 - a. Inspect and discuss condition of construction to be selectively demolished.
 - b. Review structural load limitations of existing structures.
 - c. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - d. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
 - e. Review locations within Tree Protection Zones where trenching may interfere with existing root systems and propose alternate trench locations to avoid or reduce damage to root systems. Refer to PART 3 - EXECUTION.
 - f. Review areas where existing construction is to remain and requires protection.
4. Pre-demolition: Prior to beginning Work, photographically record existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations and furnish copies to the Owner's representative prior to beginning work.

B. Stipulations

1. Plant Protection:
 - a. Protect trees and shrubs against cutting, breaking, skinning and bruising of bark; permit no traffic or stockpiling within drip line.
 - b. Do not change earth surface within drip line of trees and shrubs except as approved in writing by the Owner.
 - c. Do not park vehicles or store materials, supplies and construction equipment within Tree Protection Zone.
 - d. Install a temporary 6-foot high chain link fence as manufactured by White Cap or approved equal, typically at the "drip line" of the tree(s) and planted areas to be protected from construction damage, except as otherwise directed by the Arborist / Owner's Representative. Post may be steel driven type, or self-supporting type.
 - e. Obtain specific instruction from Arborist / Owner's Representative for pruning of trees, shrubs, roots or disturbance of soil within spread of tree branches. The Contractor shall utilize protection measures as outlined by Arborist / Owner's Representative, which may include directional drilling, or hand clearing to expose the roots.

- f. Generally cutting of roots two inches or greater shall be avoided. Roots one inch and greater in diameter that must be cut shall be cut cleanly and obliquely with the cut surface facing down.
- g. Exposed and pruned roots shall be covered with light well-drained soil backfill and mulch over. The area shall be kept moist.
- h. Unless the Contractor has secured and marked approved trench locations within Tree Protection Zones prior to beginning trenching, any trenching required within the Tree Protection Zone, shall be done by hand and as directed by the Arborist / Owner's Representative.
- i. Provide periodic watering for all planting within Contract limit and any adjacent areas affected by the work. Maintain moisture to a minimum 6" depth as accepted by the Owner's Representative.
- j. Using an approved pruning saw, provide selective tree limb pruning as accepted by the Owner's Representative if branches interfere with new construction. Limb diameter shall be limited to 5" diameter and shall be pruned just outside the branch collar in accordance with American National Standards Institute, (ANSI 300) and International Society of Arboriculture,



(ISA) standards.

- k. Approved branches to be shortened must be cut just above a fork with another living branch which is plus or minus 1/2 the diameter of the removed branch as shown in the pruning figure herein. Branches to be removed which exceed 2" in diameter shall be severed with a 3-step cut to prevent bark peeling. Final cuts must not injure the branch collar or branch bark ridge of the remaining branches and trunk.

C. Plant Replacement: Contractor shall replace trees cut or severely damaged due to the Contractor's work as follows:

- 1. An ISA Certified Arborist may be retained by the Owner to determine the condition of trees in question as to their ability to survive in a healthy condition and in their original shape, or a pruned aesthetically pleasing shape acceptable to the Owner. Comply with recommendations to rehabilitate as recommended by the Arborist, or to replace in accordance with the requirements below.
- 2. Trees size shall be determined by Diameter at Breast Height (DBH). Replacement of trees and shrubs shall also include providing acceptable plant installation, automatic irrigation system and a minimum maintenance period of 120 days. If plant(s) is not acceptably maintained and is not healthy and thriving at the end of the 120 day maintenance period, the Contractor shall continue the maintenance work until such time that healthy tree(s) and/or shrub(s) is achieved.
- 3. Replace any damaged planting in kind using "specimen" plants as follows and at no cost to Owner:
 - a. Trees up to 3" DBH: Replace with 36" box size.
 - b. Trees 3" to 6" DBH: Replace with 72" box size.
 - c. Trees 6" to 12" DBH: Replace with 84" box size.
 - d. Trees 12" DBH and larger: Tree value shall be determined by Arborist using Council of Tree and Landscape Appraisers (CTLA) method. Replace damaged tree with largest available nursery boxed tree and cash difference between value of damaged tree and nursery stock replacement cost.
 - e. Shrubs: Replace with 15-gallon can size.

D. Work Included:

- 1. Site Preparation
- 2. Work is in accordance with the Drawings and specifications and includes but is not necessarily limited to the following:
 - 1) Clearing and grubbing.
 - 2) Identification and protection of vegetation indicated to remain.
 - 3) Removal of existing site improvements, such as paving, curbs, gutters, fences, structures, slabs, foundations and walls.
- 3. Locate and identify existing utility services and provide coordination, shutoff, capping, and continuation of utility services.
- 4. Remove, store and protect all items designated and directed to be returned to Owner or reinstalled.
- 5. Obtain and pay for permits required for execution of this work.

E. Hazardous materials: If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Owner. Owner will remove hazardous materials under a separate contract.

1.05 SUBMITTALS

- A. Record Drawings: Indicate points of disconnection and capping, abandonment and removal of existing utility services; include utility names, sizes and locations, relationship to permanent structures located on site and on adjacent property, and certificates of severance of utility services from respective utility companies or owners.
- B. Survey of Existing Conditions: Provide to Owner a Survey of Existing Conditions. Record existing conditions, including underground utilities, etc. on As Built Drawings by use of field measurements and preconstruction photographs. Make permanent record of measurements, materials, and construction details required to make exact reproduction.
- C. Submittals to be as specified in Sections 01300

1.06 PROJECT CONDITIONS

- A. Coordination: Coordinate this work with the work of other Sections to avoid delay and interference with other work.
- B. Nuisances: Keep dirt, dust, noise and other objectionable nuisance to a minimum. Use temporary enclosures, coverings and sprinkling, and combinations thereof, as necessary to limit dust to lowest practicable level, except do not use water to the extent that it causes flooding or contaminated run-off.
- C. Traffic: Conduct work to ensure minimum interference with vehicular and pedestrian traffic, and to permit unencumbered access to site and adjacent properties.
 - 1. Do not close or obstruct streets, sidewalks, alleys or other public passageways without permission from authorities having jurisdiction.
 - 2. If required by governing authorities, provide alternate routes around closed and obstructed traffic ways.
- D. Utility Service: As far as possible, conduct work to ensure minimum interference with utilities to insure on site and off site operations are uninterrupted.
- E. Protections:
 - 1. Prevent movement and settlement of adjacent structures. Install temporary barriers, fences, guard rails, enclosures, shoring, bracing, planking, barricades, lights, warning signs and other protections required to protect structures, utilities, landscaping and other items that are to remain in place.
 - 2. Protect bench marks movements and reference points from displacement and damage; and if displaced or damaged, replace at no cost to the Owner.
 - 3. Install and maintain required bracing, shoring and supports when removing structural elements and be responsible for safety and support of structure. If safety of structure appears to be endangered, cease operations and immediately notify the Owner. Do not resume operations until safety is restored.

PART 2 - PRODUCTS

2.01 PROTECTIVE FENCING

- A. As accepted by Owner's Representative and as specified herein.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine areas in which work is to be performed. Report in writing to the Owner's Representative all prevailing conditions that will adversely affect satisfactory execution of work. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Survey of Existing Conditions: Record existing conditions, including underground utilities, etc. by use of measured drawings and preconstruction photographs.
- C. Starting work constitutes acceptance of the existing conditions and the Contractor shall then, at his expense, be responsible for correcting all unsatisfactory and defective work encountered.
- D. Install and maintain temporary fencing and other required protective devices and exclude construction activities from tree zones except as supervised by the Arborist / Owner's Representative.
- E. If access to tree zones cannot be avoided an intact four inch layer of mulch with minimum 1.25 inch thick, metal strap linked plywood shielding shall be maintained in the tree zone where heavy equipment will be operated.
- F. Locate and clearly flag trees and vegetation to remain or to be relocated, as diagrammed and noted in the Construction Documents.

3.02 TRENCH LOCATION CONFIRMATION IN ROOT ZONES

- A. Where utility line trenches, including irrigation mainlines and lateral line trenches, occur in Tree Protection Zones, Contractor shall layout exact proposed trench locations and review locations with the Owner's Representative. Adjustment of trench locations to avoid cutting root systems shall be at no additional cost to the Owner.

3.03 CLEARING

- A. Field Verification: Before removing non-designated trees, shrubs, stumps, bushes, vines, rubbish, undergrowth and deadwood as shown on the Drawings and as specified, obtain verification from Owner's Representative.
- B. Remove non-designated trees, shrubs, stumps, bushes, vines, rubbish, undergrowth and deadwood as well as fences and incidental structures that interfere

with the construction as shown on the Drawings and as specified. Obtain verification from Owner's Representative prior to removal.

3.04 UTILITIES

- A. Contact local utility companies 48 hours minimum prior to start of demolition work. Confirm verbal notices and written notices. Verify locations of all utilities entering site and their locations on site.
- B. Cooperate with the Owner's utility companies, adjacent property owners, and other building trades in maintaining, protecting, re-routing or extending utilities passing through work areas which serve structures located on project site and on adjacent properties.
- C. Verify that utilities that are to be removed, capped or abandoned are turned off, or are disconnected, or are re-routed to new locations before starting demolition.

3.05 DEMOLITION/REMOVAL

- A. General:
 - 1. Remove materials in an orderly and careful manner. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover and protect openings to remain.
 - 2. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
 - 3. Repair or replace all removal work performed in excess to that required at no cost to the Owner. Repair or replacement shall match and equal construction, condition and finish existing at time of award of Contract.
- B. Backfill and compact areas excavated and open pits and holes resulting from removal operations. Comply with requirements specified in Earthwork, Section 02301 for backfill materials, compaction and installation methods.
- C. Rough grade site within removal areas to meet adjacent contours and to provide positive drainage. Leave site in clean condition acceptable for performance of subsequent construction operations.

3.06 CLEANUP AND DISPOSAL

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
 - 1. Transport trash, rubbish and debris daily from site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - 3. Remove and promptly dispose of contaminated, vermin-infested and dangerous materials encountered.
 - 4. Do not burn or bury materials on site.

- B. Clean excess soil may be distributed on site as accepted by Owner's Representative, if it does not adversely affect specified finish grades or percolation of water into planting soil.
- C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began
- D. Upon completion of work under this Section, remove all tools, equipment and temporary enclosures and structures.
- E. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during site preparation, by methods and with materials so as not to change existing function and warranties.

END OF SECTION

SECTION 02200
SITE PREPARATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Site preparation shall consist of all clearing, grubbing, stripping, (demolition), and related work necessary to prepare the project site for construction operations.
 - 2. No open burning of debris, lumber, or other scrap will be permitted.
 - 3. Trees and vegetation to be left standing shall be protected from damage incident to site preparation and construction operations by the erection of barriers or by such other means as the circumstances require.

1.02 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Submit a waste management plan for on-site sorting of construction debris.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.01 DEMOLITION

- A. Demolish and remove any fences, posts, poles, or other structures from within the project site, areas to be cut or areas to receive fill, and pipeline alignments.

3.02 CLEARING

- A. Clearing shall consist of the felling, trimming and cutting of trees, and the removal of downed timber, shrubs, grasses, debris and rubble from the project site which will obstruct or otherwise impede construction operations.
- B. Clear the following areas:
 - 1. Reservoir Site
 - 2. Access Road

3.03 GRUBBING

- A. Grubbing shall consist of the removal and disposal of stumps, roots larger than 3 inches in diameter, and matted roots from the construction area. This material, together with logs and other organic debris, shall be excavated and removed to a

depth of not less than 18 inches below the original surface level of the ground in areas indicated as construction areas under this Contract, such as areas for structures, pavement, fills. Depressions made by grubbing shall be filled with structural backfill material and compacted to make the surface conform with the original adjacent surface of the ground, unless further excavation is required. Grub borrow areas to the extent necessary to obtain material free of stumps and roots.

3.04 STRIPPING

- A. Strip the upper 8 inches of soil containing vegetation and root matter from all areas to receive fill and from all areas to be excavated.

3.05 DISPOSAL

- A. Felled Trees and Downed Timber: Cut up and stockpile where directed by the Engineer.
- B. Strippings: Stockpile stripped material and use it to restore the site.
- C. Dispose of remaining vegetation and debris in accordance with Section 01140.
- D. For demolition and construction waste disposal, a minimum of 50 percent of non-hazardous construction and demolition debris must be recycled or salvaged. Submit a waste management plan for on-site sorting of construction debris.
 - 1. Identify the materials to be diverted from disposal by recycling, reuse on the project, or salvage for future use or sale.
 - 2. Specify if materials will be sorted on-site or mixed for transportation to a diversion facility.
 - 3. Identify the diversion facility where the material collected will be taken.
 - 4. Identify construction methods employed to reduce the amount of waste generated.
 - 5. Specify that the amount of materials diverted shall be calculated by weight or volume, but not by both.

END OF SECTION

SECTION 02301

EARTHWORK

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Perform all excavation, shoring, dewatering, backfilling, compaction and grading necessary or required for the construction of the work as covered by these Specifications and indicated on the Drawings. The excavation shall include, without classification, the removal and disposal of all materials of whatever nature encountered, including water and all other obstructions that would interfere with the proper construction and completion of the required work.

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM).
- B. State of California, Department of Transportation, Caltrans Standard Specifications (Caltrans Standard Specifications)
- C. State of California, Department of Transportation, Manual of Test (California Test).

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Submit the following under the Product Review category.
 - 1. Sheeting and Shoring Plan: Refer to paragraph 1.08, below and Section 01040, paragraph 1.14.
 - 2. Potholing Report as described in Paragraph 3.02.
 - 3. Samples and Test Results: Furnish, without additional cost to the Owner, such quantities of import materials as may be required by the Engineer for test purposes. Cooperate with the Engineer and furnish necessary facilities for sampling and testing of all materials and workmanship. Submit test results for import materials. Tests shall be performed within 60 days of the submission. All material furnished and all work performed shall be subject to rigid inspection, and no material shall be delivered to the site until it has been favorably reviewed by the Engineer, or used in the construction work until it has been inspected in the field by the Engineer.

1.04 QUALITY ASSURANCE

- A. Source Quality Control: Test import materials proposed for use to demonstrate that the materials conform to the specified requirements. Tests shall be performed by an independent testing laboratory.

- B. Field Quality Control:
 - 1. The Engineer will:
 - a. Review and test materials proposed for use.
 - b. Observe foundations, site grading and borrow operations.
 - c. Observe placement and compaction of fill.
 - d. Test soils during placement of fill.
 - 2. Contractor shall excavate holes for in-place soil sampling. Contractor shall be responsible for costs of additional inspection and re-testing resulting from non-compliance.
- C. Testing Methods:
 - 1. Durability Index: Manual of Test, State of California, Department of Transportation.
 - 2. Specific Gravity: ASTM D854
 - 3. Laboratory Compaction: ASTM D1557, Method A or C.
 - 4. In-place Density: ASTM D1556 or ASTM D2922.
 - 5. Particle Size Analysis of Soils: ASTM D422.
 - 6. Plastic Limit and Plasticity Index: ASTM D4318.
 - 7. Soil Classification: ASTM D2487.
 - 8. In-place Moisture Content: ASTM D3017.
- D. Definitions
 - 1. Relative Compaction: In-place density divided by the maximum dry density laboratory compaction expressed as percentage.
 - 2. Rock Excavation: Excavation of solid ledge rock that, in the opinion of the Engineer, requires for its removal drilling and blasting, wedging, sledging, barring or breaking up with power-operated tools. The term "Rock Excavation" indicates a method of removal and not a geological formation.
 - 3. Pipe Zone: Zone of material that extends 4 to 6 inches from below the bottom of pipe to 12 inches above the crown of the pipe.

1.05 EXPLOSIVES

- A. Do not use explosives unless specifically authorized, in writing, by the Engineer.

1.06 SUBSURFACE INVESTIGATIONS

- A. Geotechnical investigations for design purposes for this project were made for the City of Morgan Hill by Cal Engineering & Geology in a report dated 11 August 2016.
- B. This report is available for examination by bidders from the Owner at the City of Morgan Hill, Department of Public Works, 100 Edes Court, Morgan Hill, CA. While the records of data obtained may be considered by the Contractor to be correct, any conclusions or recommendations made in the reports are for information to the Design Engineer and are not a part of the Contract Documents. Copies of the boring logs are in the Appendix of these Specifications and their locations are shown on the Drawings.

- C. The bidders may make additional subsurface investigations at the site prior to the bidding of the project. Prior to making any drillings or excavations, the bidder shall secure permission from the Owner, and property owners if on private property.

1.07 REFERENCE SPECIFICATIONS

- A. Whenever the words "Standard Specifications" are referred to, the reference is to the State of California, Department of Transportation, Standard Specifications dated 2015.

1.08 ADDITIONAL SAFETY RESPONSIBILITIES

- A. The Contractor shall select, install and maintain shoring, sheeting, bracing, and sloping as necessary to maintain safe excavations. The Contractor shall be responsible for ensuring such measures: (1) comply fully with 29 CFR Part 1926 OSHA Subpart P Excavations and Trenches requirements, (2) provide necessary support to the sides of excavations, (3) provide safe access to the Engineer's sampling and testing within the excavation, (4) provide safe access for backfill, compaction, and compaction testings, and (5) otherwise maintain excavations in a safe manner that shall not endanger property, life, health, or the project schedule. All earthwork shall be performed in strict accordance with applicable law, including local ordinances, applicable OSHA, CalOSHA, California Civil Code, and California Department of Industrial Safety requirements.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Crushed Rock: Class 2, 3/4-inch maximum aggregate base, Standard Specifications Section 26.
- B. Pipe Bedding Materials:
 - 1. Sand: Standard Specifications, Paragraph 19-3.025B. Free-draining sand (less than 5% passing a No. 200 sieve).
- C. Imported Backfill: Imported nonexpansive soil with liquid limit no greater than 40% and a plasticity index no greater than 15%, free from clods or rocks larger than 2 inches in greatest dimension, and free from organic material.
- D. Native Backfill: Native soil prepared as necessary to be free from clods or rocks larger than 2 inches in greatest dimension, and free from organic material.
- E. Engineered Fill: On-site soils with an organic content of less than 3% by weight, free of any hazardous or deleterious materials, and meeting the gradation requirements below may be used as Engineered Fill to achieve project grades, except when special materials (such as drainage material) are required. Engineered Fill material shall not contain rocks or lumps larger than 3-inches in greatest dimension, shall not contain more than 15% of the material larger than 2½ inches, and shall contain at least 20% passing the No. 200 sieve. All import fills shall be approved by the Engineer prior to delivery to the site. At least five (5) working days prior to importing

to the site, a representative sample of the proposed import fill shall be delivered to the Engineer for evaluation.

- F. Landscape Fill: Imported or native backfill free from chemicals, salts or other materials harmful to plant growth.
- G. Impervious Material: Imported or on-site fined-grained clayey sand soil (SC) with a minimum percentage of material passing the No. 200 sieve of 50% and an expansive index (EI) of less than 50. The material shall be free of organics, rocks, or clods greater than 4 inches in diameter.
- H. Water: The water used shall be reasonably free of objectionable quantities of silt, oil, organic matter, alkali, salts and other impurities. Water quality must be acceptable to the Engineer.
- I. Aggregate Base: Refer to Section 02700.
- J. Warning Tape: 3-inch-wide, inert, fade-resistant plastic film resistant to acids, alkalis, and other components likely to be encountered in soil. Tape shall be blue, imprinted with "CAUTION WATER MAIN BELOW", Griffolyn Terra Tape, or equal. Provide similar warning tape for sewer, storm drain, and electrical buried utilities.
- L. Detection Tape: Plastic metallic type consisting of a blue color coded polyethylene or melinex film, a solid core aluminum foil detection layer and other layers as required. The tape shall be resistant to acids, alkalines and other components likely to be encountered in soils. It shall be designed for both conductive and inductive locating procedures. The tape shall be blue, imprinted "CAUTION WATER MAIN BELOW, Terra Tape D" by Griffolyn Company; Detectatape by Allen Systems; or equal. Provide similar detection tape for sewer, storm drain, and electrical buried utilities.
- M. Controlled Low Strength Material: Refer to Section 02065.
- N. Riprap: Refer to Section 02370.

PART 3 - EXECUTION

3.01 CONTROL OF WATER

- A. All excavations shall be kept free from water and all construction shall be in the dry.
 - 1. Groundwater was not found in any of the borings. Soil and bedrock colors observed in samples indicate consistently oxidized conditions, which suggests that the water table does not tend to fluctuate through the intervals drilled. Perched and shallow ground water will not likely be encountered in the excavations. Therefore, the need for temporary dewatering systems, such as sloping excavations to a sump pump location, trenching from the base of excavations to discharge water by gravity flow, or other means are not anticipated. If the need arises, design of construction dewatering shall be determined by the Contractor.
 - 2. Furnish, install, maintain, and operate all necessary pumping and other equipment for dewatering all excavations. At all times have on the project

sufficient pumping equipment for immediate use, including standby pumps for use in case other pumps become inoperable.

3. Provide a sufficient number of pumps so as to hold the groundwater level at an elevation of not less than 1 foot below the lowest elevation of the pipe, duct or other material to be placed.
4. Dispose of water in such a manner as to cause no injury or nuisance to public or private property, or be a menace to the public health.
5. The dewatering operation shall be continuous, so that the excavated areas shall be kept free from water during construction, while concrete is setting and achieves full strength, and until backfill has been placed to a sufficient height to anchor the work against possible flotation.
6. Continue dewatering during backfilling operations such that the groundwater is at least 1 foot below the level of the compaction effort at all times. No compaction of saturated materials will be allowed.
7. Dewatering devices must be adequately filtered to prevent the removal of fines from the soil.
8. The Contractor shall be responsible for any damage to the foundations or any other parts of existing structures or of the new work caused by failure of any part of the Contractor's protective works. After temporary protective works are no longer needed for dewatering purposes, they shall be removed by the Contractor.
9. If pumping is required on a 24-hour basis, requiring engine drives, then engines shall be equipped in a manner to keep noise to a minimum. Refer to Section 01140 for noise control requirements.
10. Prevent disposal of sediments from the soils to adjacent lands or waterways by employing whatever methods are necessary, including settling basins.

- B. The Contractor shall be responsible for furnishing temporary drainage facilities to convey and dispose of surface water falling on or passing over the site.

3.02 EXISTING UTILITIES

- A. General: The known existing buried utilities and pipelines are shown on the Drawings in their approximate location. The Contractor shall exercise care in avoiding damage to all utilities as he will be held responsible for their repair if damaged. There is no guarantee that all utilities or obstructions are shown, or that locations indicated are accurate. Utilities are piping, conduits, wire, cable, ducts, manholes, pull boxes and the like, located at the project site and adjoining said site.
- B. Check on Locations (Potholing): Contact all affected utility owners and request them to locate their respective utilities prior to the start of "potholing" procedures. The utility owner shall be given 7 days written notice prior to commencing potholing. If a utility owner is not equipped to locate its utility, the Contractor shall locate it.
- C. Clearly paint the location of all affected utility underground pipes, conduits and other utilities on the pavement or identify the location with suitable markers if not on pavement. In addition to the location of metallic pipes and conduits, non-metallic pipe, ducts and conduits shall also be similarly located using surface indicators and detection tape if present and shall then be similarly marked.

- D. After the utility survey is completed, commence "potholing" to determine the actual location and elevation of all utilities where crossings, interferences, or connections to new pipelines or other facilities are shown on the Drawings, marked by the utility companies, or indicated by surface signs. Prior to the preparation of piping shop drawings, or the excavating for any new pipelines or structures, the Contractor shall locate and uncover these existing utilities to a point 1 foot below the utility. Submit a report identifying each underground utility and its depth and location. Any variation in the actual elevations and the indicated elevations shall be brought to the Engineer's attention.
- E. Excavations around underground electrical ducts and conduits shall be performed using extreme caution to prevent injury to workmen or damage to electrical ducts or conduits. Similar precautions shall be exercised around gas lines, telephone and television cables.
- F. Excavations in streets shall have a surface dimension of no more than 18" x 18". Air spades and vacuum excavators shall be used to limit the size of the excavation and damage to adjacent facilities. Backfill after completing potholing. In existing streets pave with 1 inch of cold mix asphalt concrete.
- G. Interferences: If interferences occur at locations other than shown on the Drawings, the Contractor shall notify the Engineer, and a method for correcting said interferences shall be supplied by the Engineer. Payment for interferences that are not shown on the plans, nor which may be inferred from surface indications, shall be in accordance with the provisions of the General Conditions, Paragraph 3.7. If the Contractor does not expose all required utilities prior to shop drawing preparation, he shall not be entitled to additional compensation for work necessary to avoid interferences, nor for repair to damaged utilities.
- H. Any necessary relocations of utilities, whether shown on the Drawings or not, shall be coordinated with the affected utility. The Contractor shall perform the relocation only if instructed to do so in writing from the utility and the Engineer.
- I. Shutdowns: Planned utility service shutdowns shall be accomplished during period of minimum use. In some cases this may require night or weekend work. Such work shall be at no additional cost to the Owner. Program work so that service will be restored in the minimum possible time, and shall cooperate with the utility companies in reducing shutdowns of utility systems to a minimum.
 - 1. Disconnections: No utility shall be disconnected without prior written approval from the utility owner. When it is necessary to disconnect a utility, the Contractor shall give the utility owner not less than 72 hours notice when requesting written approval. The Contractor shall program his work so that service will be restored in the minimum possible time.
- J. Overhead Facilities: There may be existing overhead electric and telephone transmission lines at the site. These overhead utilities are not shown on the Drawings. Extreme caution shall be used when working in the vicinity of overhead utilities so as to prevent injury to workmen or damage to the utilities. The Contractor shall be required to comply with the applicable provisions of the California Construction Safety Orders when working anywhere on this project.

3.03 GENERAL CONSTRUCTION REQUIREMENTS

- A. Site Access: Access to the site will be over public and private roads. Exercise care in the use of such roads and repair at own expense any damage thereto caused by Contractor's operations. Such repair shall be to the satisfaction of the Owner or agency having jurisdiction over the road. Take whatever means are necessary to prevent tracking of mud onto existing roads and shall keep roads free of debris.
- B. Barriers: Barriers shall be placed at each end of all excavations and at such places along excavations as may be necessary to warn all pedestrian and vehicular traffic of such excavations.
- C. Demolition of Pavement: Where trenching or excavation occurs in paved areas, the pavement shall be scored and broken ahead of the trenching or excavation operation. The extent of paving removed shall be limited to the minimum necessary for the excavation.
- D. Dust Control: Take proper and efficient steps to control dust.
- E. Permits: Refer to General Conditions, Paragraph 5.10.
- F. Storage of Materials: Neatly place excavated materials far enough from the excavation to prevent stability problems. Keep the materials shaped so as to cause the least possible interference with plant operations and drainage.
- G. Existing Facilities: Maintain access to existing facilities to permit continued operation. Maintain access for fire fighting equipment and to fire hydrants.

3.04 COMPACTION

- A. Relative compaction or compaction is defined as the in-place dry density of the compacted soil divided by the laboratory maximum dry density as determined by ASTM Test Method D1557, latest edition, expressed as a percentage.
- B. Moisture conditioning of soils shall consist of adding water to the soils if they are too dry and allowing the soils to dry if they are too wet.
- C. Add water to the backfill material or dry the material as necessary to obtain moisture content within range of 1-3% of optimum. Employ such means as may be necessary to secure a uniform moisture content throughout the material of each layer being compacted.
- D. After the material has been moisture conditioned, compact it with compaction equipment appropriate for the use to achieve specified compaction.
- E. If the backfill material becomes saturated from rains or any other source because it was not compacted to the specified density or was not backfilled and compacted to surface grade, through negligence or otherwise, remove the faulty material and replace it with suitable material compacted to the specified density. No additional payment will be made for doing such work or removal and replacement.

F. Compaction of embankment and backfill materials by flooding, ponding or jetting is not permitted.

G. When densities of compacted materials do not meet the requirements, remove and/or recompact the material until the requirements are met. If the Engineer determines that the nature of the ground in which the trench lies precludes compaction of the backfill to the specified density, compact the backfill to the maximum practicable density. The Contractor will be backcharged the cost of retesting all failing tests, including the initial retest. Such backcharges will be deducted from the Contractor's Progress Payments.

H. Material Requirements

1. Engineered Fill: Engineered Fill consisting of on-site soils or imported soils of low expansion potential shall be compacted to no less than 90% relative compaction with moisture content between about 1 and 3% above the laboratory optimum value.
2. Engineered Fill in Pavement Areas: the upper 6-inches of subgrade soil shall be compacted to no less than 95% relative compaction with moisture content between 1 and 3% above the optimum value.
3. Aggregate Base: In accordance with Section 02700.
4. Pipe Bedding Material: Sand if used as bedding shall be compacted to no less than 90 percent relative compaction.
5. Pipe Zone Material: Compact by hand methods under the haunches of the pipe and in areas not accessible to mechanical tampers unless otherwise specified or shown on the Drawings.
6. Landscape Fill: Compact to a minimum 85 percent of maximum density, in accordance with ASTM Test Method D1557 unless otherwise specified or shown on the Drawings.
7. Impervious Material: Compact to a minimum 90 percent of maximum density, in accordance with ASTM Test Method D1557 unless otherwise specified or shown on the Drawings.

I. Testing Frequency:

- a. Trench Backfill: Test every 200 feet of trench.
- b. Earthwork: Test every 500 square feet for each 2 feet of fill.
- c. Structural Backfill:
 - 1) Sub-base: Test every 200 square feet.
 - 2) Base:
 - i. Test every 200 square feet of building footprint, with no less than 2 tests per structure.
 - ii. Test every 200 cubic yards of material placed within 10 feet around the building.

3.05 SITE GRADING

A. Rough Grading: After completion of stripping, rough grade cut areas to the lines, grades and contours shown on the Drawings.

B. Subgrade Preparation: Subgrade preparation shall be performed after stripping and any necessary excavations have been performed. Subgrade soil in areas to

receive Engineered Fill, foundations, or pavements shall be scarified to a minimum depth of 8-inches, moisture conditioned and compacted to the recommendations presented in Section 3.04. Subgrade preparation shall also extend a minimum of 5-feet beyond the outermost limits of the proposed improvements. After the subgrades have been prepared, the areas may be raised to design grades by placement of engineered fill. If unstable, wet or soft soil is encountered, processing of the soil shall be performed before compaction can be achieved. When construction schedule does not allow for air-drying, other means such as lime treatment, over-excavation and replacement, geotextile fabrics, etc. shall be considered to help stabilize the subgrade. The method to be used shall be determined by the Contractor based on the actual site conditions.

Prepared soil subgrades shall be non-yielding when proof-rolled by a fully loaded water truck or equipment of similar weight, in the presence of the Engineer. The Engineer will determine what areas tested by proof-rolling are soft zones that require corrective work.

1. Soft Zone Corrective Work: Remove all soft material as indicated by the Engineer from all soft zones exposed by proof-rolling. Properly dispose of unsuitable material off site.
2. Fill the resulting voids with moisture-conditioned backfill in level 8-inch uniform layers measured before compaction. Compact with appropriate equipment in accordance with the requirements of Section 3.04 unless otherwise specified or shown on the Drawings.
3. Soft zone corrective work will be considered a change in the scope of project work and will be paid for as extra work by a Change Order, Paragraph 9-4 of the General Conditions.

C. Scarifying: Upon completion and favorable review of the soft zone correction work scarify to a minimum 8-inch depth all areas where fills are required. Moisture condition the scarified surface to within 2% of optimum water content, and compact in accordance with the requirements of Section 3.04 unless otherwise specified or shown on the Drawings.

D. Engineered Fill Placement:

1. Do not place any fill until the Engineer has inspected, tested to his/her satisfaction, and favorably reviewed the prepared subgrade.
2. Construct fills as shown on the Drawings, true to line, grade and cross-section. Construct fills of Engineered Fill.
3. Engineered fill shall be placed in horizontal lifts each not exceeding 8-inches in uncompacted thickness, moisture conditioned to the required moisture content, and mechanically compacted to the recommendations in Section 3.04.
4. For fill to be placed on an existing slope with an inclination of 5H:1V or steeper, the fill shall be keyed and benched into the existing slope.
5. Toe keys shall extend a minimum of 2-feet into the bedrock material and have a width of 8-feet or 1½ times the width of the compaction equipment, whichever provides a wider excavation. Toe keys shall slope toward their backs with a slope of at least 2%.
6. Benches shall be created by cutting a minimum of 6-feet into the existing slopes as the new fill is being placed. Vertical spacing of benches shall not be more than about 6-feet.
7. The materials excavated from the benches shall be mixed with the slope fill and the fill shall be compacted to the requirements in Section 3.04.

8. Recompect material thus removed by benching along with the new embankment material.
 9. It may be necessary to overbuild slopes and trim back to the compacted core to achieve adequate compaction of slope faces.
- E. Ditches: Cut ditches accurately to the cross sections and grades shown. Take care not to overexcavate ditches, and backfill excessive excavation to grade. Trim all roots, stumps, rock and other foreign matter from the sides and bottom of the ditches. Compact the surfaces of ditch slopes and bottom.
- F. Landscaped Areas: Use Landscape Fill in the top 2 feet of areas to be landscaped, compacted in accordance with the requirements of Section 3.04 unless otherwise specified or shown on the Drawings.

3.06 TRENCH EXCAVATION

- A. Excavation for pipe and other utilities such as duct banks shall be in open cut. The trench shall be as wide as necessary for sheeting and bracing and the proper performance of the work up to the maximum width permitted by the typical cross-sections shown on the Drawings. The sides of the trenches shall be vertical in paved areas. The bottom of the trench shall be constructed to the grades and shapes indicated on the Drawings. Should the Contractor desire to use other equivalent methods, it shall submit its method of construction to the Engineer for favorable review prior to its use.
- B. Take care not to overexcavate. Accurately grade the bottom of the trenches to provide uniform bearing and support for each section of the pipe or conduit at every point along its entire length, except for the portions of the pipe sections where it is necessary to excavate for bell holes and for the proper sealing of pipe joints, and as hereinafter specified. Dig bell holes and depressions for joints after the trench bottom has been graded. In order that the pipe rest on the bedding for as nearly its full length as practicable, bell holes and depressions shall be only of such length, depth and width as required for properly making the joint. Remove stones as necessary to avoid point bearing.
- C. Backfill and compact overexcavations in accordance with the requirements of Section 3.04 with Pipe Bedding Material or Engineered Fill. There shall be no additional payment to the Contractor for overexcavations not directed by the Engineer. Remove unsatisfactory material encountered below the grades shown as directed by the Engineer and replace with Pipe Bedding Material or Engineered Fill. Payment for removal and replacement of such unsatisfactory material directed by the Engineer shall be made in accordance with the provisions of the General Conditions.
- D. Grade trenches so that they are uniformly sloped between the pipe elevations shown on the Drawings. If no elevations are shown on the Drawings, provide 3 feet of minimum cover. Comply with the minimum and maximum trench widths shown on the Drawings. Notify the Engineer if the trench width exceeds the maximum allowable width for any reason.

- E. For all piping or conduits to be placed in any excavated and backfilled area, such as at manholes or for building connections, the structural backfill shall be first compacted to a level at least 3 feet from the top of the piping or conduit elevation and then retrenched to pipe grade.
- F. Provide ladders for access to the trench by construction and inspection personnel.

3.07 EXCAVATION FOR STRUCTURES

- A. All excavation for structures shall be done to the dimensions and levels indicated on the Drawings or specified herein. Excavate to such width outside the lines of the structure to be constructed as may be required for proper working methods, the erection of forms and the protection of the work.
- B. Take care to preserve the foundation surfaces shown on the Drawings in an undisturbed condition. If the Contractor overexcavates or disturbs the foundation surfaces shown on the Drawings or specified herein, without written authorization of the Engineer, he shall replace such foundations with concrete fill or other material approved by the Engineer in a manner that will show by test an equal bearing value with the undisturbed foundation material. No additional payment will be made for the added quantity of concrete fill or other material used because of overexcavation.
- C. Inspection of Excavation: Notify the Engineer when excavation for the structure is complete. No forms, reinforcing steel, concrete, or precast structure shall be placed until the excavation has been inspected by the Engineer.
- D. Where unsatisfactory material is encountered below the grades shown for structural excavations, it shall be removed and replaced with Engineered Fill as directed by the Engineer and compacted. Payment for removal and replacement of such unsatisfactory material directed by the Engineer shall be made in accordance with the provisions of the General Conditions.

3.08 SUPPORT OF EXCAVATIONS

- A. Adequately support excavation for trenches and structures to meet all applicable requirements in the current rules, orders and regulations. Excavation shall be adequately shored, braced and sheeted so that the earth will not slide or settle and so that all existing structures and all new pipe and structures will be fully protected from damage. Keep vehicles, equipment, and materials far enough from the excavation to prevent instability.
- B. Take all necessary measures to protect excavations and adjacent improvements from running, caving, boiling, settling, or sliding soil resulting from the high groundwater table and the nature of the soil excavated. Attention is directed to Section 832 of the Civil Code of the State of California relating to lateral subadjacent supports, and wherever structures or improvements adjacent to the excavation may be damaged by such excavation, the Contractor shall comply with this law.
- C. The support for excavation shall remain in place until the pipeline or structure has been completed. During the backfilling of the pipeline or structure, the shoring,

sheeting and bracing shall be carefully removed so that there shall be no voids created and no caving, lateral movement or flowing of the subsoils.

3.09 TRENCH BACKFILL

- A. Bedding material shall consist of free-draining sand (less than 5% passing a No. 200 sieve), lean concrete or sand cement slurry. Sand if used as bedding shall be compacted to no less than 90 percent relative compaction.
- B. Jetting of trench backfill shall not be allowed.
- C. If sand is used as bedding in utility lines located on slopes, soil plugs shall be provided at 30-foot intervals to reduce the potential for the utility trenches to serve as a conduit for water.
- D. Place bedding and backfill materials true to the lines, grades, and cross-sections indicated on the Drawings and compacted to the degree specified on the Drawings. Place bedding and backfill materials in horizontal lifts not to exceed 6-inches in thickness measured before compaction. The difference in level on either side of a pipe shall not exceed 4 inches.
- E. Backfill material shall not be placed over the pipe or conduit until after the joints have been completed and inspected by the Engineer.
- F. It shall be incumbent upon the Contractor to protect the pipe or conduit from damage during the construction period. It shall be its responsibility to repair broken or damaged pipe at no extra cost to the Owner. Carefully place backfill around and over the pipe and do not allow it to fall directly upon the pipe. Tamping of backfill over the pipe shall be done with tampers, vibratory rollers and other machines that will not injure or disturb the pipe.
- G. Do not allow construction traffic nor highway traffic over the pipe trench until the trench backfill has been brought back even with existing adjacent grade.

3.10 STRUCTURAL BACKFILL

- A. Crushed Rock Subgrade: Place a layer of rock, compacted in accordance with the requirements of Section 3.04, under structures to the lines, grades and minimum thicknesses shown on the Drawings. Unless shown specifically otherwise in the Drawings, do not use rock as backfill above the elevation of the highest base slab of the structure.
- B. Backfill Adjacent to Structures:
 - 1. Backfill shall be Engineered Fill compacted in accordance with the requirements of Section 3.04 unless otherwise specified or shown on the Drawings.
 - 2. Do not place backfill against structures until the concrete has been patched and cured.
 - 3. Do not place backfill against structures until at least 28 days after the concrete was placed, or until the concrete has achieved the required specified 28-day compressive strength, whichever is earlier. Concrete strength shall be

demonstrated by field cured cylinders tested at the Contractor's cost, prepared and tested in accordance with ASTM C31 and ASTM C39.

4. Do not place backfill against hydraulic structures until the structure has passed the specified leakage tests.
5. Place backfill in uniform, level layers, not exceeding 8 inches thick measured before compaction. Bring backfill up uniformly on all sides of the structure, and on both sides of buried walls.

3.11 ROAD EMBANKMENTS

- A. Construct roadway embankments in accordance with the Engineered Fill requirements of Section 3.05 and Standard Specifications, Sections 19-5 and 19-6, except Paragraphs 19-5.06, 19-6.025, and 19-6.03 are not applicable.
- B. Engineered Fill satisfying the material requirements of Section 2.01 shall be used for road embankments.
- C. Prior to placing any embankment material, scarify all areas to receive fill to a depth of 8-inches. Moisture condition the scarified surface to within 2% of optimum water content, and compact in accordance with the requirements of Section 3.04 unless otherwise specified or shown on the Drawings.

3.12 FINISH GRADING

- A. Finish grade the site to the elevations shown on the Drawings. Finish grading shall be uniform and pleasing and shall provide drainage from all areas to collection points. The finished surfaces shall be smooth and compacted.

3.13 DISPOSAL OF EXCAVATED MATERIAL

- A. Dispose of unsuitable material or excavated material in excess of that needed for backfill or fill offsite in accordance with the requirements of Section 01140.

3.15 SITE GRADING

- A. Tolerances: Grade the site to the elevations shown on the Drawings within the tolerances provided here:
 1. Excavation:
 - a. Plus or minus ½ inch.
 2. Backfill: Where backfilling due to excavation or temporary cut and fill operations, place lifts as specified herein with the following tolerance:
 - a. Plus or minus 1 inch.
 3. Subgrade:
 - a. Plus or minus ½ inch.
 4. Fine grading (finished surface):
 - a. Sidewalks: ¼ inch when tested with a 10-foot straight edge.
 - b. Asphalt pavement: ¼ inch when tested with a 10-foot straight edge.
 - c. Concrete pavement: ¼ inch when tested with a 10-foot straight edge.
 - d. Landscaped areas: Plus or minus ½ inch.

- B. Ditches and Swales: Cut ditches accurately to the cross sections and grades shown. Trim all roots, stumps, rock, and other foreign matter from the sides and bottom of the ditches.
 - C. Gravel Areas: Place gravel material onsite to finished grade elevations as shown on the Drawings, unless otherwise noted.
 - D. Landscaped Areas: Use Landscape Fill in the top 2 feet of areas to be landscaped.
 - E. Where filter fabric is installed within an earthen or rock-lined drainage swale or channel, overlap filter fabric a minimum 12 inches with upstream fabric placed over downstream fabric. Join seams per manufacturer recommendations.
 - F. Uniformly grade and provide drainage away from areas to collection points. Grade surfaces to drain away from structures at a minimum of 2 percent, unless otherwise noted on the Drawings.
-
- 1. Except where shown otherwise on the Drawings, restore the finish grade to the original contours and to the original drainage patterns. Grade surfaces to drain away from structures at a minimum of 2 percent, unless otherwise noted on the Drawings.

END OF SECTION

SECTION 02370

SLOPE PROTECTION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Provide all labor, materials, and equipment for placing riprap slope protection.

1.02 REFERENCES

- A. State of California, Department of Transportation, Caltrans Standard Specifications (Caltrans Standard Specifications)
- B. Standard Specifications for Public Works Construction (SSPWC), aka "Greenbook"

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Submit the following under the Product Information category.
 - 1. Samples: Furnish such quantities of construction materials as may be required by the Engineer for test purposes. The Contractor shall cooperate with the State and furnish necessary facilities for sampling and testing of all materials and workmanship. All materials furnished and all work performed shall be subject to rigid inspection, and no materials shall be used in the construction work until it has been inspected by the Engineer.
 - 2. Submit a signed certification from each source of supply for each material indicating that the material meets the Specification requirements.

PART 2 - PRODUCTS

2.01 RIPRAP

- A. Riprap:
 - 1. Refer to SSPWC section 200-1.6.
- B. Filter Fabric:
 - 1. Non-woven, non-biodegradable, needle punched geotextile filter fabric per Specification section 02301.

PART 3 - EXECUTION

3.01 RIPRAP INSTALLATION

- A. Foundation Preparation: Trim and dress the slopes to conform to cross sections shown on the Drawings. Where such areas are below the allowable minus tolerance limit, they shall be brought to grade by filling with earth similar to the adjacent material and compacted to a comparable density. Immediately prior to

placing the filter rock, the prepared base will be inspected by the Engineer, and no material shall be placed thereon until that area has been approved.

- B. Filter Blanket: Spread filter uniformly on the prepared base to the slope lines and grades indicated on the Drawings. Placing of material by methods, which will tend to segregate particle sizes within the filter rock layer will not be permitted. Any damage to the surface of the base during placing of the filter layer shall be repaired before proceeding with the work. Compaction of the filter rock layer will not be required, but it shall be finished to present a reasonably even surface free from mounds or windrows.
- C. Riprap: Place rock for riprap on the filter blanket in such a manner as to produce a reasonably well graded mass of rock with the minimum practicable percentage of voids. Comply with the following tolerance to the lines and grades shown on the Drawings. A tolerance of plus 3 inches or minus 0 inches from the slope lines and grades shown on the Drawings will be allowed in the finished surface of the riprap. Place riprap to its full course thickness in one operation and in such a manner as to avoid displacing the filter rock material. Distribute the larger rocks over the entire surface. The entire mass of rocks in their final position shall be roughly graded to conform to the gradation specified. The finished riprap shall be free from pockets of small stones and clusters of larger stones. Placing riprap in layers will not be permitted. Placing riprap by dumping into chutes or by similar methods likely to cause segregation of the various sizes will not be permitted. The desired distribution of the various sizes of rocks throughout the mass shall be obtained by selective loading of the material at the quarry or other source; by controlled dumping of successive loads during final placing; or by other methods of placement, which will produce the specified results. Rearranging of individual stones by mechanical equipment or by hand will be required to the extent necessary to obtain a reasonably well-graded distribution of rock sizes as specified above. Maintain the riprap protection until the Contract is accepted. Replace any material displaced by any cause to the lines and grades shown on the Drawings.

END OF SECTION

SECTION 02480

MECHANICALLY STABILIZED EARTH RETAINING WALL (MSE WALL)

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes design, furnishing materials, and installation of mechanically stabilized earth (MSE) walls constructed in accordance with the Drawings and this Section.
- B. Design and installation of a complete wall system will include the following individual components:
 - 1. Concrete leveling pad
 - 2. Precast concrete facing blocks
 - 3. Soil reinforcement elements
 - 4. Mechanical connectors for attaching soil reinforcement to wall
 - 5. Wall drainage materials as necessary
 - 6. Wall backfill
 - 7. Vehicle barriers

1.02 REFERENCES

- A. ASTM International (ASTM) Standard Specification or Test Method:
 - 1. C140 Sampling and Testing Concrete Masonry Units
 - 2. C1372 Dry-Cast Segmental Retaining Wall Units
 - 3. D1557 Laboratory Compaction Characteristics of Soil Using Modified Effort
 - 4. D1785 Poly(Vinyl Chloride) (PVC) Plastic Pipe Schedules 40, 80, and 120
 - 5. D2564 Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
 - 6. D3080 Direct Shear Test of Soils under Consolidated Drained Conditions
 - 7. D4595 Tensile Properties of Geotextiles by the Wide Width Strip Method
 - 8. D5262 Evaluating the Unconfined Tension Creep and Creep Rupture Behavior of Geosynthetics
 - 9. D5818 Exposure and Retrieval of Samples to Evaluate Installation Damage of Geosynthetics
 - 10. D6637 Determining Tensile Properties of Geogrids by the Single or Multi-Rib Test Method
 - 11. D6638 Determining Connection Strength between Geosynthetic Reinforcement and Segmental Concrete Units
 - 12. D6916 Determining the Shear Strength Between Segmental Concrete Units (Modular Concrete Blocks)
- B. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. Standard Specifications for Transportation Materials and Methods of Sampling and Testing, 43rd Edition, 2023.
- C. Federal Highway Administration (FHWA):
 - 1. FHWA-NHI-00-043 Mechanically Stabilized Earth Walls Reinforced Soil Slopes Design & Construction Guidelines.
 - 2. NHI-10-024 Vol I and NHI-10-025 Vol II, Design and Construction of Mechanically Stabilized Earth Walls and Reinforced Slopes.
- D. 2022 California Building Code (CBC).

1.03 DEFINITIONS

- A. Wall Design Engineer: Civil Engineer, licensed in California, employed or contracted by the Contractor who is in responsible charge of the MSE wall internal and external stability.
- B. Design Drawings: Documents produced by the Contractor's Wall Design Engineer illustrating the mechanically stabilized earth wall layout and describing its components.
- C. Drawings: Contract Drawings (documents) produced by the Engineer of Record describing the overall project.
- D. Drainage backfill: Granular fill located immediately behind the wall facing material and intended to provide drainage of perched groundwater.
- E. Reinforced backfill: Compacted fill placed behind the drainage backfill, and in lifts above and below the geogrid.
- F. Retained backfill: Compacted fill placed behind the reinforced backfill.
- G. Unit fill: Granular fill used to fill hollow modular block facing units.
- H. Geogrid: Geosynthetic, polymeric, reinforcing grid formed by a rectangular or triangular network of integrally connected tensile elements with apertures of sufficient size to allow interlocking with compacted structural backfill.
- I. Modular block facing units: Precast concrete facing blocks tied to the geogrid with positive mechanical connection. Also referred to as "precast concrete blocks" in this Section.

1.04 SUBMITTALS

- A. Design Drawings:
 - 1. Layout drawings, sealed and signed by the Wall Design Engineer, including plans and wall profiles showing, but not limited to, the following:
 - a. Plans depicting the horizontal alignment of both the wall top and bottom, beginning and end stations, extent of soil reinforcing, wall drain alignments and any existing structures or utilities in the work area.
 - b. Elevation views showing wall top and bottom elevations, beginning and end stations, openings, horizontal and vertical breaks, and final grade lines in front and behind wall.
 - c. Wall sections showing excavation requirements, fill requirements, typical reinforcing extents, and the locations and dimensions of the facing, backfill, subgrade, levelling pads, and drainage system.
 - d. Reinforced soil material parameters and extents of reinforced soil volume.
 - e. Location, size and type of soil reinforcement, manner of connection to wall facing, and including method of reinforcing around existing structures or utilities.
 - f. Coping, corner, radius, changes of elevation, and wall opening details.
 - g. Wall nominal batter.
 - h. Location of geotextile filter fabric and impermeable membranes.
 - i. Drainage details.
 - j. Location, dimensions, and materials for constructing the leveling pads.

2. Provide any additional details necessary to complete construction of the wall system, including the wall system's interface with the adjacent freestanding elements as necessary.
- B. Product Data:
 1. Precast concrete block Certificate of Compliance certifying that the materials conform to these Specifications.
 2. Certified Mill Test results of geosynthetic reinforcing material.
 3. System field installation manual by manufacturer.
- C. Calculations:
 1. Strength and stability analysis of the MSE wall conforming with AASHTO Standard Specifications, FHWA NHI-10-024, FHWA-10-025 and FHWA-NHI-00-043, and sealed and signed by the Wall Design Engineer.
- D. Physical Samples:
 1. Palette of manufacturer's standard precast concrete block colors and textures for selection by Owner.

1.05 QUALITY ASSURANCE

- A. Contractor's field supervising staff shall have at least 3 years of experience in construction of MSE walls.
- B. Contractor's Wall Design Engineer shall have at least 5 previous projects of similar construction.
- C. Manufacturer Quality Control: The geogrid manufacturer shall have a manufacturing quality control program that includes QC testing by an independent laboratory. Quality control testing shall test at a minimum the following properties:
 1. Tensile strength.
 2. Melt flow index (HDPE).
 3. Molecular weight (Polyester)

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Handle, ship, and store all facing units in such a manner as to prevent damage to the precast concrete blocks and geogrid materials.
- B. Precast concrete blocks showing excessive chips, cracks or fractures shall be discarded and replaced at no additional expense to the Owner.
- C. Geogrid shall be free of significant scrapes, kinks, folds and tears. Any geogrid exhibiting these signs shall be discarded and replaced at no additional expense to the Owner.

PART 2 - PRODUCTS

2.01 CONCRETE LEVELING PAD

- A. Type B concrete as defined in Section 03300.

2.02 AGGREGATE LEVELLING PAD

- A. Aggregate base as defined in Section 02301.

2.03 MODULAR BLOCK FACING UNITS

- A. Conform to ASTM C1372 and the requirements below.
- B. Precast blocks shall conform to the following architectural requirements:
 - 1. Face color: As selected by Owner.
 - 2. Face finish: As selected by Owner. Other face finishes will not be allowed without written approval of Owner.
 - 3. Bond configuration: Running bond with seams nominally located at midpoint of vertically adjacent units, in both straight and curved alignments.
 - 4. Exposed surfaces of units shall be free of chips, cracks, or other imperfections when viewed from a distance of 10 feet under diffused lighting.
- C. Precast concrete blocks shall conform to the following structural and geometric requirements measured in accordance with ASTM C140:
 - 1. Compressive strength: 4,000 psi minimum
 - 2. Absorption: Less than 10% for standard weight aggregates
 - 3. Dimensional tolerances: $\pm 1/8"$ from nominal unit dimensions in width and depth, not including rough split face. $\pm 1/16"$ from nominal unit height.
 - 4. Unit size: 8" (H) x 16" (W) x 12" (D) minimum.
 - 5. Unit weight: 75 lbs/unit minimum for standard weight aggregates.
- D. Modular concrete units shall conform to the following performance testing:
 - 1. Inter-unit shear strength in accordance with ASTM D6916 (NCMA SRWU-2): 1,500 plf minimum at 2 psi normal pressure.
 - 2. Geogrid/unit peak connection strength in accordance with ASTM D6638 (NCMA SRWU-1): 900 plf minimum at 2-psi normal force.

2.04 GEOGRID SOIL REINFORCEMENT

- A. Geosynthetic reinforcement shall consist of geogrids manufactured specifically for soil reinforcement applications and shall be manufactured from high tenacity polyester yarn or high-density polyethylene (HDPE). Polyester geogrid shall be knitted from high tenacity polyester filament yarn with a molecular weight exceeding 25,000 Meg/m and a carboxyl end group values less than 30. Polyester geogrid shall be coated with an impregnated PVC coating that resists peeling, cracking, and stripping.
- B. The Long Term Allowable Tensile Design Load (T_a) is to be evaluated based on a 75-year design life of the geogrid material and shall be determined as follows:
$$T_a = T_{ult} / (RF_{cr} * RF_d * RF_{id} * FS)$$
 - 1. T_{ult} : Short Term Ultimate Tensile Strength
 - a. Determined in accordance with ASTM D4595 or ASTM D6637.
 - b. T_{ult} is based on the minimum average roll values.
 - 2. RF_{cr} : Reduction Factor for Long Term Tension Creep
 - a. RF_{cr} shall be determined from 10,000-hour creep testing performed in accordance with ASTM D5262.
 - b. $RF_{cr} = 1.45$ minimum.
 - 3. RF_d : Reduction Factor for Durability
 - a. RF_d shall be determined from polymer specific durability testing covering the range of expected soil environments.
 - b. $RF_d = 1.10$ minimum.
 - 4. RF_{id} : Reduction Factor for Installation Damage

- a. RF_{id} shall be determined from product specific construction damage testing performed in accordance with ASTM D5818 (GRI-GG4). Test results shall be provided for each product to be used with project specific or more severe soil type.
 - b. $RF_{id} = 1.05$ minimum.
 - 5. FS: Overall Design Factor of Safety
 - a. FS shall be 1.5 unless otherwise noted for the maximum allowable working stress calculation.
 - C. The maximum design tensile load of the geogrid shall not exceed the laboratory tested ultimate strength of the geogrid/facing unit connection as limited by the "Hinge Height" divided by a factor of safety of 1.5. The connection strength testing and computation procedures shall be in accordance with ASTM D6638 for connection strength between geosynthetic reinforcement and segmental concrete units (NCMA SRWU-1).
- 2.05 UNIT FILL
- A. Free-draining aggregate, as necessary and in accordance with accepted MSE wall system.
- 2.06 DRAINAGE BACKFILL
- A. Crushed Rock in accordance with Section 02301.
- 2.07 REINFORCED BACKFILL
- A. Reinforced backfill material and compaction requirements necessary to maintain the stability of the wall shall be the responsibility of the Contractor and the Wall Design Engineer.
 - B. The soil pH shall be between 5.0 and 9.0.
- 2.08 RETAINED BACKFILL
- A. Imported Backfill or Engineered Fill meeting the additional requirements of Imported Backfill in accordance with Section 02301.
- 2.09 DRAINAGE SYSTEM
- A. Drainage piping shall conform to ASTM D1785, schedule 40, 4-inch nominal size unless otherwise noted on the Drawings.
 - B. Perforate or slot where noted on plans.
 - C. PVC solvent cement to conform with ASTM D2564.
 - D. Any piping exposed to sunlight shall receive a UV-resistant coating.
- 2.10 GEOTEXTILE FILTER FABRIC
- A. Geotextile filter fabric shall be 4.0 oz/sy, polypropylene, needle-punched nonwoven fabric in accordance with AASHTO M288.

PART 3 - EXECUTION

3.01 BASE LEVELING PAD

- A. Leveling pad material shall be placed to the lines and grades shown on the Drawings to a minimum thickness of 6 inches and extend laterally a minimum of 6 inches in front and behind the wall unit.
- B. Aggregate base leveling pad materials shall be compacted to a minimum of 95% of maximum dry density per ASTM D1557.
- C. Leveling pad shall be prepared to ensure full contact with the base surface of the concrete units.

3.02 CONCRETE UNIT INSTALLATION

- A. First course of units shall be placed on the leveling pad at the appropriate line and grade. Alignment and level shall be checked in all directions; ensuring that all units are in full contact with the base and properly seated.
- B. Place the front of units side-by-side. Do not leave gaps between adjacent units. Layout of corners and curves shall be in accordance with manufacturer's recommendations.
- C. Place unit fill and install shear connecting devices per manufacturer's recommendations as necessary.
- D. Maximum stacked vertical height of wall units, prior to unit drainage fill and backfill placement and compaction, shall not exceed two courses.

3.03 DRAINAGE BACKFILL INSTALLATION

- A. Place drainage fill behind wall units. Drainage backfill shall not be compacted. Place and compact reinforced backfill soil behind drainage fill to elevation without delays to avoid raveling of drainage fill.
- B. Separate from reinforced fill with geotextile filter baric to prevent raveling and migration of fines.

3.04 STRUCTURAL GEOGRID INSTALLATION

- A. Geogrid shall be oriented with the highest strength axis perpendicular to the wall alignments.
- B. Geogrid reinforcement shall be placed at the strengths, lengths, and elevations shown on the accepted Shop Drawings.
- C. The geogrid shall be laid horizontally on compacted backfill and attached to the wall units. Place the next course of concrete units over the geogrid. The geogrid shall be pulled taut and anchored prior to backfill placement on the geogrid.
- D. Geogrid reinforcements shall be continuous throughout their embedment lengths and placed side-by-side to provide 100-percent tensile capacity coverage at each level. Spliced connections between shorter pieces of geogrid or gaps between adjacent pieces of geogrid are not permitted.
- E. Cover geogrid the same day it is placed.

3.05 DRAINAGE SYSTEM

- A. Place drains at the invert elevations shown on the Drawings.
- B. Drain pipe below reinforced backfill shall be solid without perforations.
- C. The drain rock behind the modular block facing units shall drain thru the face with horizontal PVC drains spaced not more than 20 feet on center, placed at the lowest unit course above grade.
- D. Where drain pipes exit the modular block facing unit, the maximum gap size around the pipe shall not exceed 1 inch, and the drain rock behind the face shall be wrapped with a non-woven geotextile drain fabric to prevent raveling.
- E. Install geocomposite drain system between the reinforced backfill and retained backfill parallel to wall face, and at the limits of the reinforced backfill perpendicular to the wall face. The geocomposite drain shall extend at least 50% of the wall face height, but no more than 80% of the wall face height.

3.06 REINFORCED BACKFILL PLACEMENT

- A. Reinforced backfill shall be placed, spread, and compacted in such a manner that minimizes the development of slack in the geogrid and installation damage.
- B. Reinforced backfill shall be placed and compacted in lifts not to exceed 8 inches. Lift thickness shall be decreased to achieve the required density, as needed.
- C. Reinforced backfill shall be compacted to a minimum of 95% of maximum dry density per ASTM D1557. The moisture content of the backfill material shall be uniformly dispersed throughout each layer. Backfill materials shall have a placement moisture content not more than 1%, nor less than 3% of optimum moist content, as determined by ASTM D1557.
- D. Only lightweight hand operated equipment shall be allowed within 3 feet of the back face of the concrete unit wall.
- E. Construction equipment and vehicles shall not be operated directly upon the geogrid reinforcement. A minimum fill thickness of 8 inches is required prior to operation of tracked vehicles over the geogrid.
- F. At the end of each day's operation, the Contractor shall slope the last lift of reinforced backfill away from the wall units to form a v-ditch to direct incidental rain runoff that might occur in non-working hours around the back face of the wall. The Contractor shall not allow surface runoff from adjacent areas to enter the wall construction site.

3.07 RETAINED BACKFILL PLACEMENT

- A. Retained backfill shall be compacted to a minimum of 92% of maximum dry density per ASTM D1557. The moisture content of the backfill material shall be uniformly dispersed throughout each layer. Backfill materials shall have a placement moisture content not more than 1%, nor less than 3% of optimum moist content, as determined by ASTM D1557.

3.08 CAP INSTALLATION

- A. Modular block facing units shall be topped with a cap unit unless an integral concrete gutter system is specified on the Drawings.

- B. Cap units shall be adhered to underlying units with an all-weather adhesive recommended by the manufacturer.

3.09 AS-BUILT CONSTRUCTION TOLERANCES

- A. Vertical and horizontal alignment of the wall face shall not vary by more than $\frac{3}{4}$ -inch when measured along a 10-foot straightedge.
- B. The top of wall elevation shall not vary by more than $\frac{3}{4}$ -inch from the specified elevation.
- C. The wall alignment shall not vary by more than 1-1/2-inch from the specified horizontal alignment.
- D. Overall vertical tolerance (plumbness) of the wall shall not exceed $1\frac{1}{4}$ -inch per 10-ft of wall height from the specified wall batter. In no case shall the installed wall batter be negative.
- E. All units shall be laid snugly together and parallel to the straight or curved line of the wall face.

END OF SECTION

SECTION 02485

SOIL NAIL WALL

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. This specification covers the material, fabrication, handling, installation and testing requirements for permanent soil nails and wall construction in a top-down permanent earth retaining wall system.
2. This specification does not cover the temporary slope support, including elements furnished and installed by the Contractor for support of excavated slopes during construction. The support shall, as a minimum, include the support items shown in the Drawings, and any additional support elements required to maintain slope stability or for safety of the work. Some temporary support will be removed in subsequent phases of construction, and other temporary support will remain, covered by other materials in subsequent construction.
3. The soil nail wall system shall be designed by the Contractor's Wall Design Engineer. The design shall address slope, soil nail, and shotcrete wall analysis:
 - a. Global (overall) slope stability analysis,
 - b. Geotechnical service and strength limit states,
 - c. Structural strength limit states

1.02 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 117 Standard Tolerances for Concrete Construction and Materials
2. ACI 506.2 Specifications for Shotcrete
3. ACI 318 Building Code Requirements for Structural Concrete

B. ASTM International (ASTM) Standard Specification or Test Method:

1. ASTM A123 Standard Specification for Zinc Coating (Hot-Dip) on iron and Steel Products
2. ASTM A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
3. ASTM A572 Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
4. ASTM A615 Standard Specification for Deformed and Plain Carbon-Steel Bars in Concrete Reinforcement
5. ASTM A775 Standards Specification for Epoxy-Coated Steel Reinforcing Bars
6. ASTM C33 Concrete Aggregates

C. Federal Highway Administration:

1. FHWA-NHI-14-007 FHWA GEC 007 February 2015

D. State of California, Department of Transportation (CALTRANS):

1. Test 217 Sand Equivalent

- E. California Building Code (CBC) 2022 Edition
- F. Additional Available Information
 - 1. Geotechnical Report by Cal Engineering and Geology, titled Geotechnical Investigation Report, East Dunne Hillside Water Reservoir Project, Morgan Hill, California dated August 11, 2016

1.03 DEFINITIONS

- A. Design Drawings: Documents produced by the Contractor's Wall Design Engineer.
- B. Drawings: Contract Documents produced by the Engineer of Record.
- C. Wall Design Engineer: Civil Engineer licensed in California employed or contracted by the Contractor who is in responsible charge of the soil nail structure and slope stability.
- D. Proof Load Test: Tension testing on an installed soil nail that will be used for production.
- E. Verification Load Test: Tension testing on a sacrificial soil nail that will not be used in production, but left in place without removal.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Contractor Experience: Submit a brief description of at least five (5) representative soil nail projects of similar or larger scope, including the owner agency's name, address, and current phone number; location of project; project contract value; and scheduled completion date for the project. Minimum installed wall area = 10,000 square feet; minimum installed soil nails = 500.
- C. Contractor Personnel:
 - 1. At least 45 calendar days before starting soil nail work, submit names of the Wall Design Engineer, on-site supervisors, and drill operators assigned to the project, and a summary of each individual's experience. Only those individuals designated as meeting the experience requirements shall be used for the project. The Contractor cannot substitute for any of these individuals without written approval of the Owner or the Owner's Representative. Work shall not be started nor materials ordered until the Contractor's qualifications have been approved by the Owner's Representative. The Owner's Representative may suspend the work if the Contractor substitutes unapproved personnel for approved personnel during construction. If work is suspended due to the substitution of unqualified personnel, the Contractor shall be fully liable for all additional costs resulting from the suspension of work, and no adjustment in contract time resulting from the suspension of the work shall be allowed. The Contractor shall have overall contractual responsibility for both the design and construction.
 - 2. Contractor's supervising staff engineer shall have at least 3 years of experience in the design and construction of soil nail walls.
 - 3. Contractor's foreman and drillers shall have at least 3 years of experience in the construction of soil nail walls.
 - 4. Shotcreting nozzlemen shall be ACI Certified.
 - 5. Contractor's nail testing foreman shall have soil nail testing experience on at least 5 projects.

D. Design:

1. General:

- a. At least 30 days before the planned start of the wall construction, the Contractor shall submit complete design calculations and Design Drawings to the Owner's Representative for review. Include all details, dimensions, quantities, ground profiles, and cross-sections necessary to conduct the work.
- b. Design parameters shown on the Drawings are minimum requirements, and the final design may require additional soil nails, hardware, reinforcing, shotcrete thickness, and drainage piping necessary to meet the project requirements. The Contractor's Wall Design Engineer shall provide complete construction documents, but in all cases satisfy the minimums as shown on the Drawings, including where those exceed Code minimums.
- c. Design Drawings and calculations shall be signed and sealed by the Contractor's Wall Design Engineer.
- d. The Contractor shall not begin the work until the submittal requirements have been favorably reviewed by the Owner's Representative.
- e. Contractor's Wall Design Engineer shall have a minimum experience of 5 projects of similar construction.

2. Design Calculations:

- a. A narrative describing the overall soil nail wall design.
- b. Applicable code requirements and references.
- c. Design criteria, including soil/rock shear strength parameters (friction angle and cohesion), unit weights, pullout resistances, steel resistances, and shotcrete resistance values. Any additional subsurface borings, laboratory work, or other subsurface data collected for the design shall also be included.
- d. Soil nail critical cross-sections including soil/rock strata, piezometric levels, and location, magnitude, and direction of applied loads.
- e. Values and associated LRFD load factors (or alternately ASD factors of safety) used in design for pullout resistance, surcharges, soil/rock unit weights, nail head strengths, and strengths of steel, shotcrete, and concrete materials. Global stability soil resistance/load factors (or alternately ASD factors of safety) used in verifications.
- f. Seismic design coefficient and other seismic design criteria applicable for the geographic area of the project.
- g. Design calculation sheets with the project number, structure location, designation, date of preparation, initials of designer and checker, and page number at the top of each page. Provide an index page with the design calculations.
- h. Design notes including an explanation of symbols and computer programs used in the design.
- i. Structural design calculations for wall facing(s) and nail head/facing connections including consideration of facing flexural and punching shear strength, headed stud tensile strength, upper cantilever, minimum reinforcement ratio, cover, and splice requirements.

3. Design Drawings: Design Drawings shall include all information required for the construction and quality control of the work. Design Drawings shall include, but not be limited to, the following items:

- a. A plan view of the structure(s) identifying:

- 1) A reference baseline and elevation datum.
 - 2) The offset from the construction centerline or baseline to the face of the wall at its base at all changes in horizontal alignment.
 - 3) Beginning and end of wall.
 - 4) Soil nail horizontal control locations.
 - 5) Right-of-way and permanent or temporary construction easement limits, location of all known active and abandoned existing utilities, adjacent structures or other potential interferences. The centerline of any drainage structure or drainage pipe behind, passing through, or passing under the wall.
 - 6) Subsurface exploration locations shown on a plan view of the proposed wall alignment with appropriate reference base lines to fix the locations of the explorations relative to the structure(s).
 - 7) Limit of longest nails.
- b. An elevation view of the structure(s) identifying:
- 1) The elevation at the top of the wall, at all horizontal and vertical break points, and at least every 50 ft along the wall.
 - 2) Elevations at the base of the wall.
 - 3) Soil-nail elevations, vertical and horizontal spacing, and the location of wall drainage elements and permanent facing expansion/contraction joints (if applicable) along the wall length.
 - 4) Existing and finished grade profiles both behind and in front of the wall.
- c. All necessary cross-section(s) to construct the wall.
- d. General notes for constructing the soil nails including construction sequencing or other special construction requirements.
- e. Design parameters and applicable codes.
- f. Horizontal and vertical control points.
- g. A listing of the summary of quantities on the elevation drawing of each wall showing the estimated surface area.
- h. Nail wall typical sections including staged excavation lift elevations, wall and excavation face batter, nail spacing and inclination, sizes of nail bars (also referred to as tendons), and corrosion protection details.
- i. Typical details of production and test nails defining the nail length, minimum drill hole diameter, inclination, and test nail bonded and unbonded test lengths.
- j. Details, dimensions, and schedules for all nails, reinforcing steel, wire mesh, bearing plates, headed studs, etc. and/or attachment devices for shotcrete.
- k. Dimensions and schedules of all reinforcing steel.
- l. Details and dimensions for wall appurtenances such as barriers, coping, drainage gutters, fences, etc.
- m. Details for terminating walls and adjacent slope construction.
- n. Facing finishes, color and architectural treatment requirements (if applicable) for permanent wall facing elements.
- E. Construction Submittals:
1. Construction Plan: Before starting the soil nail work, the Contractor shall submit a Construction Plan to the Owner's Representative that includes the following:
 - a. Project start date and proposed detailed wall construction sequence.

- b. Drilling and grouting methods and equipment, including the drill hole diameter proposed to achieve the specified nominal pullout resistance values and any variation of these along the wall alignment.
 - c. Field criteria for determination of casing during soil nail drilling.
 - d. Soil Nail grout mix design, including grout material certifications, type of grout mixer, grout water to cement ratio, type of cement, and type of admixtures. Provide compressive strength test results complying with ASTM C109 by a qualified independent testing laboratory verifying the grout mix design meets the required 3-day and 28-day compressive strengths.
 - e. Nail grout placement procedures and equipment.
 - f. Tendon couplers.
 - g. Temporary shotcrete materials and methods. Provide the minimum 3-day and 28-day shotcrete compressive strengths.
 - h. Methods of survey and locating excavation face, shotcrete faces, and drill holes during construction.
 - i. Soil nail testing methods and equipment setup.
 - j. Identification number and certified calibration records for each test jack, pressure gauge, dial gauge, and load cell to be used. Jack and pressure gauge shall be calibrated as a unit. Calibration records shall include the date tested, the device identification number, and the calibration test results, and shall be certified for an accuracy of at least 2 percent of the applied certification loads by a qualified independent testing laboratory within 365 calendar days prior to submittal.
 - k. Manufacturer's Certificates of Compliance for materials including: ultimate strength of the tendon, epoxy coating (where used), and encapsulation.
 - l. Equipment for drilling anchors including proposed drilling and grouting method and equipment including drilling type, use of cased or open hole method, proposed drill hole diameter, method of drill cutting removal and grouting equipment.
- 2. Verification and Proof Test Data and Graphs: Test data to include nail location, date of testing, time test began, the weather conditions, the operator of the test equipment, the other observers present, the length of the bar, the grout length, the bar yield stress, the load and displacement values for each increment.
 - 3. Monitoring Plan: At least 30 calendar days before starting the soil nail work, where the Drawings show existing structures or utilities require monitoring, the Contractor shall submit a Monitoring Plan to the Owner's Representative for review.
- F. Records:
- 1. Contractor is responsible for maintaining daily detailed records of construction. Records shall be submitted to the Owner's Representative within 7 business day after construction activities.
 - 2. As-built record drawings shall be provided to the Owner's Representative within 30 days after completion of work. As-built drawings shall include monitoring points, where required.

1.05 QUALITY ASSURANCE

- A. Construction Standard: Applicable quality requirements of the ACI 301, ACI 506.2, and FHWA GEC 7.
- B. Preconstruction Meeting:
 - 1. Owner's Representative, Contractor and subcontractors, and inspectors meet at least 2 weeks prior to start of construction.
 - 2. Meeting agenda includes:
 - a. Excavation.
 - b. Caving and casing potential.
 - c. Mix design.
 - d. Construction joint layout.
 - e. Finishes required.
 - f. Curing and protection methods.
 - g. Verification Tests
 - h. Proof Tests
 - i. Test acceptance criteria
 - j. Resolve any difficulties foreseen by any interested party

1.06 DELIVERY, STORAGE AND HANDLING

- A. Tag with suitable identification. Transport and store so material is not damaged and to avoid corrosion.
- B. Handle, ship and store material in a manner that will prevent distortion, rust, damage to coating or any other damage. Do not move or handle soil nails until encapsulation has reached sufficient strength to resist damage during handling
- C. Store material in a clean, properly drained location out of contact with the ground and covered with plastic or other approved material.
- D. Ensure that dissimilar metals are not in contact with each other.
- E. Replace or repair all damaged material in an approved manner.

PART 2 - PRODUCTS

2.01 SOIL NAILS TENDONS

- A. As noted on the Drawings.

2.02 CORROSION PROTECTION

- A. As noted on the Drawings.

2.03 NAIL GROUT

- A. As noted on the Drawings.

2.04 WALL DRAINAGE NETWORK

- A. As noted on the Drawings.

2.05 SHOTCRETE FACING

- A. As noted on the Drawings.

PART 3 - EXECUTION

3.01 SOIL EXCAVATION

- A. Wall Face Excavation:
 - 1. Excavation shall proceed in stages exposing the minimum amount of soil or rock face which will allow the practical and expeditious installation of the soil nails and construction facing system while assuring stability of the excavated face and minimizing ground movements but shall not exceed 5 feet of vertical cut.
 - 2. Use temporary stabilizing berms or other methods to prevent or minimize sloughing at the wall face due to ground conditions.

3.02 SOIL NAIL INSTALLATION AND GROUTING

- A. Construction Procedure:
 - 1. The earth retention wall is to be constructed from the top down as the soil in front of the wall is removed and the nails are installed and grouted at each level. The exposed soil face shall be retained with a construction facing consisting of mesh reinforced shotcrete. Drainage systems shall be installed prior to applying initial shotcrete.
- B. Drilling:
 - 1. Care should be taken to drill a straight and properly sized hole. Holes for soil nails shall be drilled where shown on the favorably reviewed Shop Drawings and within the tolerances specified. The diameter of the drill bit shall not be less than 1/8-inch smaller than the specified hole diameter. Install soil nails within 3 inches of the indicated position and within 3 degrees of that indicated on the Drawings.
 - 2. For anchors installed at or below the water table an installation system shall be used that is not adversely affected by the presence of water and prevents the hole from caving. In the event a hole caves, the hole shall be consolidation grouted and redrilled. The use of self-drilling soil nail bars will not be allowed.
 - 3. The Contractor shall be responsible for selecting the drill hole diameter provided it meets the minimum diameter shown on the Drawings, and favorably reviewed drill methods and installation methods.
- C. Soil Nail Insertion:
 - 1. The anchors shall be placed in accordance with the manufacturer's recommendations. Soil nails shall be completely inserted in the drilled hole. The Contractor shall remove any nails that cannot be fully placed in the drilled holes and either clean or re-drill the hole. Do not drive or force soil nails into the drilled holes.
 - 2. Centralizers shall be used for the full length of the anchor in accordance with the manufacturer's recommendations, but centralizers shall be positively attached to the anchors at no less than as shown on the Drawings.
 - 3. Care shall be taken not to damage the corrosion protection and/or centralizers during installation of the anchor.

4. The anchorage assembly shall be installed properly aligned with the anchor axis.
- D. Anchor Grouting:
1. Grouting operations shall be in accordance with the FHWA CEG 7.
 2. Prior to installing each nail into the hole, the nail shall be clean and free of oil, grease or extraneous substances.
 3. After the nail holes have been drilled, the grout shall be injected from the lowest point of the nail. The grout is placed after insertion of the nails into the hole. Grout shall be placed on an incline or bed by injecting the grout with grout tubes.
 4. The Contractor shall take care to withdraw the outlet end delivering the grout below the grout surface to prevent the creation of voids.
 5. Contractor shall grout holes promptly after drilling but no more than 2 hours after drilling. All holes shall be completely grouted the same day as drilled and in a continuous operation. The Contractor shall not leave any hole ungrouted overnight. Cold joints in the grout are not allowed except at the top of the test bond length of proof tested production soil nails.
 6. Grout volumes shall be measured and recorded for each individual nail.
 7. The space above the bottom elevation of the inclined drill hole opening shall be filled with additional grout. A temporary cover may be used as a grout dam.
 8. After grouting, the anchor shall remain undisturbed until the grout has reached 1,500 psi or 72 hours, whichever occurs later.

3.03 DRAINAGE

- A. Placement of all drain strips, piping, and drainage components shall be complete prior to placing initial shotcrete (except the wall footing drain).
- B. During shotcrete placement, the outlet drain pipe must be adequately covered to prevent penetration of shotcrete into the system.
- C. Complete drainage continuity shall be ensured by the Contractor during all phases of construction.

3.04 REINFORCING

- A. Placement of all reinforcing shall be complete prior to placing shotcrete.

3.05 SHOTCRETE

- A. Preconstruction test panels are required per ACI 506.2, and may be shot offsite prior to project mobilization, provided that the methods and materials are substantially similar to those used for this project.
- B. Initial Shotcrete: Initial shotcrete placement shall meet ACI 506.2 requirements and the Drawings.
- C. Final Face Shotcrete: Final face shotcrete placement shall meet ACI 506.2 requirements and the Drawings.

3.06 GENERAL SOIL NAIL TESTING REQUIREMENTS

- A. Perform verification and proof testing of soil nails as specified herein and shown on the Drawings. Provide qualified personnel and equipment, as required by these

specifications, to set-up and operate the soil nail test equipment, and to test shotcrete.

- B. The soil nail wall verification, proof and production testing shall be performed with the same equipment, drill method, drill hole diameter, inclination, grout mix design and grouting procedure as used for the production soil nails.
- C. The minimum unbonded length for verification test nails shall be 10 feet and the bonded length of the soil nail shall be as shown on the Drawings. Provide the required unbonded length necessary to entirely embed the soil nail into the soil type to be tested.
- D. The Maximum Allowed Test Load shall be 80 percent of the soil nail ultimate strength.
- E. Verification test shall not be performed until at least the third day after grout placement and results of the 3-day grout compressive strength test results confirming the minimum required strength has been reached.
- F. Proof testing of soil nails shall not be performed until the soil nail grout and shotcrete facing have cured for at least 72 hours and achieved their specified 3-day design strength.
- G. Provide an oversized bearing plate or other load apparatus as required to distribute the test load to avoid damage to the shotcrete facing. The Contractor is solely responsible for determining the size of all components related to soil nail testing, including bearing area needed to protect the shotcrete facing.
- H. Test equipment shall include two dial gauges, free-standing dial gauge support, calibrated jack and pressure gauge and reaction frame. The pressure gauge shall be graduated in 50-psi increments or less and matched to the calibrated jack side such that the test load is at least 50 percent of the maximum pressure gauge level to allow for accurate reading of the pressure at each test increment. Measure the soil nail head movement with the two dial gauges capable of measuring 0.001-inch increments. Dial gauges shall be tripod mounted and independently freestanding of the soil nail wall system.

3.07 VERIFICATION TEST REQUIREMENTS

- A. Provide and install verification soil nails and perform testing where noted on Drawings to verify the required nail pullout resistance and drilling and installation methods. Verification soil nail testing will be sacrificial and will not be incorporated as production soil nails.
- B. Owner's Representative will verify test locations to confirm that verification tests will be performed in each different anticipated soil type or the presence of groundwater. Verification test soil nails shall be assumed to be drilled to the same length of production nails located in the same level.
- C. The bonded length for the verification test soil nails and the Verification Test Load (VTL) shall be as indicated on the Drawings but shall not be less than 10 feet.
- D. Perform verification testing by incrementally loading the verification test soil nail to failure or until the maximum allowable test load is reached in accordance with loading schedule Table 1 below. Record the soil nail movement at each load increment.

- E. The Alignment Load (AL) is the minimum load required to align the testing apparatus but shall not exceed two and a half percent (2.5%) of the VTL. Reset the dial gage to zero "0" after reaching the alignment load.
- F. Hold each load increment as noted while maintaining all load increments within two percent (5%) of the intended load. Repump jack as necessary to maintain load during hold time.
- G. Monitor the verification test soil nail for creep at the load listed and measuring the nail movement at the intervals listed in Table 1. Measure and record soil nail movements at the increments shown below.

Table 1 – Verification Test Load Schedule (Sacrificial Nails)

Load	Hold Time	Record Nail Movement
Alignment Load (2.5% VTL)	1 minute	-
0.13 VTL	10 minutes	1, 2, 5, 10 minutes
0.25 VTL	10 minutes	1, 2, 5, 10 minutes
0.38 VTL	10 minutes	1, 2, 5, 10 minutes
0.50 VTL	10 minutes	1, 2, 5, 10 minutes
0.63 VTL	10 minutes	1, 2, 5, 10 minutes
0.75 VTL (Creep Test)	60 minutes	1, 2, 5, 10, 20, 30, 50, 60 minutes
0.88 VTL	10 minutes	-
1.00 VTL (Creep Test)	60 minutes	1, 2, 5, 10, 20, 30, 50, 60 minutes
Alignment Load	1 minute	Record permanent nail movement

3.08 PROOF TEST REQUIREMENTS

- A. Perform proof test on ten percent (5%) of production soil nails and additional one per soil nail row, as selected by the Owner's Representative. Proof tests shall be evenly spaced vertically and horizontally, or as indicated on the drawings. Provide at least one proof test per nail installation shift.
- B. Owner's Representative will verify test locations to confirm that proof tests will be performed in each different anticipated soil type or the presence of groundwater.
- C. Production proof test nails shall have temporary bonded and unbonded lengths during testing. The temporary unbonded length of the test nail shall be at least 5 feet. The bonded length of the soil nail during proof production tests shall be as shown on the Drawings, but shall not exceed 10 feet. Proof test nails shall be fully grouted after testing.
- D. Perform proof tests by incrementally loading the proof test in accordance with the loading schedule Table 2 below. Record the soil nail movement at each load increment.
- E. The Alignment Load (AL) is the minimum load required to align the testing apparatus but shall not exceed two and a half percent (2.5%) of the PTL. Reset the dial gage to zero "0" after reaching the alignment load.

- F. Hold each load increment as noted while maintaining all load increments within five percent (5%) of the intended load. Repumping the jack as necessary to maintain the load.
- G. Monitor the proof test soil nail for creep at 100 percent the PTL load increment. Measure and record soil nail movements at intervals shown in Table 2.
- H. Where the nail movement between 1 minute and 10 minutes exceeds 0.04 inches, maintain the maximum test load for an additional 50 minutes and record movements at 20, 30, 50, and 60 minutes.

Table 2 – Proof Test Load Schedule (Production Nails)

Load	Hold Time	Record Nail Movement
Alignment Load	1 Minute	-
0.17 PTL	Until Movement Stabilizes	-
0.33 PTL	Until Movement Stabilizes	-
0.50 PTL	Until Movement Stabilizes	-
0.83 PTL	Until Movement Stabilizes	-
1.00 PTL	10 minutes	1, 2, 3, 5, 6, and 10 minutes
Alignment Load	1 minute	-

- I. Contractor shall not continue to next row or provide final shotcrete cover over soil nails until Owner's Representative has provided acceptance of proof test for all soil nails tested above the next scheduled row.

3.09 SOIL NAIL TEST ACCEPTANCE CRITERIA

- A. A soil nail test is acceptable if the following criteria are met:
 - 1. For verification tests, the total creep movement is less than 0.08-inch and between 6-minute and 60-minute readings and the creep rate is linear or decreasing throughout the creep test load hold period.
 - 2. For proof tests, the total creep movement is less than 0.04-inch during the 10 minute readings OR is less than 0.08-inch during the 60-minute readings and the creep rate is linear or decreasing throughout the creep test load hold period.
 - 3. The total measured movement at the maximum test load exceeds 80 percent of the theoretical elastic elongation of the test soil nail unbonded length.
 - 4. A pullout failure does not occur at 1.0 times the VTL for verification test, or 1.0 times the PTL for proof test. Pullout failure is defined as the inability to further increase the test load while there is continued pullout movement of the test soil nail. Record the pullout failure load part of the test data.
- B. Acceptance of a soil nail test is at the sole discretion of the Owner.
- C. Installation methods that do not satisfy the soil nail testing requirements will be rejected. The Contractor will be responsible for reperforming any and all portions of the testing at no additional cost to the Owner until satisfactorily obtaining results.

- D. Maintaining stability of the temporary unbonded test length for subsequent grouting is the Contractor's responsibility. If the unbonded test length of production proof test nails cannot be satisfactorily grouted subsequent to testing; the proof test nail shall become sacrificial and shall be replaced with an additional production nail installed at no additional cost to the Owner.

3.10 TEST NAIL REJECTION

- A. If a test nail does not satisfy the acceptance criterion:
 - 1. For verification test nails, the Owner's Representative will evaluate the results of each verification test. Installation methods that do not satisfy the nail testing requirements shall be rejected. The Contractor shall propose alternative methods and install replacement verification test nails. Replacement test nails shall be installed and tested at no additional cost.
 - 2. For proof test nails, the Owner's Representative may require the Contractor to replace some or all of the installed production nails between a failed proof test nail and the adjacent passing proof test nail. Alternatively, the Owner's Representative may require the installation and testing of additional proof test nails to verify that adjacent previously installed production nails have sufficient load carrying capacity. Installation and testing of additional test nails or installation of additional or modified nails as a result of proof test nail failure(s) shall be at no additional cost to the Owner.

3.11 FIELD QUALITY CONTROL

- A. Perform drilling, installation, grouting and testing in the presence of the Owner's Representative. Notify the Owner's Representative at least two weeks prior to the beginning of drilling.
- B. Confirm soil nails are ready for special inspection. Owner's Representative will perform special inspection for soil nail wall installation in accordance with CBC Chapter 17 and FHWA GEC 7.
- C. Notify the Owner's Representative if the drilling orientation exceeds the vertical and horizontal tolerances for any hole.
- D. Confirm centralizer layout based on the favorably reviewed shop drawings.
- E. Record and submit the soil nail installation to the Owner's Representative, including but not limited to:
 - 1. Driller's log
 - 2. Grouting and grout volumes at each anchor
 - 3. Installations out of tolerance
 - 4. Testing raw data
- F. Test soil nail grout in accordance with ASTM C109. Test one set of samples at 3 days and 28 days for every 50 cubic yards of grout placed, for every mix design used. Provide grout test results to the Owner's Representative within one (1) business day of test.
- G. Prior to soil nail testing, confirm hydraulic jack and pressure gauge match submitted and favorably reviewed calibration sheets. Verify that measurement devices are in accordance with favorably reviewed submittals.
- H. Inspect all ground support on a daily basis.

END OF SECTION

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SECTION 02510

WATER SYSTEM PIPING AND ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Furnish and install all piping, including fittings, valves, and accessories as shown on the Drawings, described in the Specifications, and as required to completely interconnect all piping for a complete and operable systems.

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO)
- B. American National Standards Institute (ANSI)
- C. American Society of Mechanical Engineers (ASME)
- D. ASTM International (ASTM)
- E. American Water Works Association (AWWA)
- F. NSF/ANSI Standard 61 Drinking Water System Components (NSF 61)

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Shop Drawings:
 - 1. Layouts and schematics: Submit detailed installation drawings of all piping and connected equipment. The drawings shall include each pipe, all fittings, valves, and other appurtenances (Product Review submittal).
 - 2. Submit data to show that the following items conform to the Specification requirements:
 - a. Pipe, fittings, and accessories.
 - b. Flexible couplings and flanged coupling adapters.
 - c. Restrained joints.
 - d. Valves.
 - e. Air release valves.
 - f. Pressure relief valves.
 - g. Pressure reducing and altitude valves.
 - h. Fire hydrants.
 - i. Water meters.
 - 3. Submit certified test reports as required herein and by the referenced standard specifications.
 - 4. Disinfection Plan in accordance with Section 11003.
 - 5. All items that are submitted for use on water pipelines including, but not limited to, piping and valve linings, solvent cements, welding materials, gaskets and gasket lubricants, and additives in concrete or cement mortar shall (in accordance with Section 64591 of the California Water Works Standards) be NSF certified for use in water systems. Submit proof of NSF 61 certification for each item submitted.

- C. Manuals: The Contractor shall furnish manufacturer's installation and operation manuals, bulletins, and spare parts lists for the following items:
 - 1. All valves over 4-inch size.
 - 2. Air release valves.
 - 3. Pressure relief valves.
 - 4. Pressure reducing and altitude valves.
 - 5. Water meters.
- D. Affidavits: Submit affidavits from the manufacturer of the following valves and meters:
 - 1. Butterfly valves.
 - 2. Gate valves.
 - 3. Air release valves.
 - 4. Pressure relief valves.
 - 5. Pressure reducing and altitude valves.
 - 6. Water meters.
- E. The preceding submittals shall be in the Product Information Category except where noted.

1.04 QUALITY ASSURANCE

- A. Materials and equipment under this Section shall be furnished by manufacturers regularly engaged in the design and manufacture of the materials and equipment for a period of at least 5 years.
- B. Pipe installed under this contract may be inspected for compliance by the Engineer, Owner and/or an independent testing laboratory selected by the Owner.
 - 1. Pipe rejected by the Engineer or Owner shall be immediately removed from the job site.
- C. Acceptance of materials shall be subject to strength and quality testing in addition to inspection of the completed product. Acceptance of installed piping systems shall be based on inspection and leakage tests as specified hereinafter.
- D. Factory Quality Control: The Contractor shall test all products as required herein and by the reference specifications.
- E. Field Quality Control
 - 1. The Owner will:
 - a. Inspect pipe fabrication and witness any test
 - b. Inspect field welds and test the welds if it is deemed necessary
 - 2. The Contractor shall:
 - a. Perform leakage tests
 - b. Be responsible for the costs of additional inspection and retesting by the Owner resulting from noncompliance.

1.05 POTHOLING

- A. Do not prepare any shop drawings for, or make final order for, or design any pipe materials for any particular section of pipeline until all utilities in that section of pipeline have been exposed, as specified in paragraph Section 02301 and until such time as no interferences are found between said existing utilities and the proposed pipeline alignment. If interferences are found in any particular section of pipeline, do not prepare any shop drawings for, or make final order for, or design

any pipe materials for that particular section of pipeline until the pipeline alignment has been modified by the Engineer to eliminate all such interferences.

1.06 CONSTRUCTION SCHEDULING/SEQUENCING

- A. Construction under this Contract involves expansion and/or modification of the existing water system which must continue to provide service to all buildings during construction.
- B. Connections and utilities changes must be programmed to provide the least possible interruptions of service. Prior to any shutdown, all materials, fittings, supports, equipment and tools shall be on the site and all necessary labor scheduled prior to starting any connection work. The Contractor shall notify the Engineer in writing at least 7 days in advance of any required shutdowns so that affected customers may be notified. In general, shutdowns shall not exceed four hours in duration unless specifically authorized or indicated in the suggested construction sequence. If a shutdown of more than four hours is required, the Contractor shall first install temporary water service connections to all affected houses and other buildings. All temporary piping shall be disinfected in accordance with Section 11003 before being put into service.
- C. All work under this Contract shall be conducted in a manner which will minimize shutdowns, open roadways, or traffic obstructions caused by the construction. Shutdowns causing damage to adjacent public and private property shall not be permitted, and any damage resulting shall be the sole responsibility of the Contractor.
- D. Planned utility service shutdowns shall be accomplished during periods of minimum use. In some cases this will require night or weekend work, which shall be at no additional cost to the Owner. The Contractor shall program his work so that service will be restored in the minimum possible time, and shall cooperate with the Owner in reducing shutdowns of the utility system to a minimum. No utility interruption will be permitted without the prior approval of the Engineer.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Pipe and valve sizes are nominal inside diameter unless otherwise noted.
- B. All materials delivered to the job site shall be new, free from defects, and marked to identify the material, class, and other appropriate data such as thickness for piping.
- C. Acceptance of materials shall be subject to strength and quality testing in addition to inspection of the completed product. Acceptance of installed piping systems shall be based on inspection and leakage and bacteriological tests as specified hereinafter.

2.02 GENERAL MATERIAL REQUIREMENTS

- A. Gaskets:
 - 1. Water systems shall be SBR, NSF 61 certified.
 - 2. Stormwater systems shall be SBR.

- B. Bolts and Tie Rods: Unless specified otherwise herein, flange bolts and nuts, coupling bolts and nuts, tie rods and other hardware shall be as follows:
 - 1. Exposed: Electroplated zinc or cadmium steel.
 - 2. Concrete Encased: Steel
 - 3. Buried: Type 304 stainless steel, minimum tensile strength: 60,000 psi.
 - 4. Apply an anti-gauling compound to the threads of stainless steel bolts.

2.03 PIPING MATERIALS

- A. Pipe Designation: Piping materials for miscellaneous small piping are designated on the Drawings. New water transmission mains shall be the ductile-iron pipe system.
- B. Pipe Systems: Each designation identifies not only the pipe itself, but the entire system as well as including the associated fittings, appurtenances, and installation and test procedures.
- C. Ductile-Iron (DI), Mechanical Joint:
 - 1. Pipe: Ductile-iron, pressure Class 350, AWWA C151.
 - 2. Joints: Restrain all joints. Mechanical Joint, AWWA C111 as modified, except where flanged joints are shown on the Drawings or where making connections to valves.
 - a. Restrained joints: Provide restrained joints capable of deflection after the restraint is installed. For mechanical joints use Megalug Restraints by EBAA Iron, or equal.
 - 3. Fittings: Ductile-iron push-on or mechanical joints, AWWA C110 or AWWA C153.
 - 4. Lining:
 - a. Cement mortar: Pipe furnished shall have standard thickness cement mortar lining in accordance with AWWA C104 and C602. Seal coat cement mortar lining.
 - 5. Coating:
 - a. Buried piping: Asphalt coated in accordance with AWWA C110, C115, C151, C153, approximately 1-mil thick.
 - b. Exposed or submerged piping: Refer to Section 09960. Ship bare or with a factory primed compatible with selected field paint system.
 - c. Exterior of buried pipe shall be coated with a layer of arc-sprayed zinc conforming to ISO 8179-1 "Ductile iron pipes, fittings, accessories and their joints – External zinc-based coating-Part 1 Metallic zinc with finishing layer". The mass of applied zinc shall be 200 grams/square meter of pipe surface area. A finishing layer topcoat shall be applied over the zinc. Pipe marking shall clearly indicate that a zinc coating layer has been provided.
 - 6. Pipe taps:
 - a. Direct threaded taps are not acceptable.
 - b. Pipe branch line connections shall be made using service saddles, by using reducing flanges on tees, or by tapping blind flanges on tees.
 - c. Saddle Tapping
 - 1) Saddle tapping shall be used for service connections up to 2 inches in diameter. Service saddles shall:
 - a) Be designed and sized for piping material to be used with.
 - b) Provide full support around the circumference of the pipe

- 2) Be one stainless steel strap
 - 3) Have threads that match the threads of the corp stop being used
 - 4) Acceptable Manufacturers:
 - a) Smith-Blair; equivalent by Mueller; Ford; Rockwell or equal.
- D. Ductile Iron (DI), Flanged:
1. Pipe: AWWA C115, minimum thickness Class 53.
 2. Flanges: Ductile iron, plain faced, AWWA C115.
 - a. Provide insulating flanges with two cathodic test stations for buried ductile iron to steel connections.
 3. Fittings:
 - a. Flanged: Ductile iron, AWWA C110 or AWWA C153.
 4. Lining:
 - a. Cement mortar: Pipe furnished shall have standard thickness cement mortar lining in accordance with AWWA C104 and C602. Seal coat cement mortar lining.
 5. Coating:
 - a. Buried pipe shall receive asphalt coating per AWWA C115.
 - b. Exposed or submerged pipe requiring protective coating per Section 09960 shall be shipped bare or shall be factory primed compatible with selected field paint system.
 - c. Exterior of buried pipe shall be coated with a layer of arc-sprayed zinc conforming to ISO 8179-1 "Ductile iron pipes, fittings, accessories and their joints – External zinc-based coating-Part 1 Metallic zinc with finishing layer". The mass of applied zinc shall be 200 grams/square meter of pipe surface area. A finishing layer topcoat shall be applied over the zinc. Pipe marking shall clearly indicate that a zinc coating layer has been provided.
 6. Flange Gaskets: Full face, 1/8 inch-thick SBR rubber, AWWA C115, Appendix A.
 7. Flange Bolts: AWWA C115, Appendix A unless stainless steel is required in paragraph 2.02.
 8. Pipe Taps:
 - a. Threaded metal pipe branch lines up to 1 inch in diameter from ductile iron pipe may be made with direct threaded taps, provided the ductile iron wall thickness is in excess of the minimum shown in Tables A.1 and A.2 of AWWA C151 for four full threads. Bosses may be used at the taps to provide the required pipe wall thickness. Service saddles or reducing flanges on tees shall also be permitted.
- E. Copper Pipe:
1. Pipe: Copper, ASTM B88
 - a. Buried: Type K (soft drawn).
 - b. Exposed: Type L (hard drawn).
 2. Joints:
 - a. Buried: Compressed.
 - b. Exposed: Soldered.
 3. Solder: ASTM B32, Alloy Sn94, Sn95 or Sn96. Solder and flux shall contain less than 0.2% lead.
 4. Fittings:

- a. Soldered: Wrought copper, ASTM B73 for materials and ANSI B16.22 for dimensions; or cast bronze, ASTM B62 for materials and ANSI B16.18 for dimensions.
- b. Flared: AWWA C800 and ANSI B16.26.

2.04 PIPE COUPLINGS

- A. General: For typical pipe joints refer to pipe material specifications. Other joint devices shall be furnished where called for as specified below.
- B. Flexible Couplings and Flange Coupling Adaptors:
 - 1. Sleeve: Cast-iron or fabricated steel.
 - 2. Followers: Cast-iron, ductile-iron, or steel.
 - 3. Sleeve bolts: ASTM A325, Type 3; malleable iron; or equivalent, except for buried and submerged, which shall be Type 304 stainless steel or Type 316 stainless steel, respectively.
 - 4. Coating: Fusion epoxy or high build epoxy line and coat sleeve and followers.
 - 5. Pressure rating: The test pressure of the applicable service or 50 psi, whichever is greater.
 - 6. Performance: Longitudinal movement and angular deflection capabilities shall meet AWWA C-219.
 - 7. Flanged Coupling Adaptor Flanges: Match mating flanges. If required by connecting valve or other device, provide flanges with inside diameter equal to nominal pipe diameter.
 - 8. Manufacturers:
 - a. Flexible couplings: Smith-Blair 411 or 431, Dresser Style 38 or 138 or equal.
 - b. Flange coupling adaptors:
 - 1) Connecting new pipe or new pipe to existing non-ferrous pipe: Smith-Blair 912 or 913, Dresser Style 128-W, or equal.
 - 2) Connecting new pipe to existing ferrous pipe: Insulating flange coupling adaptor with insulating boot: Smith-Blair 932 or 933, or equal.
 - c. Restrained Couplings: Smith-Blair 471; Romac 'Alpha' series (12-inch and smaller), Romac 400 RG (14-inch and larger); or equal
 - d. Restrained Flange Coupling Adaptors: Smith-Blair 'Flange-Lock' 920; Romac RFCA; or equal
 - 9. Gaskets: SBR rubber.
 - 10. Joint restraint: Provide joint harnesses (tie rod lug or attachment plate assemblies) across flexible couplings and flange coupling adaptors where indicated on the Drawings. For flanged coupling adaptors, anchor studs may be substituted for the harnesses on pipe up to 12-inch. Design restraint in accordance with AWWA M-11 for 250 psi if size of the rods is not indicated on the Drawings.
 - 11. Protection for buried connectors and adaptors:
 - a. Double-wrap with polyethylene encasement, AWWA C105 and tape the edges of the encasement with PVC tape.
 - 12. Bonding: Bond all flexible couplings and flange coupling adaptors unless insulated couplings are required.
- C. Dismantling Joint:

1. General: The Dismantling Joint shall be a self-contained flanged restrained joint fitting, including both flanged components and sufficient harness bars to withstand the imposed thrust complying with AWWA C219 where applicable. The Dismantling Joint shall be furnished as a complete assembly consisting of spigot piece, flange adapter, tie bars, and gasket. The gasket seal and compression stud and nut arrangement shall be separate and independent of the tie bar restraint system.
 2. Performance: No less than 5 inches of longitudinal adjustment and installed with 4 inches of inward adjustment and 1 inch of expansion.
 3. Pressure Rating: 150 psi.
 4. Spigot Piece and Flange Adapter: Steel ASTM A53 or ductile iron ASTM A536, grade 65-45-12.
 5. Exterior Fasteners: All exterior fasteners including the bars shall be 316 stainless steel. The bar diameter shall be equal to the corresponding bolt diameter of the mating flange.
 6. Flanges: AWWA C207 Class D.
 7. Coating: Coated inside and out with a fusion bonded epoxy coating applied to a DFT thickness of 5 to 10 mils. The epoxy shall comply with the requirements of AWWA C550 and AWWA C213. Stainless steel fasteners and tie bars shall not be painted.
 8. Flanged gaskets shall be full faced gaskets SBR, 1/8 inch thick.
 9. Wedge gaskets shall be EPDM Grade 199, Buna-S or Buna-N.
 10. Manufacturer: The dismantling joint shall be Style 131 as manufactured by Dresser Industries/SVE or equivalent by Romac; or equal.
- D. Flexible Rubber Spools:
1. Type: Built-up, single arch (unless otherwise shown on Drawings) rubber expansion joints with full rubber flanges and retainer rings.
 2. Materials: EPDM cover over EPDM tube, reinforced with nylon or polyester body and galvanized steel retainer rings, NSF 61 certified .
 3. Pressure Rating: 190 psi.
 4. Manufacturers:
 - a. Standard: Proco Series 230; Holz Type 200; Garlock Style 200HP; or equal.
 - b. Concentric Reducers: Proco RC Series; Holz 200TC.
 - c. Eccentric Reducers: Proco RE Series; Holz 200TE.
- E. Flexible Expansion Joints:
1. Type: Double ball joints with integral expansion sleeves. Minimum 30 degrees deflection and 12 inches expansion.
 2. Materials: Ductile-iron conforming to AWWA C153.
 3. Pressure rating: 350 psi minimum.
 4. Lining: Fusion epoxy.
 5. Connections: Flanges.
 6. Manufacturer: EBBA Iron Flex-Tend; or equal.

2.05 VALVES AND ACCESSORIES

- A. General Requirements for Valves:
1. All valves of each type shall be the product of one manufacturer.

2. All valves shall be furnished with control assembly, operators, handwheels, levers, or other suitable type wrench including handles as specified herein or as shown on the Drawings.
 3. All threaded stem valves shall open by turning the valve stem counter-clockwise.
 4. The exterior of all valves and valve operators shall be painted with two coats of Tape Coat Mastic; Protecto Wrap CA1180 Mastic; or equal, except where otherwise indicated.
- B. Valves and Accessories:
1. Butterfly valves:
 - a. Rating: 150 psi water. Leaktight in both directions.
 - b. Type: Flanged body, or as shown on the Drawings, AWWA C504, geared operator, resilient seated, 90 degree seating.
 - c. Connections: Flange as shown on the Drawings.
 - d. Materials: Cast-iron body, ASTM A126, Class B, or ASTM A48, Class 40; cast-iron or ductile-iron disc with Ni-Chrome or Type 316 stainless steel edge; Type 304 stainless steel shaft; disc shall be secured to shaft with Type 304 stainless steel taper pins.
 - e. Operator: Traveling-nut type, 2-inch standard AWWA nut, designed for buried service, watertight to 10 psi with extension stem as detailed on the Drawings and with a ground level position indicator. Provide three valve operator tee handles to the Owner.
 - f. Valve seat: Buna-N seat shall be applied to the valve body. Cartridge type seats with retaining rings are not acceptable.
 - g. Bearings: Self-lubricating and corrosion resistant.
 - h. Internal diameter of valve at the throat shall be no less than the nominal diameter of the valve less 1-½ inches.
 - i. Finish: Internal, shop line with two-component high-solids epoxy in accordance with AWWA C550; external, factory applied high-solids epoxy, 12 mils minimum thickness.
 - j. Testing: Test in accordance with AWWA C504, except that leakage test shall be in both directions.
 - k. Manufacturers: Pratt Groundhog, equivalent by DeZurik, or equal.
 - l. See section 15135 for motorized electric actuators, where motorized butterfly valves are identified on the Drawings.
 2. Gate Valves:
 - a. Rating: 200 psi water
 - b. Type: Cast Iron body, Resilient seated, non-rising stem, AWWA C509, as modified herein
 - c. Stem seal: O-ring
 - d. Finish: Fusion epoxy
 - e. Actuator:
 - 1) Buried: 2-inch square nut
 - 2) Abovegrade (Indoor): Handwheel
 - f. Connection: Flanged, or as shown on the Drawings.
 - g. Manufacturers: American Darling CRS-80; equivalent by Kennedy; or equal.
 3. Air release valves:
 - a. Standard: AWWA C512, except as modified herein.

- b. Air Release Valves (ARVs):
 - 1) Function: Releases accumulated air under pressure at pipeline high points.
 - 2) Materials: Cast or ductile iron body; stainless steel float.
 - 3) Pressure Rating: 150 psi.
 - 4) Manufacturers: Apco Series 200; equivalent by Valmatic; or equal.
- c. Combination air release valves,
 - 1) APCO Model 145C, equivalent by ValMatic, or equal.
 - 2) Materials: Cast-iron body, Buna-N seat, and stainless steel float.
 - 3) Operating pressure: Under 150 psi
- 4. Swing Check Valves, 2-inch through 12-inch
 - a. Rating: 200 psi working pressure, 400 psi shell test pressure
 - b. Type: Swing, metal seats, plain configuration, no outside lever, AWWA C508
 - c. Connections: Flanged, 125-pound ANSI
 - d. Materials: Cast iron, bronze trim.
 - e. Manufacturers: M & H Style 59; equivalent by Clow; or equal.
- 5. Silent check valves, 3-inch and larger:
 - a. Rating: 200 psi through 12-inch
 - b. Headloss: Not more than 2.5 ft. at 8 ft./sec. velocity.
 - c. Type: Straight, globe-style, configuration; Center guided plug with spring operated shut-off.
 - d. Connections: Flanged, 125-pound ANSI. If connecting flanges are not full-face metal flanges, provide intermediate flanges where required to retain valve seat.
 - e. Materials: Cast iron, bronze trim, stainless steel spring.
 - f. Manufacturers: APCO Series 600; Valmatic 1800 Series; or equal.
- 6. Valve boxes, adjustable screw type:
 - a. Materials: Cast-iron, top and center sections and base and cover.
- 7. Globe-Style, Automatic Altitude Control Valve (one-way tank fill)
 - a. Altitude Valve (one-way tank fill):
 - 1) General: Control valves shall consist of a main valve of globe configuration with hydraulically controlled, diaphragm-actuated stem assembly. Hydraulic control assemblies shall be as described in succeeding paragraphs.
 - 2) Main Valve Construction: Ductile iron body and cover, 175 psi rated, with NSF-61 fusion epoxy lining, bronze trim, stainless steel stem, nut and spring, Buna-N diaphragm and seat disc. Provide valve in globe (straight-thru) configuration with 125-pound flange connections.
 - 3) Control: Hydraulic Altitude Pilot - A hydraulic pilot shall be provided to operate on the differential force between two spring loads and the water level in the reservoir. When the reservoir head exceeds the pressure of the primary spring, the pilot system shall force the main valve to close.
 - 4) Accessories:
 - a) Check Feature: Provide accessory piping at downstream tap of main valve to piping connection at diaphragm with an in-line swing check valve to prevent reverse flow through the main valve.

- b) Limit Switch: Provide electronic limit switch assemblies on main valve for indication that valve has reached 'full-open' OR 'full-closed' position.
 - c) Opening/Closing Speed Controls: Provide adjustable needle valves on pilot piping between the upstream and downstream taps of the main valve to the piping connections at the diaphragm at all installations.
 - d) Strainers: Provide bronze Y-strainer with stainless steel screen on pilot piping between the upstream tap of the main valve to the piping connection at the diaphragm.
- 5) Manufacturers: Cla-Val 210-01; (globe configuration); Watts; Singer; or equal.

2.06 SERVICE CONNECTIONS

- A. General: All corporation stops, service clamps or saddles, and service connection accessories shall be the product of one (1) manufacturer.
- B. Corporation Stops:
 - 1. Rating: 100 psi water
 - 2. Type: Thread inlet; compression connection outlet
 - 3. Manufacturer: Mueller Co. Model 110; equivalent by Ford; or equal.
- C. Meter Boxes:
 - 1. Type: Plastic structural foam box with plastic locking cover having a hinged plastic reader lid and a metal base plate.
 - 2. Manufacturer: Mueller Co., H-1310 and H-1312; equivalent by Clow; or equal.
- D. Service Saddles:
 - 1. Materials: Ductile iron saddle with electro-galvanized straps and hardware for aboveground and bronze or 304 stainless steel for buried, and nitrile or neoprene gaskets.
 - 2. Type: For ductile iron pipe 4 inches and less, single strap saddles may be used. For pipe greater than 4 inch, double strap saddles shall be used.
 - 3. Manufacturers: Smith-Blair; equivalent by Mueller; or equal.

2.07 APPURTENANCES

- A. Provide all necessary assembly bolts, washers and nuts, thrust blocks, supports, gaskets, flanges, and all other appurtenant items shown on the Drawings, specified or required for the proper installation and operation of the piping, and devices included in or on the piping, equipment, and piping accessories.

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

- A. General Handling and Placing:
 - 1. Exercise great care to prevent injury to or scoring of the pipe lining and coating, as applicable, during handling, transportation or storage. Handle fusion epoxy coated pipe in accordance with AWWA C213. Pipe shall not be stored on rough ground and rolling of the pipe on the coating will not be

- permitted. Repair any damaged pipe sections, specials, or fittings or replace at the direction of the Engineer.
2. Inspect each pipe, fitting, valve and accessory carefully before installation. Inspect the interior and exterior protective coatings and patch all damaged areas in the field or replaced at the direction of the Engineer.
 3. Place or erect all piping to accurate line and grade and backfill, support, hang, or brace against movement as specified or shown on the Drawings, or as required for proper installation. Remove all dirt and foreign matter from the pipe interior prior to installation and thoroughly clean all joints before joining.
 4. Use reducing fittings where any change in pipe size occurs. Bushings shall not be used, unless specifically noted on the Drawings. Use eccentric reducing fittings wherever necessary to provide free drainage of lines.
 5. Connections between ferrous and non-ferrous piping and accessories shall be made using a dielectric coupling, union, or flange.
- B. General Buried Piping Installation:
1. Trenching, bedding, and backfill for buried piping shall be as shown on the Drawings and as specified in Section 02301.
 2. Where no grade elevations are shown on the Drawings, buried piping shall have at least 3 feet of cover. Where pipe grade elevations are shown on the Drawings, install the pipe with straight grades between the indicated elevations.
 3. Provide each pipe with a firm, uniform bearing for its full length in the trench except at field joints. Do not lay pipe in water or when trench conditions or weather are unsuitable for such work.
 4. Protect buried piping against thrust by use of restrained pipe joints, or thrust blocks if shown on the Drawings. Securely brace all exposed free pipe ends. Cap or plug pipe ends that are left for future connections as shown on the Drawings and in a manner favorably reviewed by the Engineer.
 5. Do not pull bell and spigot, gasketed joints more than 75% of the maximum deflection permitted by the pipe manufacturer.
 6. Where piping leaves a structure or concrete encasement, provide a joint capable of angular deflection within 12 inches of the structure for pipes 12-inch and smaller or as shown on the Drawings for larger pipe sizes. Conform to details on the Drawings where such details are shown.
 7. Coat bolts on buried flanges or other buried appurtenances in accordance with Section 09960. Wrap the appurtenance with polyethylene encasement and tape the encasement tightly closed to the pipe.
 8. Field closure connections for restrained joints: Pipe cut in the field where necessary and when favorably reviewed by the Engineer shall be connected by one of the following methods:
- C. Water Main Installation:
1. The Contractor is advised that precautions taken to keep the pipeline clean during construction will facilitate achieving the disinfection requirements of this project with a minimum of effort and expense. Compliance with these suggested minimum procedures will not relieve the Contractor of the disinfection requirements.
 2. Prior to installation, thoroughly clean the interior of each length of pipe and each fitting or valve and inspect to ensure that no foreign material remains. Cover both ends with plastic and do not uncover them until just prior to completing the joint.

3. Whenever pipe laying is discontinued for short periods, or whenever work is stopped at the end of the day, close the open ends of the pipe with watertight plugs or bulkheads.
4. Provide adequate trench pumping to ensure against groundwater contacting the inside of the pipeline at any time. Do not lower any pipe or fitting into a trench where groundwater is present and may enter the pipe. When necessary, pump the water from trenches and keep the trench dry until the joints have been completed and the open ends of the pipe have been closed with a watertight plug. Do not remove the plug until the trench has again been pumped dry.
5. Keep new pipe sections clean and dry.
6. When making the connection between a new pipeline and an existing pipeline, or when repairing a damaged pipe, take the following extra precautions:
 - a. When excavating a leaking or broken pipeline, "valve-off" the system gradually to less than watertightness. This is to prevent causing areas of zero pressure which would allow entry of foreign material. A flow should be maintained which is slightly less than trench pump capability. Once the break is exposed and cleaned to disallow site contamination, the valving can then be made watertight.

D. Installation Specifics:

1. Ductile-Iron Pipe:
 - a. Buried pipe shall be installed in accordance with AWWA C600.
 - b. Support and brace encased pipe to support the pipe and to prevent movement during testing and placement of the concrete encasement. The braces and supports shall be erected of materials and by methods that will prevent any future contact of the pipe with the environment surrounding the encasement.
 - c. Wrap buried pipe with 8 mil polyethylene film in accordance with AWWA C105. Continuously seal seams and overlaps with tape. Seal circumferential overlaps with two turns of tape, half lapped. Gather excess polyethylene on top of pipe so as not to block backfill material from getting under bottom of pipe. Use caution so as not to rip or cut the polyethylene film. Seal any rips or cuts in the film with tape.
 - d. Wherever the pipeline crosses over or under a sewer main or house service lateral, center a standard length pipe, 18-foot minimum, on said sewer main or lateral so as to have the pipeline joints as far as possible away from the sewer. This may require field cutting of some pipe pieces.
 - e. Flanged Joints: Flanged joints shall be made up tight with care being taken to avoid undue strain in the flanges, fittings, and other accessories. Bolt holes shall be aligned for each flanged joint. Bolts shall be full-size for bolt holes; use of undersize bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Adjoining flange faces shall not be out of parallel to such a degree that the flanged joint cannot be made watertight without overstraining the flange. Replace any flanged pipe or fitting whose dimensions do not allow the making of a proper flanged joint as specified herein by one of proper dimensions. Clean flanges prior to making joints. Buried flanged pipe connections shall be made with the

smallest practical "bell" hole. After the joint is completed, take special care to completely fill the "bell" hold under and around the pipe with compacted backfill.

- f. Provide an insulated flanged joint on all buried ductile-iron piping 6 inches in diameter and larger within 2 feet of each structure. Provide an electrolysis test station with a pair of leads on each side of the insulated flange.
 - g. Restrained Joints: Install in accordance with manufacturer's instructions. Pull slack out of joint after makeup.
2. Copper Pipe:
- a. Bends shall be made in a manner that does not crimp or flatten pipe.
 - b. Dielectric unions shall be installed at connections with ferrous piping.
 - c. Pipe shall have joints squarely cut clean, properly fluxed and heated before solder is placed in the joint. Joints must be driven up tight before solder is added. Compression and flared joints shall be made up in accordance with the manufacturer's instructions. Brazing shall be in accordance with ANSI B31.1.

3.02 COUPLING INSTALLATION

- A. Flexible Couplings and Flange Coupling Adaptors: Prior to installation, thoroughly clean oil, scale, rust, and dirt from the pipe to provide a clean seat for the gasket. Care shall be taken that the gaskets are wiped clean before they are installed. If necessary, flexible couplings and flanged coupling adapter gaskets may be lubricated with soapy water or manufacturer's standard lubricant before installation on the pipe ends. Install in accordance with the manufacturer's recommendations. Bolts shall be tightened progressively, drawing up bolt on opposite sides a little at a time until all bolts have a uniform tightness. Workers tightening bolts shall be equipped with torque-limiting wrenches or other favorably reviewed type. Anchor studs on restrained flanged coupling adapters shall be installed so as to lock into holes drilled through pipe wall in accordance with manufacturer's recommendation.
- B. Tie Rods: Except where double-nutting is required, install the nuts snug. Tighten the nuts gradually and equally at opposite sides of the pipe until snug to prevent misalignment and to ensure that all rods carry equal loads. If double-nutting is required, double-nut each end of each tie rod. The space between the pairs of nuts shall be 1/2-inch greater than the distance between the lugs. Provide double-nutting at buried locations and where otherwise required on the Drawings.
- C. Flexible Expansion Joints: Install in accordance with manufacturer's instructions unless otherwise shown, install flat, with one-half the maximum expansion.

3.03 INSTALLATION OF VALVES AND ACCESSORIES

- A. Wrap buried valve bodies as specified for flexible couplings and flanged coupling adapters.
- B. Use reducing fittings where any change in pipe size occurs between valves or accessories and the attached pipeline. Bushings shall not be used, unless specifically noted on the Drawings. Use eccentric reducing fittings wherever necessary to provide free drainage of lines.

3.04 CLEANING

- A. Prior to testing, the inside of each completed pipeline shall be thoroughly cleaned of all dirt, loose scale, sand and other foreign material. Cleaning shall be by sweeping, flushing with water internal cleaning device or "pig" or blowing with compressed air, as appropriate for the size and type of pipe. Flushing shall achieve a velocity of at least 3 feet per second. The Contractor shall install temporary strainers, temporarily disconnect equipment or take other appropriate measures to protect equipment while cleaning piping. Cleaning shall be completed after any pipeline repairs.

3.05 FIELD TESTING

- A. General: Perform leakage tests on all pipe installed in this project. Furnish all equipment, material, personnel, test media and supplies to perform the tests and make all taps and other necessary temporary connections. The test pressure, allowable leakage and test medium shall be as specified. Test pressure shall be measured at the highest point on the line, except that pressure at lowest point shall not exceed pipe manufacturer's rated test pressure, unless specifically noted otherwise. Perform leakage tests on all piping at a time agreed upon and in the presence of the Engineer. The Contractor may purchase water for construction, cleaning, testing and disinfection of the pipelines from the City at a fire hydrants designated by the City. At any connection to the City water system, the Contractor shall provide an air-gap or reduced pressure backflow valve system to prevent backflow into the water source.
- B. Buried Piping: Perform the leakage test for buried piping after all pipe is installed and backfilled. However, preliminary tests may be conducted prior to backfill. If preliminary tests are conducted, provide any necessary temporary thrust restraint.
- C. Accessories: It is the responsibility of the Contractor to block off or remove equipment, valves, gauges, etc., which are not designed to withstand the full test pressure.
- D. Testing Apparatus: Provide pipe taps, nozzles and connections as necessary in piping to permit testing including valves to isolate the new system, addition of test media, and draining lines and disposal of water, as is necessary. Plug these openings in a manner favorably reviewed by the Engineer after use. Provide all required temporary bulkheads.
- E. Correction of Defects: If leakage exceeds the allowable, repair or replace the installation and repeat leakage tests as necessary until conformance to the leakage test requirements specified herein have been fulfilled. All visible leaks shall be repaired even if the pipeline passes the allowable leakage test.
- F. Reports: Keep records of each piping test, including:
 - 1. Description and identification of piping tested.
 - 2. Test pressure.
 - 3. Date of test.
 - 4. Witnessing by Contractor and Engineer.
 - 5. Test evaluation.
 - 6. Remarks, to include such items as:
 - a. Leaks (type, location).
 - b. Repairs made on leaks.

- 7. Submit test reports to the Engineer.
 - G. Venting: Where not shown on the Drawings, the Contractor may install valved "TEES" or corporation stops and saddles at high points on piping to permit venting of air. Valves shall be capped after testing is completed.
 - H. Testing Specifics:
 - 1. Water Transmission Mains:
 - a. Method: AWWA C600, as modified herein.
 - b. Duration: Four hours.
 - c. Pressure: 150 psi measured at lowest point of section of pipeline being tested.
 - d. Medium: Potable water.
 - e. Allowable Leakage: Leakage shall be defined as the quantity of test medium that must be added to the section of pipeline being tested to maintain the specified test pressure for the specified test duration. Maximum allowable leakage shall be as specified in AWWA C600.
 - 2. Copper Pipe:
 - a. Duration: Four hours.
 - b. Pressure: 150 psi.
 - c. Medium: Water.
 - d. Allowable Leakage: None.
- 3.06 DISINFECTION OF POTABLE WATER SYSTEMS
- A. See Section 11003.

END OF SECTION

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SECTION 02630

DRAINAGE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Furnish and install all structures, piping, fittings, and accessories, and perform all earthwork and grading as shown on the Drawings, described in these specifications, and as required to construct a complete and operable storm water runoff drainage system.
- B. Related Sections:
 - 1. Section 02085: Precast Concrete Utility Vaults
 - 2. Section 02301: Earthwork

1.02 REFERENCES

- A. American Association of State Highway and Transportation Officials (AASHTO)
- B. State of California, Department of Transportation, Standard Specifications (Standard Specifications)
- C. ASTM International (ASTM):
 - 1. ASTM D3034: Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
 - 2. ASTM D2321: Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
 - 3. ASTM D1784: Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
 - 4. ASTM D3212: Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
 - 5. ASTM F477: Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
 - 6. ASTM F679: Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
 - 7. ASTM F1336: Standard Specification for Poly(Vinyl Chloride) (PVC) Gasketed Sewer Fittings
 - 8. ASTM F1417: Standard Practice for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air
- D. Uni-Bell PVC Pipe Association:
 - 1. UNI-PUB-6: Installation Guide for Solid-Wall PVC Sewer Pipe (4-48 in.)
- American Water Works Association (AWWA):
 - 1. AWWA M23: PVC Pipe – Design and Installation

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.

- B. Shop Drawings:
 - 1. Pipe Layouts:
 - a. Drawings indicating layout of piping, fittings, valves, and other appurtenances necessary for a completed pipeline.
 - 1) Coordinate piping with precast concrete structure shop drawings.
- C. Product Data:
 - 1. Submit data on the following items showing compliance under this section:
 - a. Pipe, fittings, and accessories
 - b. Gaskets
 - c. Connections to existing pipelines, laterals, and structures
 - d. Flexible couplings and flanged coupling adapters
 - e. Cleanouts
 - 2. Certifications:
 - a. Certified affidavit of compliance with reference specifications specified herein.
 - b. Certified field test reports specified herein.

1.04 DELIVERY, HANDLING, AND STORAGE

- A. Cover pipe from direct sunlight and protect from heat sources, such as heaters, boilers, steam lines and engine exhaust, to protect pipe and coatings.
- B. Protect gaskets from direct sunlight and heat sources.

1.05 QUALITY ASSURANCE

- A. The Pipe Manufacturer shall be a member of the Uni-Bell PVC Pipe Association.

PART 2 - PRODUCTS

2.01 PRECAST CATCH BASINS AND COVERS

- A. Catch Basins: Precast concrete structures conforming to the dimensions and details shown on the Drawings and designed to withstand an AASHTO H-20 loading. Provide interlocking joints where depth requires more than one unit. Minor variations from the drawings may be accepted to permit the use of manufacturer's standard methods of fabrication.
- B. Covers: Covers shall be supplied by the manufacturer of the catch basin and be matched to the catch basin.
 - 1. Solid Covers: Galvanized steel checker plate designed for AASHTO H-20 loading. Provide four 1/2-inch galvanized steel threaded anchors for each cover.
 - 2. Grates and Frames: Fabricated steel grating and frames, hot dip galvanized after fabrication, and designed for AASHTO H-20 loading. Firmly embed frames in the concrete. Gratings shall fit neatly in the frames and bear firmly without rocking. Grating shall be bicycle proof. Provide two locking bolts and clips for each grate.
- C. Manufacturers: Christy; or equal.

2.02 PRECAST CONCRETE SECTIONAL MANHOLES

- A. Refer to information noted in the details provided in the Contract Drawings.

2.03 SUBGRADE DRAINAGE PIPING

- A. Collector Pipe: PVC40, material per ASTM D1784, cell class 12454, design per ASTM D2729, with two rows of 1/2-inch (minimum) diameter perforations, 120-degree separation at 5-inch spacing.
- B. Conveyance Pipe: PVC40 Sewer Pipe, material per ASTM D1784, cell class 12454 , design per ASTM D2729, solid-walled
- C. Joints: solvent weld.
- D. Fittings: Solvent weld, socket type, of same material as the pipe, ASTM D2729.
- E. Cement: Solvent weld, ASTM D2564, as recommended by the pipe manufacturer for the schedule and size to be joined, IPS724 CPVC by Harrington Plastics; no equal.

2.04 STORM DRAIN PIPE

- A. Provide the following storm drain materials where identified on the Drawings.
- B. Polyvinyl Chloride Pipe (PVC)
 - 1. Pipes 4 inches through 15 inches shall be SDR 35 per ASTM D3034
 - 2. Lay length: Pipe furnished shall have normal laying length of 18 feet to 22 feet.
 - 3. The pipe shall be made of PVC compound having a cell classification of 12454 or 12364 in accordance with ASTM D1784.
 - 4. Pipe shall be homogenous throughout, free of voids, cracks, inclusions, and other defects.
 - 5. Gasketed pipe shall be marked with an insertion depth mark on the spigot end.
 - 6. Pipe for non-potable water and wastewater uses shall be green or white in color.
 - 7. Pipe outside diameters shall be equal to those of cast iron unless otherwise specified.
 - 8. External Coating: Not Used.
 - 9. Internal Lining: Not Used.
 - 10. Pipe and Fitting Identification:
 - a. Buried piping: Pipe markings shall conform to ASTM D3034.
 - 1) Pipe shall have markings at the ends of each pipe:
 - a) Manufacturer's name or trademark and code
 - b) Nominal pipe size

- c) Legend (e.g., "SDR-35 PVC Sewer Pipe" or "PS 46 PVC Sewer Pipe")
 - d) ASTM Designation
 - 2) Molded and fabricated fittings shall have markings including:
 - a) Manufacturer's name or trademark
 - b) Nominal size
 - c) Material designation (e.g., "PVC")
 - d) ASTM Designation
- 11. Acceptable Pipe Manufacturers:
 - a. Charlotte Pipe and Foundry Company
 - b. Diamond Plastics Corps.
 - c. Westlake Chemical Corporation
 - d. or equal

C. Fittings

- 1. Fittings may be molded, or fabricated fittings manufactured in accordance with:
 - a. Fittings 4 inches through 15 inches shall be SDR 35 per ASTM D3034
- 2. Fittings shall be made of PVC compound having a cell classification of 12454 or 13343 in accordance with ASTM D1784.
- 3. Pipe used in fabricated fittings shall have a wall thickness equal to or greater than the wall thickness of the pipes to which the fitting will be joined.
- 4. Fittings may also be supplied as ductile iron fittings in accordance with AWWA C110 and/or C153.
- 5. Acceptable PVC fitting manufacturers shall be the same as identified for pipes.

D. Joints

- 1. Joints: Joints shall be gasketed push-on type conforming to ASTM D3212.
- 2. Joint lubricant shall be approved by the Pipe Manufacturer and shall have no detrimental effect on the gasket or pipe.

E. Connections to Gravity Structures (E.G., Manholes, Catch Basins)

- 3. At connections to structures, use a water-stop gasket produced from elastomeric material.
- 4. Use non-shrinking or expansive type grout.
- 5. Manhole Adaptors: Manhole adaptors shall be SBR rubber manhole waterstops for use with PVC sewer pipe in accordance with ASTM C923.
 - a. Acceptable Manufacturers:
 - 1) Fernco; or equal
- 6. Transition Donuts: Transition donuts shall be elastomeric plastic resistant to sewage and grease, chemicals, and normal sewer gases. They shall be designed to be inserted in the bells of sewer pipe to adapt the bell to accept the spigot of a smaller size spigot. They shall have reversed fins on the inside

and outside to grip the bell and spigot. Transition donuts cast or grouted into concrete pipe or manhole sections shall have an outside diameter at least 2 inches greater than the inside diameter.

- a. Acceptable Manufacturers:
 - 1) Fernco; Indiana Seal; or equal

PART 3 - EXECUTION

3.01 INSTALLATION OF PRECAST CATCH BASINS

- A. Install catch basins, level and set to grade, on a 6-inch sand or gravel leveling course, compacted to 95% relative density. Grout joints between sections smooth with mortar.
- B. Connect pipes to the structures through the openings provided. Grout firmly in place to form a tight seal. Place pipe ends flush or cut off flush with the inside face of the structure.

3.02 CONSTRUCTION OF DRAINAGE DITCHES AND SWALES

- A. Construct drainage ditches and swales in accordance with Section 02301 and 03300 true to the line, grades, contours and slopes shown on the Drawings.
- B. Grade ditch inverts carefully to match the inverts of the culverts they join to provide smooth transitions of flowline between ditches and structures.
- C. Pave ditches where indicated on the Drawings. Asphalt pavement shall be in accordance with Paragraph 39-7.01 of the Standard Specifications. Concrete pavement shall conform with Section 03300.

3.03 PIPING INSTALLATION

- A. General Handling and Placing:
 - 1. Do not store pipe on rough ground. Any damaged pipe sections, specials, or fittings shall be repaired or replaced at the expense of the Contractor as satisfactory to the Engineer.
 - 2. Carefully inspect each pipe, fitting, valve and accessory before installation to insure there is no defective workmanship or obstructions.
 - 3. Place or erect all piping to accurate line and grade and backfill, support, hang, or brace against movement as specified or shown on the Drawings, or as required for proper installation. Remove all dirt and foreign matter from the pipe interior prior to installation and thoroughly clean all joints before joining.
 - 4. Use reducing fittings where any change in pipe size occurs. Do not use bushings unless specifically noted on the Drawings. Use eccentric reducing fittings wherever necessary to provide free drainage of lines.
 - 5. Cover pipe stored outside for more than two months with canvas or other opaque material. Provide for air circulation under the covering.
 - 6. Place pipe within the installation areas at least 24 hours prior to installation to permit temperature equalization.
 - 7. Cut pipe ends squarely, ream and deburr inside and out.

8. Solvent Weld Joints: Clean pipe ends and sockets and join in strict conformance with the pipe manufacturer's instructions. Make joints in accordance with ASTM D2855. Handle solvent cements and primers in accordance with ASTM F402.
- B. General Buried Piping Installation:
 1. Trenching, bedding, and backfill for buried piping shall be as shown on the Drawings and as specified in Section 02301.
 2. Where pipe grade elevations are shown on the Drawings, install the pipe with straight grades between the indicated elevations.
 3. Provide each pipe with a firm, uniform bearing for its full length in the trench except at field joints. Do not lay pipe in water or when trench conditions or weather are unsuitable for such work.
 4. Where piping leaves a structure or concrete encasement, provide a joint capable of angular deflection within 12 inches of the structure for pipes 12 inch and smaller or as shown on the Drawings for larger pipe sizes. Conform to details on the Drawings where such details are shown.
 5. Snake buried PVC pressure pipe from side to side in the trench in long sweeps.

END OF SECTION

SECTION 02700
PAVING AND SURFACING

PART 1 - GENERAL

1.01 SUMMARY

- A. Furnishing all labor, material, equipment, tools and services required for the placing and compacting of asphalt concrete pavement for pavement restoration, roadways, and tank subgrade to the lines, grades and dimensions shown on the Drawings and as specified herein.
- B. Related Sections:
 - 1. Section 01300: Submittals
 - 2. Section 02301: Earthwork
 - 3. Section 13211: Welded Steel Tanks

1.02 REFERENCE SPECIFICATIONS

- A. Whenever the words "Standard Specifications" are referred to, the reference is to the State of California, Department of Transportation, Standard Specifications, latest edition.
- B. American Society for Testing and Materials (ASTM):
 - 1. D422 Test Method for Particle-Size Analysis for Soils
 - 2. D1556 Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method
 - 3. D2027 Specification for Cutback Asphalt (Medium Curing Type)
 - 4. D2922 Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
- C. California Department of Transportation (CALTRANS):
 - 1. California Test 216 Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates
 - 2. California Test 231 Method of Test for Relative Compaction of Untreated and Treated Soils and Aggregates by the Area Concept Utilizing Nuclear Gauges

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Submit the following under the Product Information category.
 - 1. Samples: Furnish, without additional cost to the Owner, such quantities of construction materials as may be required by the Engineer for test purposes. The Contractor shall cooperate with the Engineer and furnish necessary facilities for sampling and testing of all materials and workmanship. All materials furnished and all work performed shall be subject to rigid inspection,

- and no materials shall be used in the construction work until it has been inspected by the Engineer.
2. Submit a signed verification from each source of supply for each construction material employed on this project indicating that the materials meet the Specification requirements.
 3. Mix design for asphalt concrete.
 4. Submit manufacturer's certification of the actual volatile organic compounds (VOC) content for all pavement paints and bituminous pavement sealers proposed for use on this project. Submit certification of the actual VOC content for coatings manufactured after 1 September 1987. No coatings manufactured before 1 September 1987 shall be allowed. VOC content shall be measured in grams per liter by weight of coating as applied excluding water and color added to the tint base.
 5. Submit verification that bituminous pavement sealers and paint products furnished meet applicable Bay Area Air Quality Management District (BAAQMD) regulations as to allowable VOC content for the time and place of application and use intended.

1.04 QUALITY ASSURANCE

- A. Comply with "Standard Specifications" of State of California, Department of Transportation (CALTRANS).

1.05 REGULATORY REQUIREMENTS

- A. All work, material, procedures and practices under this Section shall conform with requirements of the California Air Resources Board (CARB) and the Bay Area Air Quality Management District (BAAQMD).

PART 2 - PRODUCTS

2.01 ASPHALT CONCRETE

- A. Asphalt Concrete: 1/2-inch maximum HMA Type A shall conform to the applicable requirements of Section 39 of the Standard Specifications. Asphalt binder shall be paving asphalt or liquid asphalt (cutback). Mineral filler shall consist of portland cement or mechanically reduced rock. Proportioning shall be as set forth in Paragraph "D" below.
- B. Asphalt Binder: PG 64-10 conforming to the requirements of Section 92 of the Standard Specifications. Bitumen ratio shall be selected by the supplier in accordance with the tests specified in Paragraph 39-3.04 of the Standard Specifications.
- C. Mineral filler shall be mechanically reduced rock, conforming to the following gradations when tested in accordance with ASTM D422:

Particle Size	Percentage
Passing No. 200 sieve	75-100
Finer than 0.05 mm	65-100
Finer than 0.02 mm	35-65

Finer than 0.01 mm	26-35
Finer than 0.0005 mm	10-22

D. Mix Design:

Mix	Type	Grade	Binder Content (%)
Normal	A	3/4" max.	4.5 to 6.5

2.02 TACK COAT

- A. Material for tack coat shall be SS-1 or SS-1h grade emulsified asphalt conforming to Section 39, 92, and 94 of the Standard Specifications.

2.03 HEADERS

- A. At straight sections, wood headers shall be constructed of 2-inch x 6-inch construction heart redwood, held in place by 2-inch x 4-inch stakes, of the same materials, 2 feet long and set at 4-foot centers.
- B. At curved sections, wood headers shall be constructed of three 1-inch x 4-inch construction heart redwood bender boards. Boards shall be lapped at one-third of the length of individual boards, with no two boards lapped at the same place. Hold boards in place with stakes same as above.

2.04 AGGREGATE BASE

- A. Aggregate base shall conform to the applicable requirements of the Standard Specifications Section 26, for Class 2 aggregate base. The aggregate base shall conform to that specified for the 3/4-inch maximum, unless otherwise indicated. Paragraphs 26-1.06 and 26-1.07 are not applicable.

2.05 TEMPORARY PAVEMENT (COLD MIX)

- A. Temporary pavement shall consist of No. 4 sieve maximum aggregate size, graded in accordance with Section 39 of the Standard Specifications. The aggregate shall be blended with 5-8% SC-800 liquid asphalt.

2.06 DISTRIBUTING EQUIPMENT

- A. Distributors shall be of the pressure type with insulated tanks and shall be equipped with the following:
1. A tachometer of the auxiliary wheel type, which registers speed in feet per minute.
 2. Charts and devices to provide for accurate and rapid determination and control of the amount of asphalt being applied.
 3. A hose and nozzle attachment to be used for areas inaccessible to the spray bar.
 4. A pressure gauge for determining application pressure.
 5. A thermometer for determining temperature of the asphalt.

Distributors and booster tanks shall be so maintained as to prevent dripping of asphalt from any part of the equipment.

Spray bars shall have a minimum length of 9 feet. Spray bars and extensions shall be the full circulating type and shall be adjustable to permit varying height above the surface to be treated.

The nozzles attached to the bar shall be either the conical or flat slotted type. The distance center to center of the nozzles shall not exceed 6 inches. The valves, which control the flow from nozzles, shall be of a positive acting design so as to provide a uniform unbroken spread of asphalt on the surface. Valves shall be operated so that all valves may be simultaneously opened or closed. Each valve shall also be capable of similar independent control.

Spreading equipment shall be so designed and articulated that uniform application of the asphalt, in controlled amounts, may be made ranging from 0.02 to 1.0 gallon per square yard of surface and with a range of pressure from 25 to 75 psi.

- B. A trough shall be located under the sprays, properly arranged to be swung out of the way after the sprays are operating in a uniform manner at the desired pressure or, in lieu thereof, building paper shall be spread over the treated surface for a sufficient length back so that the sprays are operating properly when the uncovered surface is reached. The building paper shall then be removed and disposed of. If the cutoff is not sufficiently positive, the similar use of paper may be required at the end of the area being covered. The distributor shall be operated in such a manner that liquid asphalt will not be splashed on adjacent guardrails or structures. Any asphalt so splashed may be removed at the expense of and by the Contractor.

PART 3 - EXECUTION

3.01 GENERAL

- A. This Specification shall cover newly paved areas as well as existing pavement restoration.
- B. Where trenching or other construction activity has resulted in damage to a localized area of pavement, the damaged pavement shall be cut back 6 inches and shall be removed and replaced.
- C. Where the damaged area extends over more than 50% of the road width or paved area, as determined by the Engineer, the full pavement width or area shall be cut away, removed and repaired.
- D. Structures such as valve boxes, manhole frames and covers, and electrical vaults shall be adjusted to grade as necessary within paved areas.
- E. Existing asphalt pavement islands of 50 ft² or less and strips 18 inches or less in width shall be removed and replaced.
- F. Adjust existing manholes, meter boxes, cleanouts, etc. to match the new grade.

3.02 PAVEMENT CUTTING

- A. Where trenching or excavation occurs in paved areas, the existing pavement shall be scored and broken ahead of the trenching or excavation operation. The extent of paving removed shall be limited to the minimum necessary for the excavation. All existing asphalt or concrete surfacing shall be saw cut vertically in a straight line and removed from the jobsite prior to starting the trench excavation. This material shall not be used in any fill or backfill.
- B. Pavement shall be cut accurately and on neat lines. The asphalt pavement shall be saw cut to a minimum depth equal to or greater than one-half the thickness of the pavement section. Any pavement damaged outside these lines shall be re-cut and restored at the expense of the Contractor. Should voids develop under existing pavements during construction, Contractor shall remove the affected pavement, repair voids and replacement pavement section at the expense of the Contractor.
- C. Construct joints between successive runs that are vertical and at right angles to the line of the improvement. Exercise care in construction of all joints to ensure that the surface of the pavement is true to grade and cross-section. Lapped joints will not be permitted.

3.03 PLACEMENT OF AGGREGATE BASE

- A. Subgrade Preparation: The subgrade shall be watered or dried as required to bring the soil, as close as practicable, to the optimum moisture content for proper compacting and then compacted, as specified, to a relative compaction of not less than 95% in the upper 6 inches with moisture content between 1 and 3% above the optimum value. When compaction of the subgrade areas on fill and embankments has been properly obtained, only such additional rolling will be required as necessary to obtain a thoroughly compacted subgrade immediately prior to placing the aggregate base thereon.
- B. Aggregate Base Tolerance: The aggregate base shall not be placed before the subgrade is approved by the Engineer. The finished aggregate base shall not vary more than 0.05 foot above, nor 0.10 foot below, the planned grade.
- C. Aggregate Base Placing: The aggregate base material shall be spread on the prepared subgrade by means of approved spreading devices subject to approval by the Engineer; the aggregate base material may be dumped in piles upon the subgrade and spread by bulldozing ahead from the dumped material. Each layer shall not exceed 0.50 feet. Segregation of large or fine particles of aggregate shall be avoided, and the material as spread shall be free from pockets of large and fine material.
- D. Compaction: The relative compaction of each layer of compacted aggregate base material shall not be less than 95% as determined by California Test 216 or ASTM D1556 (Sand Cone), or California Test 231 or ASTM D2922 (Nuclear method when approved by the Engineer). Compaction shall be in accordance with Section 26-1.05 of the Standard Specifications. Aggregate base, after compaction, shall be watered as provided in Section 17 of the Standard Specifications. Paragraph 17-1.04 is not applicable.

3.03 PRIME COAT APPLICATION

- A. Prime Coat: In advance of spreading paving materials, a prime coat of liquid asphalt shall be applied to all base course surface areas to be covered with asphaltic concrete.
 - 1. Preparation of Base Course: Immediately before applying the prime coat, the area to be surfaced shall be cleaned of all loose material by means of hand brooms.
 - 2. Application: Liquid asphalt shall be applied by pressure distributors at a temperature between 125 and 200°F. The Engineer reserves the right to require an adjustment of the temperature of the liquid asphalt at the time of placement. The rate of application shall be between 2/10 and 3/10 gallon per square yard. Excess liquid asphalt, which has failed to penetrate the base, shall be covered with fine sand. All loose sand shall be removed from the treated areas before placing any surfacing material thereon. Liquid asphalt shall not be applied when the atmospheric temperature is below 50°F. The prime coat shall be applied at least 24 hours in advance of paving. Immediately in advance of paving asphalt concrete surfacing, additional prime coats shall be applied, as directed by the Engineer, to areas where the prime coat has been damaged.

3.04 TACK COAT APPLICATION

- A. Tack Coat: In advance of spreading bituminous material, a tack coat shall be applied to all vertical surfaces of concrete foundation ringwalls.
 - 1. Preparation: Immediately before applying a tack coat, the area to be surfaced shall be cleaned of all loose material.
 - 2. Application: The tack coat shall be applied by means of pressure distributors by pressure hand-spray equipment. The rate of application shall be 1/20 gallon per square yard. Emulsified asphalt shall not be applied when the atmospheric temperature is below 40°F. If emulsified asphalt Type SS-1 is used, it may be diluted with an equal part of water. The rate of application of the dilution shall be such that the rate of application of undiluted emulsion shall be within the tolerances specified.

3.05 PLACEMENT OF ASPHALT CONCRETE

- A. Delivery and Spreading: Bituminous mixtures shall be delivered at temperatures specified in the Standard Specifications. Spreading of the mixture shall be in accordance with Section 39 of the Standard Specifications. Paragraph 39-8 does not apply. All loads shall be covered with tarpaulin or other material during transportation. The top layer of asphalt concrete shall not exceed 0.25 feet in compacted thickness.
- B. Compaction: Initial or breakdown rolling and the final rolling of the uppermost layer of the asphalt concrete shall be compacted in accordance with Section 39 of the Standard Specifications. Paragraph 39-8 does not apply. The Engineer reserves the right to require an adjustment of the temperature of the asphalt concrete at the time of placement.
- C. Pavement Thickness: Pavement thickness as indicated on the Drawings.

- D. Joining Pavement: The joints between old and new pavements or between successive days' work shall be carefully made in such manner as to ensure a continuous bond between old and new sections of the course. Edges of existing pavement shall be exposed and cleaned and edges cut to straight, vertical surfaces. All joints shall be painted with a uniform coat of tack coat before the fresh mixture is applied.
- E. Protection of Pavement: After final rolling, no vehicular traffic of any kind shall be permitted on the pavement until it has cooled and hardened and in no case less than 6 hours.

3.06 APPLICATION OF FOG SEAL

- A. A fog seal shall be applied to the upper surfaces of all installed asphalt concrete. It shall be applied in accordance with the applicable requirements of Section 37, BITUMINOUS SEALS, of the Standard Specifications, Seal Coats. Subparagraphs 37-1.08 and 37-1.09 are not applicable.

3.07 PAVEMENT RESTORATION

- A. Final pavement restoration shall be made as soon as practicable after backfilling. In that period of time between backfilling and final pavement restoration, the trench shall be maintained level with the adjacent pavement and shall be covered with a 1-inch minimum layer of cutback. Prior to placing the final pavement, the temporary pavement shall be removed, the aggregate base excavated to the lines indicated on the Drawings, and the existing pavement edges saw cut as herein specified. The final asphalt pavement shall not be placed before the primed aggregate base surface is approved by the Engineer.

3.08 HEADERS

- A. Install wood headers along pavement edges bordered by soil. Install new headers where existing wood headers are damaged during construction, or removed for construction. Install headers with uniform slope between spot elevation indicated on the Drawings or to conform to existing grades.

3.09 PAVEMENT MARKINGS

- A. Preparation: Immediately before applying the paint, the pavement surface shall be thoroughly cleaned of all dust, dirt, scale, curing compound, oil, grease, or other objectionable matter as directed by the Engineer. Solvent material that will damage the pavement shall not be used as a cleaning agent.
- B. Tolerances: Marking and striping shall be within 2 inches of the correct alignment. Dimensions of marking and stripings shall be within ½-inch.
- C. Mixing: Mechanical mixers shall be used to mix paint. Prior to applying, the paint shall be mixed a sufficient length of time to thoroughly mix the pigment and vehicle together, and shall be kept thoroughly agitated during its application.
- D. Application: Pavement marking shall be applied only on dry surfaces and only during periods of favorable weather. Painting shall not be performed when the atmospheric temperature is below 40°F when using solvent-borne paint or below

50°F when using water borne paint; when freshly painted surfaces may become damaged by rain, fog, or condensation; nor when it can be anticipated that the atmospheric temperature will drop below said 40°F or 50°F temperatures during the drying period.

1. Immediately following the preparation of the pavement, the paint shall be applied. The paint shall be applied at the rate of 100 to 110 square feet per gallon of paint. The stripe painting machine shall have a compressor capacity of at least 105 cubic feet per minute and be capable of operating at an air pressure of 125 psi. The paint shall be mechanically agitated while the machine is in operation. The striping machine shall be equipped with a guide post so designed that the machine will hold exactly to the alignment. The propelling vehicle shall be equipped with a guide post so designed that the machine will hold exactly to the alignment. The propelling vehicle shall be equipped with a speedometer or tachometer, and with a suitable device for determining the quantity of paint in the container. The paint container and spray nozzles on the machine shall be thoroughly cleaned before starting each day's work. The stripe shall be of the required width, with clean, true edges and without sharp breaks.
 2. Application of a bituminous seal coat and the permanent pavement marking shall meet local and state requirements. The Contractor shall allow sufficient time before applying permanent pavement marking so that the paint does not bleed, curl or discolor when applied to bituminous surfaces. If bleeding or discoloring occurs, apply an additional coat(s) of paint as needed to provide a clean and neat final product.
 3. Remove existing permanent or temporary markings and striping which are to be abandoned or obliterated, by wet sandblasting or other favorably reviewed methods. Dry sandblasting may be used in selected areas only with prior approval of the Engineer and with approval of the air pollution control authority having jurisdiction over the area in which the work will be performed. Obliteration of traffic striping with black paint or light emulsion oil shall be done only with the prior favorable review shall not be used as a removal agent.
- E. Provide all warning devices required to protect the painting operation and the finished work. Repaint, to the applicable specifications, any portion of the stripe damaged by any type of traffic within 24 hours after the stripe has been applied. For striping less than 50 feet in length, favorably reviewed portable painting equipment may be used.

END OF SECTION

SECTION 02810

IRRIGATION

PART 1 - GENERAL

1.01 DESCRIPTION

- A. The work in this section consists of furnishing, layout and installing an irrigation system complete, including certification of irrigation system installation as required by the State of California Model Water Ordinance described herein.
- B. Related work specified elsewhere includes:
 - 1. Section 02301, EARTHWORK
 - 2. Section 02900, PLANTING
 - 3. Section 16000, ELECTRICAL stub-out for controller

1.02 CALIFORNIA MODEL WATER EFFICIENT LANDSCAPE ORDINANCE REQUIREMENTS

- A. Contractor shall be familiar with and follow the State of California Model Water Ordinance, California Code of Regulations, Title 23 Waters, Division 2, Department of Water Resources, Chapter 2.7. Also, the Contractor is responsible to follow all local water ordinances.
- B. Pursuant to the requirements of the California Model Water Efficient Landscape Ordinance, the Contractor shall submit a Certification of Installation to the Local Jurisdiction /water purveyor as described in the construction documents and these specifications. Certification shall at a minimum include the following documents:

PART 1. Project Information Sheet

PART 2. Certification of Installation according to the landscape documentation package.

PART 3. Irrigation Scheduling and Controller Programming

PART 4. Schedule of Landscape and Irrigation

PART 5. Landscape Irrigation Audit Report

PART 6. Soil Management/Analysis Report with verifying implementation, see Planting Specification for analysis requirements.

1.03 QUALITY ASSURANCE

- A. Manufacturer's Specifications: Follow manufacturer's current printed specifications and drawings in all cases where the manufacturers of articles used in the Contract furnish directions covering points not specified or shown in the drawings.
- B. Ordinances and Regulations: All local, municipal and state laws, codes and regulations governing or relating to all portions of this work are hereby incorporated into and made a part of these Specifications. Anything contained in these

Specifications shall not be construed to conflict with any of the above codes, regulations or requirements of the same. However, when these Specifications and Drawings call for or describe materials, workmanship or construction of a better quality, higher standard, or larger size than is required by the above codes and regulations, the provisions of these Specifications and Drawings shall take precedence. Furnish without extra charge additional materials and labor required to comply with above rules and regulations.

C. References, Codes and Standards:

1. AB 325 and 1881 State of California Model Water Efficient Landscape Ordinance, California Code of Regulations Title 23.
2. California Environmental Quality Act (CEQA)
3. Water Use Classification of Landscape Species (WUCOLS).
4. American Society of Irrigation Consultants (ASIC) Design Guidelines.
5. California Landscape Standards, California Landscape Contractors Association, (CLCA) Sacramento, California.
6. CAL-OSHA, title 8, Subchapter 4-Construction Safety Orders and Subchapter 7-General Industry Safety Orders.
7. California Electric Code.
8. California Plumbing Code (UPC) published by the Association of Western Plumbing Officials.
9. NFPA 24, Section 10.4, Depth of Cover.
10. Underwriters Laboratories (UL): Electrical wiring, controls, motors and devices, UL listed and so labeled.
11. American Society of Testing Materials (ASTM).

D. Furnish without extra charge any additional material and labor when required by the compliance with all above mentioned codes and regulations, though the work be not mentioned in these specifications or shown on the drawings.

E. Experience: Assign a full-time employee to the job as supervisor for the duration of the Contract with a certified landscape technician, irrigation certification through CLCA or minimum of four (4) years experience in landscape irrigation installation.

F. Labor Force: Provide a landscape installation and maintenance force thoroughly familiar with, and trained in, the work to be accomplished to perform the task in a competent, efficient manner acceptable to the Owner's Representative.

G. Explanation of Drawings:

1. Due to the scale of the Drawings, it is not possible to indicate all piping offsets, fittings, sleeves, etc., which may be required. Carefully investigate the conditions affected all of the work and plan accordingly, and furnish all required fittings. Install system in such a manner to avoid conflicts with planting, utilities and architectural features.
2. Do not install the irrigation system as shown on the Drawings when it is obvious in the field that obstructions, grade differences or discrepancies in arc dimensions exist that might not have been considered in engineering. Bring such obstruction or differences to the attention of the Owner's Representative. Notify and coordinate irrigation Work with applicable contractors for location and installation of piping and sleeves through or under walls, pavement and structures. In the event this notification is not given, the Contractor shall assume full responsibility for any revision necessary.

H. Existing Tree Root Systems:

1. Where it is necessary to excavate adjacent to existing trees, the Contractor shall comply with Section 02100 SITE PREP & PLANT PROTECTION for the protection of existing vegetation.
2. Where Irrigation is shown within the drip line of existing trees, Contractor shall determine in the field where irrigation can be installed without impacting or damaging existing roots. Contractor shall layout exact proposed trench locations or equipment and review locations with the Arborist and Owner. Adjust the system as required to avoid damage to tree roots and as directed by the Arborist and Owner.
3. Excavation within the drip line shall be done by hand only, with no exceptions unless approved or directed by the Arborist or Owner.
4. All roots 2 inch (50mm) and larger in diameter, except directly in the path of pipe or conduit, shall be tunneled under and shall be heavily wrapped with burlap, to prevent scarring or excessive drying.
5. Where a ditching machine is run close to trees having roots smaller than 2 inch (50 mm) in diameter, the wall of the trench adjacent to the tree shall be hand trimmed, making clean cuts through.
6. The Contractor is responsible for securing the services of a Certified Arborist at no cost to the Owner.

I. Coordinate plant locations with emitter locations.

1. Adjust plant locations in relation to the subsurface emitter s as required to ensure that the plant roots receive the proper amount of water in order for it to thrive.
2. Coordinate planting and irrigation and provide hand watering of emitter irrigated and drip irrigated areas as required to maintain moist root zones until end of plant establishment period.

1.04 PROTECTION OF EXISTING STRUCTURES AND UTILITIES

- A. The Drawings show, if applicable, existing above and below grade structures and utilities that are known to the Owner. Locate known existing installations before proceeding with construction operations that may cause damage to such installations. Existing installations shall be kept in service where possible and damage to them shall be repaired with no adjustment of Contract Sum. If other structures or utilities are encountered, request Owner's Representative to provide direction on how to proceed with the Work. If a structure or utility is damaged, take appropriate action to ensure the safety of persons and property.

1.05 SUBMITTALS, in accordance with Section 01300

A. Materials List:

1. Submit required copies of the cut sheets and a complete list of materials proposed for installation, along with any proposed substitutions clearly identified and obtain the Owner Representative's written approval thereof before proceeding. Use only accepted materials and items of equipment.
2. List all materials by manufacturer's name and model number.
3. Submit to the Owner Certification of Installation as required by the State of California Model Water Ordinance.

- B. Substitutions:
1. If the Contractor desires to substitute a product, he shall list each item and note it as a "substitution" and provide the following information:
 - a. Descriptive information describing its similarities to the specified product.
 2. If the product is approved and, in the opinion of the Owner's Representative, the substituted product does not perform as well as the specified product, the Contractor shall replace it with the specified product at no additional cost to the Owner.
- C. Operations and Maintenance Manuals:
1. Prior to the final acceptance of the irrigation system, furnish three (3) individually bound Operation and Maintenance Manuals to the Owner's Representative for use by the Owner. The manuals shall contain complete enlarged drawings, diagrams and spare parts lists of all equipment installed showing manufacturer's name and address. In addition, each Service Manual shall contain the following:
 - a. Index sheet indicating the Contractor's name, address and phone number.
 - b. Copy of the Landscape Irrigation Audit
 - c. Copy of the 12-month irrigation schedule and estimate of annual water consumption
 - d. Copies of equipment warranties and certificates.
 - e. List of equipment with names, addresses and telephone numbers of all local manufacturer representatives.
 - f. Complete operating and maintenance instructions in sufficient detail to permit operating personnel to understand, operate and maintain all equipment.
 - g. Parts list of all equipment such as controllers, valves, solenoids and heads.
- D. Record Drawings:
1. Dimension the location of the following items from two (2) permanent points of reference such as building corners, sidewalks, road intersections, etc.:
 - a. Connection to existing water lines/meter.
 - b. Connection to electrical power.
 - c. Gate valves.
 - d. Routing of irrigation pressure lines (a dimension at least every 100 feet and as required to identify all changes in direction and location).
 - e. Remote control valves.
 - f. Routing of control valves.
 - g. All sleeve locations.
 - h. Routing of all control wiring.
 - i. Include all invert elevations below 12".
 2. Deliver a reproducible record drawing to the Owner's Representative within seven (7) working days before the date of final review. Delivery of the record drawings shall not relieve the Contractor of the responsibility of furnishing required information in the future.
- E. Controller Plan:
1. Provide one Irrigation Diagram plan in each controller housing. The plan shall show the area controlled by each valve in different colors and for orientation, any major permanent structure such as buildings and roads.

2. Charts to be waterproof and hermetically sealed between two pieces of transparent 10 mil thick plastic and installed in each controller on the door as accepted by the Owner's Representative no later than the time of the coverage test of the irrigation system.
- F. Maintenance Material - supply the following tools to the Owner:
1. Three (3) sets of specialized tools required for removing, disassembling and adjusting each type of head, valve or other equipment supplied on this project.
 2. Two (2) keys for each type of equipment enclosure.
 3. Two (2) keys for each type of automatic controller.
 4. Two (2) keys for each type of valve (including square type key for valves larger than 2")
 5. Two (2) quick-coupler keys and matching hose swivels for each type of quick-coupling valve installed.
 6. All lock keys shall be keyed alike.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Furnish and deliver materials in manufacturer's packaging, bearing original legible labeling.
- B. The Contractor is cautioned to exercise care in handling, loading, unloading, and storing PVC pipe and fittings. All PVC pipe shall be transported in a vehicle which allows the length of the pipe to lie flat so as not to subject it to undue bending or concentrated external load at any point. Any section of pipe that has been dented, cracked, or otherwise damaged shall be discarded and, if installed, shall be replaced with new piping.

1.07 SEQUENCING AND SCHEDULING

- A. Acceptance: Do not install main line trenching prior to acceptance by Owner's Representative of rough grades completed under another Section.
- B. Coordination: Coordinate with the work of other sections to insure the following sequence of events:
1. Sleeves and Conduits: Installation of all sleeves and conduits to be located under paving and through walls prior to placement of those materials.
 2. Bubbler Heads: Install after placement of tree, but prior to backfill with planter soil mix.
 3. On-Structure Equipment: Install piping and risers after waterproofing is accepted.
 4. Coordinate work schedule with Owner to avoid disruption of landscape maintenance of existing landscaping.
 5. Install piping prior to soil preparation (planting soil amendment installation).

1.08 WARRANTY

- A. In addition to manufacturer's guarantees and warranties, work shall be warranted for one (1) year from date of final acceptance against defects in material, equipment and workmanship. Warranty shall also cover repair of damage to any part of the

premises resulting from leaks or other defects in materials, equipment and workmanship to the satisfaction of the Owner.

- B. Include a copy of the warranty form in the Operation and Maintenance Manual.

1.09 OPERATION

- A. Routine: Inspect and adjust all heads and control valves.
- B. Controller: Inspect regularly for power interruption and reset clock as required. Adjust station timing to accommodate changes in plant growth and weather conditions.
- C. System Failure: Perform all repairs within one (1) operating period. Replacements to match removed products and materials in all respects. Report promptly all damage not resulting from Contractor's operations. Repair all damage caused by Contractor at no expense to Owner.
- D. Climate Change: Set and program automatic controllers in response to seasonal requirements and requirements of newly planted materials.

PART 2 - PRODUCTS

2.01 PIPE

- A. Pressure Main Line Pipe and Fittings: All PVC fittings shall bear the manufacturer's trademark name, material designation, size, applicable I.P.S. schedule and NSF seal of approval.
- B. All main line pipe shall be solvent welded and shall be schedule 40 unless shown otherwise on the Drawings.
 - 1. PVC Pressure Rated Pipe: ASTM D2241 NSF approved Type I, Grade I, solvent welded PVC with an appropriate standard dimension ratio (S.D.R.).
 - 2. PVC Scheduled Pipe: ASTM D1785 NSF approved, Type I,
 - 3. Grade I, solvent welded PVC.
 - 4. PVC Solvent-weld Fittings: ASTM D2466 Schedule 40, 1-2, II-I NSF approved.
 - 5. Solvent Cement and Primer for PVC solvent-weld pipe and fittings: Type and installation methods prescribed by the manufacturer.
 - 6. Connections between Main Lines and RCVs: Schedule 80 PVC (threaded both ends) nipples and fittings unless required otherwise by local jurisdiction.
 - 7. Valves 2-inch and larger shall be flanged only.
 - 8. Copper pipe shall be Type K or Red Brass where threaded joints are required and Type L otherwise.
- C. All lateral line pipe shall be solvent welded and shall be schedule 40 unless shown otherwise on the Drawings.

2.02 CONTROLLER ENCLOSURES

- A. Type: Use one of the following:
1. Stainless steel, NEMA Type 3 rated, with back panel, padlocking hasp and padlock Rain Bird, Le Meur, "Strong Box" or approved equal. See Detail for pedestal construction.
 2. Rain Bird, "Non-Central" Controller Assemblies
 - a. LXMM – ESP – LXM Cabinet, Powder Coated Steel
 - b. LXMPED – ESP-LXM Pedestal, Powder Coated Steel
 3. Verify correct equipment to fit the specified equipment from Rain Bird Services Corporations "Package Systems" for "Central Control" projects. Available from Rain Bird Services Corporation (RBSC) (888) 444-5756.
 4. Le Meur, (714) 822-5100.
 5. "Strong Box" available from John Deere, (800) 347-4272.

2.03 REMOTE CONTROL VALVE: As shown on Drawings and with the following minimum requirements:

- A. Remote control valves shall be those normally manufactured for irrigation systems and shall have a slow, consistent speed of closure through entire closing operation, including last portion. To ensure this, the effective diaphragm working area/valve seating opening ratio must be a minimum 3 to 1.
- B. Shall be mechanically self-cleaning to help prevent diaphragm or solenoid port plugging. To ensure this, the flush rod should be tapered to vary the size of the port opening as the diaphragm raises and lowers, thus allowing trapped material to escape. Rod is to be finished with a serrated surface to help scrub trapped material out. Screens not acceptable.
- C. Shall have removable valve seat so valve can be repaired without removal from irrigation line.
- D. Shall have ability to operate manually without the use of wrenches or special keys.
- E. Shall have one-piece solenoid that attaches directly to valve without shunts or clips that can be lost.
- F. Shall have cross top handle to adjust maximum travel of diaphragm to allow "tuning" of valve and closure.

2.04 BOX FOR REMOTE CONTROL VALVE

- A. Rectangular black plastic valve box - Ametek, Carson, Christy, Rain Bird or accepted equal with non-hinged bolt down black colored lid marked "irrigation". Box body shall have knock outs. Do not saw cut body. The minimum size box is as shown on Drawings. Increase box size as required to fit. Valve box lids are to indicate the controller letter and station number of valve as accepted by Owner's Representative. Also refer herein to required polyurethane tag at valve solenoid control wire under Control Wires. Locate the identification in center of the lid. Provide separate box for each valve. Provide H/20 Loading concrete boxes with bolt-down concrete lids for all valves that occur in paved areas.

2.05 CONTROLLER GROUND

- A. Provide each pedestal controller with its own ground rod. Separate the ground rods by a minimum of eight feet. The ground rod shall be an eight foot long by 5/8" diameter U.L. approved copper clad rod or as recommended by controller manufacturer. Install no more than 6" of the ground rod above finish grade. Connect #8 gauge wire with a U.L. approved ground rod clamp to rod and back to ground screw at base of controller with appropriate connector. Make this wire as short as possible, avoiding any kinks or bending. Install within pedestal housing base unless otherwise noted.
- B. Provide each irrigation controller with its own independent low voltage common ground wire.

2.06 CONTROLLER(S): With rain shutoff switch.

- A. Rain Bird ESP-LXME-ET – 8 station base model expandable to 48 stations via hot-swappable 4, 8, or 12 station modules.
- B. Rain Bird ET Manager Cartridge – Upgrades ESP LXM to an ET/Weather Based Irrigation Controller. ET Manager Cartridge saves water by making real-time adjustments to the irrigation schedule based on hourly weather information received from Weather Reach signal which is no charge in Northern California.
- C. Rain Bird ETM RG – Tipping Rain Gauge for site.

2.07 CONTROL WIRES

- A. Connections between automatic controllers and the solenoid-operated electric control valves shall be made with direct burial copper wire 14- AWG-UF 600 volt (minimum size). Pilot wires shall be a color other than white, and shall be a different color for each automatic controller with wires sharing a common trench. Common wires shall be white in color, with a different color stripe for each controller with wiring sharing the same common trench. No stripe is required if multiple controller wiring is not present.
- B. Size of wire shall conform to the remote control valve manufacturer's specification for control wire sizes, but in no case shall the control wire be smaller than #14. Runs over 2,000 lineal feet shall be #12- AWG-UF 600 volt copper wire.
- C. All wire splices are to be made within a valve box, with a copper crimp-type connector, and a "3-M" #DBY splice kit or Rain Bird "DBTWC25".
- D. Use continuous control wiring between controllers and remote control valves (no splices).
- E. Provide polyurethane tag at valve solenoid control wire that shows the controller number and station number. Also refer to valve box lid identification.
- F. Provide a spare control wire in each RCV box for future.

2.08 BUBBLER HEADS

- A. Tree Bubbler: Rain Bird RWS-M-B-C-1402, 0.5 GPM, Check Valve, or approved equal. 2 per tree.
- B. Shrub Bubbler: Rain Bird 1402, 0.5 GPM, or approved equal. 1 per shrub.

2.09 ISOLATION VALVE:

- A. Valves 3 inches and smaller: 125 lb. WSP bronze gate valve with screw-in bonnet, non-rising stem and solid wedge disc, NIBCO T-113 K, or approved equal. Valves shall be line size.
- B. Valves larger than 2": shall have square nut stem and o-ring connections for key operation.

2.10 BOX FOR ISOLATION VALVE

- A. 10" diameter black plastic, Ametek, Brooks, Christy, Rain Bird with bolt down black lid marked "irrigation," or accepted equal. Avoid locating valve in paved areas. Provide H/20 Loading concrete box with bolt-down concrete lid if valve is located in paved area. Obtain location approval by Owner's Representative.

2.11 SWING JOINTS

- A. Bubblers: Use Dura, Lasco, Rain Bird or equal pre-assembled swing joints with O-rings.

2.12 BACKFLOW PREVENTION DEVICE

- A. As required by Code and as shown on Drawings. Verify with Owner if Anti-freeze Jacket is required and provide as required.
- B. Riser assemblies from main line burial depth to backflow preventers shall be Schedule 40 brass pipe.
- C. All metallic pipe and fittings installed below grade shall be painted with two coats of Koppers #50 Bitumastic, or approved equal. Pipes may be wrapped with an approved asphaltic tape in lieu of the liquid-applied coating.
- D. Backflow preventer shall receive a minimum 6 inch thick concrete coordinated to fit backflow preventer enclosure as shown and as accepted by the Owner's Representative.

2.13 BACKFLOW PREVENTION DEVICE ENCLOSURE

- A. "Smooth Touch" enclosure without sharp edges, by Strong Box, available from V.I.T., Escondido, CA (800) 729-1314 or equal. Coordinate size of enclosure with

plumbing for minimum clearance and size. Enclosure to include concrete footing with hasp and staple to receive padlock. Padlock N.I.C.

2.14 CONDUIT/SLEEVES

- A. Sleeving shall be Schedule 40 PVC pipe sleeves and a minimum of two times the aggregate diameter of all pipes contained within the sleeve. Provide vertical sweep for all electrical conduit on each side of hardscape and terminate ends at 12" minimum depth and 12" from hardscape surface.

2.15 RCV IDENTIFICATION TAGS: Plastic or brass tags with valve number, approximately 2" by 2" with number imprinted, as accepted by Owner.

2.16 MISCELLANEOUS INSTALLATION MATERIALS

- A. Solvent Cement and Primers for Solvent-weld Joints: Make and type approved by manufacturer(s) of pipe and fittings. Maintain cement proper consistency throughout use.
- B. Pipe and Joint Compound: Permatex: Do not use on irrigation inlet port.

2.17 MISCELLANEOUS EQUIPMENT/ACCESSORIES

- A. Sleeves and Conduits: See Drawings.
- B. Key(s) for Quick-Coupling Valves:
 - 1. Type: Same manufacturer as Quick-Coupling Valve.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Sleeves and Conduits: Verify that all installed sleeving and conduits are undisturbed and are free of defects or errors introduced by the work of other sections.
- B. Water Meter/Water Pressure: Test and verify that existing water pressure is the minimum pressure at maximum system g.p.m. to operate the irrigation system as indicated on the drawings.
- C. Notification: Submit written notification to Owner's Representative within ten (10) working days of above inspections describing all acceptable and non-acceptable site conditions.

3.02 CONNECTIONS TO SERVICES

- A. Provide and coordinate connection to water meter.
- B. Provide and coordinate connection of irrigation controller to electrical power source.

3.03 INSTALLATION

- A. Install irrigation system components in accordance with this Section, with the Drawings, with the manufacturer's recommendations, and with established industry standards. The Contractor shall do nothing that may jeopardize any manufacturer warranty.
- B. Conduits and Sleeves:
 - 1. Coordination: Provide conduits and sleeves and coordinate installation with other trades.
 - 2. Extent: Install conduits and sleeves where control wires and pipes pass under paving or through walls as shown on Drawings. Extend twelve inches (12") beyond edges of paving and walls and cap ends until ready for use.
- C. Excavating and Trenching:
 - 1. Dig trenches wide enough to allow a minimum of three inches (3") between parallel pipe lines. Provide a minimum cover from finish grade as follows:
- D. Pipeline Assembly:
 - 1. Install pipe and fittings in accordance with manufacturer's current printed Specifications.
 - 2. Clean all pipes and fittings of dirt, scale and moisture before assembly.
 - 3. Solvent-welded Joints for PVC Pipes:
 - a. Solvents: Use solvents and methods specified by pipe manufacturer.
 - b. Curing Period: Minimum of one (1) hour before applying any external stress on the piping and at least 24 hours before placing the joint under water pressure.
 - 4. Threaded Joints for Plastic Pipes:
 - a. Use Permatex on all threaded PVC fittings except irrigation heads and quick coupler valve ACME threads.
 - b. Joining: Use strap-type friction wrench only. Do not use metal-jawed wrench. Assemble finger tight plus one or two turns.
 - 5. Laying of Pipe:
 - a. Bedding On-grade: Remove from trench all rocks or clods. Bed pipe in at least 2 inches of soil excavated from trench. Backfill on all sides of piping to provide a uniform bearing.
 - b. Snaking: Snake pipe from side to side of trench bottom to allow for expansion and contraction. Minimum allowance for snaking is one (1) additional foot per 100 ft. of pipe.
 - c. Moisture Restrictions: Do not lay PVC pipe when there is water in the trench. Do not assemble PVC pipe unless the pipe is dry.
- E. Control Valves:
 - 1. Install in valve boxes where shown on Drawings and group together where practical. Install box flush with finish grade, not necessarily level. If valve

- occurs in drainage swale, relocate out of drainage swale as approved by Owner's Representative.
2. Where two or more valves are installed adjacent to each other, provide at least six inches (6") separation. Align boxes in a row, perpendicular with pavement edge.
 3. Permanently mark valve box lid with 2" black valve number and controller letter or with numbered metal tag inside box as approved by Owner's Representative.
 4. Refer to control wiring for required spare wire in each valve box.
- F. Irrigation Head Installation:
1. Bubblers:
 - a. Coordinate installation with planting contractor to insure timely and proper placement of heads at new planting.
- G. Automatic Controller:
1. General: Install with lock box cutoff switch per local code and manufacturer's current printed specifications. Provide each controller with its own independent low voltage common ground wire.
 2. Connection to Valves: Connect remote control valves to controller in clockwise sequence to correspond with station setting beginning with Stations 1, 2, 3, etc.
 3. Labeling: Affix controller letter (i.e., "A") on inside of controller cabinet door with minimum of one-inch (1") high permanent letter.
 4. Irrigation Diagram: Affix a non-fading, waterproof copy of irrigation diagram to cabinet door below controller name. Irrigation diagram to be sealed between two plastic sheets, 20 mil. minimum thickness. Use a legible reduced copy of the Record Drawing for the irrigation diagram clearly showing all valves operated by the controller, station, number, valve size, and type of planting irrigated. Color code area operated by each valve.
- H. Control Wiring:
1. General: Install control wires in common trenches with irrigation mains and laterals wherever possible. Lay to the bottom side of pipe line. Provide looped slack at valves. Snake wires in trench to allow for contraction of wires. Tie wires in bundles at 10 ft. intervals.
 2. Extra Length: Provide 30 inches (30") extra control wire at each remote control valve splice to facilitate the removal of the remote control bonnet to finish grade without cutting wires.
 3. Spare: Install one unconnected spare control wire running from the controller through each intermediate control valve box.
 4. Size: Minimum size of wire is to be determined strictly by the manufacturer's current printed specifications for remote control valves, but not smaller than #14.
 5. Detection Wire: Install a bare #12 copper wire or greater on top of the PVC supply line for the purpose of possible future mine detection search. Install the control wires on the bottom of the PVC supply line with electrical tape every ten feet (10').
 6. Splicing: Crimp control wire splices at remote control valves. Seal with specified splicing materials. In-line splices will be allowed only on runs exceeding 2500 feet and only in junction boxes.
- I. Closing of Pipe and Flushing of Lines:

1. Capping: Cap or plug all openings as soon as lines have been installed to prevent entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.
- J. Rain Shutoff Switch:
 1. Install switch in area not affected by irrigation or rain shadow. Provide wires in rigid conduit as accepted by Owner's Representative.
- K. Detection Wire and Warning Tape:
 1. Install a bare # 12 copper wire or greater on top of the PVC supply line for the purpose of possible future mine detection search.
 2. Install a continuous PVC irrigation mainline warning tape 12" above the supply line.
- L. RCV IDENTIFICATION TAGS: Install in remote control valve box as recommended by manufacturer and as accepted by Owner's Representative.

3.04 MISCELLANEOUS EQUIPMENT

- A. Install miscellaneous equipment with concrete footings, brackets, etc., as required and as recommended by manufacturer.

3.05 FIELD QUALITY CONTROL

- A. Testing of Irrigation System:
 1. Make hydrostatic tests with risers capped when welded PVC joints have cured at least 24 hours. Center load piping with backfill to prevent pipe from moving under pressure. Keep all couplings and fittings exposed.
 2. Install two (2) pressure gauges at opposite ends of main line system. Pump system up to a minimum of 125 psi the day preceding the scheduled test and verify that pressure is holding. Inspect system early following day and immediately notify Owner's Representative if the test confirmation must be postponed.
 3. Apply continuous static water pressure of 125 psi in accordance with Caltrans Standard Specifications Section 20-5.03H, except after a drop in pressure (5 psi maximum), then the pressure must stabilize and remain stable for a one (1) hour minimum period before acceptance of the test.
 4. Leaks detected during tests shall be repaired and test repeated until system passes tests at no additional cost to Owner.
- B. Irrigation Audit Report with Certificate of Completion
 1. Per the requirements of the California Model Water Efficient Landscape Ordinance, the Contractor shall perform an irrigation audit and provide a report with certificate of completion to the local agency that may include, but is not limited to: inspection, system tune-up, system test with distribution uniformity, reporting run off that causes overland flow, and preparation of an irrigation schedule. Irrigation audits shall be conducted by a CLIA Certified landscape Irrigation Auditor by the Irrigation Association. Operation of the irrigation system outside the normal watering window is allowed for auditing and system maintenance.

- C. Adjustment of the System:
1. Flush and adjust all irrigation heads for optimum performance.
 2. Set all irrigation heads perpendicular to finished grades unless otherwise noted on the drawings.
 3. When the landscape irrigation system is completed and before planting, perform a coverage test in the presence of the Owner's Representative to determine if the water coverage for planting areas is adequate.
 4. Test controllers individually in the presence of the Owner's Representative and the Owner's Representative. Demonstrate that all control valves operate electronically. Provide vehicles and radio equipment as necessary to expedite this process.
 5. Demonstrate to Owner's Representative that irrigation scheduling programmed into controller is adequate for plant requirements without causing runoff, and that scheduling capacities of controller are utilized.

3.06 IRRIGATION SCHEDULING AND CONTROLLER PROGRAMMING

- A. Per the requirements of the California Model Water Efficient Landscape Ordinance All irrigation schedules and programs shall be developed, managed and evaluated to utilize the minimum amount of water required to maintain plant health.
- B. Irrigation controller Scheduling and Programming Parameters to be conducted by a CLCA Certified Irrigation manager and submitted to the local agency as part of the Certificate of Completion.
- C. Parameters used to set the automatic controller shall be developed for each of the following:
1. Plant establishment period
 2. Established landscape period
 3. Temporary irrigated area (if applicable)
- D. Each irrigation schedule shall consider for each station all of the following that apply:
1. Irrigation interval (days between irrigation)
 2. Irrigation run times (hours or minutes per irrigation event to avoid runoff)
 3. Number of cycle starts required for each irrigation event to avoid runoff
 4. Amount of applied water scheduled to be applied on a monthly basis
 5. Application rate setting
 6. Root depth setting
 7. Plant type setting
 8. Soil type
 9. Slope factor setting
 10. Shade factor setting
 11. Irrigation uniformity or efficiency setting
- E. Total annual applied water shall be less than or equal to Maximum Applied Water Allowance (MAWA). Actual irrigation schedules shall be regulated by automatic irrigation controllers using current reference evapotranspiration data (CIMIS or soil moisture sensor data).

3.07 BACKFILL AND COMPACTING

- A. General: After system is operating and required tests and reviews have been made, backfill excavations and trenches with clean soil, free of debris.
- B. Backfill for All Trenches: Regardless of the type of pipe covered, compact to minimum 95% density under pavements and 85% under planted areas.
- C. Finishing: Dress off areas to finish grades. Re-dress any areas which subsequently settle.
- D. Owner's testing agency will test backfill compaction in areas under paving.

3.08 MAINTENANCE

- A. The entire irrigation system shall be under full automatic operation for a period of 2 days prior to any planting.
- B. The Owner's Representative reserves the right to waive or shorten the operation period.
- C. Maintain/repair system for full duration of plant maintenance period.
- D. Pursuant to the requirements of the California Model Water Efficient Landscape Ordinance, the Owner is to provide a regular maintenance schedule with certificate of completion to the local water agency that may include, but is not limited to: routine inspection, adjustment and repair of the system and its components, replenishing mulch, fertilizing, pruning, weeding, removing and obstruction to emission devices. Operation of the irrigation system outside the normal watering window is allowed for auditing and system maintenance. Systems to be maintained to meet or exceed an average landscape irrigation efficiency of 0.71.

3.09 REVIEWS PRIOR TO ACCEPTANCE

- A. Notify the Owner's Representative in advance for the following reviews, according to the time indicated:
 - 1. Supply line pressure test and control wire installation - 72 hours.
 - 2. Coverage and controller test - 72 hours.
 - 3. Final review - 7 days.
- B. No reviews will commence without record drawings, without completing previously noted corrections, or without preparing the system for review.

3.10 FINAL REVIEW AND CLEANUP

- A. Operate each system in its entirety for the Owner's Representative at time of final review. Any items deemed not acceptable by the Owner's Representative shall be reworked to the complete satisfaction of the Owner's Representative.

- B. Provide evidence to the Owner's Representative that the Owner has received all accessories and equipment as required before final review can occur.
- C. Final acceptance and start of warranty period will occur no earlier than the end of the plant maintenance period.
- D. For time of final review, Contractor shall arrange a meeting with the Owner's maintenance personnel to demonstrate the operation of the irrigation systems automatically in order to verify acceptance and to familiarize the maintenance personnel with the system and recommended programming.

END OF SECTION

SECTION 02820

FENCES AND GATES

PART 1 - GENERAL

1.01 SUMMARY

- A. All materials and work required for the furnishing and installation of chain link fence, gates, barbed wire and appurtenances.
- B. Related Sections:
 - 1. Section 03300: Concrete Mixtures, Handling, Placing and Constructing

1.02 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. A53 Specification for Pipe, Steel Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 2. A121 Specification for Zinc-Coated (Galvanized) Steel Barbed Wire
 - 3. A702 Specification for Steel Fence Posts and Assemblies
- B. State of California, Department of Transportation, Standard Specifications, 2015 (Standard Specifications).

1.03 STANDARD SPECIFICATIONS

- A. All work and materials shall conform to the requirements of Section 80 of the Standard Specifications, except as modified herein. Paragraphs 80-3.03, 80-3.04, 80-4.03 and 80-4.04 do not apply. In case of any conflict between the Standard Specifications and the Contract Plans and Specifications, the latter shall control.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Submit in the Product Review category complete descriptive information and technical specifications on the chain link fence, gates, barbed wire and appurtenances.
- C. Product data including manufacturer's catalog cuts indicating material specifications and specified options.
- D. Shop drawings including layout of fences and gates with dimensions, details, and finishes of components, accessories, and post foundations.
- E. Samples including sample of fabric.

1.05 QUALITY ASSURANCE

- A. Contractor's Qualifications: An experienced installer who has designed and constructed chain-link fences and gates control systems similar in material, design, and extent to those indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Comply with requirements of local Fire Marshal Fire and Prevention Department having jurisdiction for emergency operation of gated entry points.
- C. Comply with applicable provisions in the CBC, adopted edition and the National Electrical Code (NEC).
- D. All work shall be in strict conformance with manufacturer's printed instructions and recommendations.
- E. ENGINEERING RESPONSIBILITY: Preparation of data for chain-link fences and gates, gate control systems including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

1.06 STRUCTURAL PERFORMANCE

- A. Provide chain-link fences and gates capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. MINIMUM POST SIZE AND MAXIMUM SPACING FOR WIND VELOCITY PRESSURE: Determine based on mesh size and pattern specified, and on the following minimum design wind pressures and according to CLFMI WLG 2445:
 - a. Wind Speed: _____ mph.
 - b. Fence Height: As shown on the Drawings.
 - c. Line Post Group: IA, ASTM F1043, Schedule 40 steel pipe.
 - d. Wind Exposure Category: _____.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in good condition and properly protected against damage to factory-finished surfaces.
- B. Store materials in a clean, dry location. Cover with protective materials to avoid damage, especially from dust, chemicals, and moisture in the air.
- C. Handle materials carefully on the job site to protect factory finishes.

PART 2 - PRODUCTS

2.01 CHAIN LINK FENCING

- A. Chain link fence fabric shall be 6'-0" high, except for 4'-0 feet high section mounted on top of the lower soil nail wall, as shown on Drawings and shall conform to Section 80-4.01B of the Standard Specification, unless noted otherwise herein.

Fabric for 6'-0" high fence shall have twisted top and knuckled bottom selvages.

Fabric for 4'-0" high fence shall have knuckled top and bottom selvages.

1. Chain Link Fence Fabric: PVC coated over galvanized steel wire.
 2. Galvanized Steel Core Wire: ASTM A 641, tensile strength 75,000 psi with 0.30 oz./sq.ft. zinc for 11 gage wire.
 2. PVC Coating: ASTM F 668, Type 2B, 7 mil thermally fused polyvinyl chloride.
 3. PVC Coating Color: Black.
 4. Size: Helically wound and woven to height as indicated on Drawings with 2 inch mesh and 11 gage wire with diameter of 0.120 inch and breakload strength of 850 lb.
- B. Unless otherwise shown on the Drawings, the fence shall have top rail and bottom tension wire, and outbound extension arms with three strands of barbed wire.
- C. Fence posts, braces and top rails shall be Schedule 40 galvanized steel pipe ASTM F 1083 or ASTM F 669, Group IC. Line posts shall be 2 inches in diameter. Corner and end posts shall be 2-1/2 inches in diameter. Gate posts shall be a minimum of 4 inches in diameter. Braces and top rails shall be 1-1/4-inches in diameter. Posts shall have galvanized caps to exclude moisture. Truss rods shall be 3/8-inch-diameter galvanized steel. Turnbuckles, tension wires, tie wires and hog rings shall conform to Section 80-4.01C of the Standard Specifications. Steel fence framing shall have PVC coated finish in accordance with ASTM F 1234, 10 – 14 mils in black color to match chain link fabric.
- D. Barbed wire shall conform to ASTM A121, Class 3, 13-3/4 gauge wire with 4-point round barbs.
- E. Concrete foundations for fence posts shall be as detailed on the Drawings and as specified in Section 03300.

2.04 GATES

- A. Gates shall be installed in the sizes and at the locations as shown on the Drawings. Steel gate framing and fabric shall have PVC coated finish in accordance with ASTM F 1234, 10 – 14 mils in black color to match chain link framing and fabric.
- B. Unless shown otherwise on the Drawings, gates in chain link fence shall be of the same height as the adjacent fence. Fabric shall conform to Section 80-4.01B of the Standard Specifications. Gates shall be in accordance with Section 80-4.01D of the Standard Specifications, except as modified herein. Gate frames shall be of all welded construction and shall be hot-dip galvanized after construction. Top and bottom horizontal rails and vertical end members shall be 1-1/2-inch-diameter Schedule 40 steel pipe, ASTM F 1083 or ASTM F 669, Group 1A. On gates more than 8 feet wide, equally spaced interior vertical members of 1-1/2-inch-diameter Schedule 40 steel pipe shall be added such that no gate frame panel will be more than 8 feet wide. Gate frames shall have 3 strands of barbed wire across the top. Gates shall be furnished complete with all necessary hardware, including hinges, latches and stops.
1. Swinging Gates: All swinging gate panels shall be cross trussed with 3/8-inch-diameter truss rods with turnbuckles. Gates shall be hinged to swing open 180 degrees. All gates shall be furnished with a keeper and a plunger-bar type

latch with provision for a padlock. On double swing gates the plunger-bar shall drop into a buried center stop when the gate is closed. Latches and padlocks shall be accessible from both sides of the gate.

PART 3 - EXECUTION

3.01 INSTALLATION OF CHAIN LINK FENCING

- A. Install chain link fencing and gates at the locations shown on the Drawings and in accordance with Section 80-4.02 of the Standard Specifications. Chain link fabric and barbed wire shall be stretched with mechanical equipment.
- B. The area to be fenced shall be uniformly and smoothly finish graded before beginning the fence installation. Fence shall be installed after roadway surfacing has been completed. Except where crossing a drainage ditch, the finish grade shall not deviate from a straight line by more than 3 inches. Where crossing a drainage ditch, a line post shall be provided at the top of slope on each side and the fabric shall follow a straight line between the posts. Within the ditch, short post sections shall be embedded to a depth of 4 feet at a maximum spacing of 12 inches on center across the ditch. Posts shall be long enough to overlap the fabric by 12 inches, and each post shall be fastened to the fabric by a minimum of 3 tie bands.
- C. Corner and end post assemblies and the panels on each side of all gates shall be as detailed on the State of California, Department of Transportation, Standard Plans, Plan A85. Line posts at 1,000-foot maximum intervals shall have top braces and cross truss rods with turnbuckles as detailed on Standard Plan A85 even though fabric is stretched with mechanical equipment. Top brace shall remain in place after fence is completed.
- D. All posts shall be embedded into the ground in concrete footings as shown on the Drawings. Allow concrete footings to cure for seven days before installing fence.
- E. Fence fabric shall be securely fastened to the outward side of the posts with the lower edge at the ground level. Fencing and gates shall be properly braced to prevent sagging.
- F. Demonstrate that all gates swing smoothly or roll freely without binding or dragging, that all gates are lockable, and that all gate hardware operates properly. Demonstrate that all automatic gate operators function properly.
- G. Surplus excavated material remaining after the fence has been constructed shall be disposed of as specified in Section 01140.

END OF SECTION

SECTION 02900

PLANTING

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Provide planting work and planting maintenance complete as shown on the drawings and as specified including staking and layout of the landscaping and soil sampling as required by the State of California Model Water Ordinance.
- B. Related work specified elsewhere includes:
 - 1. Section 02100, SITE PREP & PLANT PROTECTION
 - 2. Section 02301, EARTHWORK
 - 3. Section 02810, IRRIGATION

1.02 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. Ordinances and Regulations: All local, municipal and state laws, codes and regulations governing or relating to all portions of this work are hereby incorporated into and made a part of these Specifications. Anything contained in these Specifications shall not be construed to conflict with any of the above codes, regulations or requirements of the same. However, when these Specifications and Drawings call for or describe materials, workmanship or construction of a better quality, higher standard than is required by the above mentioned codes and regulations, the provisions of these Specifications and Drawings shall take precedence. Furnish without extra charge additional materials and labor required to comply with above rules and regulations.
 - 2. Contractor shall be familiar with and follow the State of California Model Water Ordinance, California Code of Regulations, Title 23 Waters, Division 2, Department of Water Resources, Chapter 2.7. Also, the Contractor is responsible to follow all local water ordinances and the Soil Management/Analysis Report with verifying implementation.
 - 3. "Sunset Western Garden Book," Lane Publishing Co., Menlo Park, California; current edition.
 - 4. "American Standards for Nursery Stock," American Association of Nurseryman, 230 Southern Building, Washington, D.C. 20005.
 - 5. US Composting Council Compost analysis Program (CAP)
 - 6. Test Methods for the Evaluation of Composting and Compost (TMECC)
 - 7. International Society of Arboriculture, Guide for Plant Appraisal, latest version.
 - 8. United States Composting Council (USCC) Seal of Testing Assurance (STA) program.
 - 9. TMECC: Refers to "Test Methods for the Examination of Composting and Compost," published by the United States Department of Agriculture and the United States Compost Council (USCC).
 - 10. Manufacturer's recommendations.

- B. Qualifications:
1. Experience: Assign a full-time employee to the job as foreman for the duration of the Contract who is certified landscape technician, certification through CLCA or minimum of four (4) years experience in landscape installation and maintenance supervision, with experience or training in turf management, entomology, pest control, soils, fertilizers and plant identification.
 2. Labor Force: Provide a landscape installation and maintenance force thoroughly familiar with, and trained in, the work to be accomplished to perform the task in a competent, efficient manner acceptable to the Owner.
- C. Requirements:
1. Supervision: The foreman shall directly supervise the work force at all times and be present during the entire installation. Notify Owner's Representative of all changes in supervision.
 2. Identification: Provide proper identification at all times for landscape maintenance firm's vehicles and a labor force uniformly dressed in a manner satisfactory to Owner's Representative.
- D. Plant Material Standards
1. Quality and Size of Plants: Conform to the State of California Grading Code of Nursery Stock, No. 1 grade and American Standards for Nursery Stock," American Association of Nurseryman. Use only nursery-grown stock which is free from insect pests and diseases.
 2. Comply with federal and state laws requiring inspection for plant diseases and infestations. Submit inspection certificates required by law with each shipment of plants, and deliver certificates to the Owner. Obtain clearance from the County Agricultural Commissioner as required by law, before planting plants delivered from outside the County in which planted.
- E. Coordinate plant locations with irrigation emitter locations.
1. Adjust plant locations in relation to the subsurface emitter s as required to ensure that the plant roots receive the proper amount of water in order for it to thrive.
 2. Coordinate planting and irrigation and provide hand watering of emitter irrigated and drip irrigated areas as required to maintain moist root zones throughout plant establishment period.
- F. Damage from Deer, Rodents, Insects and Disease
1. Investigate planting for signs of damage from Deer, Rodents, Insects and Disease and provide repellents, barriers, or treatment and/or replacement upon discovery. Replace all damaged plants as described below in PLANTING ESTABLISHMENT MAINTENANCE.

1.03 SUBMITTALS, per Section 01300

- A. Submit to the Owner's Representative, Manufacturer's current catalog cuts and technical data sheets of the following:
1. Fertilizers
 2. Iron Sulfate
 3. Tree Ties /Support
 4. Erosion Control Netting

- B. Plants and Seeding Samples: Submit following planting samples along with certificates of compliance / analytical data from suppliers for degree of compliance and recommendations:
 - 1. Plants: Submit typical sample of each plant variety, or entire plant quantity to site for approval by Owner's Representative.
 - 2. Certificates of compliance for Hydroseed Mixes, Mulch and Tackifier for Erosion Control Seeding.
 - 3. Plant Photographs: Prior to shipping plants, provide color photographs in digital format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery. Review and acceptance of any or all of the photographs does not signify that those plants are acceptable, and until the plants are inspected by the Owner's Representative on site will acceptance of the plants be determined.
- C. Soil Amendment and Mulch Sample and Analysis Reports:
 - 1. Organic Mulch: Submit 1-pint sample with source and list of ingredients.
 - 2. Rock Mulch: Submit 1-pint sample(s) and source.

1.04 PROJECT/SITE CONDITIONS

- A. Site Visit: At beginning of work, visit and walk the site with the Owner's Representative to clarify scope of work and understand existing project/site conditions.
- B. Protection of Plants from Deer: Contractor shall be responsible for protection of all planting from deer and rodents as described in Part 3- Execution.

1.05 WARRANTY AND REPLACEMENT

- A. Warrant all plants and planting to be in a healthy, thriving condition until the end of the maintenance period, and deciduous trees, shrubs and vines beyond that time until active growth is evident.
- B. Replace all dead and damaged plants and plants not in a vigorous condition immediately upon discovery and as directed by the Owner's Representative at Contractor's expense. Install replacement plants before the final acceptance at the size specified.
- C. Warrant all plant material for a period of one year after final acceptance of the maintenance period against plant materials with defects at the time of installation.
- D. Warrant plant installation and maintenance by Contractor against defects for a period of one year.

PART 2 - PRODUCTS

2.01 PLANTS

- A. Plant the variety, quantity and size indicated. The total quantity tabulated on the drawings are considered approximate and furnished for convenience only. Contractor shall perform his/her own plant quantity calculations and shall provide all plants shown on the Drawings. If plants are shown on the Drawings but are not identified, Contractor shall provide plants of similar size and variety to nearby identified plants at no additional cost to the Owner.
- B. Measure trees and shrubs with branches in normal position. Height and spread dimensions indicated refer to the main body of the plant, and not from branch tip to tip.
- C. Tag plants of the type or name indicated and in accordance with the standard practice recommended by the American Association of Nurserymen.
- D. Install healthy, shapely and well rooted plants with no evidence of having been root-bound, restricted or deformed.
- E. Ensure that the plants arrive at the site in proper condition for successful growth. Protect plants in transit from windburn and sunburn. Protect and maintain plants on site by proper storage and watering.
- F. Substitutions will not be permitted, except as follows:
 - 1. If proof is submitted to the Owner's Representative that any plant specified is not obtainable, a proposal will be considered for use of nearest equivalent size or variety with an equitable adjustment of contract price.
 - 2. Substantiate and submit proof of plant availability in writing to the Owner's Representative within 10 days after the effective date of Notice to Proceed.
- G. Tree Form: Trees shall have a symmetrical form as typical for the species/cultivar and growth form.
 - 1. Central Leader for Single Trunk Trees: Trees shall have a single, relatively straight central leader and tapered trunk, free of co dominant stems and vigorous, upright branches that compete with the central leader. Preferably, the central leader should not have been headed; however, in cases where the original leader has been removed, an upright branch at least $\frac{1}{2}$ the diameter of the original leader just below the pruning point shall be present.
 - 2. Potential Main Branches: Branches shall be evenly distributed radially around and appropriately spaced vertically along the trunk, forming a generally symmetrical crown typical for the species.
 - 3. Headed temporary branches should be distributed around and along the trunk as noted above and shall be no greater than $\frac{3}{8}$ " diameter, and no greater than $\frac{1}{2}$ diameter of the trunk at point of attachment.
- H. Tree Trunk
 - 1. Trunk diameter and taper shall be sufficient so that the tree will remain vertical without the support of a nursery stake.

2. Trunk shall be free of wounds (except properly-made pruning cuts), sunburned areas, conks (fungal fruiting-bodies), wood cracks, bleeding areas, signs of boring insects, galls, cankers and/or lesions.
3. Tree trunk diameter at 6" above the soil surface shall be within the diameter range shown for each container size below, except where shown otherwise:

<u>Container</u>	<u>Trunk Diameter in inches</u>	<u>Soil level from Container Top</u>
24" Box	1.5" to 2. 5"	2.25 to 3"

4. Tree trunks shall be undamaged and uncut with all old abrasions and cuts completely callused over. Do not prune plants prior to delivery.

I. Tree Roots

1. Trunk root collar (root crown) and large roots shall be free of circling and/or kinked roots. Contractor may be required to remove soil near the root collar in order to verify that circling and/or kinked roots are not present.
2. The tree shall be well rooted in the container. When the trunk is lifted the trunk and root system shall move as one and the rootball shall remain intact.
3. The top-most roots or root collar shall be within 1" above or below the soil surface. The soil level in the container shall be within the limits shown in above table.
4. The rootball periphery shall be free of large circling and bottom-matted roots.
5. On grafted or budded trees, there shall be no suckers from the root stock.

J. Shrubs

1. Each shrub must stand upright without support.
2. All container shrubs shall be free of girdling roots, defined as those roots greater than 1/8" diameter circling the periphery of the rootball. The top of the rootball shall be free of "Knees" (roots) protruding above the soil, and the bottom shall be free of matted roots.

2.02 SPECIAL HYDROSEED MIXES FOR EROSION CONTROL (Non-irrigated unless noted otherwise)

- A. Seed: Incorporate the following seed uniformly in hydromulch with tackifier at the specified rates per acre. Provide seed of the latest crop, labeled in accordance with the California Food Agricultural Code with the following ingredients per acre:

1. Hydroseed Mix:

a. HABITAT MIX

40 lbs. per acre

Bromus carinatus / Native California Brome

Elymus glaucus / Blue Wildrye

Hordeum californicum / California Barley

Festuca idahoensis / Idaho Fescue

Stipa pulchra / Purple Needlegrass

Poa secunda / Native Pine Bluegrass

b. CALIFORNIA NATIVE WILDFLOWER MIX

8 lbs. per acre

Achillea millefolium / White Yarrow

Clarkia elegans / Elegant Clarkia

Collinsia heterophylla / Chinese Houses
 Eschscholzia californica / California Poppy
 Gilia capitata / Globe Gilia
 Lasthenia glabrata / Goldfields
 Layia platyglossa / Tidy Tips
 Linum lewisii / Blue Flax
 Lupinus microcarpus / "Ed Gedling" Golden Lupine
 Lupinus succulentus / Arroyo Lupine
 Nemophila menziesii / Baby Blue Eyes
 Phacelia campanularia / California Blue Bells
 Triphysaria versicolor / Yellow Owl's Clover

Wood Fiber: As specified below, minimum 2,000 lbs/acre
 Fertilizer (16-20-0): 500 lbs/acre
 Stabilizer: As provided with Hydroseed Mulch with Tackifier specified below,
 minimum 100 lbs/acre

As available from Pacific Coast Seed, Livermore, CA (925) 373-4417; Delta
 Growers Seed, Stockton, CA (209) 931-0684 and others.

- B. Seeds of Legumes: Inoculated with pure culture of nitrogen-fixing bacteria prepared specifically for legume species in accordance with inoculant manufacturer's instructions.
- C. Seed Certification: All seed shall be in conformance with the California State Seed Law of the Department of Agriculture. Each seed bag shall be delivered to the site sealed and clearly marked as to species, purity, percent germination, dealer's guarantee, and dates of test. In addition, the container shall be labeled to clearly reflect the amount of Pure Live Seed (PLS) contained. Prior to seeding at the request of the owner, the contractor shall provide a letter of certification, original Association of Official Seed Analysts (AOSA) seed test results, and calculations of PLS content.
- D. Seed Inoculation: All legume seed shall be pellet-inoculated and provided in Bulletin AXT-280 of the University of California Cooperative Extension, "Pellet Inoculation of Legume Seed." Inoculant sources shall be species specific and shall be applied at a rate of 2 pounds of inoculant per one hundred pounds of seed.
- E. Fiber Mulch with Tackifier: "Conwed Fibers Flex Terra" at the rate of 4000 lbs. per acre, Buffalo Grove, IL, (800) 366-1180; EcoFiber; or equal fibrous, wood cellulose with tackifier containing no growth or germination inhibiting factors and manufactured in such a manner that after addition and agitation in slurry tanks with fertilizer, seed, water and other approved additives, the fibers in the material become uniformly suspended to form a homogeneous slurry; and that when hydraulically sprayed on the ground, the material forms a blotter-like ground cover impregnated uniformly with seed; and which, after application, allows the absorption of moisture and rainfall to percolate to the underlying soil. The fibrous mulch in its air-dry state shall contain not more than 15% by weight of water. The fiber shall have a temporary green dye and shall be accompanied by a certificate of compliance stating that the fiber conforms to these specifications.

- F. The Tackifier/Stabilizer: Shall be an organic substance supplied in powder form and shall be psilium-based and packed in clearly marked bags stating the contents of each package. The California Department of Food and Agriculture shall certify the material as an Auxiliary Soil Chemical.
- G. Hydroseed Fertilizer: Hydroseed fertilizer to be used in the slurry shall be commercial fertilizers conforming to the requirements of the California Food and Agricultural Code; uniform in composition, with a guaranteed chemical analysis of 16% Nitrogen, 20% Phosphoric Acid, and 0% Potash (16-20-0) plus Sulfur (approximately 15%).

2.03 FERTILIZERS

- A. Commercial fertilizer, pelleted or granular form, conform to the requirements of Chapter 7, Article 2, of the Agricultural Code of the State of California for fertilizing materials as follows:
 - 1. Type A:
21 gram planting tablets 20% Nitrogen, 10% Phosphoric Acid and 5% Potash (20-10-5) available from Agriform or 10gm BestPacks packets 20% Nitrogen, 10% Phosphoric Acid and 5% Potash (20-10-5) available from Best Fertilizer Co.
 - 2. If commercial fertilizer having this analysis is not obtainable, other similar commercial fertilizer may be used providing it meets the approval of the Owner's Representative.
- B. IRON SULFATE: Agricultural dry form

2.04 ORGANIC AMENDMENT: For use with in situ soils (on-grade). See EARTHWORK 02301

2.05 PLANT BACKFILL: Except for acid loving plants (Azaleas, Rhododendrons, Ferns, Camellias, etc.), use a mixture of 2 parts soil from the hole, and 1 part amendment with iron added at the following rates:

- 1.

<u>Size</u>	<u>Rate</u>
1 gallon can plants	iron, 1/4 cup
5 gallon can plants	iron, 1/3 cup
15 gallon can plants	iron, 1/2 cup
24" box and larger	iron, 1 cup
- 2. Mix the iron, amendment and soil thoroughly for use only in the top 8 inches of backfill around plants. For acid loving plants, mixture to be 1/2 soil from the hole and 1/2 amendment only in the top 8 inches.

2.06 MULCH

- A. Crushed Rock Layer:

1. 3/4-inch #4 Crushed rock layer, no fines.
 - B. Submittal: Submit samples of rock mulch to the Owner's Representative for approval within two weeks of award of Contract. Resubmit until acceptable to Owner, at no extra cost.
- 2.07 TREE SUPPORT POLES (ON-GRADE PLANTING): Peeled lodge pole pine logs, clean, smooth, new, and sized as follows:
- A. Support poles for trees up to 36" box size.
 - B. Type: Peeled lodge pole pine logs, clean, smooth, new, and sized as follows:
 1. Three-inch (3") diameter by eight to ten feet (8' - 10') long for trees greater than 8' high and 1-1/2" and larger caliper.
- 2.08 TREE TIES
- A. Rubber strap, 24-inch minimum length without sharp edges adjacent to trunk, V.I.T. cinch-tie, Dublin, CA, (818)882-9530, or approved equal.
- 2.09 EXISTING PLANTING SOIL (TOPSOIL): See EARTHWORK 02301
- 2.10 IMPORTED PLANTING SOIL (TOPSOIL): See EARTHWORK 02301
- 2.11 EROSION CONTROL NETTING
- A. New, with a uniform, open plain-weave, flame-retardant mesh. The mesh shall be natural brown-tan and made from unbleached single jute yarn. The yarn shall be of loosely twisted construction and shall not vary in thickness by more than one-half its normal diameter. Furnish jute mesh in rolled strips to meet the following requirements:
 1. Width: 48 inches, with a tolerance of one-inch wider or narrower.
 2. Not less than 78 warp ends per width.
 3. Not less than 41 weft ends per yard.
 4. Weight shall average 1.22 pounds per linear yard, with a tolerance of 5 percent heavier or lighter.

PART 3 - EXECUTION

3.01 FINE GRADING AND SOIL PREPARATION. See EARTHWORK 02301

3.02 PLANTING SOIL PLACEMENT. See EARTHWORK 02301

3.03 EROSION CONTROL NETTING

- A. Verify finished grades and provide Jute Mesh over the mesh on all slopes 3:1 and steeper as accepted by the Owner's Representative. Install jute mesh loosely up and down the slope in accordance with manufacturer's specifications and as follows. Fit the soil surface contour and hold in place with 12-inch long, 11-gauge (minimum) steel wire staples driven vertically into the soil at 18- to 24-inch spacing. Jute mesh strips shall overlap along all edges at least 6 inches. Ends of side strips shall be buried into the soil at least 6 inches. Drive staples along edges to securely anchor mesh to ground.

3.04 TREE AND SHRUB PLANTING

- A. Mark tree and shrub locations on site using stakes, gypsum or similar approved means and secure location approval by the Owner's Representative before plant holes are dug. Review location of plants in relationship to irrigation heads.
- B. Test drainage of plant beds and pits by filling with water (minimum 6"). The retention of water in planting beds and plant pits for more than two (2) hours shall be brought to the attention of the Owner's Representative. If rock, underground construction work, tree roots, poor drainage, or other obstructions are encountered in the excavation of plant pits, alternate locations may be selected by Owner's Representative.
- C. Excavate tree, shrub and vine pits as follows:

<u>Excavation for</u>	<u>Width</u>	<u>Depth</u>
Boxed Trees	Box + 24"	depth of Box
Canned Trees (15 gc)	Can + 18"	depth of Can
Canned Shrubs (1 or 5 gc)	Can + 12"	depth of Can
- D. Square Tree Pits
 - 1. Drilled tree pits shall be modified to a square pattern with pit walls scarified to promote root penetration.
- E. Break and loosen the sides and bottom of the pit to ensure root penetration and water test hole for drainage as required above.
- F. Backfill plant holes with mix as specified, free from rocks, clods or lumpy material. Backfill native soil free of soil amendments under rootball and foot tamp to prevent settlement. Backfill remainder of the hole with soil mix and place plant tablets or packets 3 inches below finish grade and 1/2-inch from roots at the following rates:

1.	<u>Size</u>	<u>Rate</u>
	1 gallon can plant -	1 tablet or packet
	5 gallon can plant -	3 tablets or packet
	15 gallon can plant -	6 tablets or packet
	24-inch box plant -	6 tablets or packet
	36-inch box plant -	8 tablets or packet

- G. Carefully remove and set plants without damaging the rootball. Superficially cut edge roots vertically on three sides. Remove bottom of plant boxes before planting. Remove sides of boxes after positioning the plant and partially backfilling.
- H. Set plants in backfill with top of the rootball 2 inches above finished grade. Backfill remainder of hole and soak thoroughly by jetting with a hose and pipe section. Water backfill until saturated the full depth of the hole.
- I. Build 6" high watering basin berms around trees and shrubs to drain through rootball.
- J. Stake and/or guy trees as detailed and noted herein. Drive stake(s) until solid (at least 12" beyond bottom of rootball) and remove excess stake protruding above top tree tie to prevent rubbing against branches. Avoid driving stakes through rootball. If subgrade does not accept stakes to a stable degree, delete stakes and guy the trees as specified herein and as detailed. Locate tree ties to avoid contact with tree branches. Locate top tie at tree flex point.
- K. Guy Trees using 3 cables with below grade anchors and rubber collars secured with cable clamps.
- L. Remove any soil from top of plant rootballs and secure Owner's Representative's approval of rootball height prior to mulching.
- M. After approval of rootball height, install mulch as required below.

3.05 MULCH – CRUSHED ROCK ROOT PROTECTION

- A. Install rock mulch to a 2-inch depth over rootball. Install rock mulch to a 3-inch depth outside rootball as detailed.

3.06 HYDROSEED

- A. Hydroseed Application:
 - 1. General: All hydroseed applications are to be applied in a sweeping motion to form a uniform application and form a mat at the specified rates.
 - 2. Two-Step Hydroseed Application:

Step one:

<u>Lbs/Ac</u>	<u>Material</u>
2,000	Hydrstraw, or equal
500	Fertilizer
Varies	Seed as per mix specification

60	AM120 Mycorrhizal Inoculant
100	Organic Stabilizer – M Binder or equal

Step two:

2,000	Hydrostraw, or equal
1,000	Organic Stabilizer – M Binder or equal

3. Protection, handling of unused loads and reseeding as per seeded turf section above

3.07 WATERING

- A. Water all trees and shrubs immediately after planting. Apply water to all plants in sufficient amounts as conditions require to maintain the plants in a healthy vigorous growing condition until completion of the Contract. Do supplemental hand watering of plants as required to maintain optimum moisture in the root zones.

3.08 PRE-MAINTENANCE PERIOD REVIEW AND APPROVAL OF PLANTING

- A. Maintain plants from time of delivery to site until final acceptance of landscape installation.
- B. Receive approval of the installed planting prior to commencement of planting establishment maintenance period. Notify the Owner's Representative a minimum of seven (7) days prior to requested review. Before the review, complete the following:
 1. Complete all construction work.
 2. Present all planted areas neat and clean with all weeds removed and all plants installed and appearing healthy.
 3. Plumb all tree stakes.
 4. No partial approvals will be given.

3.09 PLANTING ESTABLISHMENT MAINTENANCE

- A. General Requirements:
 1. Maintenance Period: The planting establishment maintenance period required shall be 90 calendar days after all planting is complete and installation approved. The maintenance period may be suspended at any time upon written notice to the Contractor that the landscaping is not being acceptably maintained, and the day count suspended until the landscape is brought up to acceptable standards as determined by the Owner's Representative.
 2. Planting establishment maintenance immediately follows, coincides with, and is continuous with the planting operations and after all planting is complete and accepted; or longer where necessary to establish acceptable stands of thriving plants.
 3. Keep all paved areas clean. Keep the site clear of debris resulting from landscape work and maintenance operations.

4. Check irrigation systems at each watering; adjust coverage and clean and repair non-functioning heads immediately. Adjust timing of irrigation controller to prevent runoff and flooding.
 5. Maintain adequate moisture depth in soil to ensure vigorous growth, without overwatering. Check rootball of trees and shrubs independent of surrounding soils and hand water as required.
 6. Keep Contract areas free from weeds by cultivating, hoeing or hand pulling. Use of chemical weed killers will not relieve the Contractor of the responsibility of keeping areas free of weeds over 1-inch high at all times.
- B. Plant Protection and Replacement
1. Protect all areas against damage, including erosion, trespass, insects, rodents, deer, disease, etc. and provide proper safeguards, including trapping of rodent and applying protective sprays and fencing to discourage deer browsing. Maintain and keep all temporary barriers erected to prevent trespass.
 2. Repair all damaged planted areas. Replace plants immediately upon discovery of damage or loss, including damage from Deer and Rodents.
- C. Tree, Shrub and Ground Cover Maintenance:
1. Maintain during the entire establishment period by regular watering, cultivating, weeding, repair of stakes and ties, and spraying for insect pests. Prune when requested by the Owner's Representative.
 2. Keep watering basins in good condition and weed-free at all times.
 3. Replace all damaged, unhealthy or dead trees and shrubs with new stock immediately; size as indicated on the drawings.
- D. Non-irrigated Hydroseeded Erosion Control Areas: To be watered by winter rains unless noted otherwise.

3.10 FINAL PLANTING REVIEW AND ACCEPTANCE

- A. At the conclusion of the Maintenance Period, schedule a final review with the Owner, the Owner's maintenance person, and the Owner's Representative. On such date, all project improvements and all corrective work shall have been completed. If all project improvements and corrective work are not completed, continue the planting establishment, at no additional cost to the Owner, until all work has been completed. This condition will be waived by the Owner under such circumstances wherein the Owner has granted an extension of time to permit the completion of a particular portion of the work beyond the time of completion set forth in the Agreement.
- B. Submit written notice requesting review at least 10 days before the anticipated review.
- C. Prior to review, weed and rake all planted areas, repair plant basins, plumb tree stakes, clear the site of all debris and present in a neat, orderly manner.

END OF SECTION

SECTION 03100

CONCRETE FORMWORK AND FORMWORK ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Design, construction, and treatment of formwork to confine and shape concrete to the required dimensions.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 117 Standard Tolerances for Concrete Construction and Materials
 - 2. ACI 301 Specifications for Structural Concrete for Buildings
 - 3. ACI 306 Guide to Cold Weather Concreting
 - 4. ACI 318 Building Code Requirements for Structural Concrete
 - 5. ACI 347 Guide to Formwork for Concrete
- B. American Plywood Association (APA):
 - 1. Material grades and designations as specified in this Section.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Product Data:
 - 1. Formwork products: Submit technical data including installation instructions, independent laboratory test reports (ICC), handling and storage instructions.
 - a. Forms, if fabricated off construction site.
 - b. Form ties or through-bolts or coated ties, if utilized.
 - c. Form release agents.
 - d. Form coatings.
- C. Shop Drawings:
 - 1. Shop drawings and calculations for formwork beams sealed and signed by a licensed Civil or Structural Engineer in the State where the structures are being constructed.

1.04 QUALITY ASSURANCE

- A. Contractor Qualifications: See Section 03300.
- B. Construction Standard: Applicable requirements of the CBC, ACI 301, and ACI 318.
- C. Concrete Products and Materials Tests: Certified by independent commercial testing laboratories.
- D. Preconstruction Meeting: See Section 03300.

1.05 DEFINITIONS

- A. Exposed Concrete: A concrete wall, slab, beam or column which will have surfaces exposed to view in the finished work.

1.06 SYSTEM DESCRIPTION

- A. Formwork and Formwork Accessories Design Requirements:
 - 1. Design and engineer formwork. Sign and seal design calculations for formwork and formwork drawings by Licensed Civil or Structural Engineer in the state where the work will be done.
 - 2. Design formwork to withstand the pressure resulting from placement and vibration of concrete and to maintain specified tolerances. The design shall consider any special requirements due to the use of plasticized and/or retarded set concrete. Should satisfactory concrete placement require any changes in concrete mix design, the formwork shall be re-designed and modified as required for the changed mix designs.
- B. Formwork and Formwork Accessories Performance Requirements:
 - 1. Maximum deflection of facing materials reflected on concrete surfaces exposed to view shall be 1/240 of the span between structural members of the formwork, unless noted otherwise on Drawings.
 - 2. Design forms to construct a flat, uniform concrete surface requiring minimal finishing or repairs. Form design shall accommodate all of concrete mix designs being used by the Contractor.
 - 3. Conform forms for circular structures to the circular shape of the structure. Secure to forms as required or set for embedment as required, all sleeves, inserts, anchors, miscellaneous metal items, reglets, and other embedded items furnished under other Sections and required to be cast into concrete.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Lumber: Store all lumber, including plywood for forms, to prevent direct contact with the ground. Protect the stored lumber from the elements by a suitable covering, such as polyethylene film or waterproof building paper, suitably held in place.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Provide new materials meeting the requirements referenced in this Section.

2.02 FORMWORK PRODUCTS

- A. Formwork Materials:
 - 1. Provide form-facing materials that will meet the concrete finish requirements for formed surfaces of Section 03350.
 - 2. Use plywood, tempered concrete-form-grade hardboard, steel, plastic, paper, or other acceptable materials capable of producing the desired finish for form-facing materials.
 - 3. Use form-facing materials that will produce a smooth, uniform texture on the concrete.
 - 4. Do not use form-facing materials with raised grain, torn surfaces, worn edges, patches, dents, or other defects that will impair the texture of concrete surfaces.
 - 5. Provide facing-materials of clean, smooth surfaces of wood, plywood, metal, or other approved material.

6. Construct wood forms of sound lumber or plywood of suitable dimensions and free from knotholes and loose knots.
 7. Where used for exposed surfaces, dress and match boards.
 8. Furnish plywood with a waterproof, synthetic resin bonded face manufactured for formwork.
 9. Furnish steel forms that incorporate reinforcement, inserts, pipe fittings, box-outs, and other details shown on the Drawings without modification to these details.
- B. Formwork Accessories: Use commercially manufactured accessories for formwork accessories that are partially or wholly embedded in concrete, including ties and hangers. Do not use nonfabricated wire form ties. Moldings for chamfers and rustications and the recesses for joint sealants shall be smooth and of nonabsorbent material.

2.03 FORM TIES

- A. Form ties for Building or Other Structures:
1. Provide commercially manufactured steel rods or through-bolts, Cone-Snap Ties or taper ties capable of withstanding applied pressures.
 2. Other ties shall not be used.
 3. Provide form ties designed that when forms are removed, no metal shall remain within 1-1/2-inch to the finished concrete surface.

2.04 FORMWORK RELEASE AGENTS

- A. Use commercially manufactured formwork release agents that prevent formwork absorption of moisture, prevent bond with concrete, and do not stain the concrete surfaces. Coat forming surfaces using an effective, non-residual, bond breaking form coating unless otherwise noted.
- B. Do not use and formwork release agents that will impart any material or residue to the concrete surface detrimental or incompatible with any specified paint, concrete or architectural finish, adhesives, waterproofing system, plaster or coating system to be applied later. Do not use oil-based products on formed surfaces that are to be painted, coated, or bonded to other concrete.

PART 3 - EXECUTION

3.01 CONSTRUCTION AND ERECTION OF FORMWORK

- A. At construction joints, lap contact surface of the form sheathing for flush surfaces over the hardened concrete in the previous placement. Ensure formwork is placed against hardened concrete so that offsets at construction joints attain specified tolerances and minimize loss of mortar.
- B. Construct formwork so that concrete surfaces conform to the tolerance limits of ACI 117. The class of surface for offset between adjacent pieces of formwork facing material, as defined in ACI 117, shall be Class B for surfaces permanently exposed to view and Class D for surfaces that will be permanently concealed.
- C. Provide positive means of adjustment (such as wedges or jacks) of shores and struts. Do not make adjustments in the formwork after concrete has reached its

time of initial setting. Brace formwork securely against lateral deflection and lateral instability.

- D. To maintain specified tolerances, camber formwork to compensate for anticipated deflections in formwork during concrete placement. Set formwork and intermediate screed strips for slabs accurately to produce designated elevations and contours of the finished surface before removal of formwork. Ensure that edge forms and screed strips are sufficiently strong to support vibrating screeds or roller pipe screeds.
- E. When formwork is cambered, set screeds to a like camber to maintain required concrete thickness. Fasten form wedges in place after final adjustment of forms and before concrete placement.
- F. Anchor formwork to shores, supporting surfaces, or members to prevent upward or lateral movement of the formwork system before and during concrete placement.
- G. Construct formwork for wall openings to facilitate removal and to counteract swelling of wood formwork.
- H. Provide runways for moving equipment and support runways directly on the formwork or structural member without resting on the reinforcement.
- I. Place sleeves, inserts, anchors, and embedded items required for adjoining work or for support of adjoining work before concrete placement. Secure all embedments against displacement, fill voids in inserts to prevent entry of concrete, and isolate or coat surfaces of aluminum embedments to prevent reaction with the concrete.
- J. Place 3/4 in. minimum chamfer strips in the corners of formwork to produce beveled edges on permanently exposed surfaces including the top edges of walls, machinery bases and curbs. Do not bevel reentrant corners or edges of formed joints of concrete. Provide rounded top edges of sidewalks, walkways and where directed.
- K. Seal tie holes in formwork to prevent leakage where ties penetrate the formwork. Place taper form ties with the larger end on the side of the structure that will be in contact with liquid.
- L. Clean surfaces of formwork and embedded materials of mortar, grout, and foreign materials before concrete is placed.
- M. Cover surfaces of formwork with an acceptable material that will prevent bond with the concrete. A field applied formwork release agent or a factory-applied liner may be used. If a formwork release agent is used, apply to the surfaces of the formwork in accordance with the manufacturer's recommendations before placing reinforcement. Do not allow formwork release agent to puddle in the forms. Do not allow formwork release agent to contact reinforcement or hardened concrete against which fresh concrete is to be placed.
- N. Inspect formwork and remove deleterious material immediately before concrete is placed.
- O. Do not use earth cuts as forms for vertical or sloping surfaces.
- P. If inadequate support is provided by the forms, as evidenced by excessive deflection, formwork failure or leakage, remove placed concrete and replace.

- Q. Formed Surfaces:
 - 1. Ensure that the reinforcement has been favorably reviewed by the special inspector before closing up the wall forms.
 - 2. Provide exposed, unpainted concrete surfaces that are uniform in appearance and color. Apply non-staining form coating compound before placing the forms. Remove any excess coating with cloths. Scrape and clean any reused forms before coating again.
 - 3. Provide flush fitting caps over any unused form tie holes.
- R. Form Ties and Through-Bolts:
 - 1. Provide sufficient number and strength to prevent spreading of forms while placing concrete.
 - 2. Remove the removable portion immediately after stripping the forms. Avoid spalling the exposed concrete surfaces.
 - 3. Provide a separate support system for the curtains of reinforcing, with a minimum 1-inch clearance between rebar and form ties or bolts.
- S. Construction Joints:
 - 1. Ensure the end forms of walls are removable without releasing the side forms. Provide seals around reinforcement to prevent mortar leaks.

3.02 ALLOWABLE VARIATIONS FOR FORMED SURFACES

- A. General:
 - 1. Tolerances: ACI 301 and the relevant subsection of ACI 117 and as noted below:
 - 2. Set and maintain concrete forms to ensure that, after removal of the forms and prior to patching and finishing, no portion of the concrete work will exceed the tolerances. Measure variations in floor levels before removal of supporting shores.
 - 3. The specified variation for one element of the structure will not be applicable when it will permit another element of the structure to exceed its allowable variation.
- B. Variations in Size or Thickness:
 - 1. Footings:
 - a. Length and width: $\pm 1/2$ -inch
 - b. Reduction in thickness: 5%
 - 2. Slabs and walls:
 - a. Thickness of 6 inches or less: $+1/4$ -inch, -0-inch
 - b. Thickness of more than 6 inches: $\pm 1/4$ -inch
- C. Allowable Tolerances (Location, Lines and Grades):
 - 1. Horizontal misplacement or eccentricity of footings 2% of footing width, but no more than 1-inch
 - 2. Variation of vertical dimensions at all floor levels from specified position: $\pm 1/2$ -inch per 100-foot
 - 3. Variation of vertical dimensions from specified position: $\pm 1/4$ -inch
 - 4. Variation from level or from slopes specified for floors, ceilings, water channels and conspicuous lines $\pm 1/4$ -inch per 20 feet

5. Variation in location from specified position $\pm 1/4$ -inch
for sleeves, pits, floor, and wall openings:

3.03 REMOVAL OF FORMWORK

- A. When formed surfaces require finishing, remove forms as soon as removal operations will not damage concrete.
- B. Remove top forms on sloping surfaces of concrete as soon as removal will not allow concrete to sag. Perform needed repairs or treatment required at once and follow immediately with specified curing.
- C. Loosen wood formwork for wall openings as soon as loosening operations will not damage concrete.
- D. Do not damage concrete during removal of formwork for columns, walls, sides of beams, and other parts not supporting the weight of the concrete. Perform needed repair and treatment required on vertical surfaces at once and follow immediately with specified curing.
- E. Leave formwork and shoring in place to support construction loads and weight of concrete in beams, slabs, and other structural members until in-place strength of concrete is at least $f'c$.
- F. When removal of formwork or reshoring is based on concrete reaching the specified compressive strength, concrete shall be presumed to have reached this strength when test cylinders, field cured the same as the concrete they represent, have reached the compressive strength specified. Mold and cure cylinders in accordance with ASTM C31. Test cylinders in accordance with ASTM C39.
- G. When shores and other supports are arranged to allow form-facing material to be removed without allowing structural slabs or members to deflect, form-facing material and horizontal supporting members may be removed at an earlier age.
- H. Minimum duration after completion of concrete placement prior to removal of the formwork:
 - 1. Walls and wall or slab construction joints 12 hours
 - 2. Sides of beams and girders 12 hours
 - 3. Columns 12 hours
 - 4. Underside of suspended slabs, walkways, beams and girders 28 days, or 21 days and full design compressive strength verified by data from additional field cured cylinders.
- I. Construct formwork to permit easy removal.

3.04 FIELD QUALITY CONTROL

- A. Establish and maintain controls and benchmarks in an undisturbed condition until final completion and acceptance of the project.
- B. Variations from plumb and designated building lines shall not exceed the tolerances specified in ACI 117.
- C. Notify Owner when the forms are complete and ready for inspection at least 16 working hours prior to the proposed concrete placement.

- D. Concrete Placement:
1. Verify that forms and reinforcement are accurately placed and secured in position. Confirm that both forms and reinforcement have been favorably reviewed.
 2. Verify that tie wire ends have been bent back away from the forms.
 3. Verify that sleeves, castings, pipes, conduits, bolts, anchors, and other items required, are accurately and securely placed within or on the forms.
 4. Verify adequate vibrators are available.
 5. Verify construction and expansion joint faces have been prepared for the next concrete placement.
 6. Check that the mix design is compatible with the method of placement of the concrete, by pump or by batch.
 7. For wall placements, verify that the modified concrete mix required at construction joints is to be delivered.
 8. Verify the concrete delivered to site is satisfactory, including checks on the batch tickets, quality assurance tests and direct observation of the batches.
- E. Failure of the forms to comply with the requirements specified, or to produce concrete complying with requirements of this Section, shall be grounds for rejection of that portion of the concrete work. Rejected work shall be repaired or replaced at no additional cost to the Owner. Such repair or replacement shall be subject to the requirements of this Section.

END OF SECTION

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SECTION 03150

CONCRETE JOINTS AND ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Construction of joints in concrete, including materials and accessories.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 318 Building Code Requirements for Structural Concrete
- B. ASTM International (ASTM) Standard Specification or Test Method:
 - 1. ASTM A167 Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
 - 2. ASTM A675 Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
 - 3. ASTM C881 Epoxy-Resin-Base Bonding Systems for Concrete
 - 4. ASTM C920 Elastomeric Joint Sealants
 - 5. ASTM D1056 Flexible Cellular Materials - Sponge or Expanded Rubber
 - 6. ASTM D1751 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction. (Non-extruding and Resilient Bituminous Types)
 - 7. ASTM D1752 Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
 - 8. ASTM E96 Water Vapor Transmission of Materials
- C. California Building Code (CBC) 2022 Edition.
- D. International Code Council (ICC)

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Product Data: Submit technical data including installation instructions, independent laboratory test reports (ICC), handling and storage instructions.
 - 1. Expansion joint materials
 - 2. Premolded joint filler
 - 3. Bond breakers and bond breaker tape
 - 4. Joint sealants
 - 5. Epoxy bonding compounds
 - 6. Other joint accessories
- C. Shop Drawings:
 - 1. Location and details of construction, expansion, and contraction joints.
 - 2. Construction joint layout; coordinate with Section 03100.
 - 3. Sequence of concrete wall and slab pours.

- 4. Program and method of concrete placement.
- D. Quality Control Certifications
 - 1. Certification that all materials used within the joint system are compatible with each other.

1.04 QUALITY ASSURANCE

- A. Contractor Qualifications: See Section 03300.
- B. Preconstruction Meeting: See Section 03300.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Provide new materials. All materials used together in a given joint shall be compatible with one another. Coordinate selection of suppliers and products to provide compatibility. Do not use asphaltic bond breakers or asphaltic joint fillers in joints receiving sealant.

2.02 PREFORMED JOINT FILLER

- A. Structures Retaining Water or Earth: ASTM D1056, Type 2, Class C, Grade 5. Neoprene sponge rubber, closed cell, resistant to oil, medium swell, firm. Supply premolded product, Durafoam DK5151; equivalent product by Armacell; or equal.
- B. Miscellaneous Structures Above Grade: ASTM D1752 Type 1, 1-inch thick unless indicated otherwise on drawings.
- C. Separation joints between structures: Compressible Joint Filler: The joint filler shall be a non extruded watertight strip material used to fill joints between structures. The material shall be capable of being compressed at least 40 percent for 70 hours at 68 degrees F and subsequently recovering at least 20 percent of its original thickness in the first 1/2 hour after unloading. Compressible Joint filler shall be Evazote 380 E.S.P, by E-Poxy Industries, Inc., Ravena, NY; Evazote by Capital Services, Albany, NY; or equal.

2.03 BOND BREAKER

- A. Bond breaker tape shall be an adhesive backed glazed butyl or polyethylene tape which will satisfactorily adhere to the preformed joint filler or concrete surface as required. The tape shall be the same width as the joint.
- B. Bond breaker for concrete other than where tape is specifically called for on the drawings shall be either bond breaker tape or a nonstaining type bond prevention coating such as Super Bond Breaker WB by Burke Co.; Silcoseal 87, by Nox-crete Inc., or equal.

2.04 JOINT SEALANTS

- A. General: ASTM C920, polyurethane, grade and class appropriate for use. Provide a compatible primer when recommended by the manufacturer.
- B. Provide an acceptable bond-breaking tape as recommended by the sealant manufacturer.

- C. Exterior Exposure: Sikaflex-2c, by Sika Corp., Select Seal U-200 by Select Products Corp., or equal.
- D. Prepare surfaces and provide primer and sealants in strict accordance with manufacturer's recommendations.
- E. Backing Rod: Extruded, closed cell, polyethylene foam rod, compatible with sealant. Provide 5/8-inch-diameter rod for 1/2-inch joint, 1-1/4-inch rod for 1-inch joint.

2.05 SOURCE QUALITY CONTROL

- A. Forms: Verify that components pre-assembled offsite are satisfactory for the purpose. Verify that designs, products and samples have been submitted for Product Review.

PART 3 - EXECUTION

3.01 CONCRETE JOINTS

- A. General:
 - 1. Provide joints:
 - a. As shown on the Drawings and as noted below in these Specifications.
 - b. As required for constructability.
 - c. After favorable review of layout, sequence and concrete placement program.
 - d. Position and support joint materials, and other embedded items to prevent displacement. Fill voids in sleeves, inserts, and anchor slots temporarily with readily removable material to prevent entry of concrete into voids. Embedded items shall be free of all mud, oil, loose rust, or other material that might inhibit bond.
 - 2. Provide minimum curing times before the second placement:
 - a. 10 days after each adjacent concrete placement for infill pours (i.e. in-between two existing sections) or checkerboard (existing concrete on two or more sides) placement patterns.
 - b. 2 days after the first concrete placement at the joint.
 - 3. During placement of the new concrete, ensure there are no interruptions to the 14-day curing time and 14-day load restriction plan for the adjacent pours.
- B. Control Joints:
 - 1. Space typical control joints in slabs on grade or suspended slabs not exceeding 10 feet, or as shown on the Drawings. Control joints shall not be provided in water containment structures.
 - 2. If cast-in with the concrete, positively locate the preformed joint filler and hold rigidly in place during concreting.
 - 3. If saw-cut, use a wheeled power saw as soon as the concrete surface is firm enough. Saw-cut control joints must be constructed within 12 hours after concrete placement. Fill the groove with sealant over a backer rod.
- C. Construction Joints:
 - 1. Produce quality concrete, with full continuity of reinforcing and water tightness across the joints.

2. Locate horizontal joints in walls and columns at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs.
 3. Place beams, girders, haunches, drop panels, and capitals monolithically as part of a slab system, unless otherwise noted.
 4. Locate joints such that beams, girders, or slabs supported by columns or walls will not be cast until concrete in the vertical support members is no longer plastic.
 5. Make joints perpendicular to the main reinforcement.
 6. Space typical slab joints not exceeding 20 feet in the direction of the transverse or secondary reinforcing, typically the smaller reinforcing nearer to the center of the slab thickness. Space typical vertical wall joints no more than 30 feet apart.
 7. After the first concrete placement at the joint, do not walk on or disturb any reinforcing extending into the second placement area for at least 48 hours.
 8. Before depositing new concrete on or against concrete that has hardened, remove laitance and thoroughly clean and roughen the entire surface of the joint exposing clean coarse aggregate solidly embedded in mortar matrix. Provide typically 1/4-inch roughness or amplitude of the concrete surface measured from the top of the exposed aggregate to the bottom of pockets between stones.
 9. Drench the prepared joint with clean water and remove prior to the concrete pour.
 10. Use special care in vibrating adjacent to construction joints to ensure thorough consolidation of the concrete against the hardened portion of the joint. Additional hand tamping may be required.
 11. For joints that are shown on architectural drawings as having a continuous reveal or recess, leave the wood form or pour strip used to create the reveal or recess in place or re-insert before roughening. Prevent the next concrete placement from filling the reveal or recess.
- D. Expansion Joints:
1. Stop all steel reinforcing clear of the joint at each side.
 2. Provide preformed joint filler, securely fastened to the existing concrete as directed by the Manufacturer.
 3. Install bond breaker tape and a joint sealant applied in a suitable groove or recess at each accessible face after curing is completed and when directed.
 4. Tape all joints in the premolded joint filler to prevent intrusion of mortar.
- E. Bonding to Pre-existing Concrete: Mechanically roughen the old surface to a 1/4-inch amplitude, as defined in construction joint paragraph above. Apply epoxy bonding system material prior to concreting and in accordance with the manufacturer's instructions.
- F. Compressible Joint Filler: Install compressible joint filler in conformance with the manufacturer's recommendations; including surface preparation, adhesive installation, heat welding and set time.
- G. Smooth Dowels: Install smooth dowels used at movement joints at right angles to the surface of the joint. Align dowels and secure to prevent displacement during concrete placing. Install expansion caps and apply bond breaker at one end of the dowel as indicated on the Project Drawings.

3.02 FIELD QUALITY CONTROL

A. See Sections 03100 and 03300.

END OF SECTION

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SECTION 03200

CONCRETE REINFORCEMENT, REINFORCEMENT SUPPORTS, AND ANCHOR BOLTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Materials, fabrication, placement, and tolerances of reinforcement and reinforcement accessories.
 - 2. Foundation anchor bolts.

1.02 REFERENCES

- A. ASTM International (ASTM) Standard Specifications:
 - 1. ASTM A615: Deformed and plain billet - steel bars for concrete reinforcement
 - 2. ASTM F1554: Anchors Bolts, Steel, 36, 55, and 105-ksi Yield Strength
- B. American Concrete Institute:
 - 1. Details and Detailing of Concrete Reinforcement (ACI 315).
 - 2. Building Code Requirements for Reinforced Concrete (ACI 318).
- C. Concrete Reinforcing Steel Institute: Manual of Standard Practice (CRSI Manual).
- D. International Code Council: Evaluation Reports (ICC Reports).
- E. American Welding Society: D1.4 Structural Welding Code - Reinforcing Steel (AWS D1-4).

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Product Data:
 - 1. Bar supports and chairs.
 - 2. Mechanical bar connectors, including ICC Reports.
 - 3. Certified mill test results on reinforcement.
 - 4. Tests on unidentified bars.
- C. Shop Drawings:
 - 1. Bar and wire fabric layouts.
 - 2. Bar bending diagrams.
 - 3. Placing drawings showing fabrication dimensions and locations for placement of reinforcement and reinforcement supports including the length and location of lap splices and mechanical connector locations.
 - 4. Accessories and inserts layout.
- D. Quality Assurance/Control Submittals:
 - 1. Welding: Description of reinforcement weld locations, chemical analysis of reinforcement, welding procedures, and welder qualifications.
 - 2. Submit a request to relocate any reinforcement that exceeds placement tolerances.

1.04 QUALITY ASSURANCE

- A. Testing agencies that perform testing services on reinforcing steel shall meet the requirements of ASTM E329.
- B. Material Tests: Not required for bars, wire fabric rolls or sheets delivered in bundles from the mill and tagged with valid Identification Certificate.
 - 1. Unidentified Bars: Test samples from each five tons or fraction thereof for each size. If already delivered to site, test additional samples from each day of planned concrete placement. Perform one tension and one bend test from each sample for each size.
 - 2. Test standard: ASTM A615.
 - 3. Testing Laboratory: Selected by Engineer, to take samples and perform tests. Costs paid by Contractor.
 - 4. Unidentified Wire Fabric: Not acceptable.
- C. Standard: CRSI Manual, except as otherwise indicated or specified.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Prevent permanent bending and protect bar surfaces from contact with soil, oil, or other materials that may decrease bond to concrete.
- B. Bundle reinforcement and tag with suitable identification to simplify sorting and placing. Transport and store at site so material is not damaged. Store reinforcement off ground, place under cover and keep clean. Store welded fabric in flat sheets, not rolls. Keep an adequate supply of reinforcement at site to avoid delays.

PART 2 - PRODUCTS

2.01 REINFORCING BARS

- A. General: Deformed bars, ASTM A615, Grade 60.

2.02 WELDED WIRE REINFORCEMENT

- A. Plain Welded Wire: ASTM A1064; sheets with welded intersections spaced not farther apart than 12 in. in the direction of principal reinforcement.
- B. Deformed Welded Wire: ASTM A497; sheets with welded intersections spaced not farther apart than 16 in. in the direction of principal reinforcement.

2.03 TIE WIRE

- A. Annealed steel, 16-gauge minimum.

2.04 MECHANICAL CONNECTORS

- A. Type: Tension.
- B. Strength: Develop 125% of the reinforcing yield strength in tension and compression.
- C. Manufacturer:
 - 1. Tension-only: Quick-Wedge by Erico Products, Inc., or equal.

- D. Not all Mechanical Connectors are shown on the drawings, Mechanical Connectors may be required by notes on the drawings for certain splices.

2.05 SUPPORTS AND ACCESSORIES

- A. Secure and support the reinforcement within specified tolerances. Conform to CRSI Manual Chapter 3, for Types SB, BB, BC, JC, HC, CHC, and others of standard types as required. Use Class "1" plastic-coated wire chairs and spacers at waterbearing surfaces, roofs of waterbearing structures, and at all interior or exterior surfaces exposed to view or weather in the completed structure. Plastic thickness of 3/32 in. or greater at points of contact with formwork and extend the plastic along the wire at least 1/2 in. from the point of contact with the formwork. Precast concrete block supports with embedded wire ties are not acceptable.
- B. Use precast concrete supports that have a surface area of not less than 4 in.² and have a compressive strength equal to or greater than specified compressive strength of concrete being placed. Water absorption and porosity of precast concrete supports equal to or less than water absorption and porosity of concrete being placed. Use precast concrete block supports with embedded wire ties or dowels for placement on grade or on membranes. Cast the blocks with concrete equal in strength, cement type and aggregate to the parent concrete.
- C. Do not use aluminum or stainless steel supports or accessories.

2.06 FABRICATION

- A. General: CRSI Manual Chapters 6 and 7, including tolerances.
- B. Splice, development and embedment lengths: Furnish bars with lap lengths equivalent to ACI 318, Section 12, Class B splices for the specified concrete strength, bar size and location, unless noted otherwise.
- C. Bending and Forming: Fabricate bars of indicated size and accurately form to shapes and lengths indicated and required. Fabricate by methods not injurious to materials. Bend reinforcement cold. Fabricate reinforcement in accordance with fabricating tolerances of ACI 117. Reject bars with kinks or bends not scheduled.
- D. Welding: When welding of reinforcement is approved, comply with the requirements of AWS D1.4. Do not weld crossing bars (tack welding) for assembly of reinforcement, supports, or embedded items.
- E. Concrete Cover: Detail and fabricate the reinforcement to provide specified cover to outer edge of rebars and other installed items.
- F. Dowels:
 - 1. Provide deformed reinforcing bar dowels at all construction joints, unless noted otherwise.
 - 2. Provide smooth or threaded dowels where shown on Drawings.
 - 3. Provide same dowel size and spacing as the reinforcing to which they are spliced, unless noted otherwise.

2.07 ANCHOR BOLTS

- A. Headed Bolts: ASTM F1554, Grade 36, $f_{ut} = 58-80$ ksi, $f_y = 36$ ksi.

- B. Hooked Rods (J and L Bolts): ASTM F1554, Grade 36.
- C. Provide a standard hex headed bolt with the dimensions of the hex head conforming to ANSI/ASME B18.2.1 or plain rod conforming to ASTM A36 with threaded ends and double hex nuts at the anchored end.
- D. If bent bar anchor bolts are substituted for headed anchor bolts in concrete calculations shall be submitted to demonstrate concrete pullout strength of fastener in tension.
- E. Minimum bolt diameter: 1-3/8 inch.
- F. Maximum anchor bolt spacing: As shown on Drawings approximately 7 feet, 0 inches.
- G. Provide minimum embedment based on calculations prepared and submitted by the Contractor's engineer.

2.08 SOURCE QUALITY CONTROL

- A. Testing agencies that perform testing services on reinforcing steel shall meet the requirements of ASTM E329.
- B. Verify bend tolerances are not exceeded.
- C. Verify bar end cuts are within tolerance when mechanical connectors are to be used.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: CRSI Manual Chapter 8 including placement tolerances. No reduction of concrete cover is allowable for bars at concrete surfaces exposed in liquid or water-containing structures.
 - 1. Cleaning: Before placing reinforcing, and again before concrete is placed, clean reinforcement of loose mill scale, dried concrete, oil, or other materials deleterious to bond. Do not allow form coatings, release agents, bond breaker, or curing compound to contact reinforcement.
 - 2. Placement: Place, support, and fasten reinforcement as indicated. Do not exceed the placing tolerances specified in ACI 117. Do not reduce cover requirements for placing tolerances. When necessary to move reinforcement beyond the specified placing tolerances to avoid interference with other reinforcement, conduits, or embedded items, submit the resulting arrangement of reinforcement for review. Accurately place reinforcement and securely wire tie in position, at an adequate number of points, where bars cross so as to prevent displacement. Tie stirrups to bars at both top and bottom. Bend ends of tie wire inward allowing no encroachment into the concrete cover.
 - 3. Concrete cover: Provide cover for reinforcement as shown on Drawings. Provide minimum cover to the outer edge of bar spacers, hangers, and like items. For bundled bars, minimum concrete cover shall be equal to the

equivalent diameter of the bundle but need not be greater than 2 in., except the minimum cover shall not be less than specified in the table below. Base the equivalent diameter of the bundle on a single bar of a diameter derived from the equivalent total area.

4. Reinforcement supports: CRSI Manual, Chapter 3. Unless noted otherwise on Drawings, use the following reinforcement supports:
 - a. Place reinforcement supported from the ground or mud mat on precast concrete reinforcement supports.
 - b. Place uncoated reinforcement supported from formwork on reinforcement supports made of concrete, metal, or plastic.
 - c. Place zinc-coated (galvanized) reinforcement supported from formwork on wire reinforcement supports that are galvanized, coated with dielectric material, or made of dielectric material.
 - d. Reinforcement supports and embedded steel items used with zinc-coated (galvanized) reinforcement shall be zinc-coated (galvanized) or coated with nonmetallic materials.
5. Field bending: Not permitted, except where specifically shown, or approved.
6. Bar spacing: Between parallel bars, no less than 1-1/2 times the maximum aggregate size and in no case less than 1-1/2 inches. At splices, bundle and wire together bars to accomplish this.
7. Welded wire reinforcement: Install necessary supports and chairs to hold in place during concrete pours. Straighten reinforcement to lay in flat plane and bend reinforcement to fit work. Tie every other wire at laps. For slabs on soil, extend welded wire reinforcement to within 2 in. of the concrete edge. Lap edges and ends of welded wire reinforcement sheets a minimum of 12 in.. Do not extend welded wire reinforcement through contraction joints. Support welded wire reinforcement during placing of concrete to ensure required positioning in the slab. Do not place welded wire reinforcement on grade and subsequently raise into position in concrete.
8. Column dowels: Furnish and use templates for placement of column dowels.
9. Welding of reinforcing: Proceed after continuous inspection has been authorized. Welding procedure: Satisfy AWS D1.4.
10. Smooth dowels: Straight dowels at movement joints free of loose rust or scale. Include on dowels used at expansion joints an expansion cap at one end designed to allow at least 1-1/2 in. of expansion. Use an acceptable bond breaker on the dowel on one side of the movement joint.
11. Reinforcement termination: Where reinforcement does not extend through a joint, terminate the reinforcement 2 in. from the face of the joint.

3.02 FIELD QUALITY CONTROL

- A. Inspect all reinforcement installations. Provide 48 hours notice for inspection before concrete placement.
- B. Verify placement tolerances are not exceeded.
- C. Mechanical Connectors: Install favorably reviewed products, following the Manufacturer's recommendations, under continuous inspection.
- D. Welding Reinforcement: Perform only when approved and only under continuous inspection. Notify the Engineer at least 48 hours in advance of any procedure involving welding.

END OF SECTION

SECTION 03300

CONCRETE MIXTURES, HANDLING, PLACING AND CONSTRUCTING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Requirements for materials, proportioning, production, and delivery of concrete.
2. Production of cast-in-place structural concrete.
3. Methods and procedures for obtaining quality concrete through proper handling, placing, finishing, curing, and repair of surface defects.

1.02 REFERENCES

A. American Concrete Institute (ACI):

1. ACI 117 Standard Tolerances for Concrete Construction and Materials
2. ACI 301 Specifications for Structural Concrete for Buildings
3. ACI 306 Guide to Cold Weather Concreting
4. ACI 318 Building Code Requirements for Structural Concrete
5. ACI 347 Guide to Formwork for Concrete

B. ASTM International (ASTM) Standard Specification or Test Method:

1. ASTM C31 Making and Curing Concrete Test Specimens in the Field
2. ASTM C33 Concrete Aggregates
3. ASTM C39 Compressive Strength of Cylindrical Concrete Specimens
4. ASTM C40 Organic Impurities in Fine Aggregates for Concrete
5. ASTM C42 Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
6. ASTM C87 Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
7. ASTM C88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
8. ASTM C94 Ready-Mixed Concrete
9. ASTM C131 Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
10. ASTM C136 Sieve Analysis of Fine and Coarse Aggregates
11. ASTM C138 Density (Unity Weight), Yield, and Air Content (Gravimetric) of Concrete
12. ASTM C142 Clay Lumps and Friable Particles in Aggregates
13. ASTM C143 Slump of Hydraulic-Cement Concrete
14. ASTM C150 Portland Cement
15. ASTM C156 Water Retention by Concrete Curing Materials
16. ASTM C171 Sheet Materials for Curing Concrete
17. ASTM C172 Sampling Freshly Mixed Concrete
18. ASTM C173 Air Content of Freshly Mixed Concrete by the Volumetric Method
19. ASTM C192 Making and Curing Concrete Test Specimens in the Laboratory
20. ASTM C227 Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)

21. ASTM C231	Air Content of Freshly Mixed Concrete by the Pressure Method
22. ASTM C260	Air-Entraining Admixtures for Concrete
23. ASTM C289	Potential Alkali-Silica Reactivity of Aggregates (Chemical Method)
24. ASTM C309	Liquid Membrane-Forming Compounds for Curing Concrete
25. ASTM C494	Chemical Admixtures for Concrete
26. ASTM C595	Blended Hydraulic Cements
27. ASTM C618	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
28. ASTM C827	Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
29. ASTM C869	Foaming Agents Used in Making Preformed Foam for Cellular Concrete
30. ASTM C881	Epoxy-Resin-Base Bonding Systems for Concrete
31. ASTM C920	Elastomeric Joint Sealants
32. ASTM C989	Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
33. ASTM C1064	Temperature of Freshly Mixed Hydraulic-Cement Concrete
34. ASTM C1077	Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
35. ASTM C1107	Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
36. ASTM C1240	Use of Silica Fume as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar, and Grout
37. ASTM C1293	Determination of Length Change of Concrete Due to Alkali-Silica Reaction
38. ASTM C1602	Mixing Water Used in the Production of Hydraulic Cement Concrete
39. ASTM D882	Tensile Properties of Thin Plastic Sheeting
40. ASTM D1056	Flexible Cellular Materials - Sponge or Expanded Rubber
41. ASTM D1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
42. ASTM D2419	Sand Equivalent Value of Soils and Fine Aggregate
43. ASTM E96	Water Vapor Transmission of Materials

- C. State of California, Department of Transportation (CALTRANS):
 - 1. Test 217 Sand Equivalent
 - 2. Test 227 Evaluating Cleanness of Coarse Aggregate
- D. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. T26 Standard Method of Test for Quality of Water to be Used in Concrete
- E. California Building Code (CBC) 2022 Edition.
- F. International Code Council (ICC)

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Product Data:

1. Concrete mix product certification: Submit certified laboratory test results that the mix proportions and materials comply with these Specifications.
 - a. Cementitious materials: types, manufacturing location, shipping locations, and certificates showing compliance with ASTM C150, C595, C618, C845, or C989.
 - b. Coarse and fine aggregates: types, pit or quarry locations, producers' names, gradations, specific gravities, and evidence not more than 90 days old demonstrating compliance with material requirements.
 - c. Admixtures: types, brand names, producers, manufacturer's technical data sheets, and certification data.
 - d. Water: source of supply.
 - e. Ready-mix plant certification or ASTM C94 certification documentation.
 - f. Mixture proportions and characteristics.
 - g. Mix test results (see Paragraph 2.05.F for required testing).
 - h. Description of conveying equipment.
- C. Shop Drawings:
 1. After defects are identified and investigation, Contractor to submit design of repair plan specific for each noted defect. See Paragraph 3.10.
- D. Samples: Submit any item of Product Data not fully assembled by a single manufacturer.
- E. Quality Assurance/Control Submittals
 1. Test Agency Reports: Submit records of test and inspection. Submit report results.
 2. Submit advance notification of concrete placement at least 24 hours in advance.

1.04 QUALITY ASSURANCE

- A. Construction Standard: Applicable quality requirements of the CBC, ACI 301, and ACI 318.
- B. Concrete Products and Materials Tests: Certified by independent commercial testing laboratories. Submit certification on cementitious products and aggregates performed within the past 6 months. Furnish any necessary labor to assist in obtaining and handling samples at the project site or at the source of materials.

Concrete Mix Designs: By an independent commercial testing laboratory, complying with ASTM C1077 and favorably reviewed by the Engineer. Concrete mix design proportions shall be established on the basis of field experience and trial mixtures with the materials to be employed in accordance with ACI 318 Chapter 5.
- C. Concrete Mix Test Results:
 1. Submit in accordance with requirements of Paragraph 2.05.F.
 2. Allow time for review of submittals, in accordance with the general conditions, and allow time for additional reviews to provide adjustments to comply with the Specifications.
- D. Preconstruction Meeting:

1. Attend meeting with Owner and Engineer, bringing representatives of concrete supply, pumping, placement and finishing subcontractors plus testing laboratories.
2. Review preliminary concrete placing plans for walls and slabs, prior to plan submittals.
3. Meeting agenda includes:
 - a. Mix design.
 - b. Schedule of mix review.
 - c. Formwork products.(Section 03100)
 - d. Miscellaneous products.
 - e. Construction joint layout (Section 03150).
 - f. Concrete placement.
 - g. Finishes required (03350).
 - h. Curing and protection methods.
 - i. Field Testing (03300-1.04-G).
 - j. Test result distribution and review schedule.
 - k. Other special inspection requirements.
 - l. Hot weather concrete requirements.
 - m. Cold weather concrete requirements.
 - n. Resolve any difficulties foreseen by any interested party.
 - o. Other Issues

E. Concrete Tests, as Placed: Performed by the Engineer or Owner's' Representative or Testing Agency:

1. Testing agencies that perform testing services on concrete materials shall meet the requirements of ASTM C1077.
2. Provide Owner's Representative with at least 48 hours notice in advance of operations to allow for completion of quality tests and for assignment of personnel.
3. Provide and maintain adequate facilities for safe storage and proper curing of concrete test specimens on the project site for initial curing as required by ASTM C31.
4. Test frequency:
 - a. Obtain at least one composite sample for each 100 yd³, or a fraction thereof, of each concrete mixture placed in any one day.
5. Concrete samples: In accordance with ASTM C172. Provide all material required.
6. Compressive strength: A set of six standard 6-inch x 12-inch concrete cylinders shall be cast for each test set for concrete greater than 2,500 psi.
 - a. Making, storing, initial cure, and final cure of cylinders: ASTM C31. Provide site storage and initial cure, 16 hours minimum and 24 hours maximum.
 - b. Test of cylinders: ASTM C39. Testing laboratory will transport cylinders from site, cure, test, and provide report. Test two cylinders at age of 7 days, two at 28 days, and hold two for additional testing at 56 days, if required.
 - c. Evaluation: Test results from standard molded and cured test cylinders shall be evaluated separately for each specified concrete mixture. For evaluation, each specified mixture shall be represented by at least five tests.

7. Slump: Test will be performed on each 50 cubic yards or fraction thereof. Test each sample used for strength tests.
 - a. Testing: ASTM C143.
 - b. Results outside the limits indicate possible cause for rejection of concrete at the sole discretion of the Engineer.
 8. Air content: Test will be performed on concrete samples used for strength tests. Use calibrated equipment to perform the test.
 - a. Testing: ASTM C231 or ASTM C173.
 - b. Air content tests will be made on samples from the first three batches in the placement and until three consecutive batches have air contents within the range specified, at which time every fifth batch will be tested. This test frequency will be maintained until a batch is not within the range specified, at which time testing of each batch will be resumed until three consecutive batches have air contents within the range specified. Air content tests may be taken on composite samples or on samples from the batch at any time after discharge of $1/4 \text{ yd}^3$ of concrete.
 9. Temperature
 - a. Testing: ASTM C1064.
 10. Testing Agency Reports:
 - a. Include location in the work where the batch represented by test was deposited and the batch ticket number on strength test reports.
 - b. Include detailed information of storage and curing of specimens before testing on strength test reports.
 - c. Provide final reports within 7 days of test completion.
- F. Additional Tests:
1. General: Tests on hardened concrete will be performed when concrete test results as placed fail to satisfy the specification requirements. Testing will be performed by Owner's Testing Agency at Contractor's expense. Strength tests shall be considered satisfactory if the requirements of ACI 318 Section 5.6.3.3 are satisfied. If in the opinion of the Engineer, results of tests on concrete cylinders indicate the possibility of substandard concrete in the structure, cored samples may be required to be taken from the concrete.
 2. Nondestructive tests: The use of the rebound hammer, pulse-velocity method, or other nondestructive tests are permitted in evaluating the uniformity or for selecting areas to be cored; however, only core tests will be permitted for verifying the concrete strength in place.
 3. Core tests: Obtain cores in accordance with ASTM C42. Wipe cores surface-dry immediately after coring and allow to dry in air for a period not exceeding 1 hour after drilling. Seal cores in plastic bags or nonabsorbent containers until testing. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. Submit the location of cores for favorable review by Engineer before testing. Fill core holes with low-slump concrete or mortar of a strength equal to or greater than the original concrete. The Engineer will investigate low-strength test results in accordance with the requirements of ACI 318 Section 5.6.5; however, the requirements of Section 5.6.5.4 are not applicable.
 4. Repair: Repair rejected concrete by removing and replacing or other acceptable repair methods as required by Engineer. To bring rejected concrete into compliance, use repair methods that meet specification

requirements for strength, function, durability, dimensional tolerances, and appearance. Submit for acceptance the proposed repair methods, materials, and modifications. The Contractor is responsible to bring concrete into compliance with the requirements of the Contract Documents.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Cementitious Materials: Store cementitious materials in dry, weather-tight buildings, bins, or silos that will exclude contaminants. If required to be stored at the site, store immediately after delivery in a dry, weather-tight, properly ventilated structure, with adequate provisions for prevention of moisture absorption and overheating of the cement.
- B. Aggregates: Store and handle aggregate in a manner that will avoid segregation and prevent contamination with other materials or other sizes of aggregates. Store aggregates to drain freely. Do not use aggregates that contain frozen lumps. If required at site, store in piles which afford good drainage and which are protected to prevent the inclusion of foreign material. Stockpile the various sizes or gradations of aggregates separately. Site stored aggregates shall be tested for moisture content on each day of batching operations.
- C. Admixtures: Protect stored admixtures against contamination, evaporation, or damage. Provide agitating equipment for admixtures used in the form of suspensions or unstable solutions to ensure thorough distribution of the ingredients. Protect liquid admixtures from freezing and from temperature changes that would adversely affect their characteristics.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Qualify proposed materials and establish mixture proportions.
- B. Obtain materials from an NCRMA certified manufacturer or supplier or one qualified through ASTM C94. Unless allowed otherwise, all materials shall be new.

2.02 CONCRETE MATERIALS

- A. Cementitious Materials:
 - 1. General: Use cementitious materials that are of the same brand and type and from the same plant of manufacture as the cementitious materials used in the concrete represented by the submitted test records or used in the trial mixtures. The color shall not significantly alter the typical grey concrete color.
 - 2. Portland Cement: ASTM C150, Type II OR V. Comply with the requirements for low alkali cement in ASTM C150 Table 2.
 - 3. Pozzolan: ASTM C618, Mineral Admixture Class N.
 - 4. Blended Cement: ASTM C595 Type 1P(MS).
 - 5. Fly ash: ASTM C618, Class F, with the following restrictions:
 - a. Loss on Ignition: 4% maximum
 - b. SO₃ Content: 3% maximum
 - c. Moisture Content: 1% maximum
 - 6. Ground Granulated Blast-Furnace Slag: ASTM C989.

7. Silica Fume: ASTM C1240.

B. Concrete Aggregates:

1. General: ASTM C33:

- a. Aggregates used in concrete shall be obtained from the same sources and have the same size ranges as the aggregates used in the concrete represented by submitted historical data or used in trial mixtures.
- b. Provide test results confirming conformance with applicable specifications not more than 90 days old. Test results for aggregate soundness, abrasion, and reactivity may be older than 90 days, but not older than 1 year, provided test results for the other properties specified in ASTM C33 indicate that the aggregate quality has not changed.
- c. Provide free from organic materials, waste products, clay balls, shale, and mica and thoroughly washed before use.
- d. Provide aggregate meeting the combined gradation requirements below as specified in Paragraph 2.05.B. For thin sections, such as slabs or walls 10 inches thick or less, or for sections that require special placement due to shape, form or congestion of reinforcing, provide 1-inch maximum size.
- e. Nominal maximum size of coarse aggregate shall not exceed three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, and one-third of the thickness of slabs or toppings.
- f. Provide aggregates that do not deleteriously react with the alkalis in the cement. Submit data in accordance with ASTM C1293.
- g. Grading: ASTM C136. Submit results of sieve analysis.

2. Coarse Aggregates:

- a. Provide clean, hard, durable gravel, crushed gravel, crushed rock, or combinations.
- b. Deleterious substances: Submit compliance with ASTM C33, Table 3 and as follows:
 - 1) Clay lumps and friable particles: ASTM C142. Not more than 5%.
 - 2) Abrasion: ASTM C131. Not more than 45%.
 - 3) Soundness: ASTM C88. Not more than 10%.
 - 4) Cleanness: Caltrans Test 227 OR ASTM C142: For three tests, not less than 70, with an average greater than 75. Max friable/clay materials in coarse aggregate at 2% for exposed architectural concrete, 3% for liquid retaining concrete structures, and 5% for all other structural concrete.
- c. Do not use aggregate containing more than 10% of inferior materials, including: flat or elongated particles, cracked or laminated rock, or rock than can be readily broken after immersion in water for one hour.

3. Fine Aggregate:

- a. Provide natural sand or a combination of natural and manufactured sand, of siliceous, granitic or igneous origin, hard and durable.
- b. Deleterious substances: Submit compliance with ASTM C33 Table 1 and as follows:
 - 1) Organic impurities: ASTM C40 and C87. Not less than 95% relative strength by ASTM C87.

- 2) Sand equivalent: CALTRANS Test 217. For three tests not less than 70, with an average greater than 75.

- C. Combined Aggregates: Provide a mixture of fine aggregate and coarse aggregate uniformly graded between the screen sizes specified below.

Sieve Size	Percentage Passing	
	1-1/2-Inch Maximum	1-inch Maximum
2"	100	--
1-1/2"	90-100	100
1"	50-96	90-100
3/4"	45-80	55-100
3/8"	38-55	45-75
No. 4	30-45	35-60
No. 8	23-38	27-45
No. 16	17-33	20-35
No. 30	10-22	12-25
No. 50	3-10	3-15
No. 100	0-3	0-5
No. 200	0-2	0-2

2.03 WATER

- A. Mixing water for concrete and water used to make ice shall be potable water unless alternative sources of water complying with ASTM C1602 or AASHTO T26 are available. Water for washing aggregates, for mixing concrete, for patching grout and for curing shall be free from oil and contain not more than 1,000 parts per million (ppm) of chlorides as Cl, nor more than 1,300 ppm of sulfates as SO₄. Do not allow impurities that will cause a change in the setting time of the Portland Cement of more than 25%, nor a reduction in the compressive strength of mortar at 14 days of more than 5%, when compared to the results obtained with distilled water.
- B. Do not allow impurities that cause discoloration of the concrete or produce etching of the surface.
- C. The Engineer may require tests of the water should there be a question of the quality. Costs of such tests would be borne by the Owner, unless the quality does not meet the requirements in Paragraph A above.

2.04 ADMIXTURES

- A. Admixtures used in concrete shall be the same as those used in the concrete represented by submitted test records or used in trial mixtures.
- B. Air Entraining: ASTM C260, MB AE 90 by BASF or equal. AEA-92 or 92S by Euclid. Daravair by Grace. Or equal
- C. Accelerating: ASTM C494, Type C or E: POZZOLITH® NC 534 by BASF. Accelguard 80 by Euclid. Or equal

- D. Retarding: ASTM C494, Type D: Daratard 17 by Grace. Eucon Retarder 75 by Euclid. Or Equal.
- E. Water Reducing: ASTM C494, Type A: WRDA 64 by Grace. Pozzolith 200N by BASF, Eucon WR-91 by Euclid or equal.
- F. High Range Water Reducing: ASTM C494, Types F or G, second or third generation type. Add at the batch plant, after all other ingredients have been mixed and initial slump has been verified. ADVA 190 by Grace. Glenium 3030 NS by BASF, Eucon 1037 by Euclid or equal.
- G. Controlled Low Strength Material (CLSM) Admixture: See Specification Section 02065 OR ASTM C869. DaraFill by W.R.Grace, Rheocell by Master Builders, or equal.
- H. When two or more admixtures are used, they must be added to the mix separately (through dispensers or manually) and must not be mixed with each other prior to adding to the concrete mix. Add admixtures to concrete mix ingredients in liquid form by a special dispensing unit, approved by the manufacturer of the admixture as suitable for accurately dispensing the admixture. Install an alarm or indicator, which will immediately inform the batch plant operator if the dispensing unit malfunctions. Dispense admixtures uniformly into the mixing water as it is added to the concrete batch.
- I. When two or more admixtures are used, manufacturer shall certify that the admixtures are compatible with each other and will not detrimentally impact the performance of other admixtures.
- J. Admixtures containing calcium chloride or any chloride ions are prohibited.
- K. Manufacturers: WR Grace & Co., Master Builders, Inc., or equal.

2.05 CONCRETE MIX DESIGN

- A. General:
 - 1. Employ an independent commercial testing laboratory complying with ASTM C1077 and favorably reviewed by the Engineer to design all concrete mixes and carry out all necessary testing. Concrete mix design proportions shall be established on the basis of field experience and trial mixtures with the materials to be employed in accordance with ACI 318 Section 5.3.
 - 2. When the testing laboratory has mix designs meeting the specifications that are available from prior projects, submit material and mixture proportions with supporting test results and test record statistics to demonstrate compliance with the requirements of this Section and ACI 318 Section 5.3. Include calculations for f'_{cr} based on source quality test records.
 - 3. If new mix designs are required, prepare a range of trial batches for each design and submit the mixes that demonstrate satisfactory test results in accordance with ACI 318 Section 5.3.
 - 4. Allow for the variability of concrete strength from test to test by increasing the required average compressive strength over the specified strength as specified in ACI 318 Section 5.3.
 - 5. From results of these tests, plot a curve showing the relationship between w/cm and compressive strength. From the curve of w/cm versus compressive strength, select the w/cm corresponding to the required average compressive

strength f_{cr} . This is the maximum w/cm that shall be used to establish mixture proportions, unless a lower w/cm is specified in the mix proportions table below. Establish mixture proportions so that the maximum w/cm is not exceeded when slump is at the maximum specified.

6. Design the mixes far enough ahead of concrete placement to allow completion of trial batch testing and submittal of the test results and mix design to the Engineer for review.
7. Take sole responsibility for selection of laboratory, submittal of materials to laboratory in time for all tests, and overall timing of all aspects of testing program, including submittals.
8. Prepare mix designs for concrete placement by the batch process and/or by pumping, as required, and state the process on the design submittal.
9. Allow for the hot or cold weather and the time required to transport the concrete from the mixer to the site and to place within the forms. If accelerating or retarding admixtures will be required for only a proportion of the concrete placements, submit test results that include the full range of options.
10. Do not exceed the water-cementitious material ratios. Vary the water-reducing admixtures to accomplish an increase in slump or workability time.
11. Proportion cementitious materials, aggregates, and water by weight.
12. Check periodically the weight of moisture contained within the stockpiled aggregates. Compensate for this water when proportioning the concrete mix and adjust when change occurs.
13. Do not use chlorides in any concrete mix.
14. Submit any adjustments to mixture proportions or changes in materials, along with supporting documentation, made during the course of the work. If it is necessary to increase the cementitious materials content, submit a request for acceptance of the proposed revised mixture with higher cementitious materials content. Confirm the adequacy of modified proportions has been verified through the submittal of a set of new test data.
15. Resubmit mix design for review for each class of concrete when modification of the mix design is required by ACI 318 Chapter 5.3. If a class of concrete requires modification based on low strength tests, contractor shall discontinue use of mix design until corrective action can be taken, and a revised mix design is favorably reviewed.

B. Mix Proportions:

Mix Design Requirements	Concrete Type		
	A	B	C
Specified 28-Day Compressive Strength (lb/in ²)	4,000	2,500	4,500
Maximum Coarse Aggregate Size (in)	1	1	-
Air Content at Point of Placement (%)	4-1/2	4-1/2	-
Maximum Water-Cementitious Material Ratio	0.50	0.55	0.42
Minimum Cementitious Material Content (lb/yd ³)	570	510	600
Cement Type	II	II	II

- C. Cementitious Material: Either Portland Cement, cement with fly ash, cement with natural Pozzolan, blended cement, or cement with slag.

- D. Pozzolan, Slag or Fly ash: Optional. Not less than 15%, nor more than 25% of the weight of the cementitious materials. Do not use pozzolan or fly ash as an admixture in concrete made with Portland-Pozzolan cement.
- E. Modified Mix Design: Provide a modified mix design of the concrete type indicated in the table above for horizontal concrete joints, as specified in Section 03100, for environmental structures consisting of the designated concrete mix with one-half of the coarse aggregate removed. The remaining constituents shall be adjusted proportionally in the modified mix design to complete the cubic yard. Modified Mix shall meet all other requirements noted for the base mix in Paragraph 2.05.B.
- F. Mix Test Requirements:
 - 1. Testing agencies that perform testing services on concrete materials shall meet the requirements of ASTM C1077.
 - 2. Compression: ASTM C192 for cylinder preparation. ASTM C39 for cylinder tests. Submit 7-day and 28-day curing test results in accordance with Paragraph A above.
 - 3. Slump: ASTM C143. Slump range is 3 to 4 inches at point of delivery. Slump tolerances in accordance with ACI 117. When utilizing a Type I or II plasticizing admixture or a Type F or G high-range water-reducing admixture, proportion to a slump of 2 to 3 in. before the admixture is added and a maximum slump of 8 in. at the point of delivery after the admixture is added.
 - 4. Air Content: ASTM C231 or ASTM C173. Air content tolerance is $\pm 1 \frac{1}{2}\%$.
 - 5. After favorable review of the mix design, no variations of the constituents are permitted during the project without prior submittal and favorable review.
 - 6. Provide and pay for additional testing and inspection required because of changes in materials or mixture proportions.

2.06 READY-MIX CONCRETE

- A. Supply concrete for the project using one of the following methods:
 - 1. Supply concrete using truck mixers and a ready-mix plant certified by the National Ready-Mix Concrete Association.
 - 2. Qualify the supplier according to ASTM C94 Sections 8 through 11, inclusive.

2.07 CEMENT REPAIR MORTAR

- A. For repairs and patching concrete.
- B. Mix repair mortar using the same materials as concrete to be patched with no coarse aggregate. Do not use more than one part portland-cement to two parts sand by damp loose volume.
- C. For repairs in exposed concrete, make trial batches and check color compatibility of repair material with surrounding concrete. Prepare several trial batches and make test samples in an inconspicuous location for review. When the repair is too dark, substitute white portland cement for a part of the gray cement to produce a color and texture closely matching the surrounding concrete.
- D. Use a repair mortar at a stiff consistency with no more mixing water than is necessary for handling and placing. Mix the repair mortar and turn the mortar frequently with a trowel without adding water. Use mortar at a stiff consistency.

2.08 SOURCE QUALITY CONTROL

- A. Concrete:
 - 1. Maintain records verifying materials used are of the specified and accepted types and sizes and are in conformance with the material requirements.
 - 2. Provide ready-mix batch plant delivery tickets contain all product information necessary for acceptance of the concrete delivered to site.
 - 3. Document and record that the mixing and trucking equipment have adequate capacity to deliver the concrete batches to site on time, thoroughly mixed and discharge without segregation.
 - 4. Submit new data from new trial mixtures for acceptance before use in concrete when brand, type, size, or source of cementitious materials, aggregates, water, ice, or admixtures are proposed to be changed.

PART 3 - EXECUTION

3.01 PROPORTIONING CONCRETE MATERIALS

- A. Do not place concrete prior to favorable review of submittals for reinforcing steel, materials specified in this Section and the mix proposed. Unfavorable results of actual placements may require a redesign of mixes in addition to corrective work related to any defects.
- B. Do not make substitutions to the constituents tested in the design of concrete mixes without favorable review of the revised mix and the new test results.

3.02 MEASURING, BATCHING AND MIXING CONCRETE MATERIALS

- A. General:
 - 1. Measure, batch, mix, transport and deliver concrete materials and concrete in conformance with ASTM C94. If packaged dry-combined materials are used, they shall conform to the requirements of ASTM C387.
 - 2. Deliver completely mixed to the project site.
 - 3. When concrete arrives at the point of delivery with a slump below that which will result in the specified slump at the point of placement and is unsuitable for placing at that slump, the slump may be adjusted to the required value by adding water up to the amount allowed in the favorably reviewed mixture proportions. Addition of water shall be in accordance with ASTM C94. Do not exceed the specified water-cementitious material ratio (w/cm) or slump. Do not add water to concrete delivered in equipment not acceptable for mixing. After plasticizing or high-range water-reducing admixtures are added to the concrete at the site to achieve flowable concrete, do not add water to the concrete. Measure slump and air content of air-entrained concrete after slump adjustment to verify compliance with specified requirements. Do not add water unless approved by the Engineer. Do not add mixing water during hauling. Add water after delivery and only from the "hold-out" volume indicated on the mix ticket. Should water be added, revolve the mixing drum not less than 30 revolutions at mixing speed after adding and before commencing discharge.
 - 4. Deliver each load at the job site accompanied by a ticket showing mix design number, volume of concrete, the weight of cement in pounds and the total weight of each ingredient in pounds. Also show the time at which the

materials were batched and the reading of the revolution counter at the time the truck mixer was charged.

5. No retempering of partially hardened material is permitted. Do not use partially hardened concrete in the work.

3.03 FORMWORK AND FORMWORK ACCESSORIES

- A. In accordance with Section 03100.

3.04 PLACING CONCRETE AND GROUT

A. Preliminary Work:

1. Remove hardened concrete and foreign materials from the inner surface of the mixing and conveying equipment. Remove all debris from the space to be occupied by the concrete.
2. Remove water from the space to be occupied by the concrete before concrete is deposited. Divert any flow of water into an excavation through proper site drainage to a sump, or by other methods. If required by the Engineer, grout up any water vent pipes and drains after the concrete has thoroughly hardened.
3. Remove snow, ice, frost, and other foreign materials from surfaces, including reinforcement and embedded items, against which concrete will be placed.
4. Provide satisfactory redundancy in the delivery system so that work can continue in the event of a breakdown.
5. Rapidly convey concrete from mixer to final deposition by methods that prevent segregation or loss of constituents and ensure the required concrete quality.
6. Do not use aluminum materials in pumping lines, transfer hoppers or chutes . Provide conveyor belts instead of chutes when the distance is longer than 50 feet. Use a storage hopper at the start of the line.
7. For pumped concrete, provide a hose with an angle-change, to create a back-pressure at the outlet.
8. Provide illumination if necessary inside the forms, so that the placed concrete will be visible from the deck at top of formwork.
9. Before placing a concrete slab-on-grade, clean foreign materials from the subgrade and provide subgrade soils satisfying the following requirements:
 - a. Well drained and of uniform loadbearing nature.
 - b. Uniform in-place density throughout the area and at least the minimum required in Contract Documents.
 - c. Free from frost or ice.
 - d. Moist with no free water and no muddy or soft spots.

B. Embedded Items:

1. Place equipment, bolts, anchors, sleeves, inserts, structural steel members, angles and similar items which require embedment in the concrete.
2. Position and secure in place expansion joint materials, anchors, and other embedded items.
3. Hot-dip galvanize ferrous metal sleeves, inserts, anchors, and other embedded ferrous items unless shown otherwise. Set anchor bolts for equipment in templates, carefully plumbed and checked for location and elevation with an instrument, and held in position rigidly by double-nutting to the template to prevent displacement while concrete is being placed.

4. Ensure that aluminum items inserted in the concrete are isolated by a bituminous or asphaltic coating.
5. Notify engineer where modifications are necessary to avoid interference with reinforcing steel or embedded items.
6. Inspect the installation of embedded items and reinforcing.
7. Unless noted otherwise on the Drawings do not embed conduit or pipe in concrete.

C. Placing:

1. Place reinforcement in accordance with the requirements of Section 03200.
2. Do not begin to place concrete while rain, sleet, or snow is falling unless adequate protection is provided and acceptance of protection is obtained. Do not allow rain water to increase mixing water or to damage the surface of the concrete.
3. Use metal or metal-lined chutes having rounded bottoms, and sloped between one vertical section to two horizontal sections and one vertical to three horizontal sections of chute. Chutes longer than 20 ft and chutes not meeting slope requirements may be used provided the discharge is into a hopper before distributing into the forms.
4. Use pumping equipment that has sufficient capacity so that:
 - a. Initial setting of previously placed concrete does not occur before subsequent placement.
 - b. Discharge of pumped concrete does not result in segregation.
 - c. Modification of accepted concrete mixture is not required.
5. Place concrete without separation or loss of ingredients and without displacement of the reinforcement.
6. Do not place concrete that contains foreign material.
7. Do not deposit partially hardened concrete in the work.
8. Do not subject concrete to procedures that will cause segregation.
9. Deposit concrete continuously and as near as practicable to the final position.
10. Deposit concrete in one layer or in multiple layers. Do not deposit fresh concrete on concrete that has hardened sufficiently to cause formation of cold joints. Maintain, until the completion of the placement, a plastic concrete surface, approximately horizontal.
11. Do not place concrete over columns or walls until concrete in columns and walls has reached final set. Place concrete for beams, girders, brackets, column capitals, haunches, and drop panels at the same time as the concrete for adjacent slabs.
12. Maximum height of free fall for concrete during placement:
 - a. Concrete with maximum 4-inch slump: 4 feet
 - b. Concrete with high-range water reducing admixture and minimum 6-inch, maximum 9-inch slump: 8 feet
13. Place concrete continuously or in layers 12 to 20 inches in depth so that no concrete will be placed on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be placed continuously as originally planned, locate construction joints during the placement.
14. Provide a dense, impervious, homogeneous concrete, free from voids or pockets. If honeycomb, air, or rock pockets occur, repair the structure in accordance with Section 03935, and modify the placing method or mix design, to prevent recurrence of deficient concrete. Provide such repairs and

modifications at no additional cost. Honeycomb or large defects may be cause for rejection of the work.

15. When underwater placement is required, place concrete by an acceptable method. Deposit fresh concrete so that concrete enters the mass of previously placed concrete from within, displacing water with minimum disturbance of the concrete surface.

D. Time Limit: Place all concrete in its final position in slab or forms within 1-1/2 hours of batching or before the drum has revolved 300 revolutions, whichever comes first in accordance with ASTM C94. Alternatively, as part of the mix design, provide admixtures that delay the initial set and state the proposed length of time in the submittal.

E. Temperature Limits: Place all concrete in its final position in slab or forms at:

1. Less than 90°F, measured in the mix.
2. When the average of the highest and lowest ambient air temperature during the period from midnight to midnight is expected to drop below 40°F for more than three successive days, deliver concrete to meet the following minimum temperatures immediately after placement:
 - a. 55°F for sections less than 12 in. in the least dimension
 - b. 50°F for sections 12 to 36 in. in the least dimension
 - c. 45°F for sections 36 to 72 in. in the least dimension
 - d. 40°F for sections greater than 72 in. in the least dimension

The temperature of concrete as placed shall not exceed these values by more than 20°F. These minimum requirements may be terminated when temperatures above 50°F occur during more than half of any 24-hour duration.

3. Temperature measurements above refer to on-site measurements. Refer to the vibration, concrete joints and curing sections for other requirements.

F. Precast Items:

1. Supply and design vaults and manholes in accordance with the Division 2 sections for these items. Comply with additional requirements below.
2. Items may be cast on or off the site.
3. Apply all applicable portions of Section 03300, 03100, 03150, 03330, and 03350, including materials, forms, placement, finish and curing.
4. Take particular care when handling and placing the precast items. Lift or move after a minimum of 90% of the specified compressive strength has been attained. Use the average compressive strength of two test cylinders.

3.05 CONSOLIDATING

- A. Consolidate concrete by vibration. Consolidate concrete around reinforcement and embedded items into corners of forms to eliminate honeycombing or planes of weakness due to air voids and stone pockets.
- B. Use the largest and most powerful internal vibrators to consolidate the concrete. Workers shall be experienced in the use of vibrators. Do not use vibrators to move concrete within the forms. Spacing of immersion vibrator insertions shall not exceed 1-1/2 times the vibrator's radius of action in the concrete being consolidated.

- C. Furnish sufficient vibrators to complete the compaction as specified without causing delay in the depositing of concrete. Provide a minimum of 2 vibrators, and at least one unit in addition to those planned for active use.
- D. Operate vibrators with vibratory element submerged in the concrete, with frequency between 8,000 and 12,000 impulses per minute when submerged.
- E. Compact the concrete with high frequency, internal mechanical vibrating equipment, and when required, supplement by hand spading and tamping. Consolidate slabs 6 inches or less in depth by hand tampers, spreading and settling with a heavy leveling straightedge.
- F. Vibrate by direct action in the concrete for approximately 10 seconds at approximately 12-inch intervals, not against forms or reinforcements. Vibrate the concrete around the reinforcement, and around embedded fixtures and into the corners of the forms. Penetrate 6 to 12 inches into previously placed layers as new layers are placed, provided the running vibrator penetrates by its own weight. To secure even and dense surfaces, free from aggregate pockets, honeycomb, or air pockets, supplement vibration when required by forking or spading by hand or hammering the forms lightly opposite the freshly placed concrete. Revibrate the final layer. Stop vibrating when concrete is thoroughly compacted and has ceased to decrease in volume and give off air bubbles.
- G. When placing concrete with 8-inch or more slumps, reduce the time of vibration to 5 seconds and follow the admixture manufacturer's recommendations for technique.

3.10 FIELD QUALITY CONTROL

- A. Site Tests:
 - 1. Testing agencies that perform testing services on concrete materials shall meet the requirements of ASTM C1077.
 - 2. Testing Agency Reports:
 - a. Include location in the work where the batch represented by test was deposited and the batch ticket number on strength test reports.
 - b. Include detailed information of storage and curing of specimens before testing on strength test reports.
 - c. Provide final reports within 7 days of test completion.
 - 3. Furnish any necessary labor to assist in obtaining and handling samples at the project site or at the source of materials.
- B. Inspection:
 - 1. Inspect concrete batching, mixing, and delivery operations.
 - 2. Inspect forms; foundation preparation; reinforcement; embedded items; reinforcement placing; and concrete placing, finishing, and curing operations.
 - 3. Concrete not within the specified limits of air entrainment, slump, and temperature shall not be used in the work.

3.11 PROTECTION OF IN-PLACE CONCRETE

- A. Loading and support of concrete: Do not allow construction loads to exceed the superimposed load that the structural member, with necessary supplemental support, is capable of carrying safely and without damage.

- B. Protection from mechanical injury: During the curing period, protect concrete from damaging mechanical disturbances including load stresses, shock, and harmful vibration. Protect concrete surfaces from damage by construction traffic, equipment, materials, rain or running water, and other adverse weather conditions.

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SECTION 03330

CONCRETE CURING AND PROTECTION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Curing compounds, materials, methods and program.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 301 Specifications for Structural Concrete for Buildings
 - 2. ACI 305 Guide to Hot Weather Concreting
 - 3. ACI 306 Guide to Cold Weather Concreting
 - 4. ACI 318 Building Code Requirements for Structural Concrete
- B. ASTM International (ASTM) Standard Specification or Test Method:
 - 1. ASTM C156 Water Retention by Concrete Curing Materials
 - 2. ASTM C171 Sheet Materials for Curing Concrete
 - 3. ASTM C309 Liquid Membrane Forming Compounds for Curing Concrete
 - 4. ASTM C1315 Liquid Membrane Forming Compounds Having Special Properties for Curing and Sealing Concrete
 - 5. ASTM D471 Standard Test Method for Rubber Property-Effect of Liquids
 - 6. ASTM D1056 Flexible Cellular Materials - Sponge or Expanded Rubber
 - 7. ASTM E96 Water Vapor Transmission of Materials
- C. California Building Code (CBC) 2022 Edition.
- D. International Code Council (ICC)

1.03 DEFINITIONS

- A. Water Containment Structure(s): A reservoir, basin, tank, channel, sump, or conduit to be tightness tested regardless of whether it has a closed or open top or is constructed partially or entirely of concrete.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Product Data:
 - 1. Curing program, including method selected, materials proposed for use and timing of water and product application, demonstrating compliance with requirements herein.
 - 2. Curing products: Submit technical data including installation instructions, independent laboratory test reports (ICC), handling and storage instructions.
 - a. Curing materials, including sheet materials and wet blankets if applicable
 - b. Liquid applied curing compounds
 - c. Evaporation Retardant

- C. Samples: Submit any item of Product Data not fully assembled by a single manufacturer.

1.05 QUALITY ASSURANCE

- A. Construction Standard: Applicable requirements of the CBC, ACI 301, and ACI 318.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Store liquid curing compounds in accordance with the manufacturer's recommendations and do not allow to freeze.
- B. Store and handle products to retain original quality. Do not use products stored beyond the manufacturer's recommended shelf life.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Obtain materials from an established and experienced manufacturer or supplier. Provide new materials of first-class ingredients guaranteed to perform the service required.

2.02 CURING MATERIALS

- A. Cure by fog spray, or by one of the following methods after discontinuance of the fog spray. Slabs shall be continuously wet cured with sheet materials or wet blankets after discontinuance of the fog spray; liquid curing compound alone is insufficient.
- B. Liquid Curing Compound: A water-based membrane-forming resin suitable for exterior or interior use as a curing and hardening compound on freshly placed concrete.
 - 1. Provide an emulsion of synthetic resinous solids dispersed in water containing no waxes, paraffins or oils. Provide the fugitive type that will oxidize and disintegrate completely within 60 days when exposed to sunlight in exterior applications or that can be removed by washing with dilute muriatic acid or TSP in interior applications.
 - 2. Water retention requirements: ASTM C309, Type I or II, Class B, when tested in accordance with ASTM C156.
 - 3. Use white pigmented material for exterior applications (exposed to sunlight when applied or within 30 days thereafter) and clear material for interior applications.
 - 4. Comply with the applicable local air quality district.
 - 5. Exterior surfaces: Aqua Resin Cure-White by Dayton-Superior; 1200-White by W.R. Meadows; or equal.
 - 6. Interior surfaces: Spartan-Cote by Dayton-Superior; Vocomp 20 by W.R. Meadows; or equal.
 - 7. Exterior surfaces are surfaces exposed to sunlight during the curing process, which includes portions of structures which will be interior surfaces upon completion of the structure, but do not have shade or sunlight protection during the curing process.

- C. Sheet Materials: ASTM C171. Waterproof paper, plastic sheeting or white burlap-polyethylene sheet.
 - 1. Plastic sheeting: fungus-resistant, minimum 4-mil thick, clear and free of defects, having ASTM E96 perm rating of not more than 0.5.
 - 2. Waterproof paper: Two layers of non-staining kraft paper laminated with latex adhesive and reinforced with glass in both directions. Seal joints with 2-inch-wide tape with water-resistant adhesive.
- D. Wet Blankets: Clean cotton mats (burlap, except for white burlap-polyethylene sheeting noted above, is unacceptable). Provide material free from any substance that will have a deleterious effect on the concrete. Use a thickness sufficient to retain moisture between programmed applications of water.

PART 3 - EXECUTION

3.01 CURING AND PROTECTION

- A. General:
 - 1. Maintain concrete above 50°F and below 80°F in a moist condition and without external loadings for 14 days after placement and comply with requirements of ACI 305 and ACI 306.
 - 2. Allow building material storage only after conclusion of cure time and only on plywood sheets and wood sleepers that spread the load and protect the finish.
 - 3. When high evaporative conditions necessitate protection of concrete immediately after placing or finishing, make provisions in advance of concrete placement for wind-breaks, shading, fogging, sprinkling, ponding, or wet covering.
- B. Wet Cure:
 - 1. Initial moist cure: Provide a 36-hour uniform spray treatment immediately following final troweling and before the surface can dry out, but after bleeding has stopped. Use clean water and special fog spray nozzles of type and number required to keep entire surface moist. Keep all traffic off floors.
 - 2. Continued cure: After 36 hours for the balance of the 14 days, continue fog curing, or, before the surface dries out, continue curing by utilizing Sheet Material Cure (sheet materials or wet blankets) in order to keep the surface continuously wet. Place waterproof curing paper or polyethylene plastic sheeting as described below.
 - 3. Final cure: After 14 days, perform Liquid Membrane Cure, if favorably reviewed for this purpose, while slab is still damp as described below.
- C. Sheet Material Cure:
 - 1. Cover entire surface with sheet material for 14 days.
 - 2. Place and secure sheet as soon as initial concrete set occurs.
 - 3. Place smoothly upon the moist concrete surface with all joints and edges lapped a minimum of 4 inches and continuously sealed with tape.
 - 4. Securely anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet.
 - 5. Repair, replace and reseal, torn or scuffed sheets.
 - 6. Do not use paper that will leave an impression on the finish.
- D. Liquid Membrane Cure:

1. Apply the compound in accordance with manufacturer's recommendation and as noted below as soon as water sheen has disappeared from the concrete surface and after finishing operations.
2. Apply over the entire concrete surface.
3. Agitate compound thoroughly by mechanical means during use and apply uniformly in a two coat continuous operation by appropriate power-spraying equipment.
4. Use an application rate of not less than 1 gal. per 150 ft².
5. Apply curing compound in two applications at right angles to each other.
6. The material applied in each coat shall not be less than 1 gal. per 150 ft² of area.
7. Form a uniform, continuous, coherent film that will not check, crack, or peel and free from pinholes or other imperfections. Apply an additional coat immediately to areas where the film is defective.
8. Do not use curing compound on any surface where concrete or other material will be bonded to overlays, toppings, or future concrete placements unless the curing compound will not prevent bond or unless measures are to be taken to completely remove the curing compound from areas to receive bonded applications.
9. Keep alternate specified covering readily available for use in the event conditions occur which prevent correct application of the compound at the proper time.
10. Respray surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied (when slab reaches a moist condition and there is no standing water) with two additional coats of curing compound by the foregoing method and coverage.
11. Allow foot traffic only after 36 hours of cure time and only when slab is protected with paper or sheeting.
12. Remove curing compound sprayed on reinforcing steel and construction joints. Remove by sandblasting or other favorably reviewed method after curing is completed, or before placing the next pour. If the cones of tie holes are sprayed with curing compound, lightly ream prior to patching.

E. Curing Method Applications:

1. Structural Slabs (other than Water Containment Structures): Wet Cure, Sheet Material Cure, or Liquid Membrane Cure.
2. Slabs on Grade and Footings (not used to contain water): Wet Cure, Sheet Material Cure, or Liquid Membrane Cure.
3. Formed Concrete Surfaces:
 - a. None, if nonabsorbent forms are left in place 14 days.
 - b. Keep absorbent wood forms wet until they are removed.
 - c. Sheet Material Cure or Liquid Membrane Cure if forms are removed prior to 7 days.
 - d. Exposed horizontal surfaces of formed walls or columns shall be Wet Cured for 14 days or until next placement of concrete is made.
4. Concrete Joints: Wet Cure or Sheet Material Cure.

F. Other Surfaces:

1. Provide a curing program equivalent to either slab or formed system, as appropriate.
2. Include construction joint surfaces when applying curing compound.

3. Cover, or protect joint openings, exposed reinforcing, surfaces to be painted and other areas where curing compound may enter and interfere with a special finish.
 4. Remove curing compound sprayed on reinforcing or construction joints by sandblasting after curing is completed, or before placing the next pour. If the cones of tie holes are sprayed with curing compound, lightly ream prior to patching.
 5. For curing of certain interior and other slabs using hardening or coloring compounds, refer to Section 03350.
- G. Cold Weather Requirements: Provide adequate equipment for heating the placed concrete during freezing or near freezing weather:
1. Whenever the surrounding air temperature is below 40°F, or may fall below 40°F within the 24-hour period after placing concrete, maintain all freshly poured concrete at not less than 50°F for 5 days, defined as the protection period.
 2. When the average of the highest and lowest ambient air temperature during the period from midnight to midnight is expected to drop below 40°F for more than three successive days, make provisions in advance of concrete placement to maintain the temperature of the concrete. Use heating, covering, or other means to adequately maintain required temperature without overheating or drying of concrete due to concentration of heat. Do not use combustion heaters unless precautions are taken to prevent exposure of the concrete to exhaust gases containing carbon dioxide.
 3. Keep the housing, covering, or other protection in place and intact at least 24 hours after the artificial heating is discontinued.
 4. Do not use manure, salt, calcium chloride, or other chemicals on the concrete to prevent freezing.
- H. Hot Weather Requirements: Provide additional cooling to concrete when temperatures rise above 90°F, or low humidity, wind and temperature combine to cause high surface evaporation, over 0.2 lb/sq. ft./hour:
1. Provide additional water if curing by fog spray or ponding or saturated blankets.
 2. Provide shade to surfaces exposed to direct sunlight.
 3. Apply an evaporation retarder during the finishing operation, following the manufacturer's recommendation.

3.02 CONCRETE FINISHES

- A. Refer to Section 03350.

3.03 FIELD QUALITY CONTROL

- A. Concrete Curing:
1. Verify procedures and equipment is available for controlling concrete temperature during hot and cold weather conditions.
 2. Verify actual time of application of evaporation retardant, fog spray and curing materials for each placement.
 3. For cold weather applications, record at least twice a day for the six days of special concrete curing and protecting procedures the temperature of the concrete at multiple locations (including surfaces, edges and corners), the daily maximum and minimum concrete temperature, location where temperature was taken, air temperature, weather conditions, and other

special conditions. Measure concrete temperature in accordance with ACI 306.

3.04 PROTECTION OF IN-PLACE CONCRETE

- A. Loading and support of concrete: Do not allow construction loads to exceed the superimposed load that the structural member, with necessary supplemental support, is capable of carrying safely and without damage.
- B. Protection from mechanical injury: During the curing period, protect concrete from damaging mechanical disturbances including load stresses, shock, and harmful vibration. Protect concrete surfaces from damage by construction traffic, equipment, materials, rain or running water, and other adverse weather conditions.
- C. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- D. Protect concrete during the curing period such that the concrete temperature does not fall below the specified requirements of Section 03306. Maintain the concrete protection to prevent freezing of the concrete and to ensure the necessary strength development for structural safety. Remove protection in such a manner that the maximum decrease in temperature measured at the surface of the concrete in a 24-hour period shall not exceed the following:
 - 1. 50°F for sections less than 12 inches in the least dimension.
 - 2. 40°F for sections from 12 to 36 inches in the least dimension.
 - 3. 30°F for sections 36 to 72 inches in the least dimension.
 - 4. 20°F for sections greater than 72 inches in the least dimension.
- E. When the surface temperature of the concrete is within 20°F of the ambient or surrounding temperature, protection measures may be removed.

3.05 CLEAN-UP

- A. Upon completion of all work performed under this Section, remove from the site all excess materials, storage facilities and temporary facilities. Smooth and clean of debris all areas that were used or occupied during concrete construction operations and leave in first-class condition.
- B. Clean any excess curing compound off the slab after 45 day for interior spaces using water and a stiff brush.

END OF SECTION

SECTION 03350

CONCRETE FINISHING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Finishing formed and unformed surfaces.
 - 2. Sealers and hardeners for concrete.

1.02 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM C156 Test Method for Water Retention by Concrete Curing Materials
 - 2. ASTM C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
 - 3. ASTM C1028 Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
 - 4. ASTM E96 Test Methods for Water Vapor Transmission of Materials
- B. "Evaluation Reports" published by the International Code Council.

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Qualifications: A list of at least five projects completed by the proposed subcontractor within the most recent 3 years that have concrete finishes similar to those specified for this project.
- C. Product Data: Describe all products proposed for use.
 - 1. Manufacturer's data for chemical retarder and recommendations for use when exposed aggregate surface is specified.
 - 2. Provide verification of compatibility for curing compound with subsequent applied finishes, membranes and adhesives.

1.04 QUALITY ASSURANCE

- A. Contractor Qualifications: Use skilled cement finishers to perform all work.
- B. Regulatory Requirements: Comply with applicable requirements in the California Building Code, including without limitation Chapters 10, 11A, 11B, and 19.

PART 2 - PRODUCTS

2.01 MORTAR FOR FILLING VOIDS

- A. Mortar for Filling Voids: One part portland cement, two parts sand by volume mixed with only enough water to form a ball when squeezed by hand. A mixture of white and grey portland cement is required for color match (approximately 1 part white to 2 parts grey). Add mineral oxide colors as required to match colored

concrete. Substitute non-reemulsifiable, acrylic bonding agent for one-third of mixing water. Test several different mixes for color match and obtain favorable review prior to proceeding.

PART 3 - EXECUTION

3.01 FINISHING UNFORMED SURFACES

A. General:

1. Place concrete at a rate that allows spreading, straight-edging, and darbying or bull-floating before bleed water appears.
2. Strike smooth the top of walls, buttresses, horizontal offsets, and other similar unformed surfaces and float them to a texture consistent with finish of adjacent formed surface.
3. Provide a surface finish on exterior and interior horizontal concrete slabs that has a coefficient of friction not less than 0.60 for level surfaces and 0.80 for surfaces sloped 1:20 or greater. Measure friction coefficients in accordance with ASTM C1028
4. Review grades shown and recommend any adjustments necessary to achieve minimum specified slope.
 - a. For exterior paving surfaces provide a minimum slope of 1% (1/8-inch per foot) to drain surface water to catch basins, drains or edges of pavement adjacent to landscaping and drainage swales.
 - b. Slopes shall conform to the requirements of IBC Chapters 10, and 11.
5. Slope interior floor surfaces containing floor drains to drain water to the drains. Review elevations shown on Drawings for adequate slopes before setting grades. Report any conditions that will not provide adequate drainage or that will produce excessively steep slopes before proceeding.
6. Finish slabs so they do not deviate more than 1/4-inch (6.3 mm) in 10 feet from a straight edge. Finish elevations to within 1/8-inch (3.2 mm) elevations shown or required to match adjacent existing conditions. Provide "as-built" slopes for drainage no less than those shown or specified.
7. Allowed Tolerance for individual risers and treads in any flight of stairs:
 - a. 1/4-inch (6.3 mm) between the lowest and highest riser.
 - b. 3/8-inch (9.5 mm) between the deepest and shallowest tread measured in the direction of travel.
8. Slope all treads 1/8-inch (3.2 mm) down toward the nosing for drainage.
9. Finish edges and surfaces smooth, true and clean.
10. Apply finish to slabs as soon as the concrete can support the weight of the workmen.
11. Increase the humidity of the air directly above the concrete surface, prior to and during finishing operations by adding a fine fog mist of water to the air with mist nozzles when atmospheric conditions (temperature, humidity, and wind) are such that rapid evaporation of mixing water from the concrete is likely to occur.
12. When the finish is not specified, use one of the following finishes:
 - a. Scratch Finish: For surfaces intended to receive bonded cementitious mixtures.
 - b. Float Finish: For walks, drives, steps, ramps, and for surfaces intended to receive waterproofing, roofing, insulation, or sand-bed terrazzo.

- c. Trowel Finish: For exposed slab surfaces in environmental basin and containment structures. For floors intended as walking surfaces, and floors in processing, storage, and warehousing areas.
- B. Float Finish and Preliminary Steps for Other Finishes:
 - 1. Applies to slab surfaces indicated to have a wood or magnesium Float finish. This finish is also the initial step for all other finishes.
 - 2. Place, consolidate, strike off, and level concrete, eliminating high and low spots.
 - 3. Screed to grade using a strike-off board guided on accurately set screeds.
 - 4. Work the surface with a bull or darby float to embed large aggregate, consolidate surface mortar and create a smooth true surface.
 - 5. Do not work concrete further until it is ready for floating.
 - 6. When surface has taken initial set and bleed water has disappeared work surface with wood floats followed by magnesium floats (if a magnesium float finish is called for) to even out slight irregularities and further consolidate surface
 - 7. Begin floating with a hand float, a bladed power float equipped with float shoes, or a powered disk float when the bleed water sheen has disappeared, and the surface has stiffened sufficiently to permit operation of the specific float apparatus.
 - 8. Produce a finish that will meet tolerance requirements of ACI 117 for a conventional surface. Refloat the slab immediately to a uniform texture.
 - 9. When concrete has set further so that excess water and fine material will not be brought to the surface, either begin the first steel troweling if this is the preliminary step for other finishes or work the surface with magnesium or wood float if this is the final step in a Float finish. Work the surface sufficiently to consolidate the mortar and produce a finished surface at the proper grade that is free of voids, ripples or other defects. Apply a final swirl texture finish in a fan pattern with the wood or magnesium float. Retool slab edges and control joints. Leave a uniform smooth border around all slab edges and each side of control joints.
 - 10. Do not overwork the surface or add dry materials such as sand or cement.
- C. Trowel Finish:
 - 1. Applies to all slabs indicated to receive a Trowel finish.
 - 2. Complete the work required under "Preliminary Steps for Other Finishes."
 - 3. Apply a second steel troweling after the concrete has set sufficiently so mortar does not adhere to the edge of the trowel and sufficient pressure can be applied to further consolidate the surface.
 - 4. Apply a third steel troweling when the concrete has set sufficiently so the trowel produces a ringing sound. Apply sufficient pressure so the trailing edge of the trowel will produce a dense smooth surface without burning.
 - 5. Apply a fourth troweling and additional trowelings as required to produce a dense smooth finish.
 - 6. Produce a finish that meets ACI 117 tolerances for concrete floors for a moderately flat surface.
 - 7. Addition of water to surface during finishing is prohibited.
- D. Broom Finish:
 - 1. Applies to all slabs indicated to receive a Broom finish.
 - 2. Complete work required under "Preliminary Steps for Other Finishes."

3. Apply second and third steel trowelings after the concrete has set sufficiently so mortar does not adhere to the edge of the trowel and sufficient pressure can be applied to further consolidate the surface.
 4. Broom texture the surface of the slab at right angles to the normal direction of traffic. Use a stiff fiber bristled broom for Coarse Broom Finish and a fine hair broom for Fine Broom Finish. Match selected control sample.
- E. Detail Work: Applies to all concrete flatwork and to exposed top edges of all formed concrete.
1. Edging Slabs: Tool a 3/8-inch radius on all exposed edges of slabs, stair treads, curbs and other exposed horizontal edges unless a formed chamfered edge is indicated, or as otherwise noted on the Drawings. Repeat tooling with each floating or troweling operation.
 2. Apply a Trowel finish to the top of the formed walls, curbs and machine bases.
 3. Control Joints and Feature Grooves:
 - a. Cut 1-inch-deep control joints with rounded edges in all paving slabs where indicated but not more than 8 feet apart in each direction. Repeat tooling with each floating or troweling operation.
 - b. Run decorative feature grooves with a 1/4-inch-deep rounded tool before the final troweling in paving where shown.
- F. Cement Finishers Finish:
1. Use for curb faces, stair risers and other vertical formed surfaces customarily stripped and finished the same day they are placed and before the concrete fully sets.
 2. Use form work specially designed for removal before the concrete sets.
 3. Remove forms when concrete has achieved initial set and is stiff enough to retain its own shape but before it fully sets.
 4. Work over surface with a moist wood or rubber float and cement paste to fill minor voids and consolidate the surface. Fill holes and larger voids with mortar but do not build up a coating of mortar over the entire formed surface. Finish with a fine hairbrush.

3.02 FINISHING FORMED SURFACES

- A. General:
1. After form removal, give each formed surface one or more of the finishes specified on Drawings or in the Schedule of Concrete Finishes and as described below.
 2. See the Schedule of Concrete Finishes at the end of this Section and notes and schedules on Architectural and Structural Drawings for the location, and extent and type of finish required.
 3. When a finish is not specified, finish surfaces as noted below:
 - a. Environmental Surface Finish 1.0 (ESF-1.0) on concrete surfaces not exposed to view.
 - b. Environmental Surface Finish 2.0 (ESF-2.0) on concrete surfaces not exposed to view and expected to contain liquids, gases, or both.
 - c. Environmental Surface Finish 3.0 (ESF-3.0) on concrete surfaces exposed to view.
 4. Complete all patching and finishing within 10 days after the curing period is completed.
 5. Where the concrete surface will be textured by sandblasting or bush-hammering, repair surface defects before texturing.

6. Use form-facing materials meeting the requirements of Section 03100.
- B. As-Cast Finish:
 1. Environmental Surface Finish 1.0 (ESF-1.0):
 - a. Patch voids greater than 1-1/2-inch wide or 1/4-inch deep.
 - b. Remove projections greater than 1/2-inch
 - c. Patch tie holes.
 - d. Surface tolerance Class C as specified in ACI 117.
 - e. Leave surfaces with the texture imparted by the forms.
 - f. The minimum taper required to correct offsets is 1:16.
 2. Environmental Surface Finish 2.0 (ESF-2.0):
 - a. Patch voids greater than 3/4-inch wide or 1/4-inch deep.
 - b. Remove projections greater than 1/4-inch
 - c. Patch tie holes.
 - d. Surface tolerance Class B as specified in ACI 117
 - e. The minimum taper required to correct offsets is 1:16.
 3. Environmental Surface Finish 3.0 (ESF-3.0):
 - a. Patch voids greater than 1/2-inch wide or 1/4-inch deep.
 - b. Remove projections greater than 1/8-inch
 - c. Patch tie holes.
 - d. Surface tolerance Class A as specified in ACI 117.
 - e. The minimum taper required to correct offsets is 1:16.
- C. Smooth-Rubbed Finish or Filled and Rubbed Finish:
 1. Complete work required for Environmental Surface Finish 3.0 (ESF-3.0).
 2. Produce concrete finish no later than the day following formwork removal.
 3. Wet the surface and rub it with an abrasive material, such as carborundum brick, until uniform color and texture are produced.
 4. When insufficient cement paste can be drawn from the concrete itself by the rubbing process, use a grout made with cementitious materials from the same sources as used for in-place concrete.
 5. The minimum taper required to correct offsets is 1:32.

3.03 SCHEDULE OF CONCRETE FINISHES

- A. Concrete Ringwall Footing
 1. Vertical faces: ESF-1.0
 2. Top surface: trowel finish.
- B. Concrete Retaining Walls
 1. Vertical faces: filled and rubbed finish.
 2. Top surface: light broom finish.
- C. Pump Pedestals
 1. Vertical faces: filled and rubbed finish.
 2. Top surface: trowel finish.

END OF SECTION

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SECTION 05090

ANCHORS IN CONCRETE AND MASONRY

PART 1 - GENERAL

1.01 SUMMARY

- A. This section is applicable for anchors, anchor category, anchor groups, anchor systems in concrete and masonry construction. This includes, but is not limited to:
 - 1. Cast-in-place anchors bolts, welded headed anchors, and anchor studs.
 - 2. Post-installed adhesive anchors.
 - 3. Post-installed adhesive steel reinforcing bars (rebar).
 - 4. Post-installed mechanical anchors.
 - 5. Post-installed screw anchors.
 - 6. Anchors intended to be used as part of a deferred submittal.
- B. All post-installed anchors and adhesive for reinforcement shall be rated for use and installation in cracked concrete and cracked masonry. Post-installed anchors and adhesives for reinforcement rated only for uncracked concrete and uncracked masonry will not be permitted for use.

1.02 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. ACI 318 Building Code Requirements for Structural Concrete and Commentary
 - 2. ACI 350 Code Requirements for Environmental Engineering Concrete Structures and Commentary
 - 3. ACI 355.2 Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary
 - 4. ACI 355.4 Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary
- B. American National Standards Institute (ANSI):
 - 1. ANSI/ASME B1.1 Unified Inch Screw Threads (UN, UNR, and UNJ Thread Forms)
 - 2. ANSI/ASME B18.2.2 Square and Hex Nuts
 - 3. ANSI/ASME B18.22.1 Plain Washers
 - 4. ANSI/AMSE B212.15 Cutting Tools – Carbide-Tipped Masonry Drills and Blanks for Carbide-Tipped Masonry Drills
- C. American Society for Testing and Materials (ASTM), Standard Specification for:
 - 1. ASTM A29 General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought
 - 2. ASTM A108 Steel Bar, Carbon and Alloy, Cold-Finished
 - 3. ASTM A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 4. ASTM A193 Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High-Pressure Service and Other Special Purpose Applications
 - 5. ASTM A563 Carbon and Alloy Steel Nuts (Inch and Metric)
 - 6. ASTM A615 Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

7. ASTM A706 Deformed and Plain Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
 8. ASTM A1044 Stead Stud Assemblies for Shear Reinforcement of Concrete
 9. ASTM B633 Electrodeposited Coatings of Zinc on Iron and Steel
 10. ASTM B695 Coatings of Zinc Mechanically Deposited on Iron and Steel
 11. ASTM C881 Epoxy-Resin-Base Bonding Systems for Concrete
 12. ASTM F436 Hardened Steel Washers Inch and Metric Dimensions
 13. ASTM F593 Stainless Steel Bolts, Hex Cap Screws, and Studs
 14. ASTM F594 Stainless Steel Nuts
 15. ASTM F844 Washers, Steel, Plain (Flat), Unhardened for General Use
 16. ASTM F1554 Anchors Bolts, Steel, 36, 55, and 105-ksi Yield Strength
 17. ASTM F1941 Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric
 18. ASTM F2329 Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
- D. Federal Specifications A-A-1922A Type 2 only, A-A01923A Type 4 only and A-A-55614 for Expansion and Shield-Type Anchors
- E. International Code Council (ICC) Evaluation Service, Acceptance Criteria (AC) for:
1. AC 01 Mechanical Anchors in Cracked and Uncracked Masonry Elements
 2. AC 58 Adhesive Anchors in Cracked and Uncracked Masonry Elements
 3. AC 60 Anchors in Unreinforced Masonry Elements
 4. AC 106 Predrilled Fasteners (Screw Anchors) in Masonry
 5. AC 193 Acceptance Criteria for Mechanical Anchors in Concrete Elements
 6. AC 308 Post-Installed Adhesive Anchors in Concrete Elements
 7. AC 495 Cold-Formed Steel Structural Beams with Steel Angle Anchors Acting Compositely with Cast-in-Place Concrete Slabs
 8. AC 510 Seismic Qualification of Post-Installed Anchors in Concrete
- F. International Standards Organization (ISO):
1. ISO/IEC 17011 Conformity Assessment – General Requirements for Accreditation Bodies.
 2. ISO/IEC 17025 General Requirements for the Competence of Calibration and Testing Laboratories.
 3. ISO/ASQ/ASNI 9000 Quality Management Systems – Fundamentals and Vocabulary
- G. TMS 402/602 Building Code Requirements and Specifications for Masonry Structures, The Masonry Society (TMS)

1.03 SUBMITTALS

A. Product Data:

1. Anchor bolts, anchor studs, anchorage devices, and threaded rods, shall include at minimum the following:
 - a. Diameter(s)
 - b. Material grade designation, hardness, coatings, minimum yield and minimum tensile strength consistent with the Contract Documents and/or favorably reviewed deferred submittals.
 - c. Overall length, including extension length.

- d. Embedment length consistent with the Contract Documents and/or favorably reviewed deferred submittals.
 - e. Stand-offs and/or leveling nuts type, dimensional properties, material properties, grade, and location.
- 2. Submit material grade, thickness, and dimensional data for nuts and washers.
- 3. Adhesives.
- 4. Mechanical anchors, expansion anchors.
- 5. Concrete screw anchors.
- 6. Other fasteners embedded in concrete and masonry as indicated within the Contract Documents and/or favorably reviewed submittal.
- B. Accepted Criteria:
 - 1. ICC Evaluation Service Reports (ICC-ESR), or equivalent IAPMO-UES evaluation reports, for all anchor products submitted, demonstrating compliance with CBC applicable ACI acceptance criteria.
 - 2. A submittal without a relative and current evaluation report will not be accepted.
- C. Anchor Installation Plan:
 - 1. List of all anchors installed including location, diameter, material type, number, and length of anchors.
 - 2. For post-installed anchors include a description of the drilling equipment, hole cleaning and preparation procedure, adhesive injection or mechanical anchor insertion technique, preparation for rebar dowels and threaded rods, and torquing procedure.
 - 3. Testing plan for anchors, including percentage of anchors to be tested and proof loads for anchors (see Verification Testing below).
 - 4. Certified Verification Testing Report:
 - a. Detailing results of field testing required in Tests and Additional Tests below.
 - b. Certified by an independent testing laboratory or registered Professional Civil or Structural Engineer licensed to practice in the State where the project is being constructed.
- D. Anchorage in Concrete and Masonry as a Deferred Submittal:
 - 1. Complete calculations, details, and complete reference drawings that are required to be submitted as part of a deferred submittal and as defined in the CBC and within the Contract Documents, shall be prepared, stamped, signed, and furnished by a Professional Civil or Structural Engineer licensed to practice in the State where the project is being constructed.
 - 2. Comply with Specification Section 01190.
 - 3. Deferred submittal calculations and details shall be prepared and designed in accordance with the applicable codes referenced within the Contract Documents. Anchors shall be assumed to see a maximum short-term service temperature of 130°F and a long-term service temperature of 110°F, unless otherwise specified.
 - 4. Minimum Calculation and Reference Drawing Requirements:
 - a. Calculations shall be comprehensible and complete. When evaluating the structural strengths, indicate stress for comparing with strengths or show the demand versus capacity ratio in the structural elements. Evaluating the results by stating "Okay by Inspection" is not acceptable.
 - b. Derivation of forces used, including at least one complete sample calculation, showing the process used so that Engineer of Record may determine general conformance. Printouts of spreadsheets without explanation of calculations used to determine values are not acceptable.

- c. Submittal calculations and details shall demonstrate a complete vertical and lateral load path and shall clearly indicate all forces imposed on the supporting structure. Include all load combinations used in the design shall be referenced and include a clear indication whether service level or strength level was used in the design.
 - d. Reference drawings shall include plans, sections, details, and equipment information as necessary for calculations. Indicate the location of the equipment on plan which is necessary for the development of load calculations.
 - e. The Engineer of Record's review of the deferred submittal items identified in Contract Documents cannot be completed until all related items have been coordinated and submitted for review. Submittals will be returned without review if:
 - 1) The calculations and details are not sealed and signed by a Professional Civil or Structural Engineer licensed to practice in the State where the project is being constructed.
 - 2) Submittals include only calculations without reference drawings.
 - 3) Calculations have no sheet numbers or sheets are missing.
 - 4) Calculations or reference drawings are illegible.
 - 5) Calculations are made based on wrong information, assumptions, or design parameters.
 - 6) Information in reference drawings is insufficient for calculations or review.
 - 7) No details of the anchorage are provided.
5. Anchorage Details as a Deferred Submittal:
- a. Anchorage details shall be prepared, stamped, signed, and furnished by a Professional Civil or Structural Engineer licensed to practice in the State where the project is being constructed.
 - b. Anchorage details shall include the required concrete strength and masonry strength consistent with the Contract Documents, anchor bolt diameter, embed, spacing, maximum grout pad height, and edge distances consistent with the favorably reviewed submittal calculations.
 - c. Include anchoring methods and leveling criteria for equipment consistent with manufacturer's recommendations.
6. Coordination and Other Shop Drawings:
- a. The Contractor is responsible for coordinating the final foundation sizes with the final size of equipment and final anchorage calculations, including the coordination for any required edge distance as noted in the favorably reviewed anchorage submittal.
 - b. Deferred submittals that require anchor reinforcement or supplementary reinforcement identified in a favorably reviewed submittal or the Contract Documents shall be included in that specific shop drawing submittal.
 - c. Deferred submittals that require edge distance that exceeds the available edge distance noted on the Contract Drawings, shall notify the Engineer of Record prior to ordering or fabricating any materials.
- E. Quality Assurance Submittals
- 1. The Contractor shall be qualified to install cast-in-place and post-installed anchors.
 - 2. Certification of Installation:
 - a. For Post-Installed Anchors: Submit a certification of completion of each individual installing the anchors consistent with the Contract Documents or favorably reviewed deferred submittal.

3. Evaluation Reports:
 - a. Submit the current and relative ICC-ESR or IAPMO-UES reports used in the design of anchorage. A submittal without a relative and current ICC-ESR or IAPMO-UES report will be rejected.
4. Verification of Installation:
 - a. Special Inspection reports or documentation verifying the anchor installation was performed in accordance with the Contract Documents *and OR or* favorably reviewed deferred submittal.
 - b. Anchorage as a Deferred Submittal: Submit a letter from the Contractor's Engineer indicating the installation was performed as required by the favorably reviewed deferred submittal and ICC-ESR or IAPMO-UES report.
5. Test Reports:
 - a. Submit test reports for testing of anchors in accordance with the Contract Documents.

1.04 QUALITY ASSURANCE

A. General:

1. Contractor Qualifications: 5-years of experience installing similar anchors in concrete and masonry structures.
2. Anchors shall be manufactured under a certified quality system meeting the requirements of the ISO 9000 quality management system or equivalent.
3. All anchors shall be tested and evaluated under an approved quality assurance program with following-up by an inspection agency under ISO/IEC 17020 by a recognized accreditation body conforming to the requirements of ISO/IEC 17011.
4. Anchors shall be stamped with identifying marks and colors.
5. Installer Training:
 - a. Complete a thorough training with the manufacturer or the manufacturer's representative for the submitted product. Training shall consist of a review of the complete installation process for drilled-in anchors, including but not limited to:
 - 1) Hole drilling procedure(s),
 - 2) Hole preparation and cleaning technique(s),
 - 3) Adhesive injection technique(s), dispenser training and maintenance,
 - 4) Reinforcing steel dowel preparation and installation procedures,
 - 5) Proof loading and torquing.
 - b. Individuals that have not completed the quality assurance requirements of this Section will not be permitted to install anchors without qualifications specific to the products intended for use.

B. Special Inspection and Testing:

1. General:
 - a. The Owner or Owner's authorized agent, independent of the Contractor, shall employ one or more approved agencies to provide special inspections and testing in accordance with the Contract Documents, Chapter 17 of the CBC, and the current and relative ICC-ESR or IAPMO-UES.
 - b. Special Inspections and Testing shall be independent of the Contractor.
 - c. Special Inspections and Testing shall govern the quality, workmanship, and requirements for materials covered with in the Contract Documents.
 - d. Materials of construction and testing shall conform to the applicable standards listed in the referenced building code and Contract Documents.
2. Special Inspections:

- a. Special Inspections shall comply with the Contract Documents and schedules identified on the Drawings. Unless otherwise specified within the Contract Documents, at a minimum the special inspection of anchors in concrete and masonry shall comply with Chapter 17 of the CBC and ICC-ESR or IAPMO-UES evaluation reports.
 - b. At a minimum, the Special Inspector shall visually inspect the following, but not limited to: required substrate type and thickness, presence of moisture on the substrate, anchor bolt layout, hole cleaning procedures, product identification and expiration date, product installation procedures, anchor bolt location, embedment, anchor size, anchor spacing, minimum edge distance, and installation temperature.
 - c. Unless specifically identified elsewhere within the Contract Documents, all special inspections of anchors in concrete and masonry shall be continuous.
3. Verification Testing:
- a. Cast-in-place anchors are not required to be tested after installation.
 - b. Anchors to be tested shall be selected at random by the Special Inspector or as requested by the Engineer of Record.
 - c. Adhesive Anchors: Proof Loading (Pull Test)
 - 1) Test Type: Unconfined
 - 2) Load Level: Proof load levels shall not exceed the lesser of 50-percent of the expected peak load based on adhesive bond strength or 80-percent of the anchor yield strength.
 - 3) Frequency: 10% of all post-installed expansion anchors or a minimum of 2, whichever is greater.
 - 4) Duration: Maintain proof load at the required load level for a minimum of 10 seconds.
 - d. Expansion Anchors: Torque Testing
 - 1) General:
 - a) If the application of torque for an anchor is specified by the manufacturer, torque shall follow the manufacturer requirements. If no torque for the anchor is specified by the manufacturer, the anchor shall be finger-tight before testing and tested as outlined below.
 - b) If the specified torque is not achieved within the required number of turns, the anchor shall be removed or abandoned.
 - 2) Test Type: Calibrated Torque Test, having a measured error within ± 5 -percent of the specified torque.
 - 3) Load Level: 50-percent of the installation torque.
 - 4) Frequency: 10% of all post-installed expansion anchors or a minimum of 2, whichever is greater.
 - 5) Duration: 10-minute wait time after install torquing with calibrated torque wrench.
 - e. Displacement-Controlled Expansion Anchors:
 - 1) Test Type: Prior to installation, verify by placing the setting tool into the anchor body to verify the full set prior to installation of the bolt or threaded rod. Verify recommended testing requirements with the manufacturer.
 - 2) Frequency: 10% of all post-installed expansion anchors or a minimum of 2, whichever is greater.
 - 3) Duration: In accordance with the manufacturer's requirements.
 - 4) Set displacement-controlled expansion-type anchors to the recommended displacement. If the concrete cracks during installation of the anchor, the anchor shall be removed or abandoned.

- f. Undercut anchors that allow visual confirmation of full installation shall not require testing.
- C. Additional Tests:
 - 1. Anchors, washers, and nuts that require repair or are required to be replaced due to faulty work performed during installation shall be clearly identified, replaced, and re-tested at no additional cost to the Owner.
 - 2. All materials and all additional documentation to substantiate any faulty or damaged anchors, washers, and nuts in an effort to avoid replacement shall be at no additional cost to the Owner.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Handle, ship, and store material in a manner that will prevent distortion, rust, damage to the shop coat or any other damage.
- B. Store material in a clean, properly drained location out of contact with the ground, and in accordance with the manufacturer's recommendations.
- C. Ensure that dissimilar metals are not in contact with each other.
- D. Replace or repair all damaged material to an equal product. Do not install damaged anchor bolts.
- E. Anchors and reinforcing steel bars shall be straight (no bends) and free of indentations or other defects along their length and threads.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. General
 - 1. Provide only named adhesive anchor products, mechanical anchors products, and anchor material types where specified within this Section or the Contract Documents.
 - 2. Product and anchor type deviations will only be considered provided the deferred submittal anchorage design calculations for the proposed products include supporting documentation consistent with this Section and the Contract Documents.
 - a. Provide a clear explanation to substantiate any proposed deviations.
 - b. The Engineer of Record will decide whether to accept or reject any proposed deviations.
 - c. Proposed deviations without a relative and current ICC-ES, or IAPMO UES evaluation report will not be accepted.

2.02 EXPOSURE AND FINISH

- A. The following table summarizes the minimum criteria for anchor material and hardware finishes for the specified exposure condition, unless otherwise specified in the Contract Documents:

Exposure Condition	Finish Type
Interior/ Exterior: Dry conditions. Interior and exterior locations not subjected to high moisture environments.	Hot-Dip Galvanized per ASTM F2329 or ASTM A153 or ASTM A193, Grade B7, or equal
High Moisture: Exposed to extreme weather conditions or high moisture environments not subjected to submerged conditions or placement in earth.	AISI 304, Type 304 Stainless-Steel or ASTM A193, Grade B8 Class 2, or equal
Submerged and/or Buried: All submerged and buried conditions, conditions where fasteners will be continuously or intermittently wet, exposed to corrosive chemicals, exposed to earth, or as required by other Specification Sections.	AISI 316, Type 316 Stainless-Steel or ASTM A193, Grade B8M Class 2, or equal

- B. Do not install hot-dip galvanized or zinc coated anchors in high moisture, submerged, and buried conditions.

2.03 NUTS AND WASHERS

- A. Nuts and washer shall be used for the installation of all anchors, anchor bolts and anchor rods, for both cast-in-place and post-installed conditions. Comply with the following:
1. Size nuts and washers to accommodate galvanizing and plate threads where required.
 2. Do not oversize nuts or washers.
 3. Nuts shall be hex or heavy hex and shall meet the dimensional requirements of ASME B18.2.2, unless otherwise specified. Where a manufacturer specifies a type and finish of nut for a specific anchor, the manufacturer recommended nut shall be used.
 4. Washers shall be circular (round) and meet the dimensional requirements of ASME B18.21.1, unless otherwise specified. Where a manufacturer specifies a type and finish of washer for a specific anchor, the manufacturer recommended washer shall be used.
- B. The following hardware schedule summarizes the minimum criteria for nuts and washers to be used with the specified anchor material. Unless otherwise specified in the Contract Documents or a favorably reviewed submittal, the following shall apply to all anchor types:

Hardware Schedule for Nuts and Washers

Anchor Material	Nuts	Washers
ASTM F1554, Hot-Dip Galvanized, or Zinc Coated	ASTM A563, Grade A Hex or Heavy Hex Head	ASTM F844 or ASTM F436
ASTM A913, Grade B7 Alloy Steel	ASTM A194, Grade 2H Heavy Hex	ASTM F436, Type 1
ASTM 55 or 105, Hot-Dip Galvanized	ASTM A563, Grade DH Heavy Hex Head (or ASTM A194, Grade 2H)	ASTM F436, Type 3 (Round SAE Pattern)
Type 304 Stainless-Steel	ASTM F594, Alloy Group 1 CW1 (F594C) & CW2 (F594D)	AISI 304 (Type 304 Stainless-Steel)
ASTM A193, Grade B8 Class 2	ASTM A194, Grade 8 (Stainless AISI 304 Heavy Hex)	AISI 304 (Type 304 Stainless-Steel)
Type 316 Stainless-Steel	ASTM F594, Alloy Group 2 CW1 (F594G) & CW2 (F594H)	AISI 316 (Type 316 Stainless-Steel)
ASTM A193, Grade B8M Class 2	ASTM A194, Grade 8M (Stainless AISI 316 Heavy Hex)	AISI 316 (Type 316 Stainless-Steel)

C. Leveling nuts used below base plates shall conform to the dimensions and materials used for nuts.

2.04 ANCHORS AND STEEL REINFORING BAR MATERIALS

A. Headed Anchor Bolts (Cast-in-Place):

1. All headed anchor bolts shall be cast-in-place, and conform to the following, unless specified elsewhere in the Contract Documents or favorably reviewed submittal:

Headed Anchor Bolts (Cast-in-Place)

Anchor Type	Material Grade	Minimum Yield Strength	Minimum Tensile Strength
Standard: (Low-Carbon)	ASTM F1554, Grade 36	36 ksi	58 ksi
High-Strength: Low Alloy Alloy, Heat Treated	ASTM F1554, Grade 55 Grade 105	55 ksi 105 ksi	75 ksi 125 ksi
Stainless-Steel Type 304: Alloy Group 1 CW1 Alloy Group 1 CW2	ASTM F593C ASTM F593D	65 ksi 45 ksi	100 ksi 85 ksi
Stainless-Steel Type 316: Alloy Group 2 CW1 Alloy Group 2 CW2	ASTM F593G ASTM F593H	65 ksi 45 ksi	100 ksi 85 ksi

B. Welded Headed Studs (Cast-in-Place):

1. Welded headed studs shall be cast-in-place, welded directly to plates and secured in place. Welded headed studs shall conform to the following, unless specified elsewhere in the Contract Documents:

Welded Headed Studs (Cast-in-Place)

Material	Grade or Type	Minimum Yield Strength	Minimum Tensile Strength
ASTM A29	Type B, 1010, 1020	65 ksi	51 ksi
ASTM A1044	Type 1	65 ksi	51 ksi
Stainless Steel Type 304 or Type 316	ASTM A276 or ASTM A493	35 ksi	70 ksi

2. Elongation: 20-percent in 2-inches minimum.
 3. Reduction of area: 50-percent minimum.
 4. Mechanical requirements for carbon steel welded headed studs shall comply with AWS D1.1.
 5. Welded headed studs shall be attached with a stud welding gun. Fillet welding of welded headed studs will not be acceptable. Do not fillet weld headed studs.
 6. Mechanical requirements for stainless-steel welded headed studs shall comply with AWS D1.6.
 7. Avoid dissimilar metals. Plate material welded to the welded headed studs shall be compatible with the studs.
 8. Hot-dip galvanize carbon steel welded head studs after welding. Do not galvanize prior to welding.
 9. Products: Headed Anchors by Nelson Stud Welding, Inc., Tru-Weld Steel Headed Stud Anchors by TFP Corporation, or equal.
- C. Threaded Anchor Rods (Cast-in-Place and Post-Installed):
1. Intended for cast-in-place and post-installed adhesive anchors, threaded anchor rods shall be straight, fully threaded, and comply with ANSI B1.1 UNC coarse thread series.
 2. For cast-in-place threaded anchor rods, provide double nuts with a washer between nuts at the embedded end of the threaded rod. Nuts and washer material shall comply with the hardware schedule for nuts and washers.
 3. Threaded anchor rods shall conform to the following, unless specified elsewhere within the Contract Documents or favorably reviewed submittal:

Threaded Anchor Rods (Fully Threaded)

Anchor Type	Material Grade	Minimum Yield Strength	Minimum Tensile Strength
Standard (Low-Carbon)	ASTM F1554, Grade 36	36 ksi	58 ksi
ASTM A913, Grade B7 Alloy Steel	ASTM A193, B7 (AISI 4140/ 4142)	105 ksi	125 ksi
High-Strength Low Alloy Alloy, Heat Treated	ASTM F1554, Grade 55 Grade 105	55 ksi 105 ksi	75 ksi 125 ksi
Stainless-Steel Type 304: Alloy Group 1 CW1 Alloy Group 1 CW2	ASTM F593C ASTM F593D	65 ksi 45 ksi	100 ksi 85 ksi
A193, Grade B8 (Stainless-Steel AISI 304)	ASTM A193, Grade B8 Class 2	60 ksi	100 ksi
Stainless-Steel Type 316: Alloy Group 2 CW1 Alloy Group 2 CW2	ASTM F593G ASTM F593H	65 ksi 45 ksi	100 ksi 85 ksi
A193, Grade B8M (Stainless-Steel AISI 316)	ASTM A193, Grade B8M Class 2	50 ksi	90 ksi

D. Reinforcing Steel Bars (Post-Installed):

- Reinforcing steel bars used for anchoring or post-installed conditions shall be used with an adhesive anchoring system approved for use in cracked concrete and cracked masonry.
- Reinforcing steel shall be deformed bars conforming to the following:

Steel Reinforcing Bars (for use with Adhesives)

Anchor Type	Material Grade	Minimum Yield Strength	Minimum Tensile Strength
ASTM A615 (Plain-Carbon Steel)	ASTM A615 Grade 60	60 ksi	90 ksi
ASTM A706 (Low-Alloy Steel)	ASTM A706 Grade 60	60 ksi	80 ksi

- The embedded portion of reinforcing steel bars shall be straight, and free of mill scale, rust, mud, oil, and other coatings that may impair the bond with the adhesive.
- Provide 45-degree chisel or cut point on embedded end.
- Do not bend reinforcing steel bars before or after installation.
- Heating of reinforcing steel bars is not permitted.
- Do not use ASTM A615, Grade 40 reinforcing steel bars unless approved by the Engineer of Record.

2.05 POST-INSTALLED ADHESIVE ANCHORS

A. Post-Installed Adhesive Anchoring Systems in Concrete:

1. General:
 - a. Adhesive anchoring systems for concrete shall be qualified per ACI 318 and ACI 355.4.
 - b. Adhesive anchoring systems shall have a relative and current evaluation report by ICC-ES and/or IAPMO-UES. Evaluation reports for adhesive anchoring systems shall be qualified for cracked concrete in Seismic Design Categories A through F. Do not use adhesive anchoring systems specified for masonry only in concrete.
 - c. Adhesive anchors shall be installed in concrete having a minimum age of 21-days, has not been exposed to water for the preceding 14-days, and has a minimum compressive strength of 2,500 psi at the time of anchor installation. Do not drill into concrete prior to 21-days.
2. Epoxy Adhesives in Concrete:
 - a. A two-component, epoxy-based, injectable, cartridge-type system meeting the requirements of ASTM C881 Type IV, Grade 3, Class B and C.
 - b. The adhesive shall be supplied in manufacturer's standard side-by-side cartridge and dispensed through a static-mixing nozzle supplied by the manufacturer.
 - c. Products:

Epoxy Adhesive Products in Concrete

Supplier	Products	Compliance
Adhesives Technology Corporation (ATC)	Ultrabond HS-1CC	ACI 318, ACI 355.4, ICC-ESR, IAPMO-UES
DeWalt	Pure110+, or equal	
Hilti, Inc.	HIT-RE-500 V3, or equal	
Simpson Strong-Tie Company, Inc.	SET-3G, SET-XP, or equal	
Other	Approved Equal	

3. Acrylic Adhesives:
 - a. A two-component, acrylic-based (or hybrid), injectable adhesive system. The adhesive shall be supplied in manufacturer's standard side-by-side cartridge and dispensed through a static-mixing nozzle supplied by the manufacturer.
 - b. Products:

Acrylic (or Hybrid) Adhesive Products in Concrete

Supplier	Products	Compliance
DeWalt	AC200+ or equal	ACI 318, ACI 355.4, ICC-ESR, IAPMO-UES
Hilti, Inc.	HIT-HY-200, or equal	
ITW Red Head	Red Head A7+	
Simpson Strong-Tie Company, Inc.	AT-XP or equal	
Other	Approved Equal	

B. Post-Installed Adhesive Anchoring Systems for Grouted Masonry (CMU):

1. General:

- a. Adhesive anchoring systems for masonry shall be qualified per TMS 402/602.
- b. Adhesive anchoring systems shall have a relative and current evaluation report by ICC-ES and/or IAPMO-UES. Evaluation reports for adhesive anchoring systems shall be qualified for use in masonry resisting seismic and wind forces. Do not use adhesive anchoring systems specified for concrete only in masonry.
- c. Adhesive anchors shall be installed in masonry having a minimum age of 28-days and a minimum compressive strength of 1,500 psi at the time of anchor installation. Do not drill into masonry prior to 28-days.

2. Adhesives:

- a. A two-component high-solids resin and hardener material. The adhesive shall be supplied in manufacturer's standard side-by-side cartridge and dispensed through a static-mixing nozzle supplied by the manufacturer.
- b. Products:

Adhesive Products in Grouted Masonry (CMU)

Supplier	Products	Compliance
DeWalt	AC100+Gold, or equal	TMS 402/602, ICC-ESR, IAPMO-UES
Hilti, Inc.	HIT-HY 200-R HIT-HY-270, or equal	
Simpson Strong-Tie Company, Inc.	SET-XP, ET-HP or equal	
Other	Approved Equal	

2.06 POST-INSTALLED MECHANICAL ANCHORS

A. Post-Installed Mechanical Anchors in Concrete:

1. General

- a. Applicable to torque-controlled expansion anchors, displacement-controlled expansion anchors, screw anchors, and undercut anchors placed into predrilled holes and anchored in concrete by mechanical means.

- b. Post-installed mechanical anchoring systems for concrete shall be qualified per ACI 318 and ACI 355.2.
 - c. Post-installed mechanical anchoring systems shall have a relative and current evaluation report by ICC-ES and/or IAPMO-UES. Evaluation reports for mechanical anchoring systems shall be qualified for cracked concrete in Seismic Design Categories A through F. Do not use mechanical anchoring systems specified for masonry only in concrete.
 - d. Post-installed anchors shall be installed in concrete having a minimum age of 21-days unless specifically identified by the manufacturer's written literature, and meets the minimum compressive strength required per the Contract Documents at the time of anchor installation. Do not drill into concrete prior to 21-days.
- B. Mechanical Expansion Anchors in Concrete:
- 1. Mechanical expansion anchors shall be pre-assembled expanding sleeve or wedge type, threaded at one end and a tapered mandrel at the other end enclosed by a three-section expansion element, with nuts and washers.
 - 2. Anchors shall meet the description of Federal Specification A-A 1923A or A-A 1922A, Type 4.
 - 3. Every anchor, if available in one or more length per anchor diameter, shall be marked with the actual numerical length or with the length marking that is visible and legible after installation. The length identification code shall comply with ACI 355.2.
 - 4. Provide hex head stud style anchors unless flat or rod coupler styles, unless otherwise noted on Drawings or in a favorably reviewed deferred submittal.
 - 5. Carbon steel expansion anchors shall receive manufacturer's most corrosion resistant zinc coating. Zinc coating in accordance with ASTM B633, SC1, Type III or B695, or F1941.
 - 6. Products:

Mechanical Expansion Anchors in Concrete

Anchor Type	Material	Products	Compliance
Carbon Steel	Anchor: ASTM A568, Carbon Steel, or equal Expansion Part: ASTM A240, Grade 316 or AISI 304/316, Hex Nuts: ASTM A563, Grade A Washers: ASTM F844	Hilti, Inc. Kwik Bolt-TZ2 Simpson Strong-Tie Strong-Bolt 2, DeWalt Power-Stud SD6, or equal	ACI 318, ACI 355.2, ICC-ESR, IAPMO-UES
Stainless Steel	Anchor and Expansion Part: AISI 304 or 316 Hex Nuts: ASTM F594, or Type 304, Type 316 Washers: Type 304 or Type 316	Hilti, Inc. Kwik Bolt-TZ2 Simpson Strong-Tie, Strong-Bolt 2, DeWalt Power-Stud SD6, or equal	

C. Mechanical Undercut Anchors in Concrete

- Undercut anchors are post-installed anchors that derives tensile holding strength by the mechanical interlock provided by undercutting the concrete, achieved by either a specialty tool (brazen tungsten carbides) or by the anchor itself during installation. Undercut anchor types may be load-controlled, displacement controlled, or torque-controlled.
- Undercut anchors shall consist of 'through-set' configurations. Do not use 'pre-set' configured undercut anchors.
- Carbon steel undercut anchors shall receive manufacturer's most corrosion resistant zinc coating. Zinc coating in accordance with ASTM B633 Type I, B695, or F1941.
- Products:

Mechanical Undercut Anchors in Concrete

Anchor Type	Material	Products	Compliance
Carbon Steel	ASTM A193, B7, or ISO 898, Class 8.8 (Sleeve: AISI 1045 or $f_u \geq 80$ ksi)	DeWalt Atomic+ Undercut, Hilti, Inc HDA-T, or equal	ACI 318, ACI 355.2, ICC-ESR, IAPMO-UES
Stainless Steel	AISI 316	DeWalt, Atomic+ Undercut, Hilti, Inc. HAD-TR or equal	

D. Screw Anchors in Concrete

- Concrete screw anchors shall be comprised of a body with hex washer head. The hex head shall be larger than the diameter of the anchor and is formed with serrations on the underside. The anchor body is formed with threads along the length of the embedded body.
- Every anchor, if available in one or more length per anchor diameter, shall be marked with the actual numerical length or with the length marking that is visible and legible after installation. The length identification code shall comply with ACI 355.2.
- Carbon steel screw anchors shall receive manufacturer's most corrosion resistant zinc coating. Zinc coating in accordance with DIN EN ISO 4042, ASTM B633, SC1, Type III or ASTM B695M, Class 65 Type I, or ASTM B695, Class 55 (mechanically galvanized zinc).
- Products:

Screw Anchors in Concrete

Anchor Type	Material	Products	Compliance
Carbon Steel (Heat-Treated)	SAE J403, Grade 10B21	DeWalt, Screw-Bolt+, Hilti, Inc., KH-EZ, Simpson Strong-Tie, Hiten HD, or equal	ACI 318, ACI 355.2, ICC-ESR, IAPMO-UES
Stainless Steel	AISI 316	Hilti, Inc. KH-EZ, Simpson Strong-Tie Hiten HD, or equal	

- A. Post-Installed Mechanical Anchors in Grouted Masonry (CMU):
1. General:
 - a. Applicable to torque-controlled expansion anchors, displacement-controlled expansion anchors, and screw anchors placed into predrilled holes and anchored in masonry by mechanical means.
 - b. Post-installed mechanical anchors for masonry shall be qualified per TMS 402/602.
 - c. Post-installed mechanical anchors shall have a relative and current evaluation report by ICC-ES and/or IAPMO-UES. Evaluation reports for post-installed mechanical anchors shall be qualified for use in masonry resisting seismic and wind forces. Do not use post-installed mechanical anchors specified for concrete only in masonry.
 - d. Post-installed mechanical anchors shall be installed in masonry having a minimum age of 28-days and a minimum compressive strength of 1,500 psi at the time of anchor installation. Do not drill into masonry prior to 28-days.
- B. Mechanical Expansion Anchors in Grouted Masonry (CMU):
1. Mechanical expansion anchors shall be pre-assembled expanding sleeve or wedge type, threaded at one end and a tapered mandrel at the other end enclosed by a three-section expansion element, with nuts and washers.
 2. Anchors shall meet the description of Federal Specification A-A 1923A or A-A 1922A, Type 4.
 3. Every anchor, if available in one or more length per anchor diameter, shall be marked with the actual numerical length or with the length marking that is visible and legible after installation.
 4. Provide hex head stud style anchors unless flat or rod coupler styles, unless otherwise noted on Drawings or in a favorably reviewed deferred submittal.
 5. Carbon steel expansion anchors shall receive manufacturer's most corrosion resistant zinc coating. Zinc coating in accordance with ASTM B633, SC1, Type III or B695, or F1941.
 6. Products:

Mechanical Expansion Anchors in Grouted Masonry (CMU)

Anchor Type	Material	Products	Compliance
Carbon Steel	Anchor: ASTM A568, Carbon Steel, or equal Expansion Part: ASTM A240, Grade 316 or AISI 304/316, Hex Nut: ASTM A563, Grade A Washers: ASTM F844	Hilti, Inc. Kwik Bolt-TZ2 Simpson Strong-Tie Strong-Bolt 2, or equal	TMS 402/602, ICC-ESR, IAPMO-UES
Stainless Steel	Anchor and Expansion Part: AISI 304 or 316, Hex Nut: ASTM F594, Type 304, or Type 316 Washers: Type 304 or Type 316	Hilti, Inc. Kwik Bolt-TZ2 Simpson Strong-Tie, Strong-Bolt 2, or equal	

PART 3 - EXECUTION

3.01 INSTALLATION

A. General:

1. Comply with this Section and the Contract Documents.
2. Provide grout pads below base of equipment and bearing plates using non-shrink non-metallic grout having a minimum thickness of 3/4-inch and maximum not to exceed thickness of 1-inch, unless otherwise noted. Do not exceed the limits of grout pad thickness without approval from the Engineer.
3. Do not anchor directly to concrete, masonry, or equipment bases.
4. Provide leveling nuts on anchor bolts, below base plates, and adjust to the correct elevation prior to grouting.
5. Do not increase any baseplate or equipment mounting hole diameter, or slot length without the Engineer's approval.
6. Post-Installed Anchors or Post-Installed Reinforcement:
 - a. Where drilling into new or existing concrete or masonry is required, locate, and avoid all reinforcing steel at least 14-days prior to drilling.
 - b. Notify Engineer of any conflicts immediately upon discovery.
 - c. Do not drill through or cut any reinforcing steel without Engineer's approval.
7. Deviations:
 - a. For post-installed anchors (mechanical or adhesive) proposed as a substitute to cast-in-place anchors, submit request for deviation in accordance with the Contract Documents. Submit product data, evaluation reports, and anchorage calculations demonstrating equivalence, sealed, and signed by a Civil or Structural Engineer licensed in the State in which the project is located.

B. Cast-In-Place Anchors:

1. Set all anchor bolts by template, with provisions to hold bolts rigid and in correct position with respect to plan and elevation.
 2. Do not wet-set cast-in-place anchors in concrete and masonry. Wet-setting anchors will not be accepted.
 3. Post-installed anchors shall not be substituted for cast-in-place anchors without Engineer's approval.
 4. Where anchor straps are shown on the Drawings, do not substitute to anchors without approval from the Engineer.
- C. Post-Installed Adhesive Anchoring Systems:
1. Install adhesive anchors or adhesive reinforcing steel in accordance with the applicable ICC-ES or IAPMO-UES, evaluation report for the specific anchor and manufacturer's instructions.
 2. Drill holes only after concrete and masonry has achieved full design strength. Do not drill over-sized holes.
 3. Holes shall be drilled perpendicular to the concrete and masonry surface unless shown otherwise on the Drawings.
 4. Shim installed anchors to center in holes as necessary.
 5. Anchors installed in overhead conditions shall be installed using the manufacturer's recommended piston-plug and nozzle extension tubing.
 6. Adhesive anchors are not allowed in overhead applications unless specifically authorized by the Engineer.
- D. Post-Installed Mechanical Anchoring Systems:
1. Install mechanical anchors in accordance with the applicable ICC-ES or IAPMO-UES evaluation report for the specific anchor and manufacturer's instructions.
 2. Drill holes only after concrete and masonry has achieved full design strength. Do not drill over-sized holes.
 3. Holes shall be drilled perpendicular to the concrete and masonry surface unless shown otherwise on the Drawings.
- E. Repair and Modification of Connections and Anchorages:
1. The Contractor shall pay for all necessary work and material, all redesign work by the Engineer, and all additional Special Inspections and Testing made on welds, bolts, and anchors required to repair or replace faulty work performed during the original fabrication and during erection.
 2. Anchors, washers, and nuts that require repair or are required to be replaced due to faulty work performed during installation shall be clearly identified, replaced, and re-tested at no additional cost to the Owner.
 3. All materials and all additional documentation to substantiate any faulty or damaged anchors, washers, and nuts in an effort to avoid replacement shall be at no additional cost to the Owner.

3.02 FIELD QUALITY CONTROL

- A. Comply with the requirements of this Section and the Drawings.
- B. Anchoring systems shall be installed in accordance with the applicable ICC-ES or IAPMO-UES, evaluation report for the specific anchor and manufacturer's instructions.
- C. All post-installed anchoring systems shall be Special Inspected in accordance with the Contract Documents. Testing of anchoring systems shall comply with Paragraph 1.04.B. Anchoring systems that fail to meet the testing or installation requirements shall be regarded as malfunctioning and shall be considered defective.

- D. Special Inspections and testing shall be independent of the Contractor.
- E. Anchors should exhibit no discernable movement during load testing.
- F. Drilled holes that do not set properly or fail during testing may not be reused and shall be abandoned. Notify the Engineer and fill the holes with non-shrink non-metallic grout or epoxy grout. Do not drill additional holes near abandoned drilled holes without the Engineer's approval.

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SECTION 05100

STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Structural steel, stainless steel or aluminum, such as beams, channels, angles, tees, bars, pipe, tubing and plates (connection and base plates).
 - 2. Fabricated metal items, such as pipe supports, brackets, hangers, and equipment supports.
 - 3. All anchors, eye bolts, bolts, nuts, washers, inserts, and other metal items not specified elsewhere.
 - 4. All structural metal framing.

1.02 REFERENCES

- A. Aluminum Association:
 - 1. AA Manual-Aluminum Design Manual
- B. American Institute of Steel Construction Specifications:
 - 1. ANSI/AISC 360-05 Specification for Structural Steel Buildings
 - 2. ANSI/AISC 341-05 Seismic Provisions for Structural Steel Buildings Including Supplement No.1
 - 3. AISC 303-05 Code of Standard Practice for Steel Buildings and Bridges
- C. Research Council on Structural Connections:
 - 1. RCSC Specification for Structural Joints Using ASTM A325 or A490 Bolts, 2004
- D. American Iron and Steel Institute (AISI).
- E. American National Standards Institute:
 - 1. ANSI H35-1 Alloy and Temper Designation Systems for Aluminum
- F. ASTM International (ASTM) Standard Specifications:
 - 1. ASTM A36 Structural Steel
 - 2. ASTM A53 Pipe, Steel, Black and Hot-dipped, Zinc-coated Welded and Seamless
 - 3. ASTM A108 Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality
 - 4. ASTM A123 Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products
 - 5. ASTM A153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 6. ASTM A276 Stainless Steel Bars and Shapes
 - 7. ASTM A370 Test Methods and Definitions for Mechanical Testing of Steel Products
 - 8. ASTM A500 Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
 - 9. ASTM A653 Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

10. ASTM A992 Specification for Steel for Structural Shapes for Use in Building Framing
 11. ASTM B633 Electrodeposited Coatings of Zinc on Iron and Steel
 12. ASTM C827 Test Method for Early Volume Change of Cementitious Mixtures
 13. ASTM C1107 Packaged Dry, Hydraulic-Cement Grout (Non-shrink)
 14. ASTM E8 Test Methods for Tension Testing of Metallic Materials
 15. ASTM E165 Practice for Liquid Penetrant Inspection
 16. ASTM E709 Practice for Magnetic Particle Examination
 17. ASTM F2329 Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
- G. American Welding Society:
1. AWS D1.1 Structural Welding Code - Steel
 2. AWS D1.2 Structural Welding Code - Aluminum
 3. AWS D10.4 Recommended Practices for Welding Austenitic Chromium-Nickel Stainless Steel Piping and Tubing
 4. AWS A4.3-93R Standard Methods for Determination of the Diffusible Hydrogen Content of Martensitic, Bainitic, and Ferritic Steel Weld Metal Produced by Arc Welding
 5. AWS A5.1 Mild Steel Covered Arc Welding Electrodes
 6. AWS A5.3 Aluminum and Aluminum Alloy Electrodes for Shielded Metal Arc Welding
 7. AWS A5.4 Covered Corrosion-Resisting Chromium-Nickel Steel Welding Electrodes
 8. AWS A5.5 Low Alloy Steel Covered Arc Welding Electrodes
 9. AWS A5.9 Corrosion-Resisting Chromium-Nickel Steel Base and Composite Metal Cored and Stranded Welding Electrodes and Welding Rods
 10. AWS A5.10 Aluminum and Aluminum Alloy Bare Welding Rods and Electrodes
 11. ANSI/AWS B4.0-98 Standard Methods for Mechanical Testing of Welds – U.S. Customary
 12. AWS B5.1-2003 Standard for the Qualification of Welding Inspectors
 13. AWS C4.1 Oxygen Cutting Surface Roughness Gauge and Wall Chart for Criteria Describing Oxygen-Cut Surfaces
- H. American Society for Nondestructive Testing (ASNT):
1. ASNT SNT TC-1a-2001 Recommended Practice for the Training and Testing of Nondestructive Testing Personnel
 2. ANSI/ASNT CP-189-2001 Standard for the Qualification and Certification of Nondestructive Testing Personnel
- I. Federal Emergency Management Agency (FEMA):
1. FEMA 350 Recommended Seismic Design Criteria for New Steel Moment-Frame Buildings, July 2000
- J. International Code Council (ICC)
- K. California Building Code (CBC) 2022 Edition

1.03 SUBMITTALS

- A. Submit in Accordance with Section 01300.

- B. Product Data:
 - 1. Hangers, pipe and equipment supports (shelf items).
 - 2. Stainless steel and aluminum items (not fabricated).
 - 3. Certified mill test results on structural metals.
 - 4. Electrode manufacturer's data and product data, including electrodes to be used for dissimilar metals.
 - 5. Insulation between dissimilar metals.
 - 6. Manufacturer's product data sheets or catalog data for SMAW, FCAW and GMAW composite (cored) filler metals to be used.
 - 7. Non-shrink grout.
- C. Samples: Manufacturer's latest standard product.
 - 1. Structural framing.
 - 2. Designation of the members and connections that are part of the seismic load resisting system (SLRS).
 - 3. Connection material specifications.
 - 4. Locations of demand critical shop welds.
 - 5. Locations and dimensions of protected zones.
 - 6. Gusset and base plates drawn to scale.
 - 7. Welding requirements as specified in AWS D1.1 Appendix W, Sections W2.2 and W2.3.
 - 8. Locations of pretensioned bolts.
 - 9. Field assembly or erection sequence.
- D. Quality Assurance:
 - 1. Welder performance qualification test records "welder's certification".
 - 2. Written Welding Procedure Specifications (WPSs) in accordance with AWS D1.1 requirements for each different welded joint proposed for use whether prequalified or qualified by testing.
 - 3. Procedure Qualification Record (PQR) in accordance with AWS 1.1 for all procedures qualified by testing.
 - 4. Fabricator's and Erector's AISC Certifications.

1.04 QUALITY ASSURANCE

- A. General:
 - 1. Furnish materials and fabricated items from an established and reputable manufacturer or supplier. Fabricator and Erector shall both be AISC certified for the work that they are performing.
 - 2. Supply all new materials and fabricated items made from first class ingredients and construction and guaranteed to perform the service required.
 - 3. The Contractor is responsible for preparing and submitting written WPSs. WPSs for each joint type shall indicate proper AWS qualification and be available where welding is performed. WPSs shall be included with any shop drawings referencing welds. WPSs shall include the manufacturer and specific electrode.
 - 4. Quality control and quality assurance shall be provided in accordance with AISC 341 Appendix Q.
- B. Codes and Standards:
 - 1. Metalwork:
 - a. Steel: AISC Specification.
 - b. Aluminum: AA Manual.

2. Welding:
 - a. Steel: AWS D1.1.
 - b. Aluminum: AWS D1.2.
 - c. Stainless Steel: AWS D10.4.
 3. Welders:
 - a. Qualify welders in accordance with AWS D1.1 for each process, position, and joint configuration.
 - b. All welding operators are subject to examination for requalification at any time during the progress of the work.
- C. Tests:
1. General: The Owner will provide Special Inspection, defined by CBC Section 1704, for welding and high-strength bolting. Visual welding inspection and nondestructive testing (NDT) shall be conducted in accordance with a written practice by personnel qualified in accordance with AISC 341 Appendix W.
 2. Weld Tests: By a testing laboratory, selected by Engineer and paid by Owner.
 - a. Visual inspection:
 - 1) Check fit-up of joint materials. Verify satisfactory alignment of material. Verify gaps and bevels of penetration welds.
 - 2) Check during welding. Verify satisfactory technique is used.
 - 3) Check after welding completed and cleaned by wire brush or chipping hammer.
 - 4) Inspect with magnification when necessary and under strong, adequate light.
 - 5) Inspect for the following defects:
 - a) Surface cracking.
 - b) Porosity.
 - c) Excessive roughness.
 - d) Unfilled craters.
 - e) Gas pockets.
 - f) Undercuts.
 - g) Overlaps.
 - h) Size.
 - i) Insufficient throat and concavity.
 - b. Nondestructive testing: Ultrasonic testing, except where not feasible due to the type or location of the weld. Magnetic particle, liquid penetrant or radiograph tests when ultrasonic testing is not feasible.
 - 1) Ultrasonic inspection technique and standards: AWS D1.1 Part C.
 - 2) Particle inspection method: ASTM E709.
 - 3) Penetrant inspection method: ASTM E165.
 - 4) Radiography tests: AWS D1.1, Part B.
 - 5) Charpy V-Notch (CVN).
 - a) When they are used as members in the Seismic Resisting Force System, ASTM A6, Group 3 shapes with flanges 1½ inches thick and thicker, ASTM A6 Groups 4 and 5 shapes, and plates that are 1½-inch thick or thicker in built-up cross sections shall have a minimum CVN toughness of 20 ft-lbs. at 70°F.
 - b) All complete joint penetration groove welds used in the Seismic Force Resisting System shall be made with a filler metal that has a minimum CVN toughness of 20 ft-lbs at

minus 20°F, as determined by AWS classification or manufacturer certification Ultrasonic inspection technique and standards: AWS D1.1 Part C.

- c. Extent of testing:
 - 1) Visual inspection of all welds.
 - 2) Measurement of weld profiles for 25% of all welds at random.
 - 3) Magnetic particle examination or liquid penetrant examination performed on root pass and on finished welds for 25% of all shear plate, stiffener plate, column base plate, gusset plate, and miscellaneous fillet welds.
 - 4) Ultrasonic contact examination on all complete joint penetration (CJP) welds. See Drawings for CJP welded beam or girder to column moment connections. Defective welds shall be repaired and costs of retesting defective welds shall be borne by the Contractor.
- D. Additional Tests: Provide and pay for all necessary additional tests made on welds or bolts required to repair or replace faulty work performed during the original fabrication.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Handle, ship and store material in a manner that will prevent distortion, rust, damage to the shop coat or any other damage.
- B. Store material in a clean, properly drained location out of contact with the ground.
- C. Ensure that dissimilar metals are not in contact with each other.
- D. Replace or repair all damaged material in an approved manner.

PART 2 - PRODUCTS

2.01 STRUCTURAL STEEL MEMBERS

- A. W-Shapes and WT-Shapes: ASTM A992, $f_y = 50$ ksi, $f_u = 65$ ksi.
- B. M-, S-, and HP-Shapes and Channels, Angles, Structural Tees, Plates and Similar Items: ASTM A36, $f_y = 36$ ksi, $f_u = 58$ ksi. Except plates for W-Shapes and WT-Shapes ASTM A572, Grade 50.
- C. Hollow Structural Sections (HSS): Rectangular and square, ASTM A500, Grade B, $f_y = 46$ ksi, $f_u = 58$ ksi. Round, ASTM A500, Grade B, $f_y = 42$ ksi, $f_u = 58$ ksi.
- D. Steel Pipe: ASTM A53 Type E or S, Grade B, $f_y = 35$ ksi, $f_u = 60$ ksi.

2.02 STAINLESS STEEL ARTICLES

- A. Material: AISI Type 304, unless Type 316 is specifically specified.
- B. Channels, Angles and Structural Tees: ASTM A276.

2.03 FABRICATED ALUMINUM ITEMS

- A. Material: ANSI H35-1 Alloy and Temper 6061-T6 with an anodized finish.

- B. Surfaces in Contact With Concrete or Masonry: Shop prime with a bituminous mastic or zinc chromate coating.
- C. Bolted Connections: Provide stainless steel fasteners.

2.04 METAL FASTENINGS

- A. See Section 05090.

2.05 WELDING ELECTRODES, FILLER METALS

- A. Steel:
 - 1. AWS A5.1 or A5.5, E70XX category.
 - 2. AWS A5.20, A5.29, E7XTX-X except -2, -3, -10, -GS for FCAW.
 - 3. AWS A5.17 or A5.23, F7XX-EXXX for SAW.
- B. Stainless Steel: AWS A5.4 or A5.9.
- C. Aluminum: AWS A5.3 or A5.10.
- D. For welding dissimilar metals, submit the appropriate electrodes for Product Review.

2.06 GALVANIZING

- A. Hot-dip galvanize all exterior and exposed steel items, except when specified otherwise.
 - 1. Sheet steel, plain or shaped: ASTM A653, coating designation G 90, commercial grade.
 - 2. Products fabricated from rolled, pressed and forged steel shapes, plates, bars and strip 1/8-inch-thick or heavier: ASTM A123.
 - 3. Structural tubing and pipe: ASTM A53
 - 4. Grind smooth fabricated items at welded joints, edges, and corners, and galvanize after fabrication.
 - 5. Items that are specified to receive paint or a coating after galvanizing shall receive no post treatment baths and shall not be stacked or stored in a wet environment until coated.
- B. Repair Materials: Gal-Viz by ThermoCoat Welco, Pasadena, CA; ReGalv by Rotometals, Inc., San Francisco, CA; or equal.

2.07 NON-SHRINK GROUT

- A. See Section 03300 or ASTM C1107 with no shrinkage as measured by ASTM C827. Furnish a pre-mixed product consisting of properly proportioned amounts of non-metallic dimensionally stable material to which water is added.

2.08 MISCELLANEOUS ITEMS

- A. Furnish all items required to complete the project, but not specified herein, not specified in Section 05500.

2.09 FABRICATION

- A. Structural Steel Work: Comply with the applicable provisions of the AISC Specification, the AISC Standard Practice and AWS D1.1. Weld only in accordance with favorably reviewed WPSs, which are to be available to welders

and inspectors during the production process. Provide workmanship equal to standard commercial practice in modern structural shops.

1. Fabricate and assemble in the shop to the greatest extent possible, and deliver to the project as a unit ready for installation. Coordinate the work, making all provisions necessary for the passage of all applicable work into, and attachment to, the structures. Make joints carefully and neatly, with corners mitered and spliced, bolted, screwed, or welded together.
2. Make proper allowance for the expansion and contraction of the metals, and of the materials to which they are fastened.
3. Make completely watertight joints on exterior work.
4. Shape all members correctly, with no kinks, twists, dents, or other blemishes prior to erection. Evenly spring all curved work.
5. Make exposed edges free of burrs, sharp edges or corners. Make corners rounded or chamfered. Grind exposed welds smooth when specified.
6. Include supplementary parts necessary to complete each item, even though such work may not be definitely specified. Provide all such miscellaneous metalwork required by the project in accordance with good accepted standard practice.
7. Review monorail supports and splices with the hoist manufacturer.
8. Shop prime all items that are not galvanized or epoxy coated, including connection angles, using a material compatible with the finish coat, as specified in Section 09960. Provide finish paint coats as specified in Section 09960.

B. Stainless Steel Work:

1. Use the proper type of stainless steel electrodes or welding rods complying with AWS D10.4. Grind all welded joints smooth and polished, using wheels never used on carbon steel. Provide welds that eliminate injury to stainless steel parts in appearance, strength and resistance to corrosion.
2. Remove by grinding and polishing, all scratches, marks, pits and other blemishes on exposed surfaces incurred during fabrication of the material, until the entire surface possesses the same finish as the adjacent work.

C. Aluminum Work:

1. Comply with the applicable provisions of the AA Manual and AWS D1.2.
2. Back painting: When aluminum is in contact, such as with concrete, mortar, masonry, or adsorptive materials subject to wetting, including condensation, give the contact surfaces a brush coat of cut-back asphaltic, or coal tar paint. Submit paint for favorable review.
3. Aluminum shall have an anodized finish.

D. Base and Bearing Plates: Furnish under all columns, pipe supports, including rack type, supports for tanks, equipment frames and cabinets, and similar items. Provide rounded or chamfered corners.

E. Dissimilar Metals: Insulate the faying surfaces with a brush coat of cut-back asphaltic or coal tar paint or by gasketing. Submit for favorable review.

F. Metals in contact with cementitious or other material: Provide finish coating prior to erection.

2.10 SOURCE QUALITY CONTROL

A. Material Tests: Not required for materials identified with valid mill test records.

1. Unidentified materials: Test samples from each 20 tons of each material, or fraction thereof. Perform tension and bend tests, conforming to ASTM A370 for steel. Perform tension tests conforming to ASTM E8 for aluminum.
 2. Do not provide unidentified stainless steel.
- B. Welding:
1. Qualify welders in accordance with AWS D1.1 for each process, position, and joint configuration.
 2. Weld only in accordance with favorably reviewed WPSs, which are to be available to welders and inspectors during the production process.
- C. Tolerances: AISC Standard Practice.
- D. Fabrication Tests: Standard and extent: See paragraph 1.04.

PART 3 - EXECUTION

3.01 ERECTION

- A. Structural Steel Work:
1. Erect members in accordance with the AISC Specification, and the AISC Standard Practice except as modified.
 2. Incorrect fabrication or damaged members:
 - a. When a condition exists whereby parts cannot be assembled or fitted properly as a result of errors in fabrication, or of deformation due to handling or transportation, report the condition immediately. The method of correction must be approved before any corrective work is done. Make the corrective work in the presence of the Engineer.
 - b. Straighten plates and angles or other shapes using approved methods.
 - c. Do not heat already heat-treated parts for straightening.
 3. Connections:
 - a. Provide anchor bolts and other connections between structural steel and foundations. See Specification Section 05090 for additional connection requirements.
 - b. Set all anchor bolts by template, with provisions to hold bolts rigid and in correct position with respect to plan and elevation.
 - c. Detail any undesigned connections in accordance with the AISC Specification
 - d. Do not increase any hole diameter or slot length without the Engineer's approval.
 4. Install work anchored in sleeves set in concrete with non-metallic non-shrink grout. Allow a ¼-inch minimum clearance between items anchored and the sleeve.
 5. Where metal is fastened to concrete, make the connections by anchor bolts, or by fastenings embedded in concrete, such as adhesive, or expansion anchors, installed in accordance with Specification Section 05090. Contractor shall not substitute post-installed fasteners for cast-in-place bolts without prior written permission from the Engineer.
 6. Provide a 4-inch band of coal-tar epoxy applied, half in concrete and half in air, to galvanized or painted steel, partially embedded in concrete and subject to weathering.

7. Provide grout pads below base and bearing plates of non-shrink non-metallic grout having a minimum thickness of $\frac{3}{4}$ -inch unless otherwise noted. Do not bear directly on concrete slabs or equipment bases.
 8. Provide leveling nuts on anchor bolts, below base plates, and adjust prior to grouting.
 9. Complete the work square, plumb, straight and true, accurately fitted, and with tight joints and intersections.
- B. Welding:
1. Weld only in accordance with favorably reviewed WPSs, which are to be available to welders and inspectors during the production process. Perform all welding by the shielded electric arc method in accordance with AWS D1.1.
 2. Repair and make additional inspections, at the Contractor's expense, of the weld areas which have been rejected as a result of inspection. Follow this procedure until the welds are acceptable to the Engineer.
 3. Qualify welders in accordance with AWS D1.1 for each process, position, and joint configuration.
 4. All tack welds shall be of the same quality as the final welds. This includes preheat requirements. All tack welds not incorporated in the final welds shall be removed.
- C. Repair of Galvanized Coating:
1. Repair surfaces damaged by cutting or welding by the heated repair method. Repair handrails or other surfaces that will not be painted and that are field welded or damaged by the heated galvanize repair method.
 2. Heat substrate to 600°F, or apply hot process touch-up material right after welding before metal has cooled below 600°F.
 3. Rub bar of specified galvanize repair material over surface of hot substrate to apply a uniform coating of zinc. Wire brush hot coating with a clean wire brush to smooth out and bond zinc coating to substrate to apply a uniform coating of zinc.

3.02 FIELD QUALITY CONTROL

- A. Welding:
1. Qualify welders in accordance with AWS D1.1 for each process, position, and joint configuration.
 2. The Owner's testing agency will inspect shop or field welding for conformance with AWS D1.1 requirements and will verify that welds are made in accordance with favorably reviewed WPSs.
- B. Erection Sequence: Verify each stage is completed before proceeding to the next.
- C. Tolerances: AISC Standard Practice.
- D. Erection Tests: Standard and extent: See paragraph 1.04.

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SECTION 05500

METAL FABRICATIONS (MISCELLANEOUS METAL)

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. All metal fabrications and other miscellaneous metal items together with related accessory items and fasteners, including:
 - a. Steel ladders.
 - b. Steel guardrails.
 - c. Chain closures.
 - d. Gratings.
 - e. Grating and floor plate support angles.
 - f. All other metal fabrications and miscellaneous metal not covered under other sections.

1.02 REFERENCES

A. American National Standards Institute:

1. B18.23.1 Beveled Washers

B. ASTM International (ASTM):

1. A36 Specification for Carbon Structural Steel
2. A53 Specification for Pipe, Steel, Black and Hot-Dipped Zinc-Coated Welded and Seamless
3. A123 Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
4. A153 Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
5. A283 Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
6. A307 Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
7. A500 Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
8. A501 Specifications for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
9. A653 Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Gavannealed) by the Hot-Dip Process
10. A786 Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy and Alloy Steel Floor Plates
11. A793 Specification for Rolled Floor Plate, Stainless Steel
12. B632 Specification for Aluminum-Alloy Rolled Tread Plate
13. C595 Specification for Blended Hydraulic Cement
14. C1107 Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)
15. F844 Specification for Washers, Steel, Plain (Flat), Unhardened for General Use

- 16. F2329 Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
- C. Publications of the National Association of Architectural Metal Manufacturers (NAAMM):
 - 1. "Metal Product Outline; Division 5 Metal"
 - 2. "Metal Stair Manual"
 - 3. "Metal Finishes Manual"
 - 4. "Pipe Railing Manual"
 - 5. "Metal Bar Grating Manual"
- D. The Society for Protective Coatings (SSPC), Volume 2. Standards for Surface Preparation are specified by SSPC followed by SP and a number indicating the specified type of surface preparation.
- E. International Building Code (IBC)
- F. International Code Council (ICC).

1.03 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Product Data: Fully describe every product proposed for use.
- C. Shop Drawings:
 - 1. Show dimensions, finishes, joining, attachments, inserts, and relationship of work to adjoining construction.
 - 2. Indicate all shop and erection details including cuts, copes, connections, holes, threaded fasteners and welds. Indicate welds using AWS "Welding Symbols."
 - 3. Show field measured dimensions of this and adjacent work and location of inserts on fabrication drawings.
 - 4. Submit a full floor plan layout and details for all gratings and grating support frames.

1.04 QUALITY ASSURANCE

- A. Contractor's Qualifications:
 - 1. Welding procedures, welders, and welding operations shall be qualified for the type of work required in accordance with AWS Standard Qualification Procedures.
 - 2. Apply fusion epoxy coating by a specialty contractor regularly engaged in the application of fusion epoxy coatings for industrial corrosion protection applications. Application of decorative epoxy coatings to ornamental iron work is not considered an acceptable qualification.
- B. Regulatory Requirements: Comply with the following codes and reference standards unless higher standards are specified, shown or required by applicable codes:
 - 1. "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings," American Institute of Steel Construction (AISC), latest edition.
 - 2. Structural Welding Code of the American Welding Society, AWS D1.1, latest edition.

3. International Building Code (IBC), adopted edition, especially Paragraphs 1013, Guardrails, Paragraph 1012, Handrails and Paragraph 1009, Stairs.
 4. Stair, guardrail and accessibility design requirements in OSHA and CCR Title 8 Cal-OSHA and the Federal Americans with Disabilities Act (ADA).
- C. Testing:
1. Test materials in accordance with Section 05100.
 2. Test welding in accordance with Section 05100.
 3. Test fasteners in accordance with Section 05090.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver anchorage devices that will be embedded in the work of other trades in sufficient time to permit their timely installation. Provide proper setting drawings, templates, and directions for installation.
- B. Store materials above ground on platforms, skids, or other supports. Store all fasteners and welding electrodes in a weathertight and dry location until ready for use. Store packaged materials in their original labeled containers.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL

- A. Standard Structural Steel Shapes, Bars and Plates: ASTM A36.
- B. Architectural and Miscellaneous Steel Items: ASTM A283, Grade A.
- C. Steel Tubing: ASTM A500, (cold formed) Grade A, or ASTM A501 (hot formed), welded or seamless.
- D. Steel Pipe: Seamless, conforming to ASTM A53, Type E or S, Grade B.
- E. Aluminum: ASTM B483, Alloy 6061-T6 or 6063-T5 or T6 with an anodized finish.
- F. Bolts and Nuts: ASTM A307, Grade A.
- G. Plain Washers: ASTM F844.
- H. Beveled Washers: ANSI B18.23.1.
- I. Anchorages to Concrete and Masonry:
 1. Refer to Section 05090 for anchors carrying shear or tension loads 400 lbs. or more.
 2. Provide cast-in-place, expansion or bonded anchorages with minimum size 3/8-inch-diameter, 3-inch embedment.
 3. Provide a satisfactory evaluation report by ICC.
 4. Do not load the anchorage in excess of half the ICC values without inspection by Engineer.
 5. Material: Galvanized steel, or stainless steel, or as noted on the Drawings.
 6. Do not use for loads in tension or withdrawal or for loads subject to vibration.
- J. Non-Shrink Grout: See Section 03300 and Section 05100 and ASTM C1107, with no shrinkage as measured by ASTM C827. Furnish a pre-mixed product consisting of properly proportioned amounts of non-metallic dimensionally stable material to which water is added.

2.02 GALVANIZING

- A. Hot-dip galvanize all exterior ferrous metal work and all noted interior ferrous metal work.
- B. Hot-dip galvanize all sheet steel, plain or shaped in accordance with ASTM A653, G-90 Commercial Grade.
- C. Hot-dip galvanize all products fabricated from rolled, pressed and forged steel shapes, plates, bars and strip 1/8-inch thick or heavier, in accordance with ASTM A123.
- D. Hot-dip galvanize all steel hardware, nuts, bolts, washers, anchors, and threaded rods in accordance with ASTM A153 or F2329. Size thread clearance to allow for galvanized coating; rerun threads after galvanizing, if required, to assure a smooth fit.

2.03 GALVANIZING REPAIR

- A. Repair damaged galvanizing by heated repair method. Repair materials: ReGalv by Rotometals, Inc., San Francisco, CA; or equal. Specifier knows of no equal.

2.04 FUSION EPOXY COATING

- A. Fusion Epoxy Coating:
 - 1. Apply fusion epoxy coating to items so noted.
 - 2. Grind all surface irregularities smooth. Round all sharp corners; no sharp corners will be acceptable. Remove all weld spatter prior to sandblasting. Grind welds smooth; grind fillet welds to a uniform radius.
 - 3. Sandblast all surfaces to a near-white metal finish in accordance with SSPC-SP 10-94 prior to heating and coating applications.
 - 4. Use fresh epoxy resins. Submit the hot plate gel time test information to verify that epoxy resins are fresh and suitable for this application.
 - 5. Apply epoxy powder by the fluidized bed method, in strict accordance with the manufacturer's specifications. Provide a cured coating thickness of at least 12 mils.
 - 6. Preheated and post heat cure all fabricated items coated with fusion epoxy in accordance with the manufacturer's specifications.
 - 7. Provide a coating that is uniform, pinhole free and free from excessive roughness. Test all coatings with a low voltage sponge holiday detector at the protective coating applicator's shop. Only ship coated objects to the project site that are free of holidays and pinholes.
 - 8. Protect fusion coatings on fabricated work from damage. All pinholes shall be marked and repaired if, in the opinion of the Engineer, the surface is repairable. Unrepairable surfaces shall be cleaned, recoated and then cured in accordance with the manufacturer's recommendations, and retested.
 - 9. Retest fusion coatings for holidays and pinholes after they have been delivered to the project site.
 - 10. Make field touchup of the coating as recommended by the manufacturer, to a minimum dry mil thickness of 12 mils.

2.05 SHOP PRIMING

- A. Refer to Section 09900 for surface preparation, pretreatment, primers, and application techniques.

- B. Apply one shop coat of rust inhibiting primer in accordance with Section 09900 or urethane zinc-rich primer in accordance with Section 09960 to all steel fabrications not scheduled to be galvanized.
 - 1. Apply two coats of primer to surfaces not in contact but inaccessible after assembly.

2.06 ISOLATION COATINGS

- A. Coat aluminum in contact with other metals in accordance with Section 05100 or with aluminum pigmented asphalt paint or two coats of a high build polyamide epoxy paint, Tnemec 66 or equal, with a total thickness of system DF = 8.0 mils, minimum.
- B. Coat aluminum in contact with concrete, masonry or plaster in accordance with Section 05100 or bituminous mastic or zinc chromate coating, Tnemec 46-465 or equal, with a total thickness of system DFT = 8.0 mils, minimum.
- C. Provide neoprene or phenolic washers and isolation bolt sleeves or insulating compound at all stainless steel fasteners to aluminum interfaces. Isolation washers shall be capped under a stainless steel washer. Insulating compounds shall be Tef-Gel by Ultra Safety Systems Company, Lanocote by Forespar, or equal.

2.07 FABRICATIONS

- A. Steel Guardrails:
 - 1. Fabricate from 1-½-inch-nominal-diameter Schedule 40 steel pipe. Maximum post spacing 8 feet.
 - 2. Hot-dip galvanize, after fabrication, guardrails and handrails exposed to the exterior and where noted to be galvanized.
 - 3. Avoid posts at inside or outside corners. Locate posts close enough to the corner in each direction so the diagonal distance between posts does not exceed the maximum allowed rail spacing. Form the corner with tight radius pipe bends or manufactured elbows. Miters are not permitted. Where a post at a corner is unavoidable, use a manufactured three-way side outlet flush welded elbow.
 - 4. Make all wall returns, connections of a top rail to a post at the end of a run and other changes in direction with smooth tight radius pipe bends or flush welded manufactured elbows. Miters not permitted.
 - 5. Make all pipe bends on bending jigs designed to produce accurate bends without buckling or deforming the pipe walls.
 - 6. Make tee and cross intersections with manufactured flush weld type fittings or by carefully coping and welding the pipe.
 - 7. Weld all joints with continuous beads. Thoroughly fuse without undercutting or overlap. Size welds to develop the full strength of the members joined after grinding. Grind and sand all groove welds flush.
 - 8. Grind all fillet welds to a uniform radius tangent to the members joined after grinding. Round all edges and corners to a minimum radius of 1/8-inch. Sand with progressively finer grits removing all tool marks, imperfections, and scratches before proceeding to the next finer grit. Finish with 80-grit.
 - 9. Close exposed ends of pipes by welding 3/16-inch-thick closure plate inside and flush with pipe end.
 - 10. Return ends of handrails 90 degrees to walls, close exposed end and mount with 1/8-inch maximum space between end of rail and wall.

11. Bend or offset handrails where required to provide 1-½-inch minimum code required clearance between handrail and edge of floor slab, columns, ducts, pipes, pilasters or other obstructions.
 12. Provide sleeve inserts in accordance with Paragraph 2.01 of this Section for guardrail posts set in concrete.
 13. Cut and grind post ends to precise length and angle for where field welding to stair stringers is required.
 14. Provide expansion slip joints at 40-foot centers. Use an internal sleeve 4 inches long fastened to one side. Bevel exposed edges of pipe at joint.
- B. Metal Ladders:
1. Stainless steel 316 or as shown on the Drawings.
 2. Rails: 2-½-inch x 3/8-inch flat bar drilled or punched for insertion of rungs.
 3. Provide Mebac surfaces solid steel rungs by IKG Borden or equal.
 4. Rungs: 1-inch-diameter solid bar inserted into holes drilled in rails and welded on the outside. Space rungs equal distance apart. Coat rungs with an epoxy base paint containing aluminum oxide grit by Wooster "Safe-Stride" anti-slip paint; or equal OR Provide Mebac surfaces solid steel rungs by IKG Industries or equal.
 5. Provide brackets, welded to rails, spaced 8 feet on centers maximum for attachment to concrete or masonry with two ¾-inch-diameter drilled anchor bolts at each connection.
 6. Provide a retractable ladder extension where ladder does not extend above the highest surface served: Bilco "Ladder Up," equivalent by Saf-T-Climb; or equal.
- C. Chain Closure: Provide chain closures and related fittings made from 5/16-inch-316 stainless steel, with oblong links. Provide three chains 4 inches longer than the anchorage spacing for each guarded area. Mount chains as shown. Provide each chain with boat type snap hooks at each end. Provide eye bolts with 3/8-inch-shank diameter and with 7/8-inch eye for attachment of chains at each anchorage. Provide fittings of the same material and finish as the chain.
- D. Grating and Floor Plate Support Frames:
1. Material: Galvanized steel or as noted on the Drawings.
 2. Provide grating support angles for all gratings and floor plates. Fabricate grating support angles in complete, closed frames that will lie completely flat in a true plane. Install support frames so they will support the grating and floor plates with even, uniform, non-rattling bearing. Set frames so that the surface of the grating and floor plates are flush with the adjacent floor or surface.
 3. Design and fabricate support frames as required to prevent twisting due to any large ratio of length to width. Restrict the length of each closed section of long narrow support frames to 10 feet maximum.
 4. Hot-dip galvanize support frames after fabrication. Grind welds smooth on the bearing surface before galvanizing.
 5. Coat upper surfaces of steel grating support frames with bituminous mastic.
- E. Grating:
1. General Grating Requirements: Provide gratings that comply with requirements in the NAAMM Metal Bar Grating Manual.
 - a. Field measure installed grating frames before fabricating gratings.

- b. Provide grating panels that are absolutely flat, correctly sized, and fabricated to lie in their frames with uniform, non-rattling bearing on all supporting surfaces.
 - c. Fabricate with top surface of all bars flush. Install grating flush with adjacent concrete or other walking surfaces.
 - d. Provide punch serrated non-slip upper surface on grating in wet areas and areas noted to have a nonslip surface.
 - e. Band: Ends of all fixed and removable grating section Weld banding bars of the same thickness and the same depth as the main bearing bars to the ends of all bearing and cross bars. Weld the banding bars flush with the bearing bars at each panel corner and grind the weld smooth and flush. Round all edges and corners to 1/8-inch radius.
 - f. Band all shop and field cutouts and openings. Weld the banding bars to all cut bearing and cross bars.
 - g. Leave "split" openings in the gratings when required for the passage of pipes, valve stems or other devices.
 - h. Provide "fixed" grating for all operating grating platforms. Bolt "fixed" grating to support members with saddle clips and stud bolts welded to support members.
 - i. Where required for access or where noted, provide removable grating sections sized to limit the weight of any one section to 90 pounds.
 - j. Bolt removable sections in place by the same method used for fixed grating. Mark removable sections by painting the banding bars red after fabrication.
2. Steel grating:
- a. Manufacturer: Grating Pacific; IKG industries; or equal.
 - b. Welded steel grating: Hot-dip galvanized steel grating except where noted otherwise.
 - c. Main bars: As shown or not less than 1-1/4-inch high and 3/16-inch in thickness and spaced 1-3/16 inches on center. Cross bars: Spaced not more than 4 inches on center.
 - d. Size steel grating and support members as shown or 300 pounds per square foot superimposed load with a grating deflection not to exceed 1/4-inch.

F. Floor Plates:

- 1. Raised-pattern steel floor plates, ASTM A786.
- 2. Galvanized steel 3/8-inch-thick checkerplate with stiffeners sized and spaced as shown on the drawings or as required to support 100 pounds per square foot superimposed loads with a plate deflection not to exceed 1/4-inch.
- 3. Bolt floor plates to support members with 3/8-inch-diameter countersunk fasteners at 12 inches on center.
- 4. Limit the weight of any one section to 90 pounds.

2.08 ATTACHMENTS

- A. Metal Anchors: Provide metal anchors and fasteners required to secure all frames and other items rigidly in place and detailed for installation into concrete forms prior to placing concrete.
- B. Anchor Bolts and Anchorages to Concrete and Masonry: In accordance with Specification Section 05090. Full diameter hot-dip galvanized steel unless otherwise shown. Use of welding studs (Nelson studs) to anchor members to concrete is at the sole discretion of the Engineer.

PART 3 - EXECUTION

3.01 ERECTION TOLERANCES

- A. Conform to straight plumb and horizontal lines which also form a true flat plane to within 1/8-inch in 2 feet and 1/4-inch in 10 feet and 1/2 maximum overall.
- B. Curved surfaces shall conform to a true arc of a circle to within 1/8-inch in 12 inches and 1/4-inch maximum overall.

3.02 INSTALLATION GENERAL

- A. Fabricate and pre-fit metal work in the shop, in transportable components ready for field erection.
- B. Make proper allowance for expansion and contraction of the metals and of the materials to which they are fastened.
- C. Where metal is fastened to concrete, make the connection by means of sleeves and fastenings embedded in concrete or by expansion shield anchor bolts or wedge anchor bolts. Wood plugs, plastic plugs or powder driven studs are not acceptable.
- D. Construct steel work in accordance with AISC Standard practices to withstand the forces normally applied and in compliance with IBC and OSHA requirements.
- E. Grind welds smooth on all metal work exposed to view. Provide work that has:
 - 1. Surfaces that are flat, straight, square, plumb and level.
 - 2. Smooth curves, free of flat spots, and of uniform radius or, if intended to be of changing radius, follow a flowing fair curve.
 - 3. Make transitions between curved and straight portions of work at tangent points to achieve smooth and free flowing lines and surfaces without flat spots or abrupt changes in direction.
- F. Provide 1/8-inch radius corners and edges on all exposed work.
- G. Perform all welding in accordance with AWS Code D1.1. Employ methods and techniques to achieve strength and good appearance.
- H. Field Assembly: Set members to lines and elevations indicated. Align and adjust members before making permanent connections.
- I. Galvanized Metal Repair: Repair damaged galvanized metal by the heated substrate method as specified in Paragraph 2.03.
- J. Touch-up Painting (Ferrous Metals): After field assembly, clean all bare metal and all abrasions to shop coat, and spot paint with same primer used in the shop.

3.03 GUARDRAILS

- A. Provide workmanship of the highest quality performed by mechanics skilled in executing high quality architectural metal work.
- B. Set shop fabricated guardrail sections into position and align the top rail so that it is true to specified tolerances. Do field joining neatly and inconspicuously.
- C. Install horizontal sections of guardrail with the top rail exactly horizontal. Vary the height of the rail as required to accommodate sloping deck surfaces. Maintain code required minimum and maximum rail heights.

- D. Support guardrails with temporary braces and shoring to maintain true alignment until all final connections and grouting are completed.

3.04 STEEL LADDERS

- A. Install ladders with stainless steel expansion anchor bolts.
- B. Locate first rung same distance above surface below it as space between other rungs.

3.05 GRATINGS AND FLOOR PLATES

- A. Install support frames so that gratings and floor plates have continuous support and so gratings and floor plates will sit in their frames without rattling or rocking in any direction including across diagonal corners.

3.06 MISCELLANEOUS

- A. Furnish the following for field installation:
 - 1. Custom fabricated steel connectors for wood beams and other rough carpentry work.
 - 2. Door frames made of structural steel shapes for installation in the concrete pour. Provide all anchors and connectors.
 - 3. Miscellaneous metal work not specified in other Sections.

3.07 REPAIRS

- A. Repair or replace all defective work including:
 - 1. Unsightly welds.
 - 2. Discontinuous welds.
 - 3. Uneven connections.
 - 4. Variations exceeding specified tolerances.
 - 5. Kinks, bends.
 - 6. Other defects affecting the quality, strength, utility. and appearance of the work.

3.08 CLEANING

- A. Wash thoroughly using clean water and detergent.
- B. Do not use acid solutions, steel wool or other abrasives.
- C. Remove stubborn grease stains with mineral spirits.

END OF SECTION

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SECTION 09960

HIGH PERFORMANCE COATINGS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Section 09960 provides the requirements for; coating systems, surface preparation, coating application, and quality assurance/quality control relative to the equipment, structures listed in the Finish Schedule/Contract Drawings.
- B. Unless specified elsewhere, or shown on the Contract Drawings, the following shall not be coated:
 - 1. Metal completely embedded in concrete (except aluminum).
 - 2. Piping buried in ground or encased in concrete.
 - 3. Galvanized metal, including galvanized pipe supports, ladders and guardrails.
 - 4. Chain-link fence and galvanized fence gates.
 - 5. Rubber.
 - 6. Plastic pipe, including: polyvinyl chloride, polyethylene, and polypropylene piping.
 - 7. Stainless steel.
 - 8. Bronze, brass.
 - 9. Nameplates and grease fittings.
 - 10. Factory finished electrical panels.
 - 11. Factory fusion-bonded epoxy coated items.
 - 12. Aluminum or galvanized ductwork enclosed inside furred ceiling spaces.
 - 13. Aluminum handrail and aluminum guardrail.
 - 14. Fiberglass.
 - 15. Electrical conduit.
 - 16. Copper pipe.
- C. Related Sections:
 - 1. Section 01300: Submittals
 - 2. Section 11001: General Equipment and Mechanical Requirements
 - 3. Section 13211: Welded Steel Tanks
- D. The Contractor's bid shall be based upon using the products specified. If the products specified are not available in formulations that meet applicable regulations for volatile organic compound (VOC) levels at time of application, the Contractor shall submit for review products of equivalent quality and function that comply with regulations in effect at that time. A reasonable difference in cost of material between the first named items specified and the products that are required to meet regulations that change after the bid date and are in effect at the time of application may be approved for payment by Change Order in accordance with the General Conditions.

1.02 DEFINITIONS

- A. Abrasive: Material used for blast-cleaning, such as sand, grit or shot.
- B. Abrasive Blast Cleaning: Cleaning/surface preparation by abrasive propelled at high speed.

- C. Anchor Pattern: Profile or texture of prepared surface(s).
- D. American National Standards Institute (ANSI).
- E. ASTM International (ASTM).
- F. Bug Holes: Small cavities, usually not exceeding 15 mm in diameter, resulting from entrapment of air bubbles in the surface of formed concrete during placement and compaction.
- G. Coating/Lining Thickness: The total thickness of primer, intermediate and/or finish coats.
- H. Dewpoint: Temperature of a given air/water vapor mixture at which condensation starts.
- I. Dry Film Thickness (DFT): Depth of cured film, usually expressed in mils (0.001-inch). Use this definition as opposed to existing definition.
- J. Drying Time: Time interval between application and curing of material.
- K. Dry to Recoat: Time interval between application of material and ability to receive next coat.
- L. Dry to Touch: Time interval between application of material and ability to touch lightly without damage.
- M. Feather Edging: Reducing the thickness of the edge of paint.
- N. Feathering: Operation of tapering off the edge of a point with a comparatively dry brush.
- O. Field Coat: The application or the completion of application of the coating system after installation of the surface at the site of the work.
- P. Hold Point: A defined point, specified in Section 09960, at which work shall be halted for inspection.
- Q. Holiday: A discontinuity, skip, or void in coating or coating system film that exposes the underlying substrate.
- R. Honeycomb: Segregated condition of hardened concrete due to non-consolidation.
- S. ICRI: International Concrete Repair Institute.
- T. Incompatibility: Inability of a coating to perform well over another coating because of bleeding, poor bonding, or lifting of old coating; inability of a coating to perform well on a substrate.
- U. Laitance: A layer of weak, non-durable concrete containing cement fine that is brought to the surface through bleed water as a result of concrete finishing/over-finishing.
- V. Mil: 0.001-inch.
- W. National Association of Corrosion Engineers International (NACE).
- X. Overspray: Dry spray, particularly such paint that failed to strike the intended surface.

- Y. Owner: The awarding authority or entity that manages/operates the facility where the specified work will be performed. For the purposes of Section 09960, the term "Owner" may also refer to designated representatives such as the Trustee's Representative or Design Engineer.
- Z. Pinhole: A small diameter discontinuity in a coating or coating system film that is typically created by outgassing of air from a void in a concrete substrate resulting in exposure of the substrate or a void between coats.
- AA. Pot Life: Time interval after mixing of components during which the coating can be satisfactorily applied.
- BB. Resurfacer/Resurfacing Material: A layer of cementitious and/or resin-sed material used to fill or otherwise restore surface continuity to worn or damaged concrete surfaces.
- CC. Shelf Life: Maximum storage time for which a material may be stored without losing its usefulness.
- DD. Shop Coat: One or more coats applied in a shop or plant prior to shipment to the site of the work, where the field or finishing coat is applied.
- EE. Spreading Rate: Surface area covered by a unit volume of paint at a specific film thickness.
- FF. The Society for Protective Coatings (SSPC).
- GG. Stripe Coat: A separate coat of paint applied to all weld seems, pits, nuts/bolts/ washers, and edges by brush. This coat shall not be applied until any previous coat(s) have cured and, once applied, shall be allowed to cure prior to the application of the subsequent coat(s).
- HH. Surface Saturated Dry (SSD): Refers to concrete surface condition where the surface is saturated (damp) without the presence of standing water.
- II. Tie Coat: An intermediate coat used to bond different types of coatings. Coatings used to improve the adhesion of a succeeding coat.
- JJ. Touch-Up Painting: The application of paint on areas of painted surfaces to repair marks, scratches, and areas where the coating has deteriorated to restore the coating film to an unbroken condition.
- KK. Technical Practice Committee (TPC).
- LL. VOC Content: The portion of the coating that is a compound of carbon, is photo chemically reactive, and evaporates during drying or curing, expressed in grams per liter (g/l) or pounds per gallon (lb/gal).
- MM. Immersion: Refers to a service condition in which the substrate is below the waterline or submerged in water or wastewater at least intermittently if not constantly.
- NN. Weld Spatter: Beads of metal scattered near seam during welding.
- OO. Wet Film Thickness (WFT): The primer or coating film's thickness immediately following application. Wet film thickness is measured in mils or thousandths of an inch (0.001-inch) and is abbreviated WFT.

1.03 REFERENCES

- A. Section 09960 contains various guide documents, technology reports, and other industry standards relative to surface preparation, coating application, and testing methods. They are a part of Section 09960 as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of Section 09960 shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued. Where document dates are given in the following listing, references to those documents shall mean the specific document version associated with that date, regardless of whether the document has been superseded by a version with a later date, discontinued, or replaced.
- C. Standards and References are included as Appendix A.

1.04 SUBMITTALS

- A. Provide in accordance with Section 01300:
 - 1. Submit a list and description of all surfaces for which there is a question about what standard coating system to apply as part of the work covered by Section 09960 through a Request for Information in accordance with the General Conditions.
 - 2. Submit a Complete Finish Schedule including the specified Finish Schedule included in paragraph 2.02 and any additional surfaces to be coated by products submitted under this Section 09960. Denote the specific products and specific manufacturers for each item (structure, equipment, or substrate plus the manufacturer's brand name, product name, and designation number for each coat of each system to be used).
 - a. If materials other than those listed are submitted, provide information to justify and define the proposed substitution. The Owner may further require the Contractor to furnish additional test results from an independent paint laboratory comparing the proposed substitution with one of the named products, at no additional cost to the Owner.
 - b. Submit a color card or fan deck for each manufacturer and each coating product submitted.
 - 3. Prior to ordering material, confirm the items included in the Complete Finish Schedule and submit the Complete Finish Schedule plus the Owner approved colors for each location (structure, equipment, substrate).
 - 4. Current printed recommendations and product data sheets for coatings/coating systems including:
 - a. VOC data.
 - b. Storage requirements.
 - c. Surface preparation recommendations.
 - d. Primer type, where required.
 - e. Maximum dry and wet mil thickness per coat.

- f. Minimum and maximum curing time between coats, including atmospheric conditions for each.
 - g. Curing time before submergence in liquid.
 - h. Thinners/solvents for reduction and cleaning.
 - i. Ventilation requirements.
 - j. Minimum and maximum atmospheric application conditions.
 - k. Allowable application methods.
 - l. Maximum allowable moisture content (concrete substrates).
 - m. Maximum shelf life.
5. Manufacturer's Certification that the submitted coatings meet applicable Air Quality Management District regulations as to allowable VOC content for the place of application and use intended.
 6. Qualifications for Quality Control personnel to be provided on site by the Contractor including, but not limited to, the inspector's NACE and SSPC Certification numbers for the certifications requested in paragraph 1.05.E.2 of this Section 09960.
 7. Material Safety Data Sheets (MSDS) for all materials to be delivered to the job site, including coating system materials, solvents, and abrasive blast media.
 8. Detailed, written instructions for coating system treatment and graphic details for coating system terminations in the structures to be coated including pipe penetrations, metal embedments, grate frames, and other terminations shown on the Contract Drawings.
 9. A minimum of five project references, including current contact name, address, and telephone number where the Contractor has successfully performed similar coating work within the past 5 years.
 10. A minimum of five project references, including current contact name, address, and telephone number where the submitted materials have been successfully applied, in similar exposures, within the past 5 years. This submittal is only required if products not listed in Section 09960 are submitted.
 11. A letter from the selected and approved coating manufacturers for the project that verifies that the applicator meets the quality assurance requirements of paragraph 1.05.C of Section 09960 including application personnel training requirements.
 12. Information that defines the end date for field coating application for all equipment, machinery, and piping to ensure that the maximum recoat time for the shop applied primers will not be exceeded when field applied coatings are installed.
 13. Provide written confirmation by the shop and field applied coating manufacturers that compatibility between the shop and field applied coatings has been checked and approved by those manufacturers.

1.05 QUALITY ASSURANCE

A. Environmental Regulatory Requirements:

1. All work, material, procedures, and practices under Section 09960 shall conform to requirements of the local Air Resources Board or Air Quality Management District having jurisdiction. Prime or finish coat painting done in locations other than the project site shall be in accordance with air quality

regulations in effect at the place the coating is applied. Products specified herein are, to the best of the Design Engineer's knowledge, in compliance with the applicable VOC levels allowable at the date these Specifications were issued for bid.

2. The Air Resources Board or Air Quality Management District having jurisdiction may prohibit the sale or application of paints and enamels containing more than the stipulated quantities of volatile organic compounds manufactured after a stated date. Provide material meeting applicable regulations effective at the date of manufacture, or if not available, provide top of the line materials developed as replacements for specified materials and meeting applicable regulations as to VOC content.
3. If the Contractor applies coatings that have been modified or thinned other than as recommended or approved by manufacturer, the Contractor shall be responsible for any fines, costs, remedies, or legal actions that may result.
4. Surface preparation activities that result in the generation of airborne emissions shall be performed in accordance with applicable Federal, State, County, or Local regulations and ordinances. The Contractor shall be responsible for securing any and all licenses and permits required, at no additional cost to the Owner.
5. All debris (liquid or solid) generated from surface preparation or coating activities shall be disposed offsite in accordance with applicable Federal, State, County, or local regulations and ordinances. The Contractor shall be responsible for all required testing, licenses, permits, and fees, at no additional cost to the Owner.

B. Coating Manufacturer's Qualifications:

1. All protective coatings furnished under Section 09960 shall:
 - a. Be of a manufacturer who has been regularly engaged in the manufacture of protective coatings with a minimum of 10 years of successful experience.
 - b. Demonstrate to the satisfaction of the Engineer successful performance on comparable projects.

C. Coating Applicators Qualifications:

1. The application company or entity must demonstrate with written references as required in 1.04 A. 7. and 8. a minimum of five (5) years of practical experience in the application of the specified coatings and the successful completion of a minimum of five (5) projects of similar size and complexity within the last five (5) years. This must be verified in writing by the selected coating system manufacturer.
2. The application company or entity must be QP-1 and QP-2 Certified by SSPC for coatings work relevant to the qualifications of QP-1 and QP-2.
3. For the application company's or entity's personnel: employ only those persons on the project trained in the application of the specified protective coatings. Written confirmation of this must be provided by the approved coating systems manufacturer.

D. Coatings Preconstruction Meeting:

1. The Contractor shall attend a coatings preconstruction meeting prior to commencing any surface preparation or coating application work. Parties attending the meeting shall include the General Contractor, Trustee's

Representative, Coating Applicator, the Coating Applicator's Q.C. lead person, and a representative of the Coating Manufacturer. The following items shall be reviewed and discussed at the coatings preconstruction meeting.

- a. Schedule
- b. Environmental requirements
- c. Surfaces to be coated and protection of surfaces not to be coated
- d. Colors
- e. Surface preparation
- f. Application
- g. Coating repair
- h. Field quality control
- i. Housekeeping
- j. Disinfection (of potable water structures)
- k. Protection of coating systems
- l. One-year inspection
- m. Coordination with other trades / work activities/schedule
- n. Manufacturer's ongoing technical assistance.

E. Contractor Quality Control Requirements:

1. The Contractor is responsible for ensuring that the surface preparation and coating activities meet the requirements of this specification. Inspections by the Owner, or a representative of the coating manufacturer, will not relieve or limit the Contractor's responsibilities.
2. The specified quality control tasks shall be performed by an individual who has been properly trained and has a minimum of 5 years experience. The Contractor shall provide the Owner documentation indicating that the individual designated to perform quality control has received training similar to NACE CIP Level 3, SSPC PCI Level 2, and, has a minimum of 5 years field experience.
3. Coatings application shall conform to requirements of this specification and the standards referenced in paragraph 1.03.B. Changes in the coating system installation requirements will be allowed only with the written authorization of the Owner before work commences.
4. Contaminated, outdated, diluted materials, and/or materials from previously opened containers shall not be used.
5. For repairs, the Contractor shall provide the same products, or products recommended by the coating manufacturer, as used for the original coating.
6. The Contractor shall identify the points of access for inspection by the Owner. The Contractor shall provide ventilation, ingress and egress, and other means necessary for the Owners' personnel to safely access the work areas.
7. The Contractor shall conduct the work so that the coating system is installed as specified and shall inspect the work continually to ensure that the coating system is installed as specified. Coating system work that does not conform to the Specifications or is otherwise not acceptable shall be corrected in accordance with the coating manufacturer's written procedures.
8. The Contractor shall prepare and submit coating work daily reports for each day while on site. The coating work daily reports shall be submitted to the Owner no later than 1:00 p.m. the following workday. The coating work daily reports shall include the following:
 - a. Number of coating applicator employees on site.

- b. Start and finish time of work shift.
 - c. Climatic conditions at 4-hour intervals (i.e., partly cloudy, air temperature 78°F, relative humidity 63%, dew point 68°F, and WNW wind @ 4 mph).
 - d. Major equipment on site regardless of utilization (i.e., trailers, air compressors, generators, spray pumps, scaffolding, aerial lifts, pressure washers, and sandblast pots).
 - e. Inventory of coatings, solvents and abrasive media stored on site including information relative to deliveries received each day.
 - f. Summary of work performed to include:
 - 1) Substrates/structures prepared (size, quantity, and location).
 - 2) Surface preparation methods including materials consumed and equipment utilized.
 - 3) Substrates/structures coated (size, quantity, and location).
 - 4) Mixing method and time mixed (coating materials).
 - 5) Induction time, pot life, and application start time.
 - 6) Coating application methods including equipment utilized.
 - 7) Application finish time.
 - 8) Coating materials consumed [sequencing, product name, batch number(s) and manufacture date].
 - 9) Problems encountered (i.e., equipment malfunctions or disruption/interference by other trades).
 - 10) Accidents or near misses.
 - 11) Quality control testing results indicated in Appendix A.
 - 9. Mandatory quality control tests are included in Appendix A.
 - 10. Acceptance criteria for each Quality Control test shall be as indicated on the Coating Detail Sheets, the manufacturer's published data, or elsewhere in this specification, whichever is more stringent.
- F. Mandatory Hold Point Inspections:
- 1. Hold Point Inspections shall be performed in the Owner's presence. The Contractor shall provide the Owner a minimum two (2) hours notice prior to performing a Hold Point Inspection.
 - 2. Hold Point Inspections shall be performed as follows for each structure, equipment, substrate to receive coating application:
 - a. Prior to surface preparation to determine if the environmental or site conditions would be detrimental to surface preparation/coating application, and if the substrate is void of detrimental defects/contamination.
 - b. Upon completion of the specified surface preparation (concrete and non-ferrous substrates) or upon completion of the first full production day of surface preparation (ferrous substrates), ensure that the specified level of cleanliness and surface profile have been achieved.
 - c. Upon completion of each coating system component to: ensure that no visual coating defects such as runs, sags, voids, holidays, and embedment of foreign matter are present, and ensure that the specified dry film thickness has been achieved.
 - d. Upon final cure of the complete coating system to: identify visual coating defects, measure coating system dry film thickness, perform cure evaluation testing, perform holiday detection testing, and perform adhesion testing. Due to the nature and complexity of the specific

testing requirements, this Hold Point may encompass between several hours to several days.

- e. Upon completion of remedial repairs (final inspection), should the coating defects be identified at the final cure Hold Point Inspection, all previously stated Hold Points will be applicable during the coating repair process after which a final inspection will be performed. Retesting will be required for the repaired areas at no additional cost to the Owner.
- 3. The Contractor shall indicate the execution and nature of each Hold Point Inspection in the daily report.
- 4. The Owner will acknowledge participation at each individual Hold Point on a Contractor prepared document appended to the daily report. The document must include a section wherein the Owner may indicate exceptions or qualifications. It shall be the Contractor's responsibility to ensure that the Hold Point Inspection is acknowledged by the Owner.
- 5. Failure to comply with any or all of the Hold Point Inspection requirements may result in the rejection of all subsequent work.
- 6. Hold Point Inspections may only be waived by written authorization from the Owner.

1.06 ILLUMINATION

- A. Provide the following minimum illumination during all phases of work:
 - 1. General work area: 25-Foot Candles.
 - 2. Surface preparation and coating application: 30-Foot Candles.
 - 3. Inspection: 50-Foot Candles.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all coating materials in unopened containers with manufacturer's label, which must include name, batch number, manufacturer date, shelf life, and VOC content.
- B. Store in an assigned area onsite with concurrence from the coating manufacturers. Maintain storage area clean and fire safe. Dispose of used rags, thinner and buckets daily. Store solvents in closed approved storage containers.

1.08 WARNINGS

- A. Be advised that application of paint, epoxy, and protective coating materials may be hazardous. Take all necessary precautions to ensure the safety of workers and property.
- B. Be advised that as a part of this work abrasive blasting is required. This may require the use of special equipment. Become familiar with the existing site conditions and take all steps necessary to protect adjacent facilities and personnel, at no additional cost to the Owner. In addition, abrasive blasting and painting is called for in, on or around mechanical equipment, which may be damaged by grit, dust, or painting overspray. Mask, wrap, enclose, and provide all protection required to safeguard this equipment at no additional cost to the Owner.
- C. Perform abrasive blasting activities in a manner that will not cause nuisance to adjacent public and private property and equipment.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. The Coating Detail Sheets in Appendix B refer to specific manufacturers and have been provided as levels of quality as well as jurisdictional VOC compliance for the specified substrate and exposure conditions. Although not stated on the Coating Detail Sheets, the term "or approved equal" is applicable.
- B. Coatings used in each coating system shall be the products of a single coating manufacturer. Mixed manufacturer coating systems are prohibited.
- C. Alternate coating systems submitted for consideration must be of the same generic type as those specified.
- D. Coatings shall not contain heavy metals that exceed the regulated levels of the jurisdiction in which the coatings will be applied.
- E. Colors are to be factory mixed, using light-fast colorants proportioned by accurate measurement into proper type base.
- F. Abrasive Media:
 - 1. Shall not be classified as a health or environmental hazard.
 - 2. Shall be delivered to the site in sealed bag or containers.
 - 3. Shall be kept clean and dry while stored on site.
 - 4. Shall not be reused for abrasive blasting unless specifically manufactured for reuse and appropriate recycling equipment is utilized.
 - 5. Shall be of an appropriate size, shape, and hardness to produce the specified surface profile(s).

2.02 COATING SYSTEMS

- A. System Designations and Related Requirements:
 - 1. The following table provides a general list of the coating systems by both substrate and exposure conditions. Additional information regarding surface preparation, application, dry film thicknesses, and approved products by manufacturer is provided on the Coating Detail Sheets in Appendix B.
 - 2. It shall be the Contractor's responsibility to ensure that there is chemical compatibility between all shop applied primers or coatings on all machinery and equipment provided for the project and any field applied coatings. Compatibility shall mean that there is no chemical reactivity or physical property of the shop or field applied coatings which will cause or promote intercoat adhesion problems or proper cure problems for the shop or field applied coatings on machinery or equipment or piping. The Contractor shall provide written confirmation by the shop and field applied coating manufacturers that compatibility has been checked and approved by those manufacturers. The rework to correct any compatibility problem between shop and field applied coatings shall be solely the responsibility of the Contractor at no additional cost to the Owner.

System Identification	Substrate	Exposure
System No. 2: Zinc-Epoxy-Urethane	Metal	Atmospheric Exterior Direct Sunlight Non Immersion Mildly Corrosive
System No. 3: Epoxy (cycloaliphatic amine cured or curing agent providing equal chemical resistance properties)	Metal/Concrete	Non Immersion Immersion Non Potable Moderately Corrosive Color Required
System No. 5M: NSF Epoxy	Metal/Concrete	Potable Water Contact NSF/ANSI/CAN 61/600 Certification
System No. 7: Polyamidoamine Epoxy	Concrete	Below Grade (Buried)

- B. Coating System Detail Sheets:
1. Coating System Detail Sheets (CDS) are included in Appendix B.
- C. Finish Schedule:
1. The Finish Schedule identifies major structures, equipment, and substrates to be coated in accordance with Section 09960. The Finish Schedule is not intended to be a complete listing of all surfaces to be coated and other requirements may be identified elsewhere in the Specifications or on the Drawings. There may be additional surfaces for the project that require coating application which may not be listed in the Finish Schedule, and the Contractor shall be responsible for coating those surfaces in accordance with the requirements of Section 09960. The Contractor shall be responsible to identify any surfaces for which there is a question about what standard coating system to apply. Address any questions in writing in accordance with paragraph 1.04.A.2 of Section 09960. The Finish Schedule designates the coating system to be applied. Specific information relative to number of coats and film thicknesses is indicated on the Coating Detail Sheets found in Appendix B.

Structure	Substrate	Coating System	Comments
Storage Tank –Exterior	Steel	No. 2	Outdoors - Exposure to weathering
Storage Tank – Interior	Steel Immersion	No. 5M	NSF/ANSI/CAN 61/600 CertificationRequired
Storage Tank – Interior	Steel NonImmersion	No. 5M	NSF/ANSI/CAN 61/600 CertificationRequired
Piping and Pipe Supports	Ductile Iron or Carbon Steel	No. 2	Outdoors - Exposure to weathering. Including ladders, guardrail, conduits and enclosures.

Structure	Substrate	Coating System	Comments
Piping and Pipe Supports	Ductile Iron or Carbon Steel	No. 3	Inside buildings
Piping Buried	Ductile Iron or Carbon Steel	No. 7	Buried exposed to groundwater

2. Colors shall be selected by the Owner.
 3. Refer to contract drawings details regarding coating elevation termination and transitions. Steel immersion is steel beneath the top capacity level shown on drawings.
- D. The Contractor shall provide 1 unopened gallon container of each color and type of coating and solvent/thinner applied during the course of the project to the Owner upon completion of the project.

PART 3 - EXECUTION

3.01 COATINGS

- A. General:
 1. Coating application shall not proceed until the Owner has received the VOC certifications specified in paragraph 1.04.A.4, the Owner has inspected the materials, and the coating manufacturer has trained the Contractor in the surface preparation, mixing and application of each coating system.
- B. Shop and Field Coats:
 1. Shop applied prime coat: Except as otherwise specified, prime coats may be shop-applied or field-applied. Shop-applied primer shall be compatible with the specified coating system and shall be applied at the minimum dry film thickness recommended by the coating manufacturer. Product data sheets identifying the shop primer used shall be provided to the on-site coating application personnel. Adhesion tests shall be performed on the shop primer as specified in paragraph 3.01.B.3. Damaged, deteriorated, and poorly applied shop coatings that do not meet the requirements of Section 09960 shall be removed and the surfaces recoated. If the shop prime coat meets the requirements of this Section, the field coating may consist of touching up the shop prime coat and then applying the finish coats to achieve the specified film thickness and continuity.
 2. Field Coats: Field coats shall consist of one or more prime coats and one or more finish coats to build up the coating to the specified dry film thickness. Unless otherwise specified, finish coats shall not be applied until other work in the area is complete and until previous coats have been inspected.
 3. Adhesion Confirmation: The Contractor shall perform an adhesion test after proper cure in accordance with ASTM D3359 to demonstrate that: (1) the shop applied prime coat adheres to the substrate; and (2) the specified field coatings adhere to the shop coat. Test results showing an adhesion rating of 5A on immersed surfaces and 4A or better on other surfaces shall be considered acceptable for coatings 5 mils or more in thickness (Method A). Test results showing an adhesion rating of 5B on immersed surfaces and 4B

or better on other surfaces shall be considered acceptable for coating thicknesses less than 5 mils.

C. Application Location Requirements:

1. Equipment, Non-immersed: Items of equipment, or parts of equipment which are not immersed in service, shall be shop primed and then finish coated in the field after installation with the specified or acceptable color. If the shop primer requires top coating within a specified period of time, the equipment shall be finish coated in the shop and then touch-up painted after installation. If equipment removal and reinstallation is required for the project, touch-up coating work shall be performed in the field following installation.
2. Equipment, Immersed: Items of equipment, or parts and surfaces of equipment which are immersed when in service, with the exception of pumps and valves, shall have surface preparation and coating work performed in the field. Coating systems applied to immersed equipment shall be pinhole free.

3.02 PREPARATION

A. General:

1. Surface preparations for each type of surface shall be in accordance with the specific requirements of each Coating System Detail Sheet (CDS) and the manufacturer's requirements. In the event of a conflict, the more stringent requirement shall take precedence.
2. Surfaces to be coated shall be clean and dry. Before applying coating or surface treatments, oil, grease, dirt, rust, loose mill scale, old weathered coatings, and other foreign substances shall be removed. Oil and grease shall be removed before mechanical cleaning is started. Where mechanical cleaning is accomplished by blast cleaning, the abrasive used shall be washed, graded and free of contaminants which might interfere with the adhesion of the coatings. The air used for blast cleaning shall be sufficiently free of oil and moisture to not cause detrimental contamination of the surfaces to be coated.
3. Cleaning and coating shall be scheduled so that dust and spray from the cleaning process shall not fall on wet, newly coated surfaces. Hardware, hardware accessories, nameplates, data tags, machined surfaces, sprinkler heads, electrical fixtures, and similar uncoated items which are in contact with coated surfaces shall be removed or masked prior to surface preparation and painting operations. Following completion of coating, removed items shall be reinstalled. Equipment adjacent to walls shall be disconnected and moved to permit cleaning and painting of equipment and walls and, following painting, shall be replaced and reconnected.
4. Containment: The Contractor shall erect and maintain protective enclosures as required to ensure that surface preparation debris, including dust, is contained within the immediate work area. All costs associated with containment shall be paid by the Contractor.
5. Dust and Contaminants: Protect substrate from excessive dust and airborne contaminants during coating application and curing. Use temporary dust barriers to close off areas being painted from areas where other work is being performed.

B. Abrasive Blast Cleaning:

1. When abrasive blast cleaning is required to achieve the specified surface preparation the following requirements for blast cleaning materials and equipment shall be met:
 - a. Used or spent blast abrasive shall not be reused on this project.
 - b. The compressed air used for blast cleaning shall be filtered and shall contain no condensed water and no oil. Moisture traps shall be cleaned at least once every 4 hours or more frequently as required to prevent moisture from entering the supply air to the abrasive blasting equipment.
 - c. Oil separators shall be installed just downstream of compressor discharge valves and at the discharge of the blast pot discharges. These shall be checked on the same frequency as the moisture traps as defined in Item 2 above.
 - d. Regulators, gauges, filters, and separators shall be in use on compressor air lines to blasting nozzles times during this work.
 - e. An air dryer or desiccant filter drying unit shall be installed which dries the compressed air prior to blast pot connections.
 - f. The air dryer shall be used and maintained for the duration of surface preparation work.
 - g. The Contractor shall provide ventilation for airborne particulate evacuation (meeting pertinent safety standards) to optimize visibility for both blast cleaning and inspection of the substrate during surface preparation work.
 - h. If between final surface preparation work and coating system application, contamination of prepared and cleaned metallic substrates occurs, or if the prepared substrates' appearance darkens or changes color, re-cleaning by water blasting, re-blasting and abrasive blast cleaning shall be required until the specified degree of cleanliness is reclaimed.
 - i. The Contractor is responsible for dust control and for protection of mechanical, electrical, and other equipment adjacent to and surrounding the work area.

C. Solvent Cleaning:

1. Any solvent wash, solvent wipe, or cleaner used, including but not limited to those used for surface preparation in accordance with SSPC SP-1 Solvent Cleaning shall be of the emulsifying type which emits no more than 340 g/l VOCs for AIM regions, 250 g/l for CARB regions and 100 g/l for SCAQMD regions, contains no phosphates, is biodegradable, removes no zinc, and is compatible with the specified primer.
2. Clean white cloths and clean fluids shall be used in solvent cleaning.

D. Ferrous Metal Substrates:

1. Ferrous surfaces shall be prepared in accordance with applicable surface preparation specifications of SSPC/NACE specified for each coating system. Specific surface preparation requirements are stated on the CDS. The profile depth of the surface to be coated shall be in accordance with the CDS requirements and shall be measured by Method C of ASTM D4417. Blast particle size shall be selected by the Contractor to produce the specified surface profile. The solvent in solvent cleaning operations shall be as recommended by the coating manufacturer.

2. Preparation of ferrous metal surfaces shall be based upon comparison with SSPC-VIS1, and as described in the CDS for each coating system. If dry abrasive blast cleaning is selected and to facilitate inspection, the Contractor shall, on the first day of cleaning operations, abrasive blast metal panels to the standards specified. Plates shall measure a minimum of 8-1/2 inches by 11 inches. Panels meeting the requirements of the specifications shall be initialed by the Contractor and the Owner and coated with a clear non-yellowing finish. One of these panels shall be prepared for each type of abrasive blasting and shall be used as the comparison standard throughout the project.
 3. Blast cleaning requirements for steel and ductile-iron substrates are as follows:
 - a. Ferrous steel piping shall be prepared in accordance with SSPC SP-6 and primed before installation.
 - b. Ductile-iron piping surfaces including fittings shall be prepared in accordance with NAPF 500-03, NAPF 500-03-04, and NAPF 50.
 - c. Remove traces of grit, dust, dirt, rust scale, friable material, loose corrosion products or embedded abrasive from substrate by vacuum cleaning prior to coating application.
 - d. Care must be taken to prevent contamination of the surface after blasting from worker's fingerprints, deleterious substances on workers' clothing, or from atmospheric conditions.
- E. Concrete Surfaces:
1. Inspection of concrete surfaces prior to surface preparation and surface preparation of concrete surfaces shall be performed in accordance with SSPC-SP13/NACE.
 2. Prepare substrate cracks, areas requiring resurfacing and perform detail treatment including but not limited to, terminating edges, per coating manufacturer's recommendations. This shall precede surface preparation for degree of cleanliness and profile.
 3. The surface profile for prepared concrete surfaces to be coated shall be evaluated by comparing the profile of the prepared concrete with the profile of graded abrasive paper, as described in ANSI B74.18 or by comparing the profile with the ICRI 310.2 (surface profile replicas). Surface profile requirements shall be in accordance with the CDS requirements and the coating manufacturer's recommendations.
 4. Surface cleanliness of prepared concrete substrates shall be inspected after cleaning, preparation, and/or drying, but prior to making repairs or applying a coat in the coating system. If concrete surfaces are repaired, they shall be re-inspected for surface cleanliness prior to application of the coating system.
 5. Surface preparation of concrete substrates shall be accomplished using methods stated in SSPC SP-13/NACE 6. The selected cleaning method shall produce the requirements set forth below.
 - a. A clean substrate that is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste, and otherwise deleterious substances shall be achieved. Blast cleaning and other means necessary shall be used to open up air voids or "bug holes" to expose their complete perimeter. Leaving shelled over, hidden air voids beneath the exposed concrete surface is not acceptable. Concrete

substrate must be dry prior to the application of filler/surface or coating system materials.

- b. Acceptable surface preparation must produce a concrete surface with a minimum pH of 8.0 to be confirmed by surface pH testing. If after surface preparation, the surface pH remains below 8.0, perform additional water blasting, cleaning, or abrasive blast cleaning until additional pH testing indicates an acceptable pH level.
 - c. Following inspection by the Contractor of the concrete surface preparation, thoroughly vacuum clean concrete surfaces to be coated to remove loose dirt, and spent abrasive (if dry blast cleaning is used) leaving a dust-free, sound concrete substrate. Debris produced by blast cleaning shall be removed from the structures to be coated and disposed of legally off site by the Contractor.
- 6. Should abrasive blast cleaning or high or ultrahigh pressure water blasting not remove degraded concrete, chipping or other abrading tools shall be used to remove the deteriorated concrete until a sound, clean substrate is achieved which is free of calcium sulfate, loose coarse or fine aggregate, laitance, loose hydrated cement paste, and otherwise deleterious substances. Concrete substrates must be dry prior to the application of filler-surfacers or coating system materials.
 - 7. Surface cleanliness of prepared concrete substrates shall be inspected after cleaning, preparation, and/or drying, but prior to application of coating materials. If concrete surfaces are repaired, they shall be re-inspected for surface cleanliness and required surface profile prior to application of the coating system.
 - 8. Moisture content of concrete to be coated shall be tested in accordance with ASTM D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method or ASTM F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride. The ASTM D4263 plastic sheet test shall be conducted at least once for every 500 sq. ft. of surface area to be coated. The presence of any moisture on plastic sheet following test period constitutes a non-acceptable test. Concrete surfaces to be coated, which are on the negative or back side of concrete walls or structures exposed to soils (back filled) or immersed, should be waterproofed. Perform calcium chloride tests in accordance with ASTM F1869 once for each 500 sq. ft. of surface area to be coated. The Contractor shall ensure that the moisture content of the concrete is within the written parameters established by the coating system manufacturer.

F. Galvanized Steel Surfaces

- 1. Prepare in accordance with SSPC-SP16 to impart a uniform surface profile to the galvanized steel surfaces. Where this cannot be performed, prepare by abrading in accordance with SSPC-SP3, Power Tool Cleaning to achieve a uniform surface profile. Vacuum clean and solvent clean after blast cleaning or abrading and allow the solvent to fully evaporate prior to any coating application.

3.03 APPLICATION

A. Workmanship:

1. Coated surfaces shall be free from excessive runs, sags, drips, ridges, waves, laps, and brush marks. Coats shall be applied to produce an even film of uniform thickness completely coating corners and crevices. Minor and infrequent runs and sags which are within the total specified D.F.T. plus a few mils (no more than 10% more mils than the specified total D.F.T.) will be acceptable. However, frequent runs or sags which exceed these limits or otherwise will be detrimental to coating system performance shall not be accepted.
2. The Contractor's spray equipment shall be designed for application of the materials specified. Compressors shall have suitable traps and filters to remove water and oils from the air. Spray equipment shall be equipped with mechanical agitators, pressure gages, and pressure regulators, and properly sized spray tips.
3. Each coating application be applied evenly and sharply cut to line. Care shall be exercised to avoid overspray or spattering paint on surfaces not to be coated. Glass, hardware, floors, roofs, and other adjacent areas and installations shall be protected by taping, drop cloths, or other suitable measures.
4. Coating applications method shall be as recommended by the coating manufacturer.
5. Allow each coat to cure or dry thoroughly, according to the coating manufacturer's printed instructions, prior to recoating.
6. Vary color for each successive coat for coating systems when possible.
7. When coating complex steel shapes, prior to overall coating system application, stripe coat welds, edges of structural steel shapes, metal cut-outs, pits in steel surfaces, or rough surfaces with the prime coat. This involves applying a separate coat using brushes or rollers to ensure proper coverage. Stripe coat via spray application is not permitted.

B. Coating Properties – Mixing and Thinning:

1. Coatings, when applied, shall provide a satisfactory film and smooth even surface. Glossy undercoats shall be lightly sanded to provide a surface suitable for the proper application and adhesion of subsequent coats. Coating materials shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings consisting of two or more components shall be mixed in accordance with the coating manufacturer's instructions. Where necessary to suit the conditions of the surface, temperature, weather and method of application, the coating may be thinned as recommended by the coating manufacturer immediately prior to use. The VOC of the coating as applied shall comply with prevailing air pollution control regulations. Unless otherwise specified, coatings shall not be reduced more than necessary to obtain the proper application characteristics. Thinner shall be as recommended by the coating manufacturer.
2. Mixing of partial "kits" is strictly prohibited unless authorized in writing by the coating manufacturer and the Owner. This prohibition also applies to coatings mixed for touchup or repairs. If authorized to mix partial kits, the Contractor shall utilize containers with appropriate graduated markings/calibrated weight scales.

- C. Environmental Conditions:
1. Provide adequate heat, ventilation, and dehumidification to ensure that the coating manufacturer's environmental requirements are met and to ensure no loss of production days due to failure to meet coating manufacturer's environmental requirements.
 2. Provide sufficient and continuous ventilation and air movement across coated substrates to remove volatile constituents (solvent) throughout the manufacturer's published curing period.
 3. Air and surface temperatures: Prepare surfaces, apply and cure coatings within air and surface temperature range recommended by coating manufacturer.
 4. Relative humidity: Prepare surfaces, apply and cure coatings within relative humidity range in accordance with coating manufacturer's instructions.
 5. Dew Point: Do not apply coatings unless the temperature of the dew point is 5°F or greater than the temperature of the substrate.
 6. Precipitation: Do not apply coatings in rain, snow, fog, or mist.
 7. Wind: Do not spray apply coatings when the wind direction and velocity are such that overspray may result in property damage.
- D. Concrete Substrate Temperatures and Detail Treatment:
1. When the surface temperatures of the concrete substrates to be coated are rising or when these substrates are in direct sunlight, outgassing of air from the concrete may result in bubbling, pinhole formations, or blistering in the coating system. The application of the filler-surfacer and the coating system will only be allowed during periods of falling temperature. This may require that application of the filler-surfacer and coating system to occur during the cooler evening hours. Contractor shall include any cost for working outside of normal hours in the bid.
 2. Should bubbles, pinholes, or discontinuities form in the applied coating system material, they shall be repaired as recommended by the coating manufacturer. Should pinholes develop in the filler-surfacer material or in the first coat of the coating material, the pinholes shall be repaired in accordance with the recommendations prior to application of the next coat of material. Whenever pinholes occur, the air void behind or beneath the pinhole shall be opened up completely and then completely filled with the specified filler-surfacer material. Next, the coated area around the pinhole repair shall be abraded and the coating reapplied over that area.
 3. Perform application detail work per the coating manufacturer's current written recommendations and/or drawings.
- E. Protection of Coated Surfaces:
1. Items which have been coated shall not be handled, worked on, or otherwise disturbed, until the coating is completely dry and hard. After delivery at the site, and upon permanent erection or installation, shop-coated metalwork shall be recoated or retouched with specified coating when it is necessary to maintain the integrity of the film.
- F. Film Thickness and Continuity:
1. WFT of the first coat of the coating system and subsequent coats shall be verified by the Contractor, during application of each coat.
 2. Coatings shall be applied to the minimum dry film thickness specified as indicated on the CDS. Dry film thickness shall be determined using the

appropriate industry standard for the substrate (SSPC-PA 2, SSPC-PA 9, or ASTM D1400). Coatings determined to be above the maximum dry film thickness as indicated on the CDS or the coating manufacturer's product data sheet, will be removed at the Owner's discretion.

3. In testing for continuity of coating about welds, projections (such as bolts and nuts), and crevices, the Owner shall determine the minimum conductivity for smooth areas of like coating where the dry mil thickness has been accepted. This conductivity shall be the minimum required for these rough or irregular areas. Pinholes and holidays shall be recoated to the required coverage.
4. The ability to obtain specified film thickness is generally compromised when brush or roller application methods are used and, therefore, more coats may be needed to be applied to achieve the specified dry film thickness.
5. For concrete substrates, the Contractor shall apply a complete skim coat of the specified filler-surfacer material over the entire substrate prior to application of the coating system. This material shall be applied such that all open air voids and "bug holes" in the concrete substrate are completely filled prior to coating application.

G. Special Requirements:

1. Before erection, the Contractor shall apply all but the final finish coat to interior surfaces of roof plates, roof rafters and supports, pipe hangers, piping in contact with hangers, and contact surfaces which are inaccessible after assembly. The final coat shall be applied after erection. Structural friction connections and high tensile bolts and nuts shall be coated after erection. Areas damaged during erection shall be hand-cleaned or power-tool cleaned and recoated with primer coat prior to the application of subsequent coats. Touch-up of surfaces shall be performed after installation. Surfaces to be coated shall be clean and dry at the time of application. Except for those to be filled with grout, the underside of equipment bases and supports that have not been galvanized shall be coated with at least two coats of primer specified in the CDS prior to setting the equipment in place. Provide coating system terminations at leading edges and transitions to other substrates in accordance with the coating manufacturer's recommendations or detail drawings.

H. Soluble Salt Contamination of Metal Substrates:

1. Contractor shall test in accordance with SSPC Guide 15 metal substrates to be coated that have been exposed to sea water or coastal air or to industrial fallout of particulate or other sources of soluble chlorides (such as waste water exposure). If testing indicates chloride levels in excess of 25 ppm exist after the surface preparation has been completed, the Contractor shall re-clean and prepare these surfaces until chloride levels are below 25 ppm.

3.04 INSPECTION AND TESTING BY AN INDEPENDENT THIRD PARTY

- A. The Owner reserves the right to engage the services of an independent third party to provide quality control inspection. Third party inspection is in addition to any inspection required to be performed by the Contractor and does not limit the Contractor's responsibility for quality workmanship or quality control as specified.
- B. Third party inspection will be performed in a manner which limits interference / inhibits the Contractor's operations. Whenever feasible, the third party inspections will be performed concurrently with the Contractor's required inspections.

- C. Testing Discrepancies: In the event that discrepancies occur relative to test methods or test results, the findings of the Independent Third Party shall be final. The Contractor shall not be entitled to additional monies for rework/additional work necessary to satisfy the requirements of the specification as a result of the Independent Third Parties findings.

3.05 FINAL INSPECTION

- A. Contractor shall conduct a final inspection to determine whether coating system work meets the requirements of the Specifications.
- B. The Owner will subsequently conduct a final inspection with the Contractor to determine the work is in conformance with requirements of the contract documents.
- C. Any rework required shall be marked. Such areas shall be re-cleaned and repaired as specified at no additional cost to the Owner.

3.06 CLEANUP

- A. Upon completion of the work, the Contractor shall remove and dispose of surplus materials, protective coverings, spent abrasive, and accumulated rubbish.
- B. All surfaces shall be thoroughly cleaned and any damage resulting from surface preparation or coating application shall be repaired.

END OF SECTION

SECTION 09960

APPENDIX A STANDARDS AND REFERENCES AND MANDATORY QUALITY CONTROL TESTING

I. STANDARDS AND REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI/NSF 61 Drinking Water System Components
- B. ASTM International (ASTM):
 - 1. ASTM D16-11a Standard Terminology for Paint, Related Coatings, Materials and Applications
 - 2. ASTM D3960 Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
 - 3. ASTM D4262 Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces
 - 4. ASTM D4263 Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
 - 5. ASTM D4414 Standard Practice for Measurement of Wet Film Thickness by Notch Gages
 - 6. ASTM D4417 Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
 - 7. ASTM D4541 Standard Test Methods for Pull-Off Strength of Coatings on Metal Substrates Using Portable Adhesion Testers
 - 8. ASTM D4787 Standard Practice for Continuity Verification of Liquid or Sheet Linings Applied to Concrete Substrates
 - 9. ASTM D5162 Standard Practice for Discontinuity (Holiday) Testing of Nonconductive Protective Coating on Metallic Substrates
 - 10. ASTM D7234 Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Adhesion Testers
 - 11. ASTM E337 Standard Test Method for Measuring Humidity With a Psychrometer
 - 12. ASTM F1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
- C. Federal:
 - 1. FS 595b: Federal Standard Colors
- D. International Concrete Repair Institute (ICRI):
 - 1. ICRI 310.2 Guideline for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays
- E. National Association of Corrosion Engineers International (NACE):
 - 1. NACE Standard SP0188 Standard Recommended Practice – Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
 - 2. NACE Standard RP0288 Standard Recommended Practice, Inspection of Linings on Steel and Concrete
 - 3. NACE Standard SP0892 Standard Recommended Practice, Linings Over Concrete in Immersion Service
 - 4. NACE Publication TPC2 Coatings and Linings for Immersion Service

- F. National Association of Pipe Fabricators (NAPF):
 - 1. NAPF 500-03 Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings
- G. Occupational Safety and Health Administration (OSHA):
 - 1. OSHA Title 29, Part 1926 Safety and Health Standards for Construction
- H. Society for Protective Coatings (SSPC) ⁽¹⁾:
 - 1. SSPC-PA COM Paint Application Specifications and Guides (Commentary)
 - 2. SSPC-AB 1 Mineral and Slag Abrasives
 - 3. SSPC-PA 1 Shop, Field, and Maintenance Painting of Steel
 - 4. SSPC-PA 2, Level 3 Measurement of Dry Coating Thickness with Magnetic Gages
 - 5. SSPC-PA 9 Measurement of Dry Coating Thickness on Cementitious Substrates Using Ultrasonic Gages
 - 6. SSPC Technology Guide 6 Guide for Containing Debris Generated During Paint Removal Operations
 - 7. SSPC Technology Guide 7 Guide to the Disposal of Lead-Contaminated Surface Preparation Debris
 - 8. SSPC-PA Guide 10 A Guide to Safety and Health Requirements for Industrial Painting Projects
 - 9. SSPC-PA Guide 11 Protecting Edges, Crevices, and Irregular Steel Surfaces by Stripe Coating
 - 10. SSPC Technology Guide 12 Guide for Illumination of Industrial Painting Projects
 - 11. SSPC-PA Guide 15 Field Methods for Retrieval and Analysis of Soluble Salts on Steel and other Non Porous Substrates
 - 12. SSPC-PA Guide 17 Procedure for Determining Conformance to Steel Profile/Surface Roughness/Peak Count Requirements
 - 13. SSPC-PA Guide 19 Guide to Selecting Coatings for Use Over Galvanized Steel Substrates
 - 14. SSPC SP1 Solvent Cleaning
 - 15. SSPC SP2 Hand Tool Cleaning
 - 16. SSPC SP3 Power Tool Cleaning
 - 17. SSPC SP5 White Metal Blast Cleaning
 - 18. SSPC SP6 Commercial Blast Cleaning
 - 19. SSPC SP7 Brush-Off Blast Cleaning
 - 20. SSPC SP10 Near-White Blast Cleaning
 - 21. SSPC SP11 Power Tool Cleaning to Bare Metal
 - 22. SSPC SP 13 Surface Preparation of Concrete
 - 23. SSPC SP 14 Industrial Blast Cleaning
 - 24. SSPC SP 15 Commercial Grade Power Tool Cleaning
 - 25. SSPC SP 16 Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals
 - 26. SSPC-TR 2/NACE 6G198 Wet Abrasive Blast Cleaning

27.	SSPC-TR3/NACE 6A192	Dehumidification and Temperature Control During Surface Preparation, Application, and Curing for Coatings/Linings of Steel Tanks, Vessels, and Other Enclosed Spaces
28.	SSPC-TU-3	Overcoating
29.	SSPC-VIS 1	Visual Standard for Abrasive Blast Cleaned Steel
30.	SSPC-VIS 3	Visual Standard for Power and Hand – Tool Cleaned Steel
31.	SSPC-VIS 4	Visual Standards (Waterjetting)
32.	SSPC-VIS 5	Visual Standards (Wet Abrasive Blast Cleaning)
33.	SSPC-WJ 1,2,3,4	Water Jetting Surface preparation Standards

II. MANDATORY QUALITY CONTROL TESTS

Test Requirement	Reference Standard	Interval / Frequency
Measure and Record Ambient and Surface Temperatures	N/A	During coating application and initial cure. Every 3 hours.
Measure and Record Relative Humidity and Dew Point	ASTM D 337	During coating application and initial cure. Every 3 hours.
Abrasive Cleanliness	SSPC AB-1 SSPC AB-2 ASTM D 4940	Each day abrasive blasting is performed. Immediately prior to start of abrasive blasting.
Compressed Air Cleanliness	ASTM D 4285	Each day compressed air is utilized for abrasive blasting, paint application, or to remove surface contamination; immediately prior to any of the indicated operations.
Determining Level of Cleanliness (substrate condition after the specified surface preparation has been completed)	SSPC – VIS 1 SSPC – VIS 3 SSPC - VIS 4/NACE VIS 7 SSPC - VIS 5/NACE VIS 9 SSPC - SP 1 SSPC - SP 2 SSPC - SP 3 SSPC - SP 5/NACE No. 1 SSPC - SP 6/NACE No. 3 SSPC - SP 7/NACE No. 4 SSPC - SP 10/NACE No. 2 SSPC - SP 11 SSPC - SP 13/NACE No.6 SSPC - SP 14/NACE No.8 SSPC - SP 15 SSPC - SP 16 SSPC – WJ 1,2,3,4	Each day surface preparation is performed immediately prior to coating application.
Levels of Soluble Salt Contamination (steel and other nonporous substrates)	SSPC Technology Guide 15	Each day coating application is performed; immediately prior to coating application.
Surface pH (concrete or metal)	ASTM D 4262 (use 6.1 and 6.2 for metal)	Each day coating application is performed; immediately prior to coating application.
Measurement of Surface Profile (metal substrates)	ASTM D 4417	Each day surface preparation is performed. Upon completion of shift or task.
Measurement of Surface Profile (concrete substrates)	ASTM D 7682	Each day surface preparation is performed. Upon completion of shift or task.

Test Requirement	Reference Standard	Interval / Frequency
Comparison of Surface Profile (concrete substrates)	ICRI 310.2	Each day surface preparation is performed. Upon completion of shift or task.
Moisture in Concrete (plastic sheet method)	ASTM D 4263	Upon completion of surface preparation. Whenever climatic conditions substantially change.
Relative Humidity (slabs/concrete floors)	ASTM F 2170	As recommended by coating/lining manufacturer.
Measure and Record Material Temperatures (all components)	N/A	Each day coating application is performed. Immediately prior to coating application.
Wet Film Thickness	ASTM D 4414	Each day coating application is performed. Hourly during coating application.
Dry Film Thickness (ferrous metal/magnetic substrates)	SSPC-PA 2	After coating has properly cured. After each layer (component) of the specified coating system.
Dry Film Thickness (non-ferrous metal substrates)	ASTM D 1400	After coating has properly cured. After each layer (component) of the specified coating system.
Dry Film Thickness (cementitious substrates)	SSPC-PA 9	After coating has properly cured. After each layer (component) of the specified coating system.
Dry Film Thickness (destructive method – all substrates)	ASTM D 4138	Whenever verification as to the accuracy of other methods is deemed necessary.
Holiday Detection (conductive substrates)	NACE SPO 188	After coating system has properly cured. Once on entire surface and as necessary over repaired areas to verify effectiveness of the repair(s).
Holiday Detection (metal substrates)	ASTM D 5162	After coating system has properly cured. Once on entire surface and as necessary over repaired areas to verify effectiveness of the repair(s).
Adhesion Testing (metal substrates)	ASTM D 4541	After coating system has properly cured. Number of tests proportionate to surface area.

Test Requirement	Reference Standard	Interval / Frequency
Adhesion Testing (concrete substrates)	ASTM D 7234	After coating system has properly cured. Number of tests proportionate to surface area.
Final Cure (solvent rub – organic coatings)	ASTM D 5402	After coating system has been cured per manufacturer's published recommendations.

Section 09960

APPENDIX B – COATING DETAIL SHEETS

HIGH PERFORMANCE COATINGS

Coating Detail Sheet:

Coating Material:

Surface:

Service Condition:

Surface Preparation:

General:

Ferrous Metal:

Galvanized Metal:

System No. 2

Zinc-Epoxy-Polyurethane System

Metal

Exterior, exposed to direct sunlight, mildly corrosive, non-immersed.

Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning). Damaged shop coated areas shall be cleaned in accordance with SSPC SP-3 (Power Tool Cleaning) and recoated with the primer specified.

For System No. 2 over factory coated or shop primed tanks, provide the zinc rich primer on any hold backs in the field and use a compatible primer as recommended by the coating manufacturer for any factory coated or shop primed areas.

Bare ferrous metal surfaces shall be prepared in accordance with SSPC SP-6 (Commercial Blast Cleaning) 2.5 – 3.0. Ductile iron surfaces to be coated shall be abrasive blast cleaned in accordance with Section 09900, paragraph 3.02.D.

Ferrous metal with rust bleeding shall be cleaned in accordance with SSPC SP-11 (Power Tool Cleaning to Bare Metal). Areas of rust penetration shall be spot blasted to SSPC SP-10 (Near White Blast) and spot primed with the specified primer.

Damaged galvanized steel areas with exposed ferrous metal and/or rusted shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) or Power Tool Cleaned to Bare Metal in accordance with SSPC SP-11 to achieve a uniform 1.0 to 1.5 mil profile and spot primed with the primer specified.

Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-16 to impart a 1.0 to 2.0 mil profile to the galvanized steel surfaces. Where this cannot be performed, prepare by abrading in accordance with SSPC SP-3, Power Tool Cleaning to impart a 1.0 to 1.5 mil profile uniformly to the galvanized steel surfaces.

For System No. 2 over galvanized steel, delete the zinc rich primer.

Coating Detail Sheet:**System No. 2**

Application:

Field

General:

Prime coat may be thinned and applied as recommended by the coating system manufacturer, provided the coating as applied complies with prevailing air pollution control regulations.

Ferrous Metal:

Prime coats shall be a zinc rich epoxy or polyurethane primer compatible for use with urethane finish coats and applied in accordance with written instructions of the coating manufacturer or in the case of CARB or SCAQMD applications, prime with specified primer that is not zinc rich. In these cases, only a two-coat system is applied.

First/Prime Coat only underside of floor plates with a aromatic urethane zinc rich primer before placing on asphalt subgrade.

System Thickness:

Minimum of; 3 to 4 mils of zinc rich primer for ferrous metal surfaces, one intermediate or primer epoxy coat at 5 to 6 mils and one finish coat of polyurethane at 2 to 3 mils DFT.

Coatings:

Primer:

One coat at the coating manufacturer's recommended dry film thickness per coat to meet the specified minimum thickness.

Intermediate:

One coat at the coating manufacturer's recommended dry film thickness per coat to meet the specified minimum thickness.

Finish

One coat at the coating manufacturer's recommended dry film thickness per coat to meet the specified minimum thickness.

Approved Manufacturers:

1. All of California (California Air Resources Board) except SCAQMD:

System Manufacturer	First / Prime Coat(s)	Intermediate Coat(s)	Finish Coat(s)
PPG	Amercoat 68HS	Amerlock 2/400	Amershield VOC
Carboline	Carbonzinc 859 VOC	Carboguard 890 VOC	Carbothane134MC
International Paint	Cathacoat 302H	Devran 224 V	Devthane 379H
Sherwin Williams	Zinc Clad 4100	Macropoxy 646	HiSolids Polyurethane 250
Tnemec	Series 94 H ₂ O	Series V69	Series 1095

* See Product Data Sheet for applicable thinners for VOC compliance or do not thin.

END OF SYSTEM NO. 2

Coating Detail Sheet:**System No. 3**

Coating Material:

Epoxy (cycloaliphatic amine or curing agents providing similar chemical resistance performance).

Surface:

Metal

Service Condition:

Immersed, nonpotable; non-immersed, corrosive environment, color required. (Not for Biogenic Sulfide Corrosion areas.)

Surface Preparation:

Ferrous Metal:

Ferrous metal surfaces shall be prepared in accordance with SSPC SP-5 (White Metal Blast Cleaning) to achieve a uniform surface profile of 2.5 to 3.0 mils.

Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning) or SSPC-SP-3 (Power Tool Cleaning). Damaged shop coating shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) to achieve a uniform surface profile of 2.5 to 3.0 mils and spot primed with the primer specified. Shop epoxy primed surfaces shall require light abrasive blasting or abrading to achieve a uniform surface profile of 1.0 to 1.5 mils in the intact shop primer prior to receiving finish coats if the maximum recoat time for the primer has been exceeded. For ductile iron surfaces, refer to the requirements in Section 09960, paragraph 3.02.D.

Non-ferrous and Galvanized Metal:

Non-ferrous and galvanized metal shall be prepared in accordance with SSPC SP-16 to achieve a 1.5 to 2.0 mil profile that is uniform. Galvanized steel with this coating system shall not be used in immersion service in wastewater.

Application:

Field

General:

Prime coat may be thinned and applied as recommended by the coating manufacturer, provided the coating as applied complies with prevailing air pollution control regulations.

Ferrous Metal:

Prime coat shall be an epoxy primer compatible with the specified finish coats.

Non-ferrous and Galvanized Metal:

Non-ferrous and galvanized metal, non-immersed, shall be coated prior to the application of the prime coat with a grease emulsifying agent in accordance with the coating manufacturer's written instructions. Non-ferrous metal to be immersed shall not be painted. Galvanized metal shall not be immersed even if it is painted with this coating system.

Coating Detail Sheet:**System No. 3**

System Thickness:

15 to 20 mils dry film.

Coatings:

Primer:

One coat at coating manufacturer's recommended dry film thickness.

Finish:

Two or more coats at coating manufacturer's recommended dry film thickness per coat to achieve the specified system thickness.

Approved Manufacturers:

1. All of California (California Air Resources Board) except SCAQMD:

System Manufacturer	First / Prime Coat(s)	Finish Coat(s)
PPG	Amercoat 253	Amercoat 253
Carboline	Carboguard 890	Carboguard 890
International Paint	Bar-Rust 231	Bar-Rust 231
Sherwin Williams	CorCote HCR	CorCote HCR
Tnemec	Series 104	Series 104

END OF SYSTEM NO. 3

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Coating System No.	5M (NSF 61/600 Certified)
Coating Material:	NSF-Epoxy
Surface:	5M-Metal
Service Condition:	Interior potable water tanks and reservoirs and other metal or concrete components in contact with water being treated and stored for potable use.
Surface Preparation:	
Ferrous Metal:	Ferrous metal surfaces shall be prepared in accordance with SSPC SP-5 (White Metal Blast Cleaning) to achieve a uniform surface profile of 2.0 to 2.5 mils Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning) or SSPC-SP-3 (Power Tool Cleaning). Damaged shop coating shall be cleaned in accordance with SSPC SP-5 (White Metal Blast Cleaning) and spot primed with the primer specified. Cleaning shall produce a surface profile of 2.0 to 2.5 mils. Shop epoxy primed surfaces shall require light abrasive blasting or abrading prior to receiving finish coats if the maximum recoat limit has been exceeded for the primer. This cleaning shall produce a uniform surface profile of 1.0 to 1.5 mils in the intact primer.
Non-ferrous and Galvanized Metal:	Nonferrous and galvanized metal shall be prepared in accordance with SSPC SP-16 to achieve a 1.0 to 1.5 mil profile which is uniform.
Application:	Field
General:	Prime coat shall be thinned and applied as recommended by the coating manufacturer, provided the coating as applied complies with prevailing air pollution control regulations.
Ferrous Metal:	Prime coat shall be an zinc-rich primer compatible with the specified finish coats.
Non-ferrous and Galvanized Metal:	Nonferrous and galvanized metal above the high water elevation shall be cleaned prior to the application of the prime coat in accordance with SSPC SP-1 (Solvent Cleaning).
System Thickness:	Minimum 20 mils dry film (5M)
Coatings:	
Primer:	One coat zinc-rich primer compatible with intermediate coatings system at the coating manufacturer's recommended dry film thickness.

Coating System No.**5M (NSF 61/600 Certified)**

Intermediate/Finish:

One or more coats at the coating manufacturer's recommended dry film thickness per coat to the specified system thickness.

Approved Manufacturers:

1. Nonferrous and galvanized metal . Manufacturer's to provide compatible zinc-rich primer. If no zinc-rich primer is available System Manufacturer will not be permitted. All of California (California Air Resources Board) except SCAQMD:

System Manufacturer	First/Prime Coat	Intermediate Coat(s)	Finish Coat(s)
PPG	Zinc-Rich Primer	Amerlock 2/400 VOC	Amerlock 2/400 VOC
Carboline	Zinc-Rich Primer	Carboguard 635VOC, Phenoline Tank Shield	Carboguard 635VOC, Phenoline Tank Shield
International Paint	Zinc-Rich Primer	Bar-Rust 233H:IV	Bar-Rust 233H LV
Sherwin Williams	Zinc-Rich Primer	Sherplate 600	Sherplate 600
Tnemec	Zinc-Rich Primer	Series 21	Series 21

END OF SYSTEM NO. 5M (NSF 61/600 CERTIFIED)

Coating Detail Sheet:**System No. 7**

Coating Material:

Polyamidoamine epoxy

Surface:

Metal or Concrete

Service Condition:

Below grade (buried, exterior) in contact with soil.

Surface Preparation:

Ferrous Metal

Ferrous metal surfaces shall be prepared in accordance with SSPC SP-10 (Near White Metal Blast Cleaning) to achieve a uniform surface profile of 2.0 to 2.5 mils.

Shop primed surfaces which are to be incorporated in the work shall be prepared in the field by cleaning surfaces in accordance with SSPC SP-2 (Hand Tool Cleaning) or SSPC SP-3 (Power Tool Cleaning). Damaged shop coating shall be cleaned in accordance with SSPC SP-10 (Near White Metal Blast Cleaning) and spot primed with the coating specified. Cleaning shall produce a surface profile of 2.0 to 2.5 mils. Shop epoxy primed surfaces shall require light abrasive blasting or abrading prior to receiving finish coats if the maximum recoat time has been exceeded for the primer. This abrading shall produce a uniform profile of 1.0 to 1.5 mils in the intact primer.

Application:

Field

System Thickness:

Minimum 16 mils dry film.

Coating:

Two or more coats at the coating manufacturer's recommended dry film thickness per coat to the specified system thickness.

Approved Manufacturers:

1. All of California (California Air Resources Board) except SCAQMD:

System Manufacturer	First / Prime Coat(s)	Finish Coat(s)
PPG	Amerlock 400	Amerlock 400
Carboline	Carboguard 890	Carboguard 890
International	Bar-Rust 236	Bar-Rust 236
Sherwin Williams	Macropoxy 646	Macropoxy 646
Tnemec	Series V69	Series V69

END OF SYSTEM NO. 7

SECTION 11001

GENERAL EQUIPMENT AND MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: The general requirements for all of the Equipment and Mechanical work in the scope of the Project, included in Divisions 11, 12, 13, and 15, and elsewhere wherever specifically mentioned in these Specifications.
- B. Direct the attention of all subcontractors and suppliers of equipment and related appurtenances for the work to the applicable provisions in the Contract Documents wherever they may occur.

1.02 REFERENCES

- A. American Gear Manufacturers Association (AGMA).
- B. American Institute of Steel Construction (AISC).
- C. Hydraulic Institute.
- D. National Electrical Manufacturers Association (NEMA).
- E. Occupational Safety and Health Act (OSHA).
- F. California Code of Regulations, Title 8 Industrial Relations (CAL/OSHA).

1.03 STANDARDS FOR THE WORK

- A. Complete Systems: Provide pipe, fittings, wiring, and supports to produce complete, operable systems with all elements properly interconnected. If a specific dimensioned location is not shown for interconnections or smaller system elements, select appropriate locations and show them on Shop Drawing submittals for review.
- B. Provide equipment and material new and without imperfections. Erect in a neat and workmanlike manner; aligned, leveled, cleaned and adjusted for satisfactory operation; installed in accordance with the recommendations of the manufacturers and the best standard practices for this type of work so that connecting and disconnecting of piping and accessories can be readily made and so that all parts are easily accessible for inspection, operation, maintenance, and repair. Locate oil and lubrication fittings clear of and away from guards, base, and equipment and within reach from the operating floor. Coordinate location of all motor connections in order to properly orient encased electrical conduits. In order to meet these requirements with equipment as furnished, minor deviation from the Drawings may be made as favorably reviewed by the Engineer.
- C. The recommendations and instructions of the manufacturers of products used in the work are hereby made part of these Specifications, except as they may be superseded by other requirements of these Specifications.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Shop Drawings: Submit Shop Drawings to the Engineer and receive favorable review prior to fabrication, construction or delivery to the project site in accordance with Section 01300 of these Specifications. Show sizes and arrangement of equipment, foundations, and anchor bolts required; performance characteristics; fan curves and pump curves; control diagrams; wiring diagrams; motor data sheets; methods of assembly; pipe hanging details; ductwork layouts; and connections to other work. Date and sign drawings as certified for use in construction of this project. The arrangement of mechanical equipment and appurtenant piping shown on the Drawings may be varied as necessary to fit the favorably reviewed certified manufacturer's installation drawings. However, manufacturers' drawings shall not deviate in substance from the Contract Drawings and Specifications as to location, size, type, and design of equipment. The following minimum requirements shall accompany all equipment submissions:
 - 1. Overall dimensions.
 - 2. Mounting arrangement and dimensions.
 - 3. Description of materials.
 - 4. Connection sizes and orientation.
 - 5. Capacity and location of lifting eyes.
 - 6. Motor arrangement showing location of electrical connections.
 - 7. Rating data - Mechanical and Electrical as applicable.
 - 8. Detail electrical wiring diagrams, showing component designation and rating.
 - 9. Seismic design certifications and anchorage descriptions as required by Section 01190.
 - 10. Motor data as specified in Section 16050.
 - 11. List of special tools and/or spare parts to be furnished, if any.
- C. Each piece of equipment, for which certified witnessed or non-witnessed performance tests are required, shall be accompanied by a completed form containing at least the following information:
 - 1. Owner's name and location of project.
 - 2. Contractor's name and subcontractor if applicable.
 - 3. Name of item being submitted.
 - 4. Specification reference by section, paragraph and page.
 - 5. Data on item (manufacturer, general descriptive data, dimensions, size of connections, speeds, performance curves, serial number). A specific list of the test results plus a list, which shows the values that differ from Specifications.
 - 6. Motor data, type, voltage, frequency, phase, full load amperes, starting method, frame size, enclosure insulation type (NEMA Code letter), dimensions, service factor, serial number.
 - 7. Date and signature of person certifying the performance.
- D. Operations and Maintenance Manuals: Prepare and submit manuals covering installation, operation and maintenance of all equipment and machinery specified in Divisions 11, 12, 13, and 15. Refer to Section 01300.
- E. Manufacturers' Affidavits: Where called for in the Specifications, each equipment manufacturer, or their authorized representative, shall submit an affidavit conforming to the requirements of Section 01650.

1.05 RESPONSIBILITY AND CARE OF EQUIPMENT

- A. The Contractor shall be responsible for the equipment included in this Contract until it has been finally inspected, tested, and accepted in accordance with the requirements of these Specifications.
- B. The Contractor shall make his own provisions for properly storing and protecting all material and equipment against theft, injury, or damage from any and all causes. Damaged material and equipment shall not be used in the work.

PART 2 - PRODUCTS

2.01 DESIGN

- A. General: Design all equipment for the service intended, of rugged construction, of ample strength for all stresses which may occur during fabrication, transportation, erection, and during continuous or intermittent operation. Adequately stay, brace and anchor, and install equipment in a neat and workmanlike manner. Give consideration to appearance and safety, as well as utility, in the design of details. Use cathodically compatible materials of construction.
- B. Seismic: Refer to Section 01190 of the Specifications for the seismic design criteria.
- C. Controls: Unless noted otherwise, the design of the electric control of any equipment system and/or equipment package shall be the responsibility of the manufacturer of the equipment system and/or equipment package. The elementary control diagrams as shown on the Electrical Drawings and the diagrams shown on the Instrumentation Drawings are illustrative of control and monitoring requirements pertaining to various equipment of this project. The manufacturers shall design their own functional electric control devices and circuitry, in consultation with the specific elementary control diagrams and other project specifications, to meet the equipment control requirements. All such systems and package controls shall be furnished by the equipment manufacturer, except that controls shown in motor control centers and process controllers, remote control devices, and their interconnecting wiring shall be provided under Divisions 16 and 17.

2.02 MATERIALS AND STANDARD SPECIFICATIONS

- A. Materials: Design, fabricate, and assemble equipment and systems with new materials and in accordance with acceptable modern engineering and shop practices. Manufacture individual parts to standard sizes and gauges so repair parts can be installed in the field.
- B. Uniformity: Unless otherwise specified, equipment or material of the same type or classification used for the same purpose shall be the product of the same manufacturer and shall be the same model.

2.03 LUBRICATION

- A. Provide lubricants of types recommended by equipment manufacturers, in quantities sufficient for consumption prior to completion, testing and final acceptance.

2.04 STRUCTURAL METAL FRAMING

- A. Weld submerged steel surfaces which butt or bear against each other, to seal the surfaces against the penetration of the liquid. Weld all gaps between adjacent submerged steel surfaces less than 1/32-inch wide to seal the surfaces. Weld size shall be not less than the thickness of the thinnest member of the lapped or joined assembly.

2.05 EQUIPMENT BASES AND BEDPLATES

- A. Mount equipment assemblies on a single heavy cast iron or welded steel bedplate unless otherwise shown or specified. Provide bases and bedplates with machined support pads, tapered dowels for alignment or mating of adjacent items, adequate openings to facilitate grouting, and openings for electrical conduits. Round or chamfer and grind smooth all corners. Continuously weld seams and contact edges between steel plates and shapes, and grind welds smooth. Do not support machinery or piping on bedplates other than that which is factory installed. Provide jacking screws in equipment bases and bedplates to aid in leveling prior to grouting. Mount all equipment bases and baseplates on reinforced concrete pads at least 3 inches high.

2.06 ANCHORS

- A. Each equipment manufacturer shall furnish an anchor bolt pattern and the required anchor bolts, nuts, and washers of adequate design for securing bases and bedplates to concrete bases. Provide anchor bolts of length to allow for 1-1/2-inch of grout under baseplates and adequate anchorage into structural concrete unless otherwise shown or specified.
- B. Provide anchor and assembly bolts and nuts of ample size and strength for the purpose intended. All bolts shall be standard machine bolts, with cold pressed hexagon nuts. Provide suitable degauling compounds for bronze and stainless steel threaded components. Any space wholly or partially underground, or having a wall or ceiling forming part of a water channel, is classified as a moist location. Unless otherwise specified or noted on the Drawings, provide materials as follows:
 - 1. Bolts and nuts in submerged locations or submerged and embedded in concrete or buried in earth: Type 304 stainless steel.
 - 2. Bolts and nuts for supports or equipment in dry or moist locations: Galvanized steel (hot-dipped), with oversize nuts.
 - 3. Use other bolting materials where specifically called for in the Specifications or on the Drawings.
- C. Anchor all motor-driven equipment with cast-in-place anchor bolts or drilled-in anchors set with epoxy adhesive. Do not provide expansion type anchors for motor-driven equipment.
- D. Anchor all non-motor-driven equipment with cast-in-place anchor bolts or drilled-in anchors set with epoxy adhesive except that, where specifically allowed by note on the Drawings, expansion type anchors may be used.

2.07 SAFETY GUARDS

- A. Cover belt or chain drives, fan blades, couplings, nip points, exposed shafts, and other moving or rotating parts on all sides with safety guards conforming to all federal, state, and local codes and regulations pertaining; conform to the most

restrictive requirement. Design guards for easy installation and removal, complete with necessary supports, accessories, and fasteners, all hot-dip galvanized. Design guards in outdoor locations to prevent entrance of rain and dripping water. Provide tachometer test opening in line with ends of shafts. Typically, guards shall be expanded metal on a structural steel frame except that outdoor guards may be of solid material. Provide hinged doors with latch for service and lubrication access.

B. Guards to comply with CAL/OSHA 3940 through 3944.

2.08 LIFTING EYES

A. Supply all equipment weighing over 100 pounds with lifting eyes. Parts of equipment assemblies which are normally serviced separately, such as motors, to have lifting eyes of their own.

2.09 DRIVES

A. General: Provide all drive units with an AGMA rating and service factor suitable for 24 hours per day operation under the operating load.

B. Electric Motors: Conform to the requirements of Section 16050.

2.10 NAMEPLATES

A. Manufacturer's Nameplate: Furnish each piece of equipment and its driver with a corrosion-resistant metal nameplate fastened to the item in a readily readable position. This nameplate to contain the manufacturer's name, equipment rating, capacity, size, model, serial number, and speed. All information written or printed to be in English.

B. Direction of Rotation: Furnish each piece of rotating equipment with a direction of rotation arrow.

C. Functional Identification: Label each piece of equipment using a plastic laminate label with the functional name and number of the equipment.

1. Fasten labels to the equipment, its base, or other acceptable location:

- a. Letters: At least 1/2-inch high with the border trim on all sides not less than 1/4-inch.
- b. Color: Green background with white letters.
- c. Fasteners: Brass or stainless steel screwed into inserts, anchor shields, or tapped holes in equipment or base.

2.11 PROTECTION AGAINST ELECTROLYSIS

A. Where dissimilar metals are used in conjunction with each other, provide suitable insulation between adjacent surfaces so as to eliminate direct contact and any resultant electrolysis. Connections of dissimilar piping materials shall utilize dielectric unions, flanges, couplings, or bushings.

2.12 SPECIAL TOOLS

A. For each type of equipment to be furnished, provide a complete set of all special tools (including grease guns or other lubricating devices) which may be necessary for the adjustment, operation, and maintenance of such equipment.

2.13 FINISHES

- A. Conform to applicable requirements of Section 09960.
- B. Factory Painting: On pumps, motors, drives, starters, control panels, and other similar self-contained or enclosed components, apply a factory protective paint system unless otherwise noted. Paint or otherwise protect surfaces that are inaccessible after assembly by a method which provides protection for the life of the equipment.
- C. Shop Priming: Except where field sandblasting is required, apply one or more shop coats of metal primer on surfaces to be finish painted at the site, of sufficient thickness to protect surfaces until finished. Primer shall be compatible with finish coat.
- D. Rust Preventive: Coat machined, polished, other ferrous surfaces, and non-ferrous surfaces which are not to be painted with rust preventive compound.

2.14 NOISE AND VIBRATION

- A. Mechanical and electrical equipment, as installed in this project, shall not create sound levels that are **in excess of the noise requirements listed in the technical specifications** for 8 hours per day worker exposure unless otherwise noted for the specific piece of equipment involved. If the required sound level cannot be achieved by bare equipment in its designated environment, provide sound attenuating enclosures. Sound attenuating enclosures shall have necessary ventilation to prevent equipment overheating and shall be constructed for easy removal to permit maintenance. Devices necessary for day-to-day operation shall pierce the enclosure or otherwise be accessible without need to remove the enclosure.
- B. Equipment which when operating has obvious excessive vibrations shall be repaired or replaced as directed by the Engineer. Baseline vibration measurements shall be made where specified.

2.15 FACTORY TESTS

- A. Perform factory tests for each piece of equipment where specifically called for in the section specifying that equipment. Note that factory tests are inherent in many reference standards. The requirement for a factory test in a referenced standard is hereby made a part of these Specifications. Conduct factory tests at the same speeds and other conditions at which the equipment will operate in the field, except as noted.
- B. Where specifically noted, performance tests may be witnessed by the Engineer or his representative. Inform the Engineer in sufficient time to allow arrangements to be made for witness of such tests. When non-witnessed tests are performed, supply certified results.
- C. Perform factory testing of pumps in accordance with the requirements and standards of the Hydraulic Institute.
- D. Tests of other equipment shall conform to the requirements set forth in these Specifications.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Inspect each item of equipment for damage, defects, completeness, and correct operation before installing.

3.02 PREPARATION

- A. Prior to installing equipment, ensure that the areas are clean. Maintain the areas in a broom-clean condition during installation operations. Clean, condition, and service equipment in accordance with the approved Instruction Manuals and specific recommendations of the equipment manufacturer.

3.03 INSTALLATION

- A. Structural Fabrications: Conform to the AISC Code and Specification referenced in Article "Structural Steel Fabrications".
- B. Equipment: Conform to approved Operations and Maintenance Manuals. Employ skilled craftsmen experienced in installation of the types of equipment specified. Use specialized tools and equipment, such as precision machinist levels, dial indicators, gauges, and micrometers, as applicable. Produce acceptable installations free of vibration or other defects. Align and pin to common bedplate equipment and drivers connected by flexible couplings.
- C. Anchor Bolts: Deliver bolts with templates or setting drawings and verify that bolts are correctly located before structural concrete is placed.
- D. Base and Bedplate Grouting: Do not place grout until initial fitting and alignment of connected piping is completed. Level and align equipment on the concrete foundations, then entirely fill the space under base or bedplates with grout. Bevel exposed grout at 45 degree angle, except round exposed grout at horizontal surfaces for drainage. Trowel or point exposed grout to a smooth, dense finish and damp cure with burlap for 3 days. When grout is fully hardened, remove jacking screws and tighten nuts on anchor bolts. Check the installation for alignment and level, and perform approved corrective work as required to conform to the tolerances given in the applicable Instruction Manual.
 - 1. Make an allowance of at least 1-1/2 inches for grout under the equipment bases, whether or not shown on the Drawings. Use steel shims to level and adjust the bases. Shims may be left embedded in the grout, in which case they shall be installed neatly and so as to be as inconspicuous as possible in the completed work. Unless otherwise approved, all grout shall be a favorably reviewed non-shrink, non-metallic grout.
 - 2. Grout: Dimensionally stable, inorganic, premixed and resistant to acids, alkalis, and salt water, and unaffected by water and oil. It shall have high strength even when used as a pourable mixture, and shall bond well with steel and cured concrete or be compatible with a suitable bonding agent which shall then be used to effect the bond. Use in strict accordance with the manufacturer's recommendations. Provide Five Star Grout as manufactured by U.S. Grout Corporation, Bonsal Construction Grout as manufactured by Bonsal Company, or equal. Submit for favorable review by the Engineer prior to use.
 - 3. Where practicable, place the grout through the grout holes in the equipment base and work outward and under the edges of the base and across the rough top of

the concrete foundation to a peripheral form so constructed as to provide a suitable chamfer around the top edge of the finished foundation.

3.04 EQUIPMENT STARTUP AND ADJUSTMENT

- A. Arrange for an authorized factory-trained representative of the company or companies supplying the various items of equipment to check the installation and adjust and test the equipment. Said representative shall be experienced and knowledgeable of the equipment being tested. Furthermore, the representative shall assist and instruct the operating staff in adjusting and operating the equipment during the initial plant operation period.
 - 1. Provide initial lubrication for all equipment.
 - 2. Test and demonstrate to the Engineer that all equipment operates properly and specified performance has been attained. For pumps, include measurement of suction and discharge pressure at the pump and measurement of pumping rate by volumetric means or through a suitably calibrated meter for two points on the performance curve. For adjustable-speed pumps, conduct tests at a minimum of two speeds. Furnish any test equipment or measuring devices required which are not part of the permanent installation.
 - 3. In addition, demonstrate that the entire facility is in full operating condition prior to the acceptance of the work. Should any equipment or part thereof fail to operate as intended, immediately remove and replace it, all at the Contractor's expense. Pay for all tests involved in this Section.
 - 4. Pressure test equipment and connections thereto as required by these Specifications.

3.05 PERFORMANCE TESTS

- A. Upon completion of the work, and after all systems are set and balanced, conduct performance tests in accordance with Division 1 and other applicable sections of these Specifications. Submit test conditions, test data and results to the Engineer for review.

3.06 SOUND LEVEL TESTING

- A. Measure the sound level developed by all mechanical and electrical equipment provided. Perform testing as required by the technical specifications during the final operation test program with all equipment operating. Use OSHA approved instrument and record the highest sound level developed when measured according to OSHA standards in each room and space. Deliver a copy of records to the Engineer.

3.07 TOOLS, LOOSE PARTS, AND LUBRICANTS

- A. Tools and Loose Parts Supplied: Provide an inventory of tools and loose parts required to be supplied under the project. Turn over inventory and parts to the Owner. The Owner's written acknowledgment of receipt is required for project completion. Loose parts are defined as items such as special tools, keys, safety equipment, and portable equipment. Refer to Section 01700 and relevant technical sections of these Specifications for additional instructions.
- B. Recommended Spare Parts: Furnish a complete list of recommended spare parts and supplies for each equipment furnished with current prices and a source of supply.

- C. Provide a list of all recommended lubricants not listed in the Operations and Maintenance Manuals.

END OF SECTION

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SECTION 11003

DISINFECTION

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes:
 - 1. Clean, flush and disinfect all surfaces with which the process water may come in contact in the following equipment, structures, tanks, pipelines, and accessories, including:
 - a. Water storage facilities:
 - 1) Treated Water Storage Tank
 - b. Pipelines:
 - 1) Potable Water Piping
 - 2. Dispose of disinfection solution.

1.02 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. C651 AWWA Standard for Disinfecting Water Mains
 - 2. C652 AWWA Standard for Disinfection of Water Storage Facilities
 - 3. C655 AWWA Field Dechlorination
 - 4. C670 AWWA Online Chlorine Analyzer Operation and Maintenance
- B. Standard Methods for Examination of Water and Wastewater
 - 1. 9221 Multiple Tube Fermentation Technique
 - 2. 9222 Membrane Filter Technique
 - 3. 9223 Chromogenic Substrate Coliform Test
- C. National Sanitation Foundation (NSF)/American National Standards Institute (ANSI)
 - 1. NSF/ANSI Standard 60: Drinking Water Treatment Chemicals - Health Effects
 - 2. NSF/ANSI Standard 61: Drinking Water System Components - Health Effects

1.03 SCHEDULING

- A. Schedule and coordinate the work with the Owner and Engineer. Once disinfection has been satisfactorily accomplished, no further entry to the interior of the facilities will be allowed unless entry must be made to perform repairs, in which case repeat disinfection on a localized basis at no additional cost to the Owner. The Contractor shall be responsible for maintaining security of the disinfected facilities.
- B. Maintain the existing utilities in operation, except that shutdowns of up to 1 hour will be allowed when no alternative exists.
- C. Disinfect equipment, tanks and pipelines following successful pressure testing.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Submit a Disinfection Plan including:
 - 1. "Normal" disinfection procedure, methods, and materials.
 - 2. Emergency disinfection procedure, methods, and materials for mains and services which must be returned to service immediately.
 - 3. Disinfection schedule including number and type of services and length of disruption of service.
 - 4. Disinfecting agent(s).
 - 5. Method of disposal of chlorinated water

1.05 QUALITY ASSURANCE

- A. Laboratory testing related to disinfection shall be performed by a third party, coordinated with and paid for by the Contractor.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Potable Water: Use potable water from the City system.
- B. Chlorine: See the respective AWWA Standards and paragraph 3.02 below for forms of chlorine that may be used for disinfecting operations.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Provide all necessary appurtenances required for the disinfection procedures including taps, temporary piping, connections and shutoff valves. Submit data on appurtenances which will be permanently installed for review by the Engineer.
- B. The Contractor is advised that precautions taken to keep surfaces clean during construction and avoiding the entry of deleterious substances on the work during construction will facilitate achieving the disinfection requirements of this project.
- C. Prior to disinfecting, thoroughly clean accessible surfaces of dust, dirt, foreign matter and deleterious substances remove any oil by contact with absorbents. Use water sprays, steam cleaning, vacuum cleaning, swabbing, hand brushing or a combination of methods and rinsing to effect the cleaning, but do not use any method that will be detrimental to the finish surfaces. Flush inaccessible surfaces clean.

3.02 APPLICATION

- A. After completing all construction activities, including painting, and after allowing a minimum of ten days for the paint to cure, disinfect the required surfaces with chlorine solutions in accordance with the following procedures. Following

disinfection and flushing, the Contractor will take water samples for bacteriological analysis of the water. If the specified chlorine residual and bacteriological requirements are not satisfied, repeat disinfection procedure until the requirements are met. The Contractor shall pay for the additional sampling and testing at no additional cost to the Owner, until disinfection requirements are met.

- B. Disinfect all water mains and interconnected piping after testing and before being placed into service to ensure their bacteriological safety. Disinfection shall be accomplished under the supervision of the Contractor by a person skilled and experienced in the operation of water systems.
- C. Water Storage Facilities:
 - 1. Standard: AWWA C652 as amended herein.
 - 2. Forms of Chlorine: Use sodium hypochlorite or calcium hypochlorite.
 - 3. Method: 2 (Brush or Spray).
 - a. A solution of at least 200 ppm of available chlorine shall be applied directly to the surfaces of the facilities that will be in contact with process water when the facility is full to the overflow elevation.
 - b. After the surfaces have been thoroughly coated and in contact with the strong chlorine solution for 30 minutes, treated water shall be admitted into the structure and the available chlorine in the water when the structure is filled with water shall be at least 10 ppm.
 - 4. Testing and Verification:
 - a. After chlorination and before placing the water storage facility in service, water sample(s) will be collected from the full facility and tested for the presence of coliforms and the chlorine residual will be measured.
 - b. If any of the samples show the presence of total coliform bacteria, one or more of the following procedures shall be followed before placing the facility in service:
 - 1) Repeat samples shall be collected and tested until two consecutive samples are negative.
 - 2) Repeat disinfection process and resample.
- D. Pipelines:
 - 1. Preparation: Provide the system with a 1-inch minimum service cock or valve or other means to inject chlorine solution at a point within 2 or 3 feet of its junction with the supply source. When system is complete, thoroughly flush it by fully opening every outlet until clear water flows from all of them.
 - 2. Disinfecting Agent: Sodium hypochlorite or calcium hypochlorite in sufficient quantities to produce chlorine concentration of at least 50 parts per million in the system.
 - 3. Disinfecting Procedure:
 - a. Connect a hand-operated pump, or other means of injecting the disinfecting agent, to one-inch minimum service cock or valve or other injection device. Pump must provide a pressure greater than that of supply of system.
 - b. With system completely full of water and supply valve open, proceed to adjust every outlet of system so that a trickle of water flows from each.
 - c. Inject disinfectant slowly and continuously at an even rate, not in slugs, until a test at each outlet shows a free chlorine residual concentration of at least 50 parts per million.

- d. Close all outlets and valves, including valve connecting to supply line and one-inch minimum service cock on solution injection connection. Maintain condition for 24 hours. After 24 hours, test for residual chlorine at each outlet. The free residual chlorine concentration indicated should be not less than 10 ppm. If the indicated free chlorine concentration is less than 10 ppm, repeat disinfection procedure until an approved result is obtained.
 - e. When the above procedure has been completed to the satisfaction of the Engineer, flush out entire system with fresh water until tests at all outlets show a residual of not more than 0.5 ppm.
4. When making the connection between a new pipeline and an existing pipeline, or when repairing a damaged pipe, take the following extra precautions:
 - a. Clean the exterior of the existing pipeline of all dirt and debris, and spray or swab with a standard 5.25% or stronger chlorine solution (as specified) in the immediate vicinity of the work. Clean equipment and materials, including new pipe and fittings, to be used in making these connections of all dirt and debris and disinfect them. Allow at least 30 minutes contact time for disinfection before the chlorine solution is diluted or rinsed off. Provide sufficient trench pumps to prevent flooding of the trench.
 - b. When an old line is opened, either by accident or by design, the excavation may be wet or badly contaminated from groundwater. Apply liberal quantities of standard chlorine solution or tablets to the open trench areas to lessen the danger from such pollution. Tablets are recommended because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation. Scatter liberally around and locate the tablets so that flow entering the work site will contact the disinfecting agent. Trench application should be done very carefully to avoid contact by skin and clothing with chlorine solution. Minimally, safety dictates wearing safety goggles and rain gear.

3.03 FIELD QUALITY CONTROL

- A. Chlorine Residual Testing: AWWA C651, Appendix A, DPD Drop Dilution Method, except where otherwise specified. Testing shall be performed by Contractor.
- B. Bacteriological Analyses of Water: After the completion of disinfecting procedure, including the final flushing as described in AWWA C651 and heretofore, the Engineer will obtain water samples from this system for bacteriological analyses.
- C. Requirements for satisfactory disinfection of process equipment, tanks, pipelines and associated elements are:
 1. Bacteriological analyses indicate that water samples are negative for coliform organisms; and
 2. Heterotrophic plate count (standard plate count) is less than 100 colony forming units per milliliter.
 3. If bacteriological analyses do not satisfy the above requirements, then repeat disinfection procedure until these requirements are met.

3.04 DISPOSAL OF DISINFECTION SOLUTION

- A. Dechlorinate and dispose of water in accordance with applicable regulations and Section 01100.

3.05 PROTECTION OF DISINFECTED STRUCTURES

- A. If required to re-enter a disinfected structure, the work shall be conducted using techniques and work methods as necessary to maintain the disinfected status. This shall include use of disinfected foot coverings, tools, and the like. In the event the Contractor contaminates the facilities, additional flushing and disinfection of the affected system shall be performed at no additional cost to the Owner.

END OF SECTION

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SECTION 11211
CENTRIFUGAL WATER PUMPS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Provide complete, tested and operating water pumps as shown on the Drawings and as specified herein.

1.02 REFERENCES

- A. Hydraulic Institute.
 - 1. HI 14.6 Standard for Hydraulic Performance Acceptance Tests
- B. National Science Foundation
 - 1. NSF 61 Drinking Water System Components

1.03 SUBMITTALS

- A. Shop Drawings: The Contractor shall submit shop drawings for favorable review of the Pumps and accessories. Include sufficient data to show that equipment conforms to Specification requirements as indicated herein. Submit in a single complete initial package in accordance with Section 01300. Include the following:
 - 1. Pump and motor product and performance data, including a prototype pump performance curve for each application and indicate minimum continuous stable flow (MCSF). Indicate impeller trim. Submit certification that pumps and motors are suitable for adjustable speed service. Submit adjustable speed performance curves covering the range from full speed to manufacturer's recommended minimum speed. Indicate minimum continuous stable flow (MCSF) for all speeds.
 - 2. Seismic anchorage certification and related sketch.
 - 3. Pump layouts and dimensions. For retrofit installations the Contractor shall field verify the pump pad size and alignment, suction and discharge flange elevations, and alignment of connecting piping/accessories as applicable. Measurements shall be incorporated into the initial pump submittal.
 - 4. Pump performance curves.
 - 5. Seismic anchorage calculations.
- B. Performance Testing: Certified non-witnessed factory performance tests in accordance with Hydraulic Institute Standard 14.6 are required for each pump shall be not less than Grade 1U unless noted elsewhere in this specification. Obtain favorable review from the Engineer prior to shipment of the pumps.
- C. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists.
- D. Affidavits: Submit affidavit from the manufacturer stating that the equipment has been properly installed, adjusted, and tested and is ready for full time operation.

1.04 QUALITY ASSURANCE

- A. All equipment furnished under this Section shall: 1) be of a manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least 5 years; and 2) be demonstrated to the satisfaction of the Engineer that the quality is equal to equipment made by those manufacturers specifically named herein.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Pumps: Pentair Aurora; Grundfos; or equal.

2.02 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Pump Schedule:

Item	Potable Water Pumps (Booster Pumps 2A and 2B)
Quantity of Pumps	2 (lead-lag)
Liquid Being Pumped	Potable Water
Pump Type	Vertical Multistage Inline
Primary Point	350 GPM @ 370 ± 10 ft TDH
Maximum Capacity	500 GPM @ 290 ± 10 ft. TDH
Shutoff Condition	490 ± 10 ft. TDH
Maximum NPSH Required @ Maximum Capacity	28 ft.
Maximum Speed	3500 RPM, nominal, constant speed
Motor Horsepower (Max)	50 HP
Manufacturer/Model	Pentair (Aurora) PVMX 90-3, Grundfos CRN series, or equal
Piping Connections, Minimum Size (Suct. x Disch.)	4 inch x 4 inch, flanged
Minimum Guaranteed Efficiency @ Primary Point	75 %
Gauge Range: Suction Discharge	0-200 psi 0-300 psi

*OR EQUAL

- B. Pumps shall operate without excessive noise or vibration over the full operating range indicated in the pump schedule. Vibration shall meet Hydraulic Institute standards.
- C. Actual tested horsepower of each pump, with final impeller trim, shall not exceed motor nameplate horsepower at any point on the pump curve.

2.03 EQUIPMENT

- A. Provide vertical inline pumps as indicated in the Pump Schedule.
1. Pumps shall be vertical, with flexible coupling, inline, vertical pullout design. Suction and discharge connections shall be flanged.

2. Construction: Pumps for potable water service or processes shall be constructed from materials approved for potable water service in the State of California. NSF 61 certified pump assemblies shall also be permitted.
3. Vertical inline pumps shall be of cast iron construction with stainless steel internals, and EPDM elastomers and shall include the following components:
 - a. Base/Base Plate: Type CF 8M stainless steel
 - b. Motor Support: Cast Iron, ASTM A 48-Class 35B
 - c. Pump Head: Type CF 8M stainless steel
 - d. Pump Sleeve/Pump Chamber: Type 316 stainless steel.
 - e. Ring Flange: ductile iron, ASME B16.1, 125 lb rating-suction, 250 lb rating-discharge
 - f. Impeller: Type 316 stainless steel.
 - g. Impeller Neck Ring: Carbon graphite-filled PTFE
 - h. Shaft: Type 431 stainless steel.
 - i. Shaft End Bearing: Tungsten Carbide
 - j. Seal for Pump Sleeve: EPDM, NSF 61 certified
 - k. Seal: All components suitable for a pH of 5.0.
- B. Impeller: Enclosed type, statically and dynamically balanced. The first critical shaft speed shall be at least 125% of full operating speed.
- C. Pump Seal: Pumps shall have single cartridge-type mechanical shaft seals with silicon carbide stationary and rotating faces, carbon washer, EPDM elastomer, and stainless steel housing parts and springs. Provide a copper tubing flush water line from a connection at the top of the casing to each seal. At a high point on the pump head, provide a vent connection and plug.
- D. Motor: Provide motors for indoor service, suitable for operation at 230 or 460 volts, and conforming to requirements of Section 16050. Nameplate motor horsepower shall not be exceeded at any flow up through the maximum operating point in the Pump Schedule.

2.04 FINISHES

- A. Provide pumps, motors and bases with the manufacturer's standard factory-applied paint finish except as noted.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install the pump unit(s) in strict conformance with manufacturer's installation instructions. Check pump and motor alignment according to the Standards of the Hydraulic Institute after complete unit has been installed at the site.

3.02 FIELD TESTING

- A. Field test each pump. For further requirements on performance tests, refer to Section 11001.

3.03 FIELD SERVICE

- A. The equipment manufacturer shall supply a competent field service engineer to thoroughly check and inspect the equipment after installation, place the equipment

in operation, make necessary adjustments, calibrate instruments, and conduct field tests.

END OF SECTION

SECTION 13113

IMPRESSED CURRENT CATHODIC PROTECTION SYSTEM FOR INTERIOR OF WATER STORAGE RESERVOIR

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Provide an impressed current Cathodic Protection System, and furnish all labor, materials, equipment, supervision and testing, and perform all operations required to install a complete system of cathodic protection to protect the interior of the welded steel protectively coated water storage reservoir.
 - 1. The cathodic protection system shall protect against corrosion of all internal surfaces of the water storage reservoir normally in contact with water.
 - 2. The system shall be of the impressed current type as provided by a firm specializing in cathodic protection systems.
 - 3. Work Includes:
 - a. Cathodic protection calculations, shop drawings and materials list for the water storage reservoir's system.
 - b. All components of the cathodic protection system including rectifier, anodes, cables, grounding connection, switches, supports, , electrical conduit, reference electrode insulation flange components, and any other necessary items.
 - c. In-place construction of water storage reservoir's cathodic protection system.
 - d. Testing, adjusting and reporting of water storage reservoir's cathodic protection system.
 - e. Correction of all deficiencies.
 - f. Cleanup and restoration of surfaces.
- B. Related Sections:
 - 1. Section 09960: Protective Coatings
 - 2. Section 13211: Welded Steel Tank
 - 3. Section 16010: General Electrical Requirements

1.02 REFERENCES

- A. National Association of Corrosion Engineers Standard RPO 196.
- B. National Association of Corrosion Engineers International Standard RPO 388.
- C. National Electrical Manufacturers Association (NEMA).

1.03 DESIGN REQUIREMENTS

- A. The cathodic protection system shall be in accordance with National Association of Corrosion Engineers Standard RP0388, latest revision, and shall be of sufficient capacity to maintain a minimum structure-to-water potential of (-)0.85 volt, or more electro-negative, when measured against a standard Cu/CuSO₄ reference electrode. The design shall be based on results of field tests. The anodes shall be designed for a useful life of 30 years.

- B. Design Conditions: The water storage reservoir is a 80-foot-diameter by 31-foot-high welded steel reservoir. The overflow height is 25 feet from the bottom. The tank will be coated in the interior to meet specification requirements.
1. The tank is used to store treated water that has the following general characteristics:

Temperature	10 to 20°C
pH	7.5 – 8.5
Dissolved Oxygen	2 – 8 mg/L
Conductivity	200 – 500 μ mhos/cm
Total Dissolved Solids	150 to 400 mg/L
Langelier Index	+1 to -1
Chlorine Residual	0.5 – 2 mg/L
- C. Anodes and all other components that can be immersed or in contact with potable water shall be NSF 61 certified.
- D. The cathodic protection system of the reservoir interior is intended for an initial current density of about 5 microamperes per square-foot of surface. It is expected that the current density can increase to 200 microamperes per square-foot in 30 years.

1.04 SUBMITTALS

- A. Submit material or equipment data in accordance with Section 01300.
- B. Submit calculations, shop drawings and materials information for the Cathodic Protection System to the Engineer for review.
- C. Submit the following:
 1. Calculations to support the basis for design of the water storage reservoir's cathodic protection system.
 2. A complete list of equipment and materials. Include name and manufacturer, catalog number, size, finish, NSF 61 certification, and any other pertinent data necessary to determine conformance with Specifications.
 3. Certification by the cable manufacturer covering conformance of cable insulation to designated the Specifications.
 4. Wiring diagrams for the rectifier, showing all details and components.
 5. Manuals for the rectifier. Each manual shall include as-built shop drawings, operation and maintenance instructions, parts ordering data and ratings for the equipment purchased for this project.
 6. Spare Parts List: For each piece of equipment, submit a list of recommended spare parts. Include part numbers and the name, address, and telephone number of the supplier.

1.05 QUALITY ASSURANCE

- A. The corrosion control system installation and testing shall be supervised by a NACE International certified Cathodic Protection Specialist.
- B. Code Requirements:
 1. All materials, workmanship and installation shall conform to all requirements of the legally constituted authority having jurisdiction. These authorities include, but are not limited to, the latest revision of the State of California,

applicable regulations for Industrial Relations, Industrial Safety, and Electrical Orders; the National Electric Code; General Construction Safety Orders of the Industrial Accident Commission; and all other applicable State, County, or City codes and regulations. Nothing in the Drawings or Specifications is to be construed to permit work not conforming to these regulations and codes. Where larger size or better grade materials than required by these regulations and codes are specified, the Specifications and Drawings shall have precedence.

- C. Exothermic welds shall be performed by an experienced subcontractor who specializes in this type of weld.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All materials must be new, free from defects, and shall be of the best commercial quality for the purpose specified. The system shall include but not be limited to the following.

2.02 RECTIFIER

- A. The cathodic protection rectifier shall be an automatic potential controlled type rectifier which shall precisely maintain the water storage reservoir at a specific cathodic protection level. The unit shall be of solid-state design and equipped with a direct reading meter which displays the exact level of protection being provided. Circuitry shall be designed to eliminate any "I-R" drop error in the structure potential. This "error-free" reading shall then be automatically compared to the pre-set protective potential and, if any deviation exists, the output of the system shall be automatically adjusted to compensate. The rectifier shall have a minimum capacity of 8 volts and 4 amps DC.
- B. The rectifier shall include the following features:
 - 1. Total automatic control of output from 0 to 100% of rated capacity.
 - 2. Lightning protection (ac and dc).
 - 3. 110/115-volt single-phase ac input.
 - 4. Silicon rectifier stacks.
 - 5. Surge and lightning protection for all semiconductors.
 - 6. Ability to accept a copper-copper sulfate permanent reference electrode.
 - 7. Transformer taps that will permit manual adjustment of output voltage between zero and maximum voltage in a minimum of 18 evenly divided steps.
 - 8. Thermal cut-out device with automatic reset feature for over-ambient temperature protection.
 - 9. Filters to minimize the ac component in the dc output to reduce interference with radio, telephone or communication circuits.
 - 10. Indicating analog scale meters or LED digital meters, one for voltage and one for current with on-off switches and a minimum of 2% full-scale accuracy.
 - 11. Plug-in automatic control printed circuit card.
 - 12. Auxiliary ammeter shunt for field verification of rectifier output.
 - 13. Air-Cooled Rectifier Enclosure:
 - a. Housing: NEMA 3R, ventilated type, constructed of fiberglass and equipped with a padlock hasp.

- b. Ventilation opening: Covered with a 16-gauge or heavier, screen, shielded by an appropriate metal barrier that will positively prevent wires and other metallic objects inserted through the screen from contacting energized components within the rectifier.
- c. Furnish unit with identification signs.
- 14. Pressure type connectors for DC output cables marked "STR." "Anode" and "Aux" where applicable.
- 15. Wiring diagram for the rectifier showing all details and components printed on mylar film and bonded to the inside of the rectifier enclosure.
- 16. Equipped for mounting on a steel channel.
- 17. Manufacturer: Farwest Automatic Potential Control, Corpro T.A.S.C Rectifier V 70 or equal.

2.03 IMPRESSED CURRENT ANODE

- A. Provide a circumferential mixed metal oxide (MMO) a No. 8 1.5 mm wire anode assembly that is rope supported and connected to the rectifier by conductor cable. The MMO wire anode shall be comprised of a copper wire core, surrounded by a titanium substrate with a mixed metal surface coating.
 - 1. The anode life shall be for a minimum of 30 years' service at a current rating of over 15 milliamps per foot of length.
 - 2. The anode length of each segment shall not exceed 50 feet in length, and a segment connected to the rectifier conductor cable and to each other.
- B. The cable attached to the anode segment shall be a No. 8 stranded single-conductor, AWG/WMPE, sufficient length to connect to the main conductor leading from the rectifier and insulated for 600 volts. Any damage to the cable insulation or anode will require complete replacement.
- C. Arrange the MMO wire anode in a circumferential string located 10 feet from the side and 10 feet from the bottom plate. Each anode segment shall be supported and hung from the roof by a 1/2-inch-diameter nylon ropes, securely knotted at the top and bottom to the roof clevice hangar.
- D. The current flowing to the anode shall be adjusted by the automatic potential control of the rectifier to maintain the steel reservoir to water potential within the range of -850 to -1050 milli-volts.
- E. The voltage drop in each segment of the MMO wire anode shall not exceed 10%.
- F. The anodes shall be Eltech LIDA wire anodes or equal as supplied by Farwest, Corpro or equal.

2.04 CONDUCTORS

- A. All conductors: Copper.
- B. Power wire, operating at 600 volts or less: UL Type THW, #8 AWG or larger.
- C. Drain cables and test cables: Stranded single conductor, insulated for 600 volts, Type UF. Sizes shall be as shown on the Drawings.
- D. Anode cables shall be as specified in Paragraph 2.03, Impressed Current Anodes.
- E. Low Voltage Splices and Terminations:
 - 1. Wire Connectors: Either springlock type twist-on pressure connector or crimped sleeve type, as appropriate for the application.

2. Pressure Connectors: Crimped sleeve type, split bolt type or bolted split sleeve type. Bolted pressure connectors of the type that the bolt or set screw bears directly on the conductor shall not be used.
 3. Electrical Tape: PVC, pressure sensitive, 7-mil tape suitable for 600-volt applications.
- F. Wire markers: Vinyl cloth, numbered, adhesive type, Brady B-500; equivalent Thomas & Betts; or equal.
- G. Grounding Conductor: Copper, No. 8 AWG, minimum.

2.05 REFERENCE ELECTRODE

- A. Reference Electrodes: Furnish with a No. 14 AWG/HWMPE standard copper cable attached. Provide sufficient length of cable to extend to the rectifier without splicing. Reference electrode shall be provided for a minimum service life of 20 years and shall be Stealth Model SRE-00Z-CPY, EDI Model 1, or equal.

2.06 EPOXY

- A. Epoxy used for sealing the anode to cable connection for the reference electrodes: Duron 164, manufactured by the Duriron Company; Scotchcast Resin No. 4, manufactured by 3-M Company; CC-1 Potting Compound, manufactured by PSI Products; or equal.

2.07 CABLES

- A. All No. 8 AWG and larger cables utilized for the cathodic protection circuit: Single conductor, stranded, copper, Type CP, insulated for 600 volts with high molecular weight polyethylene in accordance with the requirements of ASTM D-1248, Type 1, Class C, Grade 5, and ICEA-NEMA S-6-402.
- B. All cables for ac power and No. 10 AWG and smaller utilized for the cathodic protection circuit: Type TW, stranded, copper, conforming to Federal Specification J-C-30.

2.08 INSULATING FLANGED JOINTS

- A. An insulating flange set shall be provided to the Contractor and installed for the inlet and outlet water and drain pipe connections as close to the reservoir shell as possible. Each insulating flange set shall consist of a full-face gasket, a full-length sleeve for each flange bolt, two insulating washers and two Type 316 stainless steel washers for each stainless steel bolt. The gasket shall be 1/8-inch thick, neoprene-faced over phenolic resin. Bolt sleeves shall be high-density polyethylene or nylon, and insulating washers shall be constructed of fabric-reinforced phenolic resin. The complete assembly shall have an ASA pressure rating equal to that of the flanges between which it is installed. Insulating gaskets shall be Advance Products Type F or equivalent PSI Products.

2.09 HANDHOLE COVERS

- A. Type 316 stainless steel handhold covers shall be provided to tightly enclose 5-inch diameter handholes cut at anode support location on the roof of the reservoir as shown on the Drawings. The handhole covers shall have adjustable screw turning clamps that attach to the bottom of the reservoir roof, and are

accessible for turning from the top. The handhole covers shall be electrically isolated from the reservoir by a 1/8-inch-thick neoprene gasket. The entire handhole cover can then be removed from the top for access to the anode support ropes and connecting cable.

2.10 CLEVICE INSULATORS

- A. Provide porcelain clevice insulator clips for bolting to the roof of the reservoir to hold anodes support ropes and conductor cable. Bolts and nuts shall be Type 316 stainless steel. The clevice assembly shall be cadmium plated or galvanized mild steel, shall be of the dead/end type and shall have a ceramic spool piece at the bottom for holding the anode support ropes and conductor cable.

2.11 SPLICE BOLTS

- A. Provide splice bolts and crimpets for making wire splices from anode leads to the header cable. Splice bolts and crimpets shall be of sizes required, Brundy, or equal. Provide a wire splice encapsulation kit to provide watertight electrical insulation at each spliced connection.

2.12 SERVICE SWITCH

- A. Service Switch: Externally operable, fused, heavy-duty with NEMA 3R enclosure rated at 30 amps, 120 volts.

2.13 EXOTHERMIC WELDS

- A. Make all cable connections to reservoir by the exothermic process using "Cadweld" by Erico Products, Inc.; "Thermoweld" by Continental Industries, Inc.; or equal. Fit each cable with a copper sleeve for making the weld. Cartridge sleeves and molds for each weld shall be by the same manufacturer.

2.14 NAMEPLATES

- A. Nameplates shall be manufactured of semi-rigid plastic with adhesive back. The nameplates shall be 1-inch wide by 5 inches long, with white text on a black background, inscribed as shown on the Drawings. Nameplates shall be Seton Nameplate Company; Legi-Sign; or equal.
- B. All fasteners including all bolts, nuts, washers, screws, hasps, etc. shall be Type 316 stainless steel.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General: The installation of the Cathodic Protection System shall be directed by a qualified NACE International Cathodic Protection Specialist.
- B. Provide electrical isolation as necessary to isolate areas not to be cathodically protected.
- C. Coordinate the design and installation of the Cathodic Protection System to the Contractor and protective coatings subcontractor with the water reservoir manufacturer and electrical system subcontractor.

- D. The Cathodic Protection System will be tested and adjusted for desired potential of between -860 and -1050 MV on the reservoir.
- E. Cable Connections: Cable connections shall be made to structures by gas brazing or by Cadweld connections. In all cases, wires and the surface to which they connect shall be cleaned and prepared in accordance to the manufacturer's recommendation, and only welds that are 100% free of defects will be allowed. After connecting and obtaining approval by the Engineer, bare wire and pipe shall be coated with tape.
- F. Equipment shall be installed according to the equipment manufacturer's instructions.
- G. Electrical installations shall conform to all applicable codes and standards.

3.02 RECTIFIER

- A. Mount the rectifier and connect to the power supply as shown on the favorably reviewed submittals and the Drawings. Connect the cable connected to the reservoir to the negative output terminal of the rectifier, and connect the cable connected to the anode to the positive terminals of the rectifier. Locate the rectifier as designated by the Engineer.
- B. From the storage reservoir interior, run and attach the cable from the rectifier to the anode and the control reference electrode to the auto potential controlled rectifier.

3.03 CABLES TO STRUCTURE CONNECTIONS

- A. Cables to reservoir connections shall be accomplished as shown on the Drawings. After installation of the connections, coat all exposed metal to match the coatings of the steel reservoir.
- B. Coating materials shall be removed from the surface over an area just sufficient to make the connections. The metal reservoir surface shall be cleaned to white metal by grinding or filing prior to welding the conductor.
- C. Conductor shall be welded to the steel surfaces by the exothermic process with a copper sleeve fitted over the conductor and only sufficient insulation shall be removed from the conductor to allow its placement in the welding mold. After the weld has cooled, all slag shall be removed and the weld shall be tested with a sharp hammer blow to assure proper metallurgical bond. All defective welds shall be removed and replaced. All installation of the connection, paint all exposed metal to match the coating of the steel reservoir.

3.04 CABLES

- A. Cables shall be laid without kinks and shall have a minimum slack of 12 inches. Care shall be used during installation to avoid punctures, cuts and similar damage to insulation. Any damage to insulation will require replacement of the entire cable length.

3.05 ANODE

- A. Install anode as shown on the Drawings through the clevis holders near handholes.

3.06 REFERENCE ELECTRODE

- A. Provide the reference electrode in a perforated PVC enclosure constructed and installed in the reservoir as shown on the Drawings. Loop the reference electrode cable over a clevis and spool insulator and secure with a serving sleeve designed to cause the least amount of deformation to the conductor and insulation. Provide reference electrode cable of sufficient length and extend to the automatic control unit within the rectifier without splicing.

3.07 INSULATING FLANGE JOINTS (PROVIDED BY CATHODIC PROTECTION SUBCONTRACTOR)

- A. All insulating components of the insulating flanged gasket set shall be cleaned of all dirt, grease, oil, and other foreign materials immediately prior to assembly. Bolt holes in mating flanges shall be properly aligned at the time bolts and insulating sleeves are inserted to prevent damage to the insulation. After flange bolts have been tightened, each insulating washer shall be inspected for cracks or other damage. All damaged washers shall be replaced. After assembly, resistance between each bolt and flange shall be measured with an approved insulation checker; minimum resistance shall be 50,000 ohms. Where the insulating joint is assembled in the shop and shipped as a unit, resistance shall be measured in the shop between the flanges and between each bolt and flange shall meet the above requirements. All insulating flange joints shall be coated as specified.

3.08 WORKMANSHIP

- A. The Cathodic Protection Specialist shall supervise the cathodic protection construction work from beginning to completion and final acceptance.
- B. All labor shall be performed by qualified craftsmen who have had experience on similar projects. Good workmanship shall be provided for all installations.
- C. The Cathodic Protection Specialist shall ensure that all equipment and materials fit properly in their installation.
- D. Any required work to correct improperly fit installations shall be performed by the Cathodic Protection subcontractor at no additional expense to the City.

3.09 SECURING EQUIPMENT

- A. Cutting and drilling the reservoir or appurtenances shall not be permitted, except when shown on the Drawings or approved by the Engineer.

3.10 CUTTING AND DRILLING

- A. Cutting and drilling the reservoir or appurtenances shall not be permitted, except when shown on the Drawings or approved by the Engineer.
- B. All exposed metal surfaces shall be covered with a minimum thickness of 1/4-inch of epoxy insulating material, or equal.

3.11 CLEANUP

- A. Upon completion of the initial cathodic protection work, the Contractor shall remove all surplus materials and debris that accumulate during the construction work. The entire area will be left in a neat clean condition.

PART 4 - TESTING

4.01 GENERAL

- A. After installation of the cathodic protection facilities, the Cathodic Protection System shall be tested, and adjusted by the Cathodic Protection Specialist in the presence of the City's Representative to assure conformance with the cathodic protection specifications and a complete and properly functional cathodic protection system.
- B. The Contractor shall notify the Engineer a minimum of five (5) calendar days prior to the date he desires testing to begin.
 - 1. Testing will include electrical continuity tests, insulating joint tests, and structure potential tests around the interior of the reservoir to determine if adequate cathodic protection has been provided. Adjust the system as required to obtain a minimum reservoir to water potential of -850 MV or approved equivalent, and a maximum potential of -1050 MV to prevent protective coating blistering.
- C. Training: The cathodic protection contractor shall instruct for a minimum time of one hour representing to the City all of components of the cathodic protection system, how to periodically read the structure to water potential, the current and voltage indicators and how to make adjustments to maintain the cathodic protection system in the performance range. Provide a spare parts list and where the City can acquire and install spare parts as needed.

4.02 REPORTS

- A. Upon completion of the initial installation tests, three copies of the test report will be submitted by the Cathodic Protection Specialist through the Contractor to the City describing all potentials, any deficiencies detected, schedule for correction of work defined in the original plans and specifications, and recommendations of necessary corrections. Correct any and all deficiencies and retest prior to final acceptance. Costs for retesting shall be paid by the Contractor. All deficiencies must be corrected and provide three (3) copies of a Final Test Report to the City.

4.03 WARRANTY TESTING

- A. Provide an additional onsite inspection and any adjustment as required after one year of final acceptance to determine proper functioning of all components of the cathodic protection system and as accompanied by the Contractor and a representative of the City.
- B. This warranty testing shall follow any necessary reservoir recoating following the 12-month warranty inspection of the recoating system corrected for any initially observed deficiencies. The cathodic protection system shall be readjusted and retested in the manner described for the initial installation.

END OF SECTION

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SECTION 13211

WELDED STEEL TANK

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: All labor, material, equipment, tools and services required for the design, fabrication, erection, painting and testing of a ground-supported flat-bottom welded steel water storage tank and accessories.

1.02 REFERENCES

- A. American Iron and Steel Institute (AISI)
- B. American Society for Testing and Materials Standard Specifications (ASTM):
 - 1. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
 - 2. ASTM A36 Carbon Structural Steel
 - 2. ASTM A123 Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products
 - 3. ASTM A234 Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
 - 4. ASTM B633 Electrodeposited Coatings of Zinc on Iron and Steel
- C. American Welding Society (AWS):
 - 1. AWS A5.1/5.5 Specification for Covered Carbon Steel Arc Welding Electrodes
 - 2. AWS B2.1 Specification for Welding Procedure and Performance Qualification
 - 3. AWS D1.1 Structural Welding Code
 - 4. AWS D10.4 Recommended Practices for Welding Austenitic Chromium-Nickel Stainless Steel Piping and Tubing
- D. American Water Works Association Standards (AWWA):
 - 1. AWWA D100 Welded Carbon Steel Tanks for Water Storage
 - 2. AWWA D102 Coating Steel Water Storage Tanks
 - 3. AWWA C652 Disinfection of Water Storage Facilities
 - 4. AWWA C200 Steel Water Pipe – 6 In. and Larger
 - 5. AWWA C205 Cement-Mortar Protective Lining and Coating for Steel Water Pipe
 - 6. AWWA C207 Steel Pipe Flanges for Waterworks Service
 - 7. AWWA C208 Dimensions for Fabricated Steel Water Pipe Fittings
 - 8. AWWA C213 Fusion Epoxy Lining and Coating for Steel Water Pipe
- E. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.9 Factory-Made Wrought Steel Buttwelding Fittings
 - 2. ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications

- F. California Code of Regulations, Title 8: Industrial Safety (CCR)
- G. California Code of Regulations, Title 8: Industrial Safety (CCR)
- H. 2022 California Building Code (CBC)
- I. American Petroleum Institute (API):
 - 1. API 650 Welded Steel Tanks for Oil Storage
- J. Steel Plate Fabrication Association (SPFA)

1.03 DEFINITIONS

- A. Bottom Capacity Level (BCL): The water level in the tank when the tank is emptied through the specified discharge fittings.
- B. Capacity: The net volume in gallons based on the bottom capacity level and top capacity level.
- C. Top Capacity Level (TCL): The maximum operating level of water in a tank based on the elevation at which water discharges from the tank through the overflow pipe entrance.
- D. Contractor: In this Section the Contractor is responsible to the Owner for all work. This includes work by the tank constructor and the tank manufacturer.

1.04 SUBMITTALS

- A. Submit for each tank in accordance with Section 01300.
- B. Product Data:
 - 1. Hangers, pipe and equipment supports.
 - 2. High-strength bolts.
 - 3. Stainless steel items.
 - 4. Manufactured items, including access hatches, vents, liquid level gauges and safety devices.
 - 5. Erection Plan.
 - 6. Electrode manufacturer's data.
 - 7. Mill test reports for steel materials.
- C. Shop Drawings:
 - 1. Provide comprehensive drawings that illustrate all aspects of structural construction. Drawings should fully define member sizes, locations, orientations, materials, and connections. Drawings shall be sufficient clarity to indicate the design, location, physical characteristics of the elements, nature and extent of the work and show in detail conformance with the contract documents and building codes and standards. Fabrication and erection drawings for steel tanks, foundation, and accessories indicating size and thickness of members including anchor bolt layout and embedment and details, assembly drawings, and welding details. Show detail dimensions and quantities and details of construction and erection as prepared by the tank manufacturer.

Detailed drawings for the tanks and accessories signed and stamped by a Civil or Structural Engineer licensed to practice in the state where the tanks will be constructed.

2. Detailed design calculations for the tank and accessories signed and stamped by a Civil or Structural Engineer licensed to practice in the State of California.
3. Depth versus volume calibration table for the tank in units of inches, feet and gallons.
4. In accordance with 2022 CBC, §106.3.4.2, "Deferred Submittal", the welded steel tank and all tank accessories are considered a "deferred submittal" and shop drawings and calculations for the tank and accessories shall be signed and sealed by a Civil or Structural Engineer registered in California and submitted to the Engineer of Record (EOR) who shall review them, and following favorable review, shall forward them to the Local Building Official with a notation indicating that the "deferred submittal" documents have been reviewed and been found to be in general conformance to the design of the structure. Fabrication or construction on the "deferred submittal" items shall not begin until the Engineer of Record has favorably reviewed the documents.

D. Structural Calculations:

1. A single complete set of structural calculations for the welded steel tank, ringwall foundations, and roofs signed and stamped by a registered professional Civil or Structural Engineer licensed to practice in the state where the tanks will be constructed. Submit calculations for tank shells, shell thickness, compressive stress in each ring under wind or earthquake loading combined with dead and water load. Submit calculations for welded joints. Submit calculations for reinforcement for openings in the tank shells or floors including pipe connections and manholes.

D. Manufacturer's Certifications:

1. Tank design, including welded joint details and inspection personnel data.
2. Tank fabrication, including mill tests and shop inspection report.
3. Tank erection, including field inspection and testing report.

E. Quality Assurance:

1. Welder performance qualification test records "welders certification" in accordance with AWWA D100 Section 8.
2. Written Welding Procedure Specifications (WPSs) in accordance with AWS B2.1 and D1.1 and AWWA D100 Section 8 requirements for each different welded joint proposed for use whether prequalified or qualified by testing.
3. Procedure Qualification Record (PQR) in accordance with AWS D1.1 for all procedures qualified by testing.
4. Weld joint records "weld rollout".
5. Material identification and piece marking records.
6. Welding Non-Destructive Examination (NDE) records. Radiographic inspection records. Provide a field inspection report, including radiographs and inspection records.
7. Shop and field inspection reports.

1.05 QUALITY ASSURANCE

A. General:

1. Demonstrate that the tank manufacturer has been regularly designing, fabricating and erecting similar steel tanks for at least 10 years in the State of California.
 2. Stamp and sign all shop drawings, calculations and welded joint details by a Civil or Structural Engineer registered in the State of California.
 3. Supply all new materials and fabricated items.
 4. Verify adequacy of tank foundations.
 5. The Contractor is responsible for preparing and submitting written Welding Procedure Specifications (WPSs) and Welder performance qualification test records "welders certification". WPSs for each joint type shall indicate proper AWS qualification and be available where welding is performed. WPSs shall be included with any shop drawings referencing welds. WPSs shall include the manufacturer and specific electrode.
 6. Verify material identification and piece marking on all materials.
 7. The CONTRACTOR is responsible for inspection and testing of welds in accordance with AWWA D100 Section 11.
- B. Codes and Standards:
1. Tank Manufacture:
 - a. American Water Works Association Standard D100-21.
 - b. 2022 California Building Code.
 - c. American Petroleum Institute Standard 650, latest edition.
 2. Safety of Access: CCR and CBC.
- C. Testing Program:
1. Qualification of Weld Procedures: AWWA D100.
 2. Qualification of Welders: AWWA D100.
 3. Shop and Field Weld Inspection: AWWA D100. If Section 14 applies, retain a Certified Welding Inspector.
 4. Weld Inspection Procedures: AWWA D100.
 5. Tank Bottom Weld Testing: AWWA D100.
 6. Tank Water Tests: AWWA D100.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The tank size, including nominal diameter and sidewall height, capacity, freeboard, finished floor elevation, and floor slope shall be as shown on Drawings.
- B. Tank Design and Manufacture: AWWA D100, API 650 and CBC. Note also:
1. If Section 14 is used in tank design, all provisions must be incorporated.
 2. Copper-bearing steel is not required.
- C. Safety: CCR and CBC.
- C. Seismic Requirement: The tank shall be a mechanically anchored tank which has anchor bolts to anchor the tank to the foundations. Comply with requirements specified in Section 2.02 and on Drawings. A self-anchored tank that relies on the inherent stability of the self-weight of the tank and contents to resist overturning forces shall not be permitted.

2.02 DESIGN CRITERIA

- A. Design Requirements: Materials, design, fabrication and erection AWWA D100, latest edition, 2022 CBC, and also:
1. Roof snow load: Not applicable.
 2. Roof live load:
 - a. Outside guardrails: 25 psf.
 - b. Platform and ladder areas of the tank roof around access hatches enclosed in guardrails: 50 psf.
 - c. Handrails, guardrails, and stair rails: 50 plf @ top rail; 200 lbs point.
 - d. Ladder loads: 500 lbs. on each vertical section of the ladder.
 - e. Fall Arrest and Lifeline Anchorages: 3,100 lbs, allowable, in any direction.
 3. Design Metal Temperature (DMT): $30^{\circ}\text{F} + 15^{\circ}\text{F} = 45^{\circ}\text{F}$.
 4. Wind load: In accordance with ASCE 7 Chapter 29 and AWWA D100 Section 3.1.6:
 - a. Strength-level to service-level factor for wind load: $\lambda_w = 0.6$.
 - b. Velocity pressure exposure coefficient: $K_z = 0.85$ to 1.00 .
 - c. Topographic factor: $K_{zt} = 1.0$.
 - d. Directionality factor: $K_d = 1.0$.
 - e. Wind force (drag) coefficient: C_f or $C_d = 0.63$.
 - f. Basic wind speed, $V = 105$ mph.
 - g. Gust-effect factor, $G = 0.85$.
 - h. Wind pressure: $P_w = 30.0$ lbs./ft²(vertical planes)
 - i. Wind pressure: $P_w = 18.0$ lbs./ft²(cylindrical surfaces)
 5. Seismic design: CBC Section 1613; ASCE 7, Section 15.7.7.1; AWWA D100-21, Section 13. Refer to the coefficients and factors in the below table:

SEISMIC DESIGN PARAMETERS	Coefficient / Factor
Seismic Risk Category (Table 21)	IV
Seismic Importance Factor (Table 21)	$I_E = 1.50$
Site Class (ASCE 7 Chapter 20)	C
Short-Period Site Coefficient (Table 22)	$F_a = 1.2$
Long-Period Site Coefficient (Table 23)	$F_v = 1.4$
Response Modification Factor (Table 24)	$R_i = 3.00$
Response Modification Factor (Table 24)	$R_c = 1.50$
Mapped MCE Spectral Response Acceleration, 0.2 sec.	$S_s = 2.042$
Mapped MCE Spectral Response Acceleration, 1.0 sec.	$S_1 = 0.756$
MCE Spectral Response Acceleration, 0.2 sec.	$S_{MS} = 2.451$
MCE Spectral Response Acceleration, 1.0 sec.	$S_{M1} = 1.058$
Scaling Factor (MCE to design earthquake)	$U = 2/3$
Design Earthquake Spectral Response Acceleration, 0.2 sec.	$S_{DS} = 1.634$
Design Earthquake Spectral Response Acceleration, 1.0 sec.	$S_{D1} = 0.705$
Transition Period for Longer Period Ground Motion	$T_L = 12.0$ sec.

- a. The design earthquake ground motion in this specification is based on a maximum considered earthquake ground motion, defined as a motion caused by an event with a 2 percent probability of exceedance within a 50-year period (recurrence interval of approximately 2,500 years).

- b. When information has been provided for determination of the design earthquake ground motion using either the general procedure of AWWA D100 or the site-specific procedure, both methods shall be evaluated and the design earthquake ground motion utilized as calculated by the site-specific procedure shall not be less than 80 percent of the acceleration by the general procedure.
 - c. The design seismic forces which are reduced by a factor of 0.7 in AWWA D100 equations shall be used with the allowable stress design method.
 - d. Apply horizontal and vertical design accelerations simultaneously.
 - e. Hoop stress combination: Root mean square method.
 - f. Pressure stability: check with tank full and empty for wind and seismic.
 - g. Sliding check: check tank utilizing a coefficient of friction of 0.44.
 - h. Columns shall be designed considering the effect of the horizontal dynamic forces.
 - 6. Tank anchor system: Resist tension from seismic overturning moment (AWWA D100 equation 13-19), without any reduction for vertical loads.
 - a. Design anchorage including anchor bolts, anchor straps, and anchor chairs for wind and seismic loads in accordance with AWWA D100, Section 3.8.
 - b. Anchor attachments shall be designed such that the anchor yields before the anchor chair, if used, and anchor attachment fail. Submit calculations for both the as-built condition and the corroded condition of the anchor, anchor chair, attachment, and tank shell.
 - c. Calculations shall be submitted to demonstrate that the tank shell has been designed to resist the full tensile capacity of the anchor bolts from the anchor bolt chair at the eccentricity of the chair. Reinforce shell as required to avoid locally overstressing as a result of anchor bolt chair uplift load. Design shall be in accordance with the requirements of the AISC ASD and AWWA D100.
 - 7. Soil bearing pressures:

LOAD COMBINATIONS	Allowable
Dead and live or operating loads	6,000 psf
Dead, live, operating loads plus seismic or wind loads	8,000 psf
 - 8. Construction loads: Distribute roof concentrated loads so the specified uniform live load is not exceeded. Provide roof shoring where necessary.
- B. Geotechnical investigations for design purposes for this project were made for the City of Morgan Hill by Cal Engineering & Geology in reports dated 11 August 2016 and 12 January 2024. This report is available for examination by bidders from the Owner at the City of Morgan Hill, Department of Public Works, 100 Edes Court, Morgan Hill, CA. While the records of data obtained may be considered by the Contractor to be correct, any conclusions or recommendations made in the reports are for information to the Design Engineer and are not a part of the Contract Documents. Copies of the boring logs are in the Appendix of these Specifications and their locations are shown on the Drawings.

2.03 TANK DESIGN

- A. Comply with design, seismic, and quality assurance requirements in Part 1.
- B. Roof:

1. Roof supports and stiffeners shall be designed in accordance with the requirements of the AISC and AWWA D100. In cone roof tanks with knuckle joint, calculations shall be submitted for the radial roof rafters to demonstrate that the horizontal thrust at the bottom of the diagonal kicker is sufficiently accounted for in the design of the tank shells and that the shells are designed to resist the thrust forces without locally overstressing the tank shells.
2. Lateral support of rafters shall be provided by bracing to prevent out of plane buckling and support of the compression flange.
3. Minimum thickness $3/16\text{-inch} + 1/16\text{-inch} = 1/4\text{-inch}$.
4. Design purlins and rafters for seismic water sloshing where it will occur.
5. Provide 100% lap seal welds on the underside (interior of reservoir) roof. Provide continuous fillet welds between purlins and the underside of roof plates.
6. Provide continuous fillet welds all around lapped surfaces at all purlin and rafter connections and beam supports.
7. Paint contact surfaces between roof plates and rafters.
8. Formed roof rafters, also known as press-broke roof rafters, with the submittal of supporting structural calculations are permitted.
9. The tank is configured as a double bay tank with a single center column and six (6) interior columns; however, this does not preclude the use of a single bay tank provided columns and column footings are designed in accordance with the referenced codes and standards for all loadings.

C. Roof Supports:

1. Designed in accordance with AISC.
2. Pipe or tubular columns, hermetically sealed both ends.
3. Roof rafters shall be placed above the top capacity level.
4. Paint contact surfaces between roof plates and rafters.
5. The tank is configured with a center column with hat plate; however, this does not preclude the use of an open center column support structure provided the center column and support structure are designed in accordance with the referenced codes and standards for all loadings.

D. Corrosion Allowance: $1/8\text{-inch}$ for bottom plates. $1/16\text{-inch}$ for roof plates.

E. Roof-to-Shell Joint: For cone roofs with knuckle joint provide butt-welded joint at the base of the knuckle and continuous fillet welded lapped plates, both inside and outside, at the top of the knuckle. The remainder of the roof plates shall be welded on the top-side only with a continuous full-fillet weld on all seams.

F. Shell Circumferential Joints:

1. Complete penetration butt-welded joints.
2. Vertical joints in adjacent shell courses shall not be in alignment.

G. Column Bases:

1. Design to distribute column load plus water pressure on plating without exceeding soil bearing pressure.

H. Bottom Plates:

1. Bottom plate thickness shall be in accordance with AWWA D100 plus $1/8\text{-inch}$.
2. Bottom plate joints shall be lap-welded on the top side only with a continuous full-fillet weld on all seams.

3. A hold back of approximately 3-inch width from the edge of floor plates is permitted in the inorganic zinc primer on the underside of the floor plates.
- I. Pipe Supports: Pipe supports and their connections to the tank shell are to be designed by the Contractor. Submit calculations demonstrating that the tank shell has been designed to resist the effects of concentrated loads or moments resulting from pipe supports or other attachments.

2.04 TANK ACCESSORIES

- A. General: Provide the tank complete with all pipe connections, access openings, nozzles, taps, drains, ladders, and other accessories as shown on the Drawings or required herein. All accessories shall conform to AWWA D100 and as specified. Provide all tank accessories unless noted otherwise.
- B. Stainless Steel Items: Provide AISI Type 304 material, unless Type 316 is specifically specified. Dissimilar metals shall be separated and insulated.
- C. Shell Manholes: Two 30-inch-diameter manholes located in the shell and centered 36-inches above the tank bottom. Provide suitable means to hold the manhole covers in the open position. Hinge shall be loose, so that easy bolting is possible. Hot dip galvanize after fabrication. Provide each manhole with a 1/8-inch-thick fiber sheet gasket.
- D. Piping and Pipe Connections:
 1. Distribution Pipe (greater than 2-inch):
 - a. Pipe: AWWA C200. ASTM A53-B. Schedule as shown on the Drawings.
 - b. Pipe fittings: AWWA C208. ASTM A234.
 - c. Pipe flanges: AWWA C207, Class B.
 - d. Outlet pipe: Provide removable vortex breaker plate assembly. Provide stainless steel bolts and nuts for vortex breaker supports.
 - e. Overflow pipe: Provide external overflow with reducing cone, internal and external pipe supports, and external overflow with screened discharge. Provide 1/4-inch square stainless steel mesh. Provide galvanized bolts, nuts and washers for flanges.
 - f. Pipe connections: Locate exterior face of flanges 6 inches minimum from shell plate, unless shown otherwise.
 - g. Pipe lining and coating:
 - 1) Shell Nozzle Connections: see paragraph 3.04.A
 - 2) Lining and Coating of Tank Interior Piping (inlet, outlet, overflow): AWWA C213 (Fusion-Bonded Epoxy)
 - 3) Lining of Tank Exterior Piping (overflow): AWWA C205 (Cement-Mortar lining)
 - 4) Coating of Tank Exterior Piping: see Section 09960
 2. Instrument/Sample Pipe (2-inch and smaller):
 - a. Pipe: Forged Steel, threaded, 3000 psi rated ASME B16.11, ASME B1.20.1.
 - b. Lining and Coating: see paragraph 3.04.A

- E. Roof Access:

1. Provide an exterior steel ladder with fall restraint system and guardrail to provide safe access to the roof hatch and a stainless steel interior ladder with fall restraint system from the roof hatch to the interior floor of the tank, all in accordance with the CBC and CCR. Hot-dip galvanize all parts of the exterior and interior steel ladders, intermediate landing, guardrails and ladder supports after fabrication except the stainless steel items.
2. Exterior Ladder: Furnish with OSHA compliant personal fall arrest systems or ladder safety systems, landing, and lockable access prevention at the bottom. Furnish with fall prevention devices as described below.
3. Interior Ladder: Furnish ladder with OSHA compliant personal fall arrest systems or ladder safety systems of stainless steel that conform with CBC and CCR. Provide a removable extension for the ladder safety devices above the roof hatch and other appurtenances required for use of the safety devices, including two personnel harnesses/belts. Furnish with fall prevention devices as described below. Provide dielectric connection with isolation kits, including isolation sleeves and plates, at all interior ladder supports to separate the stainless steel ladder from the support tank shell.
4. Fall Prevention Devices: For each ladder provide accessory fall prevention devices as manufactured by SAF-T Climb, Norton Safety Products, O'Keeffe's Inc., or equal. Include the following items:
 5. Products, O'Keeffe's Inc., or equal. Include the following items:
 - a. Safety rail fall arrest system (304 stainless steel).
 - b. Brackets for attaching the rail to ladder (304 stainless steel).
 - c. Removable 48-inch long rail extension (304 stainless steel).
 - d. One safety lock sleeve assembly.
 - e. Two safety harness belts.
5. Roof Hatch: Provide weathertight, hinged steel cover raised 4-inches minimum above roof. Provide 2-inch downward cover overlap. Select a cover that opens a full 180°, and can be pushed open from inside the tank. Support 300 lbs. on cover when closed. All cover hinges, handles, and hardware shall be stainless steel.
6. Guardrail: Schedule 40 pipe. Hot dip galvanize. Provide guardrail and toeboard around the roof hatch and ladder area in accordance with CBC and CCR.
7. Landings: Provide landings and supporting steel structure designed to support either a 150 psf uniform live load or 1,000 lb. concentrated load.
8. Chain Closure: Provide 5/16-inch weldless stainless oblong link chain at each rail level. Fasten with stainless steel boat type snap hook at one end and eye bolt at the other end.
9. Provide a retractable ladder extension for the tank where interior ladder does not extend above the highest surface served: Bilco "Ladder Up," equivalent by Saf-T-Climb; or equal.

F. Vents:

1. Provide one 2-foot-diameter, aluminum or FRP (clog resistant) roof vent with stainless steel screened opening.
2. Provide four welded steel perimeter vents with stainless steel screened opening as shown on the Drawings.
3. Manufacturer shall verify that adequate venting is provided to equalize pressure and prevent buckling of the tank. Center vent screen shall be designed to pop out into the interior of the tank if the internal tank pressure becomes large

enough to cause buckling of the tank shell. Maximum tank fill and discharge rate for venting design is 5,000 gpm.

8. The screen shall consist of an 18x18 Type 316 stainless steel mesh, 0.017 wire diameter or favorably reviewed equal.
9. Center vent shall be designed with a removable hood, or shall be removable with a flanged connection, in order to accept a high volume air ventilator, which rests on the open top of the vent.
10. Center vent shall be AST-Vent from Advance Tank Construction, or equal.

G. Zinc Coatings:

1. Bolts, Washers and Nuts: Electrodeposited zinc-coated to conform with ASTM B633.
2. Other Galvanized Items: Hot-dipped zinc-coated to conform with ASTM A123.

H. Liquid Level Indicator Gauge:

1. Float-operated gauge with half-travel.
2. Aluminum indicator board with black numbers and gradations on white background.
3. Calibration Scale: Feet and tenths of feet.
4. Manufacturer and Model: Shand & Jurs 92302, or equal.

I. Miscellaneous:

1. Provide threaded-type shell nozzles for ¾-inch through 2-inch connections in shell plate for level (pressure) transmitter and altitude valve sensor.

2.05 FABRICATION

A. AWWA D100, API 650, CBC, CCR and also:

1. Fabricate and assemble in the shop to the greatest extent possible.
2. Shape all members correctly, with no kinks, twists, dents or other blemishes prior to erection. Evenly spring all curved work.
3. Make exposed edges free of burrs and sharp edges. Make corners rounded or chamfered.
4. Shop prime all steel items that are not galvanized or epoxy-coated, with material that is compatible with the finish coat. See Specification Section 09960.
5. Stainless Steel Items:
 - a. Use the proper type of stainless steel electrodes or welding rods complying with AWS D10.4.
 - b. Remove by grinding and polishing, all scratches, marks, pits and other blemishes on exposed surfaces.
 - c. Use grinding wheels and other tools that have never been used on carbon steel.
6. Weld only in accordance with favorably reviewed WPSs, which are to be available to welders and inspectors during the production process.

2.06 SOURCE QUALITY CONTROL

- A. Material: Verify that satisfactory mill test reports are available on all steel, including stainless steel.

- B. Welding:
 - 1. Qualify welders in accordance with AWS D1.1 for each process, position, and joint configuration.
 - 2. Weld only in accordance with favorably reviewed WPSs, which are to be available to welders and inspectors during the production process.
- C. Report: Provide a shop inspection report including mill tests, radiographs and inspection records, before tank erection is started.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Develop a written erection plan and welding sequences for the tank bottom, side shell and roof plating for the tank.
- B. Develop this plan and sequences to minimize welding distortions and kinks between plates.
- C. Furnish this plan and sequences to the erection crew.

3.02 ERECTION

- A. AWWA D100, CBC, CCR and also:
 - 1. Comply with erection plan and welding sequences.
 - 2. Follow qualified weld procedures.
 - 3. Use qualified welders.
 - 4. Provide complete penetration butt welds at all side shell joints.
 - 5. Remove all evidence of any welding of temporary erection devices.
 - 6. Stainless steel items:
 - a. Use the proper type of stainless steel electrodes or welding rods complying with AWS D10.4.
 - b. Remove by grinding and polishing, all scratches, marks, pits and other blemishes on exposed surfaces.
 - c. Use grinding wheels and other tools that have never been used on carbon steel.

3.03 FIELD QUALITY CONTROL

- A. AWWA D100, CBC, CCR and also:
 - 1. Provide 24-hours notice of all testing to Engineer.
 - 2. Provide all testing equipment and satisfactory access to the work being inspected.
 - 3. Perform and evaluate all radiographs promptly, so any repairs can be made and re-evaluated without delay of the erection.
 - 4. The Engineer will be the sole judge of compliance with the quality of work specified herein or in AWWA D100.
 - 5. Repair all leaks and retest by the same method that discovered the leak.
- B. Tank Welding:

1. If Chapter 14, Alternative Design Basis, applies retain a Certified Welding Inspector to be present during all inspections and testing and to specify the test locations.
 2. Inspection by trepanning, air carbon arc gouging and removal of sectional segments will not be permitted.
- C. Tank Bottom: Test all joints by the vacuum method after erection and prior to painting.
- D. Tank Bottom and Side Shell: Test by the water method, after erection and prior to painting.
- E. Report: Provide a field inspection report, including radiographs and inspection records before acceptance of the tank by the Owner.

3.04 PAINTING

- A. Perform interior and exterior cleaning, preparation, and painting in accordance with AWWA D102, Section 09960, and also:
1. Paint top surfaces of all purlins, rafters, beams and all other roof structural members prior to the roof plate installation.
 2. Paint lower side of roof plates prior to installation.
 3. Provide seal welds between the underside of roof plates and the top surfaces of all purlins, rafters, beams and all other roof structural members. Protective coatings may be striped or held back where seal welds will provide 100% closure of faying surfaces (top of structural framing/underside of roof plates). Where faying surfaces are not provided with 100% closure of faying surfaces coat faying surfaces prior to welding. Coat all exposed surfaces following welding.
 3. Sealant material; polyurethane sealant; PRC Permapad RC-270, Vulkem 921, or equal - Apply in accordance with the manufacturer's instructions. All sealant material shall comply with NSF 61 requirements.
 4. Paint the underside of the floor plates prior to laying down on the asphalt concrete material.
 5. At columns, paint the top side of floor plates and the underside of column base plates prior to column erection.
 6. Proper curing time must be provided as recommended by the manufacturer.
 7. Forced air ventilation shall be used for proper curing. The air shall be drawn from the lowest part of the reservoir.
- B. Provide a first anniversary inspection of the tank painting, including testing and any required repair work, at no additional cost to the Owner.

3.05 DISINFECTION

- A. After protective coatings have been applied and accepted, disinfect the interior tank surfaces in the presence of the Engineer in accordance with the requirements of AWWA C652 and Section 11003.
- B. Water used for disinfection procedures shall be disposed of as required by Section 01100.

3.06 TESTING

- A. Following completion of erection and disinfection of the tank, the tank shall be tested for liquid-tightness by filling the tank to its overflow elevation and allowing a seven (7) day soaking period. Any leaks disclosed by this tank test shall be corrected by the Contractor in accordance with the tank manufacturer's recommendations.
- B. Volatile Organic Compound (VOC) Analysis: A minimum of five (5) days after filling the tanks, the CONTRACTOR will obtain water samples from the tanks for VOC analysis. If any VOC exceeds State action levels and the Department of Health Services (DOHS) requirements, the CONTRACTOR shall take corrective actions in accordance with the manufacturers recommendations and the tanks shall be retested, including the 5-day soaking period, until the VOCs meet the state and DOHS requirements. Refer to Section 11003.
- C. Clean water required for the initial testing shall be furnished by the Owner. Any water required for retesting shall be paid for by the Contractor.
- D. Disposal of Test Water: If required, based on failure of the above tests, water used for testing procedures shall be dechlorinated and disposed of as required by Section 01140.

END OF SECTION

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SECTION 15060

PIPE SUPPORTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes: Provide all pipe supports as shown on the Drawings, described in the Specifications.

1.02 REFERENCES

- A. American Institute of Steel Construction (AISC), Manual of Steel Construction
- B. American Society of Mechanical Engineers (ASME), ASME B31 Code for Pressure Piping
- C. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)
- D. ASTM International (ASTM)
- E. Manufacturers Standardization Society (MSS):
 - 1. MSS SP-58: Pipe Hangers and Supports - Materials, Design, and Manufacture
 - 2. MSS SP-69: Pipe Hangers and Supports - Selection and Application
 - 3. MSS SP-89: Pipe Hangers and Supports - Fabrication and Installation Practices
- F. American National Standards Institute (ANSI)
- G. American Water Works Association (AWWA)
- H. SMACNA Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems

1.03 SUBMITTALS

- A. Shop Drawings:
 - 1. Layouts and Schematics: Submit detailed installation drawings of all piping. Schematics may be submitted for piping 4 inches and smaller. The Drawings and schematics shall include: pipe support locations and types, fittings, valves, other appurtenances. (Product Review)
 - 2. Submit data to show that the following items conform to the Specification requirements:
 - a. Fabricated pipe supports and other pipe supports (Product Review).
 - 3. Submit certified test reports as required herein and by the referenced standard specifications (Product Information).
- B. Provide seismic anchorage design for Contractor designed pipe supports in accordance with Section 01190, including layout and calculations, signed and sealed by a Professional Civil or Structural Engineer registered in the State of California.

1.04 QUALITY ASSURANCE

- A. Materials and equipment furnished under this Section shall be of manufacturers who have been regularly engaged in the design and manufacture of the materials and equipment for a period of at least 5 years. Demonstrate to the satisfaction of the Engineer that the quality is equal to the materials and equipment made by the manufacturers specifically named herein, if an alternate manufacturer is proposed.

1.05 APPURTENANCES

- A. Furnish and install all necessary anchors and assembly bolts, washers and nuts, hangers, and supports; all other appurtenant items shown on the Drawings, specified or required for the proper installation and operation of the pipe supports.

1.06 PIPE SUPPORTS

- A. General:
 - 1. Piping 6 Inches and Larger: Pipe supports are shown on the Drawings for piping 6 inches and larger in diameter, where the piping is shown on layout drawings. Each pipe support used is designed to resist seismic loading except where the support is identified on the Drawings to be of the sliding type for thermal expansion. Other supports are provided to resist axial seismic loading of pipes designed for thermal expansion. Pipe supports that are considered seismic resistant are so noted on the pipe support detail sheets on the Drawings. The location and types of supports and braces are indicative and may be modified by the Contractor to suit field conditions, provided the modified support system conforms to the design criteria stated herein, and receives the favorable review of the Engineer. Where piping is shown schematically only, it shall be the Contractor's responsibility to support all such piping in accordance with the design criteria stated herein and using support details shown on the Drawings. Pipe supports have been designed assuming flanged joints on ductile iron pipe and steel pipe, unless otherwise indicated on the Drawings. If groove type mechanical couplings are used as an alternative, provide additional supports where required, particularly to resist rotation. Shop drawings of these additional supports shall be favorably reviewed by the Engineer prior to installation.
 - 2. Piping Less Than 6 Inches: Pipe supports are generally not shown for piping less than 6 inches in diameter. Where supports are not shown, it shall be the Contractor's responsibility to support all such piping in accordance with the design criteria stated hereinafter and the support details shown on the Drawings. Piping 2 ½ inches and larger shall be supported with pipe supports designed to resist seismic loads. Piping smaller than 2 ½ inches with non-hazardous contents may be supported with non-seismic resistant supports.
 - 3. Where not detailed or otherwise indicated, pipe support types and spacing shall be in accordance with the Manufacturer's Standardization Society (MSS) Standard Practice No. SP 58 and No. SP 69, except as superseded by the requirements of these Specifications.
- B. Pipe Support System Design:
 - 1. Design Loads: Pipe suspension shall be such as to prevent excessive stress or excessive variation in supporting force while system is in operation. Pipe supports shall support the sum of the weight of the pipe, fittings, appurtenances, and contents. In addition, the pipe shall be anchored to resist internal pressure forces tending to separate any unrestrained joint at

pressures 1-½ times the maximum working pressure for the applicable service.

2. Seismic Loads: Refer to Section 01190.
3. Location: All piping shall be supported in a manner that will prevent undue strain on any valve, fitting, or piece of equipment. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, at all non-rigid joints, at hose bibbs, and where otherwise shown. Where piping connects to equipment, it shall be supported by a pipe support and not by the equipment.

a. Maximum support spacing shall conform to the following table:

Pipe Size Inches	Pipe Material	Maximum Spacing Feet
1-inch and smaller	Iron or Steel	6
	Copper	4-1/2
	Plastic	continuous
	Tubing	continuous
1-¼-inch to 2-inch	Iron or Steel	8
	Copper or Plastic	5
2-½-inch to 4-inch	Iron or Steel	10
	Copper or Plastic	6
6-inch to 8-inch	Iron or Steel	12
	Plastic	8
10-inch and larger	Iron or Steel	15

- b. Piping penetrations through concrete walls and slabs are considered to resist seismic loading, provided that penetrations for pipes 3 inches in diameter and larger are complete with a wall flange.
- c. Branch piping is not considered to provide resistance to seismic forces.
4. Anchors: Anchors for connecting pipe supports to concrete shall be in accordance with Section 03200.
 - a. Provide vertical support only, that is, no lateral support, within 4 feet of an angle or tee for pipes listed above.

PART 2 - PRODUCTS

2.01 GENERAL MATERIAL REQUIREMENTS

- A. Unless specified otherwise herein bolts, nuts, and other hardware shall be as follows:
 1. Exposed: Electroplated zinc or cadmium steel.
 2. Submerged: Type 304 OR 316 stainless steel except use Monel or Hastelloy for seawater, minimum tensile strength: 60,000 psi.
 3. Concrete Encased: Steel.
 4. Buried: Type 304 stainless steel, minimum tensile strength: 60,000 psi.
 5. Apply an anti-galling compound to the threads of stainless steel bolts.

2.02 PIPE SUPPORTS

- A. Manufacture and Design: Pipe supports shall to the maximum extent possible be standard factory fabricated units conforming to the typical supports and braces shown in the Drawings and as specified below. Where required support cannot be provided by standard factory fabricated units, and is not detailed on the Drawings, the Contractor shall provide special pipe supports. Supports shall be manufactured

or special fabrications or combination as shown on the Drawings or specified. Special fabrications shall be in conformance with Section 05500. Provide $\frac{3}{4}$ inch chamfer on corners of all support elements and file or grind smooth. Supports designated to allow axial pipe movement shall have smooth and even contact surfaces.

- B. Manufacturers:
 - 1. Anvil International
 - 2. Eaton B-Line
 - 3. Or equal.
- C. The shield shall consist of an insulation layer encircling the entire circumference of the pipe and a steel jacket encircling
- D. Materials: All support systems shall be galvanized steel except that those that are submerged or that are located within a tank, channel, or other structure designed to hold water, below the top of surrounding walkway elevation or tank wall top, or otherwise called out on the Drawings, shall be Type 316 stainless steel. Trays for continuous support of plastic pipe or tubing shall be made of 20 gauge galvanized steel.
- E. Provide plastic caps with rounded corners on all exposed ends of channels.

PART 3 - EXECUTION

3.01 INSTALLATION OF PIPE SUPPORTS

- A. General:
 - 1. Install and adjust supports for each pipeline such that the pipeline is true to the indicated line and grade.
 - 2. Locate anchors and braces for any single support on a continuous structure; that is, not on two sides of a structural expansion joint.
 - 3. Tighten clamps to develop full friction along the pipeline except where loose fitting clamps are called for.
 - 4. Adjust hangers and supports to obtain required pipe slope and elevation. Shims made of material that is compatible with the piping material may be used. Adjust stanchions prior to grouting their baseplates.
- B. Electrolytic Protection: Pipe supports serving copper pipe or tubing shall be dielectrically insulated from the pipe by dielectric sleeves or plastic pipe wrap at the point of contact.

END OF SECTION

SECTION 15135

SEISMIC-CONTROLLED ELECTRIC VALVE ACTUATOR

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Electric motor-operated actuators, seismic controllers, and accessories for valves. Actuator and controller schedule is at end of this section.
- B. Work included in this Section:
 - 1. Equipment specified herein and defined by Table 3.1 is to be provided by the General Contractor.
 - 2. The General Contractor is responsible for installing all equipment as well as submitting the information required herein; coordinating delivery, off-loading, storage and handling of the equipment; equipment installation; testing and inspection; field applied coatings; and coordination of startup and training.

1.02 REFERENCES

- A. AWWA C540-87, Standard for Power Actuating Devices for Valves and Slide Gates.

1.03 SUBMITTALS

- A. Procedures: Section 01300.
- B. Coordination with Valve Submittals: Electric actuator and valve information shall be submitted together in a complete package that fully describes both the actuator and the equipment that it is serving.
- C. Shop Drawings:
 - 1. Product data fully describing all items proposed for use to demonstrate that the equipment conforms to the Specifications.
 - 2. Motor data, including requirements for circuitry. Verify that the circuits shown in the electrical drawings will accommodate the submitted actuator.
 - 3. Elementary and connection wiring diagrams clearly showing external connections to other equipment.
 - 4. Drawings showing the actuator, controller, and valve in its installed configuration
 - 5. Layout drawing for all control panels, user interfaces, etc.
- D. Performance Testing: Submit certified non-witnessed factory performance test results. Receive favorable review of test results prior to shipping the equipment.
- E. Manuals: Furnish manufacturer's installation, lubrication, operation and maintenance manuals, bulletins, and spare parts lists.
- F. Affidavits: Submit affidavits from the manufacturer stating that the equipment has been properly installed, adjusted, and tested and is ready for full-time operation.

1.04 QUALITY ASSURANCE

- A. Qualifications: Products furnished under this Section shall be supplied by a single manufacturer who has been regularly engaged in the design and manufacture of the equipment for at least five (5) years. Demonstrate to the satisfaction of the Owner's Representative that the quality is equal to equipment made by those manufacturers named herein.
- B. Regulatory Requirements: All units shall be either CSA or FM listed, and have the listing identified on the equipment nameplate.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Immediately upon delivery to job site, place materials in area protected from weather. Use non-marring slings for loading, unloading, and handling units to prevent rope or cable damage to surfaces and protective wrappings.

1.06 WARRANTY

- A. Per General Conditions, paragraph 12.11.

PART 2 - PRODUCTS

2.01 ELECTRIC VALVE ACTUATOR

- A. Manufacturer: Rotork, Limitorque, AUMA, or equal.
- B. For isolation (open/close) service, actuators shall be quarter-turn IQT series as determined by Rotork, or similar provided by Limitorque or AUMA.
- C. Housing: The actuator housing shall be cast aluminum with a ductile iron thrust base. The housing shall be rated for watertight service in up to 21 feet of submersion for 72 hours per IP68 standards.
- D. Motor: Motors shall operate on 24 VDC power supply, and be rated for 60 starts per hour. Motors shall include Class F insulation. The gear attachment and electrical connections shall include plug-in type connectors to allow removal of the motor without disassembly of the actuator.
- E. Gear Set: Gearing shall include an alloy steel worm and bronze worm gear immersed in SAE80EP oil. All gearing shall be bearing supported.
- F. Manual Controls: Each actuator shall include a declutch lever and handwheel for manual operation. Declutch lever shall be pad-lockable in both engaged and disengaged position.
- G. Protective and Monitoring Devices
 - 1. Each motor shall include thermal motor protection.
 - 2. A monitor relay shall de-energize the motor in the event of loss of power supply phase, control circuit supply, thermostat trip, local control selection, or local stop selection.
 - 3. The actuator shall include a torque sensor and circuitry to de-energize the motor if no movement occurs after an open or close signal.
 - 4. Valve position shall be monitored by a Hall Effect optical encoding device. The encoder shall track valve position in either motor or handwheel operation, and in the event of power loss.

- H. Control Signals: The actuator shall be capable of providing all control functions shown on the Drawings and as specified. Position signals to and from modulating valve actuators shall be 4-20 mA analog signals. Position signals to and from open/close service valve actuators may be discrete signals.
- I. Termination Chamber: All electrical connections shall be made in a termination chamber that is separated from the control chamber by a double seal. The control chamber shall be completely enclosed when making electrical connections.
- J. Non-intrusive Settings: The actuator covers shall not be required to be removed for site commissioning. All settings and adjustments shall be made from the exterior of the control enclosure, without exposing internal components. Control selectors shall be non-intrusive, with no moving shafts penetrating the control enclosure.
- K. Indicators: The actuator shall include a local backlight LCD display for position, torque, setup, and diagnostic information. Lights shall also be provided for visual indication of status, including "open", "closed", and "intermediate" positions.
- L. Actuator Sizing: The actuator size shall be determined by the actuator supplier, based on minimum torque requirements supplied by the valve or gate supplier and performance requirements noted in the Valve Schedule at the end of this section. Required torque output for actuator shall not exceed 60% of maximum actuator torque.
- M. Gear Reduction Assembly: The gear reduction unit shall be selected by the valve manufacturer for reducing the rotational speed from actuator. The actuator shall include a second stage gearbox that is totally enclosed, grease filled, and has a suitable torque rating for the application. Gears shall be rated AGMA 420.04 (service factor 1.25) or AGMA 460.05 (Class II) for 24-hour service.
- N. Coating: All actuators shall be primed with an epoxy coating and electrostatically powder-coated at the factory.
- O. Actuator Schedule lists associated valves, manufacturer, and model number.

2.02 SEISMIC CONTROLLER

- A. Description: Provide an industrial quality seismic sensor, reserve power system, and integrated control package to provide power and control of electric valve actuators during an emergency seismic event.
- B. Manufacturer: Earthquake Safety Systems, Inc, model MSC-W; or equal.
- C. Seismic Sensor:
 - 1. Sensor: solid state, triaxial accelerometer in three orthogonal axes (X, Y, and Z) capable of detecting vertical P and horizontal S wave accelerations. Sensor shall capture Peak Ground Acceleration (PGA) values upon exceeding setpoint and have a time history data recording module.
 - 2. Frequency Response: 0.5Hz to 15 Hz with digital filter to protect against industrial vibrations.
 - 3. Setpoints: User selectable from 0.025g to 0.5 g on each axis.
- D. Power Supply: UL rated 120 VAC, 1-phase, 60 Hz input with inverter to provide 24 VDC output and reserve 24 VDC battery power system. Battery system shall be sized to provide for one full open and one full closed cycle of the actuator.
- E. Control and Communication:

1. Communications: RS-232C Serial connection.
 2. Diagnostics: Self-diagnostics at power on and reset. LED indicator lights on the cabinet exterior shall provide the following status: "AC Power Loss", "DC Power 'ON'", "Seismic Trip", "Fault" or equal.
 3. Separate 'Open' and 'Close' push-button operators
 4. Control Outputs: Multiple independent relays, user selectable from X, Y or Z axis. N/O or N/C, rated at 6 Amps, 250VAC, dry isolated contact. 24VDC control voltage. Potentiometer for providing an adjustable 4-20mA setpoint output that can be used to close the valve to a preset open percentage following a detected seismic event. Following a system "trip" the control relay shall remain latched (default) until reset by operator, either locally or remotely.
- F. Construction:
1. All system equipment shall be housed in a NEMA 4X stainless steel cabinet with fully gasketed, lockable doors. Provide dead-front panel to conceal manual controls and indicator lights. Provide interior, hinged panel for mounting of manual controls and indicator lights.
 2. Cabinet shall include aluminum baseplate, pre-drilled, for mounting with anchor bolts on a concrete slab.

PART 3 - EXECUTION

3.01 GENERAL

- A. Contractor shall install and coordinate delivery, installation, and testing with the manufacturer. Contractor supplied actuators and controllers shall be from the same manufacturer to maintain consistency.

3.02 INSTALLATION

- A. Install in strict conformance with the manufacturer's installation instructions.

3.03 FIELD TESTING

- A. Field test all valves, actuators, and controllers. For further requirements on performance tests, refer to Sections 01650, 02510, 16010, and 17010.

3.04 FIELD SERVICE

- A. The manufacturer shall supply a competent field service Owner's Representative to thoroughly check and inspect the actuators, valves and gates after installation; place the actuators, valves and gates in operation; make necessary adjustments; calibrate instruments; and conduct field tests. The services required shall also include on-the-job training of operators including safety procedures, operating instructions, and preventive maintenance procedures. Furnish a minimum of two person-days of field services. In addition, provide 8 hours of training (total) for operation and maintenance personnel.

Table 3.1: Schedule of Actuators and Controllers

LOCATION	VALVE SIZE	VALVE TYPE	OPERATING PRESSURE	MOTOR ACTUATOR POWER SUPPLY	P&ID	SERVICE
East Dunne Hillside Reservoir	16"	Butterfly	25 psi	24 VDC	I-04	Modulating with Seismic Controller

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SECTION 16010

GENERAL ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Work Included:

1. Provide all required labor, project equipment and materials, tools, construction equipment, safety equipment, transportation, and test equipment, and satisfactorily complete all electrical work shown on the Drawings, included in these Specifications, or required for a complete and fully operating facility. In addition, provide wiring for the equipment that will be provided under other Divisions of these Specifications.
2. Provide conduit, wire and field connections for all motors, motor controllers, control devices, control panels and electrical equipment furnished under other Divisions. Coordinate with the supplier of electrical equipment specified under other Divisions.
3. Provide all conduit, wiring and terminations for all field-mounted instruments furnished and mounted under other Divisions, including process instrumentation primary elements, transmitters, local indicators and control panels. This also includes lightning and surge protection equipment wiring at process instrumentation transmitters if required. Contractor shall install vendor furnished cables specified under other Divisions.
4. Auxiliary Devices: Provide conduit and wire for power and control for all auxiliary devices such as solenoid valves, pressure switches, and instruments that are included as part of a manufacturer's packaged system (i.e., all systems specified in Divisions 11 through 15. Contractor shall be responsible for conduit and wire to these auxiliary devices even if not specifically shown on the Drawings or specified herein.
5. Provide concrete, excavation, backfill and steel reinforcement required for encasement, installation or construction of the WORK of the various Sections of Division 16 as a part of the WORK under the respective Sections, including duct banks, manholes, handholes, equipment housekeeping pads and light pole bases.

1.02 CODE COMPLIANCE AND REFERENCE STANDARDS

A. Electric equipment, materials and installation shall comply with the National Electrical Code (NEC) and with the latest edition of the following codes and standards:

1. National Electrical Safety Code (NESC)
2. Occupational Safety and Health Administration (OSHA)
3. National Fire Protection Association (NFPA)
4. National Electrical Manufacturers Association (NEMA)
5. American National Standards Institute (ANSI)
6. Insulated Cable Engineers Association (ICEA)
7. Instrument Society of America (ISA)
8. Underwriters Laboratories (UL)
9. Factory Mutual (FM)
10. Institute of Electrical and Electronics Engineers

11. American Society of Testing Materials (ASTM)
 12. Local Utility Company requirements
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.
- C. All materials and equipment for which a UL standard exists, shall bear a UL label. No such material or equipment shall be brought onsite without a UL label affixed.
- D. If the issue of priority is due to a conflict or discrepancy between the provisions of the Contract Documents and any referenced standard, or code of any technical society, organization or association, the provisions of the Contract Documents will take precedence if they are more stringent or presumptively cause a higher level of performance. If there is any conflict or discrepancy between standard specifications, or codes of any technical society, organization or association, or between Laws and Regulations, the higher performance requirement shall be binding on the Contractor, unless otherwise directed by the Owner/Engineer.
- E. In accordance with the intent of the Contract Documents, the Contractor accepts the fact that compliance with the priority order specified shall not justify an increase in Contract Price or an extension in Contract Time nor limit in any way, the Contractor's responsibility to comply with all Laws and Regulations at all times.

1.03 SUBMITTALS

- A. Shop Drawings shall be custom prepared for this project and submitted as listed in each of the Electrical Specification Sections. Shop drawings shall include the following:
1. Complete materials list stating manufacturer, brand name and catalog number of each item or class of material.
 2. For equipment, panels, boxes, control devices, wiring devices, and other uniquely-tagged items as indicated on the Drawings, include the respective tag(s) on each applicable shop drawing and cut sheet.
 3. Shop drawings for grounding work not specifically indicated on the drawings but required under the NEC.
 4. Front, side and rear elevations along with top views with required dimensional data.
 5. Location of conduit entrances and access plates.
 6. Catalog cuts defining component data.
 7. Connection diagrams, terminal numbers, internal wiring diagrams, conductor size and cable numbers.
 8. Method of anchoring, seismic requirements and weight.
 9. Types of materials and finish.
 10. Nameplates.
 11. Temperature limitations, as applicable.
 12. Voltage requirements, phase and current, as applicable.
 13. Front and rear access requirements.
 14. Test reports.
- B. O&M Manuals and other documentation, shall be submitted in accordance with these contract documents. The manuals shall be prepared specifically for this installation and shall include catalog data sheets, drawings, equipment lists, descriptions, parts lists, etc. to instruct operating and maintenance personnel unfamiliar with such equipment. All manuals and other documentation shall be

submitted as listed in each of the Electrical Specification Sections and include the following:

1. A comprehensive index.
 2. A complete "As-built" set of approved shop drawings.
 3. A complete list of the equipment supplied, including serial numbers, ranges and pertinent data.
 4. A table listing of the "as left" settings for all timing relays and alarm and trip set points.
 5. System schematic drawings "As-Built", illustrating all components, piping and electrical connections of the system supplied under this Section.
 6. Detailed service, maintenance and operation instructions for each item supplied.
 7. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
 8. The operating instructions shall also incorporate a functional description of the entire system, with references to the systems schematic drawings and instructions.
 9. Complete parts list with stock numbers, including spare parts.
- C. Record Drawings shall be promptly furnished when the equipment installation is complete. Payment may be withheld until Record Drawings have been furnished and approved.
- D. At the time of delivery of the equipment, the Contractor shall have an approved shop drawing in his possession for the Owner's Inspector and/or Owner's Engineer for verification.
- E. As-Built Drawings: As the work progresses, legibly record all field changes on a set of Project Contract Drawings, hereinafter called "As-Built Drawings". The As-Built Drawings and specifications shall be kept up to date throughout the project. As-Built Drawings shall accurately show the installed condition of the following items at a minimum:
1. One-line Diagram(s).
 2. Raceways and pullboxes.
 3. Conductor sizes and conduit fills.
 4. Panelboard Schedule(s).
 5. Control Wiring Diagram(s).
 6. Luminaire Schedule(s)
 7. Luminaire, receptacle and switch outlet locations.
 8. Underground raceway and duct bank routing including manhole/handhole locations.
 9. Plan view, sizes and locations of switchgear, switchboards, distribution transformers, motor control centers and panelboards.

1.04 TESTS

- A. The Contractor shall be responsible for factory and field tests indicated in Division 16, as required by the Engineer and as required by other authorities having jurisdiction.
- B. Furnish necessary testing equipment
- C. Pay the costs of the tests, including replacement parts and labor due to damage resulting from damaged equipment or from testing and correction of a faulty installation.

- D. Reporting
 - 1. Where test reporting is indicated, submit proof-of-design test reports for mass-produced equipment with the Shop Drawings.
 - 2. Submit factory performance test reports for custom-manufactured equipment for approval prior to shipment.
 - 3. Submit field test reports for review prior to Substantial Completion.
- E. Remove and replace equipment or material that fails a test, or, if the Engineer approves, repair and retest for compliance.
- F. Connections to equipment or materials with a factory warranty shall be as recommended by the manufacturer and shall be performed in a manner that does not void the warranty.

1.05 DEMOLITION AND RELATED WORK

- A. General
 - 1. Perform electrical demolition work as indicated.
 - 2. The Contractor is cautioned that demolition work may also be indicated on non-electrical Drawings.
 - 3. Coordinate with all trades regarding electrical de-energization, disconnection and removal, and the overall sequence of construction.
- B. Electrical Requirements for Removed Equipment
 - 1. Remove dedicated wiring and exposed conduits back to the source.
 - 2. Where control wiring to be demolished shares a conduit with other wiring to remain, the control wiring shall be abandoned in place. Where power wiring to be demolished shares a conduit with other wiring to remain, the power wiring shall be removed.
 - 3. Remove power wiring from the power source to the first pullbox or manhole remote from the panel and abandon in place the remaining wiring.
 - 4. Abandon in place wiring routed through encased conduits and cut encased conduits flush to the floor and grout flush with the floor.
 - 5. Remove remote mounted starters, disconnect switches, circuit breakers, sensors and transmitters
- C. Junction Boxes
 - 1. Wiring and conduits indicated to be extended shall be terminated in a new junction box with terminal strips.
 - 2. Provide a junction box with a NEMA rating in accordance with the area in which it is located and sized as required by the NEC.
 - 3. Properly identify wires and terminals before disconnection.
- D. Removed materials and equipment not indicated to be returned to the Owner shall, upon removal, become the Contractors property and shall be disposed of off-site.
- E. Remove and relocate material and equipment indicated to be relocated or reused, and reinstall with care in order to prevent damage.
- F. Identification
 - 1. Where motor control centers, switchboards or panelboards are indicated to have components, assemblies or circuits removed and/or reconnected, provide the affected equipment compartments with new engraved nameplates matching the existing. Modify panelboard schedule(s) to indicate revised circuits.

2. Pencil or magic marker markings directly on equipment will not be acceptable.

1.06 COORDINATION

- A. Coordinate the electrical work with the other trades, code authorities, utilities, and the Owner.
- B. Where connections must be made to existing installations, properly schedule all the required work with the Owner, including the power shutdown periods. Schedule and carry out shutdowns so as to cause the least disruption to operation of the plant and privately owned facilities.
- C. Submit a written sequencing request indicating the sequence and duration of activities to be performed during the plant shutdown.
- D. Switching, safety tagging and other project related tasks required for shutdown or to isolate existing equipment, shall be performed by the Contractor.
- E. In no case shall the Contractor begin any work in, on or adjacent to existing equipment without written authorization from the Engineer.
- F. Modifications
 1. Perform modifications or alterations to existing electrical facilities as required to successfully install and integrate the proposed electrical equipment as indicated.
 2. Perform modifications to existing equipment, panels and cabinets in a professional manner. Repair coatings of existing equipment to match existing
 3. The costs for modifications to existing electrical facilities that are required for a complete and operable system shall be included as part of the Work.
- G. Existing Utilities
 1. Exercise extreme caution when digging trenches to not damage existing underground utilities.
 2. The cost of repairs of damages caused during construction shall be included as a part of the Work.
- H. Field Verifications
 1. Visit the site before submitting a Bid to become better acquainted with the Work of this Contract.
 2. The lack of knowledge will not be accepted as justification for extra compensation to perform the Work.
 3. The Contractor shall be responsible for identifying available existing circuit breakers in lighting panel for the intended use as required.
 4. The Contractor shall be responsible for field verifying the available space in switchgear, switchboards and/or motor control centers to integrate new overcurrent protective devices meeting the requirements of these Specifications.
 5. The cost for the above field verifications shall be included as part of the Work.
- I. Installation of Temporary Power
 1. To facilitate the continuous operation of existing equipment, provide temporary equipment as indicated.
 2. Submit installation and connection details for favorable review and acceptance by the Engineer.
 3. Costs associated with these temporary installations shall be included as part of the Work.

4. Temporary wiring and equipment shall remain the property of the Contractor unless indicated otherwise.

1.07 ELECTRICAL SERVICES

- A. Contact the serving utility and verify compliance with requirements before construction.
- B. Coordinate schedules and payments for Work by utilities.
- C. Where conduits and conductors in the Work are indicated to be larger, heavier schedule, or have greater protective coating than utility requirements, provide the larger size, heavier schedule or greater protection.
- D. Provide electrical service as indicated and as required by the serving utility.
- E. Verify and provide service conduits, fittings, transformer pad, grounding devices and service wires not provided by the serving utility.
- F. Verify with the utility the exact location of each service point and type of service, and pay charges levied by the serving utilities as part of the Work.

1.08 LOCATIONS

- A. General: Use equipment, materials and wiring methods suitable for the types of locations in which they are located, as defined in Paragraph B. herein.
- B. Definitions of Types of Locations:
 1. Dry Locations: All those indoor areas which do not fall within the definitions below for Wet, Damp, Hazardous, or Corrosive Locations and which are not otherwise designated on the Drawings.
 2. Wet Locations: All locations exposed to the weather, whether under a roof or not, unless otherwise designated on the Drawings.
 3. Damp Locations: All spaces wholly or partially underground, or having a wall or ceiling forming part of a channel or tank, unless otherwise designated on the Drawings.
 4. Corrosive Locations: Areas where chlorine or sulfur dioxide gas under pressure, sulfuric acid, or liquid polymer are stored or processed. These areas are shown on the Drawings.
- C. Unless otherwise specified herein or shown on the Drawings, electrical enclosures and associated installations shall have the following ratings:
 1. NEMA 1 gasketed or 12 for dry, non-process indoor above grade locations
 2. NEMA 4X enclosures of Type 304 or 316 stainless steel in outdoor location and corrosive areas except in chlorine and HFS areas where non-metallic enclosures shall be provided..
- D. Equipment, materials and installation in areas designated as hazardous on the Drawings shall comply with NEC Articles 500, 501, 502 and 503.

1.09 PHASE BALANCING

- A. The Drawings do not attempt to balance the electrical loads across the phases. Circuits on motor control centers and panelboards shall be field connected to result in evenly distributed loads across all three phases.
- B. Field balancing of circuits shall not alter the conductor color coding requirements defined in Section 16120.

1.10 SIZE OF EQUIPMENT

- A. Investigate each space in the structure through which equipment must pass to reach its final location. Coordinate shipping splits with the manufacturer to permit safe handling and passage through restricted areas in the structure.
- B. The equipment shall be kept upright at all times during storage and handling. When equipment must be tilted for passage through restricted areas, brace the equipment to ensure the tilting does not impair the functional integrity of the equipment.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Products that are specified by manufacturer, trade name or catalog number establish a standard of quality and do not prohibit the use of equal products of other manufacturers provided they are favorably reviewed by the Engineer prior to installation.
- B. It is the intent of these Specifications and Drawings to secure high quality in all materials and equipment in order to facilitate operation and maintenance of the facility. All equipment and materials shall be new and the products of reputable suppliers having adequate experience in the manufacture of these particular items. For uniformity, only one manufacturer will be accepted for each type of product. All equipment shall be designed for the service intended and shall be of rugged construction, of ample strength for all stresses, which may occur during fabrication, transportation, erection, and continuous or intermittent operation. All equipment shall be adequately stayed, braced and anchored and shall be installed in a neat and workmanlike manner. Appearance and safety, as well as utility, shall be given consideration in the design of details.
- C. All components and devices installed shall be standard items of industrial grade, unless otherwise noted, and shall be of sturdy and durable construction suitable for long, trouble-free service. Light-duty, fragile and competitive grade devices of doubtful durability shall not be used.
- D. Where a NEMA enclosure type is indicated in a non-hazardous location, use that type of enclosure despite the fact that certain modifications such as cutouts for control devices may negate the NEMA rating.
- E. Temperature Ratings of Equipment Terminations and lugs shall be rated for use with 75-degree C conductors. Wire sizes in the Contract Documents are based on NEC ampacity tables using the 75-degree C ratings.

2.02 MOUNTING HARDWARE

- A. Miscellaneous Hardware
 - 1. Provide nuts, bolts and washers constructed of stainless steel.
 - 2. Provide threaded rods for trapeze supports constructed from continuous threaded galvanized steel, 3/8-inch diameter minimum.
 - 3. Slotted channel
 - a. Construct struts for mounting of conduits and equipment of stainless steel slotted channel.

- b. Where contact with concrete or dissimilar metals may cause galvanic corrosion, use suitable non-metallic insulators in order to prevent such corrosion.
 - c. Slotted channel manufacturer shall be Unistrut, B-Line or approved equal.
- 4. Provide plastic protective end caps for all exposed slotted channel ends. End caps shall be manufactured by Unistrut P2860-33 or approved equal
- 5. Provide stainless steel expansion anchors for attaching equipment to concrete walls, floors and ceilings. Expansion anchors shall be manufactured by Power Fasteners, Inc and be the "Power-Bolt" or "Power-Stud" series or approved equal.

2.03 LENS COLOR SCHEME

- A. See Specifications Section 16955.

2.04 NAMEPLATES

- A. For each piece of electrical equipment, provide a manufacturer's nameplate showing his name, location, the pertinent ratings and the model designation.
- B. Identify each piece of equipment and related controls with a rigid laminated engraved phenolic nameplate. Engrave nameplates with the inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using fasteners constructed of brass, cadmium plated steel or stainless steel and screwed into inserts or tapped holes as required. Where no inscription is indicated on the Drawings, furnish nameplates with an appropriate inscription furnished by the Engineer upon prior request by the Contractor.
- C. Provide engraved characters of the block style, with no characters smaller than 1/8 inch top to bottom.
- D. Each control device, including pushbuttons, control switches, and indicating lights, shall have an integral legend plate or nameplate indicating the device function. These shall be inscribed as indicated on the Drawings or as favorably reviewed by the Engineer.

2.05 PAINTING

- A. Equipment: Refer to each electrical equipment section of these Specifications for painting requirements of equipment enclosures. Repair any final paint finish, which has been damaged or is otherwise unsatisfactory, to the satisfaction of the Engineer.
- B. Wiring System: Paint all exposed conduits, boxes and fittings to match the color of the surface to which they are affixed. Paint finishes shall include proper surface preparation, prime coat and a final finish coat, and shall conform to Section 09960.

PART 3 - EXECUTION

3.01 REQUIREMENTS

- A. All electrical installations shall conform to the codes and standards outlined in this Section.

3.02 WORKMANSHIP

- A. Assign a qualified representative who shall supervise the electrical construction work from beginning to completion and final acceptance.
- B. Perform all labor using qualified craftsmen, who have had experience on similar projects. Provide first-class workmanship for all installations.
- C. Ensure that all equipment and materials fit properly in their installations.
- D. Perform any required work to correct improperly fit installations at no additional expense to the Owner.
- E. Provide materials and incidental required for a complete and operable system, even if not required explicitly by the Contract Documents.
- F. Typical incidentals are terminal lugs not furnished with vendor-supplied equipment, compression connectors for cables, splices, junction and terminal boxes, and control wiring required by vendor-furnished equipment to connect with other equipment indicated in the Contract Documents.

3.03 EXCAVATION AND BACKFILL

- A. Provide the excavations for electrical equipment foundations and trenches for conduits as shown on the Drawings.
- B. Exercise caution during all excavation work and avoid damage to existing underground pipes. Exercise extreme caution when working near existing electrical conduits and facilities. Field verify the location of all electrical facilities before proceeding with any nearby work.
- C. Refer to Division 2, Earthwork, of these Specifications for all excavation and backfilling work.

3.04 CONCRETE

- A. Where shown on the Drawings or specified, provide the required concrete installations for conduit encasement and equipment foundations.
- B. Refer to Division 3, Concrete, of these Specifications for all concrete work.

3.05 CONDUCTOR IDENTIFICATION

- A. Identify all wires and cables in conformance with the requirements of Sections 16120 and 16124. This requirement applies to all equipment provided under this contract, regardless of Division, as well as to all conductors provided or worked on during this contract.

3.06 CUTTING, DRILLING, AND WELDING

- A. Provide any cutting, drilling, and welding that is required for the electrical construction work.
- B. Structural members shall not be cut or drilled, except when favorably reviewed by the Engineer. Use a core drill wherever it is necessary to drill through concrete or masonry.
- C. Provide the required welding for equipment supports. Conduits and fittings shall not be welded to structural steel.

- D. Perform patch work with the same materials as the surrounding area and finish to match, as specified in Division 3 of these Specifications.

3.07 METAL PANELS

- A. Mount all metal panels which are mounted on or abutting concrete walls in damp locations or any outside walls 1/4 inch from the wall and paint the back sides of the panels with a high build epoxy primer. Film thickness shall be 10 mils minimum.

3.08 TESTING

- A. Perform acceptance testing in accordance with Section 16950.
- B. Perform additional testing as indicated within specific equipment sections.

3.09 EQUIPMENT STORAGE AND PROTECTION

- A. During construction, provide adequate storage for all equipment and materials that will become part of the completed facility so that it is protected from weather, dust, water, and other environmental impacts, or damage from construction operations.
- B. Store and protect products in accordance with manufacturer's instructions. Seals and labels shall be intact and legible.
- C. Store moisture sensitive products including electrical equipment, instruments and controls in weathertight, humidity and temperature-controlled enclosures to avoid condensation and dust buildup.
- D. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.
- E. Exercise care at all times after installation of equipment, motor control centers, etc., to keep out foreign matter, dust, dirt, debris, or moisture. Use protective sheet-metal covers, canvas, heat lamps, etc., as needed to ensure equipment protection.

3.10 CLEANING EQUIPMENT

- A. Before final acceptance, thoroughly clean the electrical Work of cement, plaster and other materials.
- B. Clean out and vacuum all construction debris from the bottom of all equipment.
- C. Provide and touch-up to original condition any factory painting that has been marred or scratched during shipment or installation, using paint furnished by the equipment manufacturer.
- D. Remove temporary tags, markers, stickers and the like.
- E. Remove all oil and grease spots with a non-flammable cleaning solvent by carefully wiping and scraping cracks and corners.
- F. Clean luminaires inside and out.
- G. Dispose of cleaning debris and refuse off-site.

END OF SECTION

SECTION 16050

ELECTRIC MOTOR DRIVES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section Includes: Provide motors to drive equipment specified in other sections and Divisions, including, but not limited to, Divisions 11, 12, 13, 14, 15, and 16. Refer to driven equipment sections for additional requirements. Requirements of the driven equipment Specifications shall take precedence over the requirements of this Section, where conflict occurs. This Section applies to all electric motors furnished for this project, unless otherwise noted.

1.02 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association (NEMA) Standard:
 - 1. MG 1 Motors and Generators
- B. Institute of Electrical and Electronics Engineers (IEEE) Standard:
 - 1. 112 Test Procedure for Polyphase Induction Motors and Generators
- C. Underwriters Laboratories (UL) Publication: Recognized Component Directory

1.03 SUBMITTALS

- A. For each motor, include the following data in the shop drawing submittal for the driven equipment, as part of the driven equipment's Product Review submittals:
 - 1. Machine name and specification number of driven machine
 - 2. Manufacturer's name.
 - 3. Motor model and dimension drawing, including motor weight.
 - 4. Manufacturer's type and frame designation.
 - 5. Nominal Horsepower output.
 - 6. Time rating.
 - 7. Maximum ambient temperature rating.
 - 8. Winding Insulation class and temperature rise class.
 - 9. RPM at full load.
 - 10. Voltage, number of phases, frequency and full load amperes.
 - 11. Code letter for locked rotor kVA.
 - 12. Service factor at 40°C ambient.
 - 13. NEMA design letter.
 - 14. Enclosure type.
 - 15. Bearing data including lubrication requirements, type and frequency.
 - 16. KW input power and power factor at 75% and 100% of rated horsepower output.
 - 17. Guaranteed minimum full load efficiency. Also, nominal efficiencies at 1/2 and 3/4 load.
 - 18. Type of thermal protection or overtemperature protection, if included.
 - 19. Wiring diagram for devices such as motor leak detection, temperature or zero speed switches, as applicable.
 - 20. If utilized with a variable frequency controller, verify motor is inverter duty type. Include minimum speed at which motor may be operated for the driven machinery. Provide shaft grounding information and details.

21. Power factor at 1/2, 3/4 and full load.
 22. Recommended size for power factor correction capacitors to improve power factor to 0.95 percent lagging when operated at full load.
- B. If water cooling is required for motor thrust bearings, the Shop Drawing submittals shall indicate this requirement.

1.04 COORDINATION

- A. General: Coordinate motors with driven equipment requirements. Unless otherwise specified, equipment manufacturers or suppliers shall select and provide motors for their equipment in conformance with these Specifications. Give particular attention to coordination of requirements for:
1. Power.
 2. Starting torque.
 3. Speed.
 4. Bearing load.
 5. Ambient temperature.
 6. Frequency of starting.
 7. Moisture exposure.
 8. Adjustable speed control, where applicable.
- B. Suppliers of motors to be used with adjustable speed systems shall:
1. Provide all relevant motor data to the adjustable speed control manufacturer for analysis. Provide motors in conformance with and compatible with the adjustable speed control manufacturer's equipment and requirements.
 2. Provide all relevant motor data to the pump manufacturer for vibration, reed critical frequency and other required analyses.

1.05 SPECIFIC REQUIREMENTS

- A. The following motor characteristics are specified with the driven equipment in all cases:
1. Speed.
 2. Horsepower or supplier responsibility to determine.
 3. Horizontal or vertical arrangement.
 4. Indoor or outdoor location.
- B. Additional motor characteristics are specified with the driven equipment only where the required motor differs from the typical characteristics described below or where additional properties or characteristics are required that are not specified in this Section.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Motors shall be designed, built, and installed in the driven equipment, to provide long, trouble-free life in industrial service and shall be rated in conformance with NEMA MG1. Motors rated 100 horsepower or less and rated 600V or less shall be listed in UL Recognized Component Directory or shall be listed and labeled by other organizations acceptable to the authority having code enforcement jurisdiction.

- B. Unless otherwise specified with the driven equipment, provide motors with the following typical characteristics:
1. NEMA Design: Electric motors shall be NEMA Design B unless otherwise indicated. In no case shall starting torque or breakdown torque be less than the value in NEMA MG 1. Motors shall be suitable for the indicated starting method.
 2. Voltage Ratings:
 - a. 1/2 horsepower or less: 115 volts, single phase, 60 Hz, capacitor start. Small fan motors may be split phase or shaded pole type if standard for the equipment. Dual voltage motors rated 115/230 volts, 115/208 volts, or 120-240 volts are acceptable, provided leads are brought out to the conduit box.
 - b. Above 1/2 horsepower: 460 volts, three phase, 60 Hz, squirrel cage induction motors. Dual voltage motors rated 230/460 volts or 208/230/460 volts are acceptable, provided every lead is brought out to the conduit box.
 3. All motors shall have a service factor of 1.15 in an ambient temperature of 40°C.
 - a. Exceptions: Motors, which have special enclosures or winding configurations, may carry a Unity (1.0) Service Factor. Examples are totally enclosed, explosion proof, or submersible motors.
 4. Windings shall be copper.
 5. Horizontal motors 3 HP and larger and every vertical motor shall have split-type cast metal conduit boxes. Motors shall be provided with oversized conduit boxes. Motors other than open drip-proof shall be gasketed.
 6. Provide ground lug inside the terminal box.
 7. Provide lifting eye on each motor weighing more than 50 pounds.
 8. Each motor shall be suitable for six starts per hour (5 minutes on and 5 minutes off, continuously) when powering the specific driven equipment required for this project.
 9. Each motor shall have an overall sound power level at no load not greater than given in NEMA MG1-Part 9.
 10. Inverter duty motors shall be provided with shaft grounding rings. Rings shall be factory installed, and shall be by Aegis, or equal. The motor warranty shall include coverage against VFD-induced bearing damage or failure.
 11. Motors, which have special operating characteristics such as multi-speed, high torque/high slip, short time intermittent ratings shall be nameplated to show how these characteristics differ from standard design.
- C. Motors used with variable frequency drives shall have inverter duty complying with NEMA MG-1, Section IV, Part 31, and shall be clearly identified as "Inverter Duty."
- D. Increased circuit breaker, magnetic starter, and conductor and conduit capacities required for motors larger than the indicated sizes shall be provided as part of the Contractors work.
- E. Two speed motors shall be of the two-winding type,
- F. Exempt Motors: Motors for valve operators, submersible pumps, or motors which are an integral part of standard manufactured equipment, i.e., non-NEMA mounting, common shaft with driven element, or part of domestic or commercial use apparatus may be excepted from these requirements to the extent that such variation reflects a necessary condition of motor service or a requirement of the driven equipment.

2.02 NAMEPLATE

- A. Provide stainless steel nameplate for each motor, attached to the motor by stainless steel screws or drive pins. Nameplates shall indicate clearly the information required by NEMA MG1, Part 10 and Part 12.

2.03 ENCLOSURE TYPE BY LOCATION

- A. Unless otherwise specified with the driven equipment, provide motors with the following typical enclosures:
 - 1. Indoors and non-hazardous: Horizontal motors shall be open, drip-proof; vertical motors shall be drip-proof with guard.
 - 2. Outdoors and non-hazardous: Vertical motors shall be weather-protected type I. Horizontal motors shall be totally enclosed, fan cooled. All motors shall have the following features:
 - a. Bearing protection.
 - b. Anti-corrosion treatment of external hardware and internal metal parts.
 - c. Weatherproof terminal box with gaskets between the motor, terminal box, and terminal box cover.
 - d. Guard screens on ventilation openings.
 - e. Moderate moisture resistant insulation, specified hereinafter.
 - f. Interior and exterior corrosion protection coatings.

2.04 INSULATION

- A. Three phase motors shall be provided with Class F insulation, rated to operate at a maximum ambient temperature of 40 degrees C and at the altitudes where the motors will be installed and operated, without exceeding Class B temperature rise limits stated in NEMA MG 1-12.44. Single phase motors shall have Class F insulation with temperature rise not to exceed the insulation class. Motors to be operated from adjustable frequency drives shall be provided with insulation systems to withstand 1600 volt spikes, with dV/dT as defined in NEMA MG 1-31. The adjustable frequency drive manufacturer shall coordinate with the motor manufacturer to determine when additional dV/dT protection is required. Where required, it shall be furnished and installed as per the manufacturer's written instructions.
- B. Where called for in the Specifications for the driven equipment, provide the following type of insulation:
 - 1. Moderate Moisture Resistant: Provide extra dip and bake of epoxy or polyester varnish to resist somewhat higher than normal moisture in the atmosphere.

2.05 MOTOR HORSEPOWER

- A. The maximum permissible motor loading:
 - 1. Motors with service factor 1.15 or greater: 100% of nameplate horsepower.
 - 2. Motors with service factor less than 1.15: 90% of nameplate horsepower.
- B. Probable motor horsepower ratings have been specified or shown on the Drawings. Changes from the specified horsepower may be accepted, if necessary, to assure that motors do not exceed their maximum permissible loading, as defined above, under normal operation. Motor horsepowers shall not be less than those specified in driven equipment sections. If a larger horsepower rating is required by the driven equipment, provide all changes required to motor starting

and control equipment and to the conduit and wiring system without any additional cost to the Owner.

2.06 EFFICIENCY

- A. For motors 1 Horsepower and Larger:
 - 1. Provide NEMA premium efficient units. Motors shall be stamped with the efficiency on the nameplate with the caption "NEMA Nominal Efficiency" or "NEMA Nom. Eff." Premium efficiency motors shall have nominal and minimum efficiencies at full load not less than those listed in Table 16050-1. Both efficiencies shall be included in the Shop Drawing submittal.
- B. Efficiencies shall be determined by using the IEEE 112, Test Method B using segregated loss determination.
- C. Single-phase fractional horsepower motors 1/4 HP through 3/4 HP motors shall be high-efficiency split-capacitor types having minimum efficiency ratings of not less than 64% and power factors of not less than 94.5%.

TABLE 16050-1

OPEN DRIP-PROOF (ODP)						
FULL-LOAD EFFICIENCIES OF NEMA PREMIUM EFFICIENCY MOTORS RATED 600 VOLTS OR LESS						
	2 POLE		4 POLE		6 POLE	
HP	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.
1	77.0	74.0	85.5	82.5	82.5	80.0
1.5	84.0	81.5	86.5	84.0	86.5	84.0
2	85.5	82.5	86.5	84.0	87.5	85.5
3	85.5	82.5	89.5	87.5	88.5	86.5
5	86.5	84.0	89.5	87.5	89.5	87.5
7.5	88.5	86.5	91.0	89.5	90.2	88.5
10	89.5	87.5	91.7	90.2	91.7	90.2
15	90.2	88.5	93.0	91.7	91.7	90.2
20	91.0	89.5	93.0	91.7	92.4	91.0
25	91.7	90.2	93.6	92.4	93.0	91.7
30	91.7	90.2	94.1	93.0	93.6	92.4
40	92.4	91.0	94.1	93.0	94.1	93.0
50	93.0	91.7	94.5	93.6	94.1	93.0
60	93.6	92.4	95.0	94.1	94.5	93.6
75	93.6	92.4	95.0	94.1	94.5	93.6
100	93.6	92.4	95.4	94.5	95.0	94.1
125	94.1	93.0	95.4	94.5	95.0	94.1
150	94.1	93.0	95.8	95.0	95.4	94.5
200	95.0	94.1	95.8	95.0	95.4	94.5
250	95.0	94.1	95.8	95.0	95.4	94.5
300	95.4	94.5	95.8	95.0	95.4	94.5
350	95.4	94.5	95.8	95.0	95.4	94.5
400	95.8	95.0	95.8	95.0	95.8	95.0
450	96.2	95.4	96.2	95.4	96.2	95.4
500	96.2	95.4	96.2	95.4	96.2	95.4

Source: NEMA MG1 - 2011, Table 12-12

TOTALLY ENCLOSED - FAN COOLED (TEFC)						
FULL-LOAD EFFICIENCIES OF NEMA PREMIUM EFFICIENCY MOTORS RATED 600 VOLTS OR LESS						
	2 POLE		4 POLE		6 POLE	
HP	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.	Nom. Effic.	Min. Effic.
1	77.0	74.0	85.5	82.5	82.5	80.0
1.5	84.0	81.5	86.5	84.0	87.5	85.5
2	85.5	82.5	86.5	84.0	88.5	86.5
3	86.5	84.0	89.5	87.5	89.5	87.5
5	88.5	86.5	89.5	87.5	89.5	87.5
7.5	89.5	87.5	91.7	90.2	91.0	89.5
10	90.2	88.5	91.7	90.2	91.0	89.5
15	91.0	89.5	92.4	91.0	91.7	90.2
20	91.0	89.5	93.0	91.7	91.7	90.2
25	91.7	90.2	93.6	92.4	93.0	91.7
30	91.7	90.2	93.6	92.4	93.0	91.7
40	92.4	91.0	94.1	93.0	94.1	93.0
50	93.0	91.7	94.5	93.6	94.1	93.0
60	93.6	92.4	95.0	94.1	94.5	93.6
75	93.6	92.4	95.4	94.5	94.5	93.6
100	94.1	93.0	95.4	94.5	95.0	94.1
125	95.0	94.1	95.4	94.5	95.0	94.1
150	95.0	94.1	95.8	95.0	95.8	95.0
200	95.4	94.5	96.2	95.4	95.8	95.0
250	95.8	95.0	96.2	95.4	95.8	95.0
300	95.8	95.0	96.2	95.4	95.8	95.0
350	95.8	95.0	96.2	95.4	95.8	95.0
400	95.8	95.0	96.2	95.4	95.8	95.0
450	95.8	95.0	96.2	95.4	95.8	95.0
500	95.8	95.0	96.2	95.4	95.8	95.0

Source: NEMA MG1 - 2011, Table 12-12

2.07 MOTOR THERMAL PROTECTION

- A. Single Phase Motors: Single phase 120, 208, or 230 volt motors shall have integral thermal overload protection or shall be inherently current limited.
- B. In each motor to be used with adjustable speed drives, in all motors 40 horsepower and larger, or where called for in the Specifications for the driven equipment, provide integral thermostats or other approved devices to protect the motor from overheating. Thermostats shall be snap action, bi-metallic, temperature actuated switch. Thermostats shall be normally closed and the switch point shall be precalibrated by the manufacturer. Thermostats shall be rated 125 Vac, 1 amp.

2.08 SPACE HEATERS

- A. On all outdoor motors, where called for in the Specifications for the driven equipment, or where shown on the Drawings provide space heaters or solid-state motor winding heating systems for motors. Heaters shall be 120 volts, single-

phase, as required by the control circuit voltage. Heater wattage and voltage ratings shall be indicated on motor nameplate.

2.09 MOTOR BEARINGS

- A. General: Bearings shall conform to Section 11001 – General Equipment and Mechanical Requirements, except as indicated herein.
- B. Motors greater than 2 HP shall have bearings designed for 17,500 hours (belted) or 100,000 hours (coupled) L-10 life.
- C. Fractional Horsepower: Motors with fractional horsepower through 2 HP shall be provided with lubricated-for-life ball bearings.
- D. Horizontal Motors Over 2 HP: Motors larger than 2 HP shall be provided with relubricatable ball bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.
- E. Vertical Motors Over 2 HP: Vertical motors larger than 2 HP shall be provided with relubricatable ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.
- F. Water Cooled Motors: If water cooling is required for the thrust bearings, cooling water lines shall be provided complete with shut-off valve, strainer, solenoid valve, flow indicator, thermometer, throttling valve, and, (where subject to freezing), insulation with heat tracing.
- G. Inverter Duty Motors: Provide an insulated bearing to prevent circulating bearing currents.

2.10 MANUFACTURERS, OR EQUAL

- A. U.S. Motors
- B. General Electric
- C. WEG

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install motors in driven equipment in conformance with motor manufacturer's recommendations and requirements. Motor nameplate shall be visible when installed on the driven equipment. Where applicable, shaft grounding devices shall be connected to the grounding system in accordance with the manufacturer's recommendations.
- B. Related electrical WORK involving connections, controls, switches, and disconnects shall be performed in accordance with the applicable sections of Division 16.

3.02 FACTORY TESTS

- A. Motors shall be factory tested in conformance with IEEE 112, IEEE 43 - Recommended Practice for Testing Resistance of Rotating Machinery, and NEMA MG-2. Except where specific testing or witnessed shop tests are required by the

specifications for driven equipment, factory test reports may be copies of routine test reports of electrically duplicate motors. Test report shall indicate test procedure and instrumentation used to measure and record data. Test report shall be certified by the motor manufacturer's test personnel and be submitted to the ENGINEER.

3.03 FIELD TESTING

- A. The CONTRACTOR shall perform the following field tests:
1. Inspect each motor installation for any deviation from rated voltage, phase, frequency, and improper installation.
 2. Visually check for proper phase and ground connections. Verify that multi-voltage motors are connected for proper voltage. Verify shaft grounding devices are properly grounded.
 3. Check winding and bearing temperature detectors and space heaters for functional operation.
 4. Test for proper rotation prior to connection to the driven equipment.
 5. Visually check that motor overload heaters are properly sized and that MCP breaker settings are correct for the motor installed.
 6. Test insulation (megger test) of new and re-used motors in accordance with NEMA MG-1. Test voltage shall be 1000 VAC plus twice the rated voltage of the motor.

END OF SECTION

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SECTION 16110

ELECTRICAL RACEWAY SYSTEMS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish and install complete raceway systems as shown on the drawings and as specified herein.
- B. In the event that individual equipment loads provided are larger than indicated in the Contract Documents, revise raceways, conductors, starters, overload elements, and branch circuit protectors as necessary in order to control and protect the increased connected load in conformance to NEC requirements as part of the WORK.

1.02 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI) Publications:
 - 1. C80.1 Specification for Zinc Coated Rigid Steel Conduit
 - 2. C80.5 Specifications for Rigid Aluminum Conduit
- B. Federal Specifications (FS):
 - 1. FS W C 1094 W C 1094A Conduit and Conduit Fittings, Plastic, Rigid
 - 2. FS WW C 540 WW C 540A Conduit, Metal, Rigid, (Electrical, Aluminum)
 - 3. WW C 540C Conduit, Metal, Rigid & Coupling, Elbow & Nipple, Electrical Conduit, Aluminum
 - 4. FS WW C 566 WW C 566C Flexible Metal Conduit
- C. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. RN 1 Polyvinyl Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing
 - 2. TC2 Electrical Polyvinyl Chloride (PVC) Conduit
 - 3. TC 6 PVC and ABS Plastic Utilities Duct for Underground Installation
 - 4. TC14 Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
- D. Underwriters Laboratories (UL) Standards:
 - 1. 6 Rigid Metal Electrical Conduit
 - 2. 6A Electrical Rigid Metal Conduit – Aluminum, Red Brass and Stainless Steel
 - 3. 360 Liquid-Tight Flexible Metal Conduit
 - 4. 651 Electrical Rigid Nonmetallic Conduit and Fittings
 - 5. 651A Type EB and A Rigid PVC Conduit and HDPE Conduit
 - 6. 2515 Aboveground Reinforced Thermosetting Resin Conduit

1.03 SUBMITTALS

- A. Submit complete catalog cuts of raceways, fittings, boxes, supports, and mounting hardware, marked where applicable to show proposed materials and finishes.
- B. Prepare as-built drawings of encased concealed and exposed raceways, ducts, raceways, junction boxes, pull boxes, and electrical and instrumentation equipment.

1.04 LOCATIONS

- A. Refer to Section 16010 for definitions of types of locations.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Pull and junction boxes, fittings and other indicated enclosures that are dedicated to the raceway system shall comply with the requirements of this Section.
- B. Provide exposed conduit of 3/4-inch minimum trade size and encased conduit of 1-inch minimum trade size.
- C. The use of short sections of 1/2-inch flexible conduit for final termination of field control devices and instrumentation is permitted. They may not be longer than 36 inches in length, and may only transition to the smaller size junction boxes or condulets at the field device.

2.02 CONDUIT RACEWAYS

- A. Galvanized Rigid Steel Conduit (GRS) shall be manufactured from mild steel, hot-dip galvanized inside and out, conforming to ANSI C80.1 and UL 6. Couplings shall be threaded type. Manufacturers shall be Allied Tube and Conduit, Wheatland Tube or approved equal.
- B. PVC coated rigid steel conduit (PGRS) shall meet the requirements of GRS above. A PVC coating shall be bonded to the outer surface with a thickness not less than 40 mils. The inside surfaces and threads of the conduit shall be provided with a 2-mil urethane coating. PGRS shall be manufactured in accordance with UL-6, ANSO C80.1 and NEMA RN1. Manufacturers shall be Robroy Industries Perma-Cote or Plasti-Bond series, Thomas & Betts Ocal Blue or approved equal.
- C. Liquidtight Flexible Conduit shall be constructed of a flexible galvanized metal core with a sunlight-resistant thermoplastic outer jacket. Conduit shall be manufactured in accordance with UL 360. Flexible conduit in hazardous areas shall be rated for the Class, Division and Group in which its installed. Manufacturers shall be Anaconda Sealtite, Electriflex Liqueflex or approved equal.
- D. Rigid Nonmetallic Conduit: Rigid nonmetallic conduit shall be PVC Schedule 40 (PVC 40) or PVC Schedule 80 (PVC 80) and sunlight resistant. Conduit shall be approved for underground use and for use with 90°C wires, and shall conform to NEMA TC-2 and UL 651. Manufacturers shall be Carlon, Cantex or approved equal.

2.03 CONDUIT SUPPORTS

- A. For indoor, dry locations, supports for individual conduits shall be galvanized malleable iron one-hole type with conduit back spacer. All other locations shall be Type 316 stainless steel.
- B. For indoor, dry locations, supports for multiple conduits shall be hot-dip galvanized Unistrut or Superstrut channels, or equal. All associated hardware shall be hot-dip galvanized. All other locations shall be Type 316 stainless steel.
- C. All channels, strut, threaded rods, nuts and clamps in corrosive areas shall be of epoxy resin reinforced fiberglass material. Provide Robroy, Superstrut, or equal.

2.04 FITTINGS

- A. General
 - 1. For use with metallic conduit, provide cast and malleable iron fittings of the threaded type with 5 full threads.
 - 2. Fittings
 - a. Provide fittings with neoprene gaskets and non-magnetic stainless steel screws.
 - b. Attach covers by means of holes tapped into the body of the fittings.
 - c. Covers for fittings attached by means of clips or clamps will not be accepted.
 - 3. Terminations
 - a. In outdoor areas, terminate conduit in rain-tight hubs as manufactured by Myers, O.Z. Gedney, Appleton or approved equal.
 - b. In other than outdoor areas, provide sealed locknuts and bushings.
- B. Fittings for use with rigid steel shall be hot dipped galvanized steel or galvanized cast ferrous metal; access fittings shall have gasketed cast covers and be Crouse-Hinds Condulets, Appleton Unilets, or equal. Provide threaded-type couplings and connectors; set-screw type and compression-type are not acceptable.
- C. Fittings for use with PVC-coated GRS conduit shall be PVC-coated that are the products of the same manufacturer as the conduit. Both male and female threads and internal surfaces shall contain a 2-mil urethane coating.
- D. Fittings for use with rigid nonmetallic conduit shall be PVC and have solvent-weld-type conduit connections. Boxes shall be manufactured of PVC or fiberglass reinforced polyester (FRP). Manufactures shall be Carlon, Crouse-Hinds, Hoffman or approved equal. If such are not available, then the Specification for PVC coated galvanized rigid steel fittings shall apply.
- E. Fittings for flexible conduit shall be Appleton Type ST, O.Z. Gedney Series 4Q, or approved equal.
- F. Combination expansion-deflection fittings with internal grounding shall be installed where conduit movement is expected in more than one dimension, and where conduits transition out of structures in locations where differential settlement may occur. Combination expansion/deflection fittings shall be manufactured by Crouse-Hinds Type XJGD or approved equal.
- G. Expansion fittings with internal grounding shall be installed wherever exposed raceway cross building expansion joints. Expansion fittings shall be Crouse Hinds Type XLGSA or approved equal.
- H. Union couplings for conduits shall be the Erickson type and shall be Appleton Type EC, O.Z. Gedney 3-piece Series 4, or approved equal. Threadless couplings shall not be used.
- I. Bushings:
 - 1. Bushings shall be the insulated type.
 - 2. Bushings for rigid steel conduit shall be hot dip galvanized insulated grounding type, O.Z. Gedney Type HBLG, Appleton Type GIB, or approved equal.

2.05 BOXES

- A. Boxes specified herein are for use with raceway systems only. Boxes used for housing electrical and instrumentation equipment shall be as described elsewhere in these Specifications.
- B. NEMA 1 Areas: NEMA 1 terminal boxes, junction boxes, pull boxes, etc. shall be either sheet or cast malleable iron or aluminum depending on raceway material. Boxes shall be suitable for wall mounting or have feet where self-standing. Boxes shall have continuously welded seams and welds shall be ground smooth. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. All boxes shall have hinged gasketed doors with quarter turn latches or 3-point latch (single operator) system on enclosures larger than 36 inches wide or 32 inches tall. Terminal boxes shall be furnished with terminal mounting straps and brackets. Terminal blocks shall be NEMA type, not less than 20A, 600V. Boxes shall be Concept Series as manufactured by Hoffman Engineering Co. or approved equal.
- C. NEMA 4X Areas: NEMA 4X terminal boxes, junction boxes, pull boxes, etc. shall be Type 304 stainless steel. Boxes shall be suitable for wall mounting or have feet where self-standing. Boxes shall have continuously welded seams and welds shall be ground smooth. Box bodies shall be flanged and shall not have holes or knockouts. Box bodies shall not be less than 14 gauge metal and covers shall not be less than 12 gauge metal. All boxes shall have hinged gasketed doors with quarter turn latches or 3-point latch (single operator) system on enclosures larger than 36 inches wide or 32 inches tall. Terminal boxes shall be furnished with terminal mounting straps and brackets. Terminal blocks shall be NEMA type, not less than 20A, 600V. Boxes shall be Concept Series as manufactured by Hoffman Engineering Co. or approved equal.
- D. Boxes for use in chemically corrosive areas shall be of rigid PVC. Construction shall be the same as specified for NEMA 4X areas as specified above.

2.06 CONDUIT SEALANTS

- A. Moisture Barrier Types: Sealant shall be a non-toxic, non-shrink, non-hardening, putty type hand applied material providing an effective barrier under submerged conditions.
- B. Fire Retardant Types: Fire stop material shall be a reusable, non-toxic, asbestos-free, expanding, putty type material with a 3 hour rating in accordance with UL 1479. Provide products indicated by the manufacturer to be suitable for the type and size of penetration.

PART 3 - EXECUTION

3.01 CONDUIT, RACEWAY AND FITTING INSTALLATION

- A. No wire shall be pulled until the raceway system is complete in all details; in the case of concealed work, until all rough plastering or masonry has been completed; in the case of exposed work, until the raceway system has been completed in every detail.
- B. From pull point to pull point, the sum of the angles of all of the bends and offsets shall not exceed 270 degrees.

- C. Coat threads with a conductive lubricant before assembly.
- D. Provide joints that are tight, thoroughly grounded, secure and free of obstructions by use of a mandrel. Adequately ream the conduit in order to prevent damage to the wires and cables inside. Use strap wrenches and vises to install the conduit in order to prevent wrench marks on the conduit. Any conduit with wrench marks shall be replaced.
- E. The ends of all conduits shall be tightly plugged to exclude dust and moisture during construction. Duxseal, or 3M seal spray shall be used in all applications. Plugging with tape is prohibited, even for short periods of time.
- F. For power, control and signal circuits, provide conduit per Conduit Use Tables below, unless specifically indicated otherwise on the Drawings:
 - 1. Exception: For raceways leaving a building above grade and then going below grade, provide PVC-coated GRS from a point 3 feet above grade to a point 5 feet from the building wall.
- G. Unless boxes have cast, threaded hubs, provide insulated type metallic grounding bushings for metallic conduits at all boxes. Bond together all conduits to provide continuity of the equipment grounding system. Size bonding conductor per NEC.
- H. Provide flexible conduit in lengths of not more than 36 inches at connections to motors, valves and any equipment subject to vibration or relative movement. All flexible conduits, regardless of length or manufacturer rating, shall have a dedicated ground bonding conductor pulled through, whether it is included in the conduit fill schedules or not.
- I. Conduits embedded in concrete floors on grade shall be installed between grids of reinforcing steel, or shall be encased below the floors, provided the concrete is thickened in a manner satisfactory to the Engineer. Installation of conduit below the bottom of this slab is not acceptable; embedding or encasing is required.
- J. Damage to PVC coating of coated conduits or fittings shall be repaired with factory-approved PVC patching material to the original factory condition.
- K. Underground Raceways: Slope all underground raceways to provide drainage; for example, slope conduit from equipment located inside a building to the handhole located outside the building. For additional requirements see Section 16402.
- L. Conduit Supports: Properly support all conduits as required by the NEC. Run all conduits exposed except where the Drawings indicate that they are to be embedded in the floor slab, walls, or ceiling, or to be installed underground.
 - 1. Exposed Conduits:
 - a. Support exposed conduits within 1 foot of any outlet and at intervals not exceeding NEC requirements; wherever possible, group conduits together and support on common supports. Support exposed conduits fastened to the surface of the concrete structure by one-hole clamps, or with channels. Use conduit spacers with one-hole clamps. Coordinate conduit locations with piping, equipment, fixtures, and with structural and architectural elements. Conduits attached to walls or columns shall be as unobtrusive as possible and shall avoid windows. Run all exposed conduits parallel to building lines. No diagonal runs will be accepted. Bends in parallel runs shall be concentric and shall be run straight and true.
 - b. Group together exposed conduits in horizontal runs located away from walls and support on trapeze hangers. Arrange such conduits uniformly

and neatly. Trapeze hangers shall consist of channels of adequate size, suspended by means of minimum 3/8" diameter rods or other suitable means from the ceiling or from pipe hangers. Install such runs so as not to interfere with the operation of valves or any other equipment, and keep at least 6 inches clear of any pipe which may operate at more than 100°F. Treat cut surfaces or damaged ends with corrosion-resistant coatings such as "Devcon Z", prepared by Subox Coatings; "Galvanox Type I", prepared by Pedley-Knowles; or approved equal. Application shall follow manufacturer's recommendation.

- M. All penetrations through walls into or out of corrosive locations, as defined in Section 16010 shall be made gas-tight. In concrete walls, pour concrete after the conduit is in place, if possible. If not, core drill concrete or CMU walls, install conduit and caulk around it with non-shrink grout. Install conduit seal in each conduit near the penetration.
- N. All conduit penetrations through interior walls and floors shall be sealed with fire retardant type conduit sealant.
- O. Conduit Identification: In each handhole, pullbox, cabinet, motor control center or other equipment enclosure, identify each conduit using the conduit number shown on the Drawings by means of a stamped brass tag affixed with stainless steel wire; where affixing a tag is not feasible, identify conduits by affixing a brass tag with epoxy or other approved method of stenciling to the wall or structure adjacent to the conduit terminus.
- P. Conduit Seals:
 - 1. Moisture Seals: Provide in accordance with NEC Paragraph 300.5(g).
 - 2. Gas Seals: Provide in accordance with NEC Paragraph 501.5.
- Q. Rigid PVC conduit shall be stored on a flat surface and shielded from the sun.

CONDUIT USE TABLE 1

	Inside Buildings						
	Exposed			Concealed			
Circuit Type	Standard	Corrosive	Hazardous	Above Suspended Ceilings	In Stud Walls	Embedded In Concrete	Slab On Grade
Power & 120 Vac Control	GRS	PVC Coated GRS	N/A	GRS	GRS	PVC-40*	PVC-40*
Signal	GRS	PVC Coated GRS	N/A	GRS	GRS	GRS	GRS

CONDUIT USE TABLE 2

Circuit Type	Outside Buildings			Transition
	Exposed	Buried In Soil	Duct Bank Encased In Concrete	Within 5 Feet of Building
Power & 120 Vac Control	GRS	PVC-40*	PVC-40*	PVC Coated GRS
Signal	GRS	PVC Coated GRS	GRS	PVC Coated GRS

* Provide ground wire sized per NEC requirements for all circuits.

** Aluminum and/or Fiberglass may be used in corrosive locations where environmental conditions warrant its use.

Notes:

1. Generally, the Conduit Use Tables apply.
2. Signal circuits are those subject to RF interference or induced current. MSPs, TSPs, telephone cable, coaxial cable, and manufacturer's cables specially designed for low level signals are all presumed to be part of signal circuits.
3. Provide fiberglass conduit where indicated on the Drawings.

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SECTION 16120

LOW VOLTAGE WIRE AND CABLE

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. Furnish labor, materials, equipment and incidentals necessary to install wire and cable specified under this Section. Electrical work shall be in accordance with Specification 16010 – General Electrical Requirements.
- B. Work shall include building wire, cable, wiring connections and terminations and modular wiring systems.

1.02 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM):
 - 1. B3-74 Specification for Soft or Annealed Copper Wire
 - 2. B8-77 Specification for Concentric Lay Stranded Copper Conductors, Hard, Medium-Hard, or Soft
 - 3. B173-71 Specification for Rope Lay Stranded Copper Conductors Having Concentric Stranded Members
- B. Insulated Cable Engineers Association (ICEA):
 - 1. S-66-524 Cross-Linked Thermosetting Polyethylene Insulated Wire and Cable
- C. International Electrical Testing Association (NETA);
 - 1. ATS Acceptance Testing Specifications
- D. National Electrical Manufacturers Association
 - 1. WC-3 Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
 - 2. WC-5 Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
- E. Underwriters Laboratories (UL) Standards:
 - 1. 62 Flexible Cords and Fixture Wire
 - 2. 510 Insulating Tape
 - 3. 1063 Stranded Conductors for Machine Tool Wire

1.03 SUBMITTALS

- A. Submit the following material or equipment data:
 - 1. Each type of cable and wire to be used.
 - 2. Cable and wire splices
 - 3. Wire markers

1.04 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall protect all cable and wire from being damaged at all times.
- B. Cable ends shall be protected from water entry in accordance with the manufacturer's recommended procedures. Cable ends shall not be left open in manholes or other locations subject to submergence. If the cable ends become

submerged prior to splicing or termination, the cables shall be replaced in their entirety.

- C. Cables shall be pulled into raceways in accordance with the manufacturer's requirements. Under no circumstances shall cable pulling tensions exceed the manufacturer's written instructions.
- D. Pulling tensions on raceway cables shall be within the limits recommended by the cable manufacturer. Wire pulling lubricant, where needed, shall be UL approved.

PART 2 - PRODUCTS

2.01 CONDUCTORS

- A. General: Conductors, include grounding conductors, shall be stranded copper. Aluminum conductor and/or solid conductor wire and cable will not be permitted. Insulation shall bear the UL label, the manufacturer's trademark, and identify the type, voltage, and conductor size. Conductors except flexible cords and cables, fixture wires, and conductors that form an integral part of equipment such as motors and controllers shall conform to the requirements of Article 310 of the National Electric Code, latest edition, for current carrying capacity. Flexible cords and cables shall conform to Article 400, and fixture wires shall conform to Article 402. Wiring shall have wire markers at each end.
- B. Power and Control Conductors, 600 Volts and Below:
 - 1. Solid copper wires shall be 600 volt Type XHHW, sizes #12 and #10 AWG for use with lighting and receptacle circuits only.
 - 2. Stranded copper wire for power circuits shall be 600 volt Type XHHW or RHW, Class B stranding, sizes #12 AWG and larger.
 - 3. Stranded copper wire for control circuits shall be 600 volt Type XHHW or RHW, Class B stranding, size #14 AWG.
 - 4. Control wires inside panels and cabinets shall be machine tool grade type MTW, UL approved, rated for 90 degrees C at dry locations.
 - 5. Fixture wire shall be 600 volt, silicone rubber insulated, 200°C, UL Type SF 2, with stranded copper conductors.
 - 6. Conductors for feeders as defined in Article 100 of the NEC shall be sized to prevent a voltage drop exceeding 3 percent at the farthest outlet of power, heating, and lighting loads, or combinations of such loads, and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.
 - 7. Conductors for branch circuits as defined in Article 100 of the NEC shall be sized to prevent voltage drop exceeding 3 percent at the farthest connected load or combinations of such loads and where the maximum total voltage drop on both feeders and branch circuits to the farthest connected load does not exceed 5 percent.

2.02 SPLICES AND TERMINATIONS OF CONDUCTORS

- A. Splices:
 - 1. Wire and Cable Splicing Materials and Applications:
 - a. For Lighting Systems and Power Outlets: Wire nuts shall be twist-on type insulated connectors utilizing an outer insulating cover and a means for connecting and holding the conductors firmly. They shall be

- UL listed and suitable for connecting two to four solid copper conductors of #14 or #12 AWG size or two or three #10 AWG solid copper conductors.
 - b. All Equipment: Crimp type connectors shall be insulated type with nylon jacket, suitable for the size and material of the wires and the number of wires to be spliced and for use with either solid or stranded conductors. They shall be UL listed.
 - c. Division 16 Equipment and Power Conductors: Bolted pressure connectors shall be suitable for the size and material of the conductors to be spliced. They shall be UL listed and of the split bolt or bolted split sleeve type in which the bolt or set screw does not bear directly on the conductor.
 - d. All Equipment: Epoxy splice kits shall include epoxy resin, hardener, and mold, and shall be suitable for use in wet locations and hazardous locations.
 - 2. Terminal Cabinets: Provide terminal cabinets per Section 17510. Termination system shall include insulated, crimp-type connectors. Coordinate the lug and boards for correct fit. All terminations shall include marker sleeves.
- B. Terminations:
- 1. Low Voltage Terminations:
 - a. Crimp type terminals shall be UL listed, self-insulating sleeve type, with ring or rectangular type tongue, suitable for the size and material of the wire to be terminated, and for use with either solid or stranded conductors.
 - b. Terminal lugs shall be UL listed and of the split bolt or bolted split sleeve type in which the bolt or set screw does not bear directly on the conductor. Tongues shall have NEMA standard drilling.
 - c. Crimp with manufacturer recommended ratchet-type tool with calibrated dies. Hand crimping tools are not acceptable.
 - C. Tape used for splices and terminations shall be compatible with the insulation and jacket of the cable and shall be of plastic material. Tape shall conform with UL 510. Varnished cambric, rubber and thermoplastic tape shall be used for all split-bolt terminations.
 - D. Wire markers shall be heat shrink type (Raychem; T&B; or equal). Wire identification numbers shall be permanently imprinted on the markers. In locations which are not practical for heat shrink type labels, such as conduit bodies and small pull boxes, machine-printed, adhesive backed wire markers shall be used. Markers shall be custom-printed with the full identification string. Individual character markers and clip-on wire markers are not acceptable.

PART 3 - EXECUTION

3.01 CONDUCTOR INSTALLATION

- A. The Contractor shall provide, terminate and test all power, control, and instrumentation conductors.

- B. The Contractor shall, as a minimum, provide the number of control wires listed in the conduit schedule or on the Contract Drawings. Excess wires shall be treated as spares for future use.
- C. Conductors shall not be pulled into any raceway until raceway has been cleared of moisture and debris.
- D. Wire in panels, cabinets, and wireways shall be neatly grouped using nylon tie straps, and shall be neatly fanned out to terminals.
- E. Provide the following types and sizes of conductors for the uses indicated for 600 volts or less:
1. Solid Copper, Sizes #12 and #10 AWG: As shown on the Drawings for circuits for receptacles, switches and light fixtures with screw-type terminals.
 2. Stranded Copper, Size #14 AWG and Larger, Individual Conductors or CC: As shown on the Drawings for the control of motors or other equipment. Size #14 shall not be used for power supplies to any equipment.
 3. Stranded Copper, Sizes #12 AWG and Larger: As shown on the drawings for motors and other power circuits.
 4. Stranded Copper, #6 AWG and Larger.
 5. Fixture Wire: For connections to all fixtures in which the temperature may exceed the rating of branch circuit conductors.
- F. Color Coding: All wire shall be coded with specific colors infused in the conductor insulation at the time of manufacture. If a conductor is specified in a gauge not available with integrally colored insulation, it shall be marked by the Contractor at the time of installation using colored electrical coding tape or an approved marking paint. Where tape or paint is used as the conductor identification system, it shall clearly distinguish the conductor over its entire exposed length in all junction boxes, manholes, conduit bodies, or other accessible intermediate locations, and at every termination. All wiring shall conform to the following wiring color code:

SYSTEM	CONDUCTOR	COLOR
120/240 Volt AC, 1-Phase, 3 Wire	Neutral Line 1 Line 2	White Black Red
120/208 Volt AC, 3-Phase, 4 Wire;	Neutral Phase A Phase B Phase C	White Black Red Blue
277/480 Volt AC, 3-Phase 4 Wire	Neutral Phase A Phase B Phase C	Grey Brown Orange Yellow
All Systems	Earth, System, or Equipment Ground	Green Insulation, Green w/ Yellow Tracer, or Bare Conductor
120 Volt AC Control Power Circuits (In field or in Control Cabinets)	Neutral Line 1 Line 2	White Black Red

SYSTEM	CONDUCTOR	COLOR
120 Volt AC UPS-derived Control Power (secondary side)	Neutral Line	White w/ Red Tracer Red w/ White Tracer
24 VAC Control Power Circuits (In field or in Cabinets)	Neutral Line	White or Grey, with Yellow Tracer Brown
12 or 24 Volt DC Control Wiring (PLC Discrete I/O, etc.)	DC Negative DC Positive DC Switched (DI/DO)	Yellow Orange Blue
120 Volt AC Control Wiring inside or outside cabinets to/from PLC Discrete I/O	Common or Neutral 120 VAC discrete inputs 120 VAC relay or discrete outputs	White or Grey, w/ Blue Tracer Blue Red
Instrumentation Twisted-shielded Cabling (PLC Analog I/O @ 4-20mA, or 1-5 Volt DC, etc.) Process Signals to/from Transmitters, Analyzers, etc.	Negative Polarity Positive Polarity (1st Conductor) Positive Polarity (2nd Conductor) Shield Drain Wire	Black White (or clear) Red Bare Conductor, or covered w/ heat-shrink tubing of a unique color
Instrumentation wiring in cabinets (PLC Analog I/O from field terminations of shielded cables).	PLC Analog Input Connections PLC Analog Output Connections	Grey Brown

- G. Exercise care in pulling wires and cables into conduit or wireways so as to avoid kinking, putting undue stress on the cables or otherwise abrading them. No grease will be permitted in pulling cables. Only soapstone, talc, or UL listed pulling compound will be permitted. The raceway construction shall be complete and protected from the weather before cable is pulled into it. Swab conduits before installing cables and exercise care in pulling, to avoid damage to conductors.
- H. Wrap all cables in manholes with fireproofing tape. Extend tape 1-inch into ducts.
- I. Cable bending radius shall be per applicable code. Install feeder cables in one continuous length unless splices are favorably reviewed.
- J. Provide an equipment grounding conductor, whether or not it is shown on the Drawings, in any flexible conduit or any raceway in which all or any portion of a run consists of non-metallic duct or conduit. For flexible conduit, an external bonding jumper is an acceptable alternative.
- K. In panels, bundle incoming wire and cables, No. 6 AWG and smaller, lace at intervals not greater than 6 inches, neatly spread into trees and connect to their respective terminals. Allow sufficient slack in cables for alterations in terminal connections. Perform lacing with plastic cable ties or linen lacing twine. Where plastic panel wiring duct is provided for cable runs, lacing is not necessary when the cable is properly installed in the duct.

- L. For cables crossing hinges, utilize extra flexible stranded wire, make up into groups not exceeding 12, and arrange so that they will be protected from chafing and excess flexing when the hinged member is moved.

3.02 CONDUCTOR SPLICES AND TERMINATIONS

- A. Splices: Install all conductors without splices unless necessary for installation, as determined by the Engineer. Splices, when permitted, and terminations shall be in accordance with the splice or termination kit manufacturer's instructions. Splice or terminate wire and cable as follows:
 - 1. Watertight Splices: Splices in concrete pullboxes, for any type of cable or wire, shall be watertight and rated for continuous submergence. Make splices in low voltage cables using epoxy resin splicing kits rated for application up to 600 volts.
- B. Terminations:
 - 1. Terminate stranded #14 wire using crimp type terminals where not terminated in a box lug type terminal. Terminals must be coordinated with type of terminal board where provided.
 - 2. Excess control wire shall be long enough to terminate at any terminal block in the enclosure, be properly taped, be identified with origin and be neatly coiled.

3.03 CONDUCTOR IDENTIFICATION

- A. Except for interior lighting and receptacle circuits, identify each wire or cable at each termination and in each pullbox, junction box, handhole, and manhole using numbered and lettered wire markers. All electrically common conductors shall have the same number. Each electrically different conductor shall be uniquely numbered. Identify panelboard circuits using the panelboard identification and circuit number. Identify motor control circuits using the equipment identification number assigned to the control unit by the motor control center manufacturer and the motor control unit terminal number. Identify other circuits as shown in the circuit schedule or as favorably reviewed by the Engineer.
- B. Conductors between terminals of different numbers shall have both terminal numbers shown at each conductor end. The terminal number closest to the end of the wire shall be the same as the terminal number.

3.04 FIELD TESTS

- A. Refer to Specification 16950 – Electrical Tests for all cable testing requirements.

END OF SECTION

SECTION 16124

SIGNAL CABLE

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.
- B. Related Work Described Elsewhere:
 - 1. Division 17: Instrumentation and Controls

1.02 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA):
 - 1. 568-C.2 Balanced Twisted-Pair Telecommunications Cabling and Components Standards
- B. American Society for Testing and Materials (ASTM):
 - 1. B8-11 Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronic Engineers (IEEE):
 - 1. 1143 Shielding Practice for Low Voltage Cables, Guide on
- D. Insulated Cable Engineers Association (ICEA)
 - 1. S-73-532 Standard for Control, Thermocouple, Extension, and Instrumentation Cable
- E. National Fire Protection Association (NFPA):
 - 1. 262 Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
- F. Underwriters Laboratories Incorporated (UL):
 - 1. 13 Standard for Power-Limited Circuit Cables
 - 2. 83 Thermoplastic-Insulated Wires and Cables
 - 3. 444 Communications Cables
 - 4. 1666 Standard for Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with the Product Information category of the General Conditions and the submittal requirements of Section 16010.

PART 2 - PRODUCTS

2.01 INSTRUMENTATION CABLE

- A. Provide UL listed, twisted pair instrumentation Tray Cable (TC) conforming to ICEA S-73-532, and suitable for transmission of 4-20mA analog, low voltage signals.

- B. The cable shall be two-conductor (2/C), three-conductor (3/C), four-conductor (4/C), or more as indicated on the Drawings.
- C. Each conductor in the cable shall be #16 AWG 7x24 stranded bare copper, or as indicated on the Drawings.
- D. Conductor insulation: Polyvinyl Chloride/Nylon
- E. Shield: Aluminum Foil, 100 percent coverage
- F. Drain wire: #18 AWG, stranded, tinned copper
- G. Jacket material: Polyvinyl Chloride, minimum thickness 0.047 inches.
- H. Insulation shall be rated at 600 volts.
- I. Temperature rating: UL dry, 90 degrees C; UL web, 75 degrees C
- J. Instrumentation cable installed in underground conduits shall be rated as suitable for the application.
- K. Instrumentation cable shall be Belden 3090A, 3091A, or approved equal.

2.02 ETHERNET (TCP/IP) CABLE

- A. Industrial use, unshielded:
 - 1. Provide UL listed, Category 6 unshielded twisted pair (UTP) Ethernet cable conforming to ANSI/TIA-568-C.2 and suitable for use in harsh environments.
 - 2. Conductors: 4 pairs of #23 AWG solid bare copper
 - 3. Conductor insulation: Fluorinated Ethylene Propylene, minimum thickness 0.01 inches
 - 4. Jacket material: Fluorinated Ethylene Propylene, factory marked at regular intervals indicating verifying organization and performance level. Minimum thickness 0.03 inches.
 - 5. Insulation shall be 300 volt class.
 - 6. Insulation temperature range: -55 to +150 degrees C
 - 7. Electrical Characteristics: Cable shall have a maximum attenuation of 20 dB per 100 meters at 100 MHz and 33 dB per 100 meters at 250 MHz
 - 8. Terminations/Connectors: Cables shall terminate in Category 6 RJ-45 crimp connectors with strain-relief boots, or at Category 6 punch down blocks at both ends.
 - 9. Cable shall be plenum-rated for flammability in accordance with NFPA 262, and suitable for use as riser cable.
 - 10. Ethernet cable installed in underground conduits shall be rated as suitable for the application.
 - 11. Industrial, unshielded Ethernet cable shall be Belden 7931A or approved equal.

2.03 RS-485 CABLE

- A. Provide UL listed, Power Limited Tray Cable (PLTC) suitable for use with RS-485 serial communication links.
- B. Conductors: 1 or 2 pair of #22 AWG stranded, tinned copper
- C. Conductor insulation: Foamed High Density Polyethylene
- D. Shield: Two-layer, Aluminum Foil, 100 percent coverage, plus tinned copper braid, 65% coverage

- E. Drain wire: #22 AWG, stranded, tinned copper
- F. Outer jacket material: Polyvinyl Chloride
- G. Insulation shall be 300 volt class.
- H. Operating temperature range: -20 to +60 degrees C
- I. RS-485 cable installed in underground conduits shall be rated as suitable for the application.
- J. Provide DB9, DB25, RJ45, or bare wire terminal block connections on each end of the cable to match the termination type at the connected equipment.
- K. RS-485 cable shall be Belden 3105A, 3107A, or approved equal.

2.04 ANTENNA FEEDER CABLE

- A. Antenna feeder cable shall be coaxial type suitable for use with a 450 MHz radio system.
- B. Use only coaxial cable recommended for specific applications such as radio antenna systems as required by the radio manufacturer or system supplier. Due to wide differences in electrical ratings and physical characteristics between cable types, any deviations from manufacturers recommended types, cable is not acceptable.

2.05 SPECIAL CABLES

- A. Cables for proprietary control or fieldbus protocols over a TCP/IP network shall be Ethernet cables.
- B. Cables required for computer systems, control equipment, or other special systems not listed above shall be provided in accordance with the system manufacturer's requirements.

PART 3 - EXECUTION

3.01 CABLE INSTALLATION

- A. Signal cable shall be installed by personnel who have a minimum of 3 years' experience in terminating and splicing shielded twisted pair cables and coaxial cables.
- B. Adequate care shall be exercised by the installers to prevent cable damage or sheath distortion. Bending radius shall not be less than 10 times the cable outside diameter.
- C. Raceways shall be swabbed before installation of cable to remove moisture and debris.
- D. Cables shall be continuous from initiation to termination without splices except where specifically indicated.
- E. Cable shielding shall be grounded at one end only of the cable. Bonding shall be to a single ground point only. Bonding from cable to cable in multiple run installations shall not be permitted.

- F. Heat shrinkable sleeving shall be installed on all cables to insulate shielding at the ungrounded cable terminations.
- G. Signal cable shall not be run in the same raceway with power and control wiring except where specifically indicated.
- H. Where installed in control consoles containing power circuits, cables shall be routed a minimum of 2 inches distant. Color coding shall be strictly observed throughout the installation.
- I. Cable in panels, cabinets, and wireways shall be neatly grouped using nylon tie straps, and shall be fanned out to terminals.
- J. For telephone cables, provide station cable to outlets. Use backbone cable for connection between telephone patch panels. Allow at least 25% spare capacity between patch panels.
- K. Manufacturer's cable pulling tension shall not be exceeded.
- L. Pulling lubricant shall be UL approved.

3.02 CONDUCTOR SPLICES AND TERMINATIONS

- A. Splices: Install all conductors without splices unless necessary for installation, as determined by the Engineer. Splices, where approved, and terminations shall be in accordance with the splice or termination kit manufacturer's instructions.
- B. Terminations:
 - 1. Crimp-type terminals shall be UL listed, self-insulating, sleeve type with ring or rectangular tongue, suitable for size and material of the wire to be terminated and for use with either stranded or solid wire. Spade type lugs are acceptable with telephone cable systems only.
 - 2. Crimp with manufacturer's recommended ratchet-type tool with calibrated dyes. Hand crimping tools are not acceptable.
 - 3. Coaxial cable and connectors shall be terminated in accordance with the manufacturer's instructions.

3.03 CONDUCTOR IDENTIFICATION

- A. Identify each wire or cable at each termination, in each pullbox, and in each handhole using numbered and lettered wire markers. All electrically common conductors shall have the same number. Each electrically different conductor shall be uniquely numbered. Identify panelboard circuits using the panelboard identification and circuit number. Identify motor control circuits using the equipment identification number assigned to the control unit by the motor control center manufacturer and the motor control unit terminal number. Identify other circuits as shown in the circuit schedule or as favorably reviewed by the Engineer. Conductor numbering shall be coordinated with the Interconnection Diagrams specified in Division 17.
- B. Conductors between terminals of different numbers shall have both terminal numbers shown at each conductor end. The terminal number closest to the end of the wire shall be the same as the terminal number.

3.04 FIELD TESTS

- A. Perform testing in accordance with Section 16950 – Electrical Tests.

END OF SECTION

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SECTION 16140

WIRING DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.
- B. Work Included:
 - 1. Installation, connection and furnishing all single, duplex, GFI and special purpose receptacles complete with wall plates and/or covers as shown on the Drawings.
 - 2. Installation, connection and furnishing of all single pole, three-way, pilot light and momentary position toggle switches complete with wall plates and or handle operators as shown on the Drawings.

1.02 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI) Publication:
 - 1. C73 Plugs and Receptacles
 - 2. C73a Plugs and Receptacles
 - 3. 568 Communication Cables
- B. Federal Specifications (FS):
 - 1. W-C-596 D & E General Specifications for Cable Outlet Electrical Connector
 - 2. W-S-896 D & E General Specifications for Flush Mounted Toggle and Lock Switches
- C. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. WD 1 General Color Requirements for Wiring Devices
 - 2. WD 6 Wiring Devices - Dimensional Specifications
- D. Underwriters Laboratories (UL) Standards:
 - 1. 20 General-Use Snap Switches
 - 2. 498 Standard for Attachment Plugs and Receptacles
 - 3. 514 Electrical Outlet Boxes
 - 4. 943 Ground-Fault Circuit-Interrupters

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with the Product Information category of the General Requirements and the submittal requirements of Section 16010.
- B. Submit complete catalog cuts of switches, receptacles, enclosures, covers and appurtenances, marked to clearly identify the proposed materials.
- C. Submit documentation showing that the proposed materials comply with the requirements of the NEC and UL.

1.04 LOCATIONS

- A. Refer to Section 16010, General Electrical Requirements, for definitions of types of locations.

PART 2 - PRODUCTS

2.01 RECEPTACLES

- A. General: Receptacles shall be heavy duty, high abuse, grounding type conforming to NEMA configurations, NEMA WD1 and UL 514 Standards.
- B. Single and Duplex Receptacles:
 - 1. Receptacles shall be of back and side wire design utilizing screw type terminals. Receptacles shall be rated 20 ampere, two-pole, 3-wire, 120-volt, NEMA 5-20 configuration, self-grounding. Color shall be brown in industrial areas and ivory or white in office and laboratory areas. Power contacts shall be a T-type design and shall be brass. Ground contacts shall be brass.
 - 2. Devices shall have a nylon composition face with a nylon or melamine body. Units shall comply with Federal Specification W-C-596E and meet UL 498 test requirements. Receptacles shall be Hubbell HBL Series; Daniel Woodhead; or equal.
- C. GFI Receptacles:
 - 1. Device shall be rated 20 ampere, 2 pole, 3 wire, 120 volt, conforming to NEMA WD-1 configuration. Face shall be nylon composition meeting UL 498 test standards. Unit shall have test and reset push buttons. Reset push button shall have a visible indicator band to indicated tripped condition.
 - 2. GFCI component shall meet UL 498 Class A standards with a tripping time of 1/40 second at 5 milliamperes current unbalance. Operating range shall extend from 31°F to 158°F. Unit shall have transient voltage protection and shall be ceramic encapsulated for protection against moisture.
 - 3. Provide Hubbell 5362SG, Daniel Woodhead, or equal.

2.02 SWITCHES

- A. Line Voltage Types: Switches shall be rated 20 amperes at 120 or 277 Volts ac only. Units shall be flush mounted, self-grounding, quiet operating toggle devices. Handle color shall be brown in industrial areas and white or ivory in office and laboratory areas. Units shall conform to Federal Specifications W-S-896 D and E, UL 20, and NEMA WD1 standards. Hubbell PRO Series; Daniel Woodhead; or equal.
- B. Low Voltage Types: Switches shall meet all of the requirements listed in Item A above except to be rated at 15 amperes for switching 24 Volts dc. Devices shall be three-position, momentary contact, spring return, center "off" configuration.

2.03 PLATES

- A. General: Plates shall be of the style and color to match the wiring devices, and of the required number of gangs. Plates shall conform with NEMA WD1, UL 514, and ANSI C73. Plates on finished walls shall be non-metallic or stainless steel. Plates on unfinished walls and on fittings shall be of zinc plated steel or cast metal having rounded corners and beveled edges.

- B. Non-Metallic: Plates shall be smooth finish with contoured edges and shall be nylon or fiberglass.
- C. Stainless Steel: Plates shall be 0.035 inches thick with beveled edges and shall be manufactured from No. 302 alloy having a brushed or satin finish.
- D. Galvanized: Plates shall be galvanized sheet steel raised 1/2 inch, with rounded corners.
- E. Cast Metal: Plates shall be cast or malleable iron covers with gaskets so as to be moisture resistant or weatherproof.
- F. Blank Plates: Cover plates for future telephone or television outlets shall match adjacent device wall plates in appearance.
- G. Damp or Wet and Corrosive Locations: Plates shall be provided with a hinged non-metallic cover/enclosure marked with "Suitable for Wet Locations when in use" and "UL Listed." Provide a gasket between the enclosure and the mounting surface, and between the hinged cover and mounting plate/base. The cover shall be TayMac Specification Grade; or equal.

PART 3 - EXECUTION

3.01 INSTALLATION OF WIRING DEVICES

- A. Rigidly attach wiring devices in accordance with the NEC and as indicated, avoiding interference with other equipment.
- B. Dry Locations: The device shall be installed in flush mounted boxes with washers as required to bring the device mounting strap level with the surface of the finished wall.
- C. Damp or Wet Exterior Locations: Install only wiring devices approved for outdoor service in these locations.
- D. Damp or Wet Interior Locations: Install only wiring devices approved for outdoor service. Adjust boxes so that front edge will be 1/4 inch beyond the rear edge of the finished wall. Use metal tubing sleeves to bring device mounting straps flush with the front edge of the finished wall.
- E. Receptacles:
 - 1. Receptacles shall be grounded by a grounding conductor, not by a yoke or screw contact.
 - 2. Receptacles shall be oriented so that the grounding slot is located at the top of the outlet.
 - 3. Receptacles shall be installed with connections pigtailed (spliced) to the branch circuit wiring so that removal of the receptacle will not lose neutral continuity and branch circuit power will not be lost to other receptacles on the same circuit.

3.02 INSTALLATION OF WALL PLATES

- A. General: Plates shall match the style of the device and shall be plumb within 1/16-inch of the vertical or horizontal.

- B. Interior Dry Locations: Install plates so that all four edges are in continuous contact with the finished wall surfaces. Plaster filling will not be permitted. Do not use oversize plates or sectional plates.
- C. Exterior and/or Wet Locations: Install plates with gaskets on wiring devices in such a manner as to provide a raintight weatherproof installation. Cover type shall match box type.

3.03 GROUNDING

- A. Devices including switches and receptacles, shall be grounded in accordance with NEC, Article 250 and Specification 16450.
- B. Switches and associated metal plates shall be grounded through the switch mounting yoke, outlet box, and raceway system.

3.04 TESTS

- A. See Specification 16950 for Testing Requirements.

END OF SECTION

SECTION 16155

MOTOR STARTERS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.
- B. Work Included: Provide all necessary labor, tools and material to install circuit protective devices as shown on the Drawings and as described in these Specifications.
- C. NEMA Enclosed Combination Starters, with Thermal Solid State Electronic Overload Relays. Starters may be of the full voltage non-reversing or full voltage reversing type.
- D. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.
- E. Related Work Described Elsewhere:
 - 1. Section 16955: Control Devices

1.02 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI) Publication:
 - 1. Z55.1 Gray Finishes for Industrial Apparatus and Equipment
- B. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. ICS 1 Industrial Control & Systems, General Requirements
 - 2. ICS 2 Industrial Control and Systems Controllers
 - 3. ICS 6 Industrial Controls and Systems: Enclosures
 - 4. 250 Enclosures for Electrical Equipment (1,000 Volts Maximum)
- C. Federal Specification (FS):
 - 1. W-C-375 Circuit Breakers, Molded Case, Branch Circuit and Service
- D. Underwriters Laboratories (UL) Standard:
 - 1. 50 Enclosures for Electrical Cabinets
 - 2. 508 Industrial Control Equipment
 - 3. 508A Industrial Control Panels
- E. National Fire Protection Association (NFPA) Publication:
 - 1. 70 National Electrical Code

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with the Product Review category of the General Requirements and the submittal requirements of Section 16010.

1.04 LOCATIONS

- A. Refer to Section 16010 for definitions of types of locations.

PART 2 - PRODUCTS

2.01 REDUCED VOLTAGE STARTERS, SOLID STATE TYPE

- A. The solid-state reduced-voltage starter shall be UL and CSA listed. The solid-state reduced-voltage starter shall be an integrated unit with power SCRs, logic board, paralleling bypass contactor, and electronic overload relay enclosed in a single molded housing.
- B. The SCR-based power section shall consist of six (6) back-to-back SCRs and shall be rated for a minimum peak inverse voltage rating of 1500 volts PIV.
- C. Units using triacs or SCR/diode combinations shall not be acceptable.
- D. Resistor/capacitor snubber networks shall be used to prevent false firing of SCRs due to dV/dT effects.
- E. The logic board shall be mounted for ease of testing, service and replacement. It shall have quick disconnect plug-in connectors for current transformer inputs, line and load voltage inputs and SCR gate firing output circuits.
- F. The logic board shall be identical for all ampere ratings and voltage classes and shall be conformally coated to protect environmental concerns.
- G. The paralleling run bypass contactor shall energize when the motor reaches 90 of full speed and close/open under one (1) times motor current.
- H. The paralleling run bypass contactor shall utilize an intelligent coil controller to limit contact bounce and optimize coil voltage during varying system conditions.
- I. Digital interface module mounted on the face of the S811 shall be used to program the soft starter. Display shall include six line LED readout. Monitoring parameters shall include line currents, pole currents, pole voltages, number of starts, and DC control voltage. Soft starter shall display motor status and the previous 5 fault conditions.
- J. Starter shall be provided with electronic overload protection as standard and shall be based on inverse time-current algorithm. Overload protection shall be capable of being disabled during ramp start for long acceleration loads via digital interface module.
- K. Overload protection shall be adjusted via the device keypad and shall have a motor full load ampere adjustment from 30 to 100% of the maximum continuous ampere rating of the starter.
- L. Starter shall have selectable overload class setting of 5, 10, 20 or 30 via a DIP switch setting on the device keypad.
- M. Starter shall be capable of either an electronic or mechanical reset after a fault.
- N. Units using bimetal overload relays are not acceptable.
- O. Overtemperature protection (on heat sink) shall be standard.
- P. Starters shall provide protection against improper line-side phase rotation as standard. Starter will shut down if a line-side phase rotation other than A-B-C exists. This feature can be disabled via digital interface module.
- Q. Starters shall provide protection against a phase loss or unbalance condition as standard. Starter will shut down if a 50% current differential between any two phases is encountered. This feature can be disabled via digital interface module.

- R. Start shall provide protection against a motor stall condition as standard. This feature can be disabled via digital interface module.
- S. Starter shall provide protection against a motor jam condition as standard. This feature can be disabled via digital interface module.
- T. Starter shall be provided with a Form C normally open (NO), normally closed (NC) contact that shall change state when a fault condition exists. Contacts shall be rated 60 VA (resistive load) and 20 VA (inductive load). In addition, an LED display on the device keypad shall indicate type of fault (Overtemperature, Phase Loss, Jam, Stall, Phase Reversal and Overload).
- U. The following control function adjustments from digital interface module are required:
 - 1. Selectable Torque Ramp Start or Current Limit Start
 - 2. Adjustable Kick Start Time: 0–2 seconds
 - 3. Adjustable Kick Start Torque: 0–85%
 - 4. Adjustable Ramp Start Time: 0.5–180 seconds
 - 5. Adjustable Initial Starting Ramp Torque: 0–85%
 - 6. Adjustable Smooth Stop Ramp Time: 0–60 seconds.
- V. Units enclosed in motor control centers shall be of the same manufacturer as that of the circuit breaker and motor control center for coordination and design issues.
- W. Maximum continuous operation shall be at 115% of continuous ampere rating.
- X. Pump Control Option – Provide control algorithm for pump start-up and shut down sequences. Control algorithm shall reduce the potential for water hammer in a centrifugal pump system. Upon a start command, the speed of the motor is increased, under the control of the IT. Soft Starter microprocessor, to achieve a gentle start. After the speed has reached its nominal value, the bypass contactors close and the pump. Upon a stop command, the bypass contactors are opened and the motor speed is decreased in a tapered manner, to gradually slow the flow until the motor is brought to a stop. The start and stop ramp times are user adjustable and are to be set for the application requirements. The pump control option shall be factory installed.
- Y. Control Power Transformer
 - 1. Provide a control power transformer mounted and wired inside of the system enclosure.
 - 2. The transformer shall be rated for an additional 100 VA for customer use.
 - 3. The transformer shall be provided with fused primary and secondary protection.
- Z. Hand-Off-Auto Selector Switch
 - 1. Provide a “Hand/Off/Automatic Selector Switch for start-stop control.
- AA. Pilot Lights
 - 1. Provide pilot lights, mounted on the enclosure door, for indication of On, Off, and Fault.
 - 2. Pilot lights shall be transformer push-to test type.
- BB. The motor controller shall be an Eaton Type S811, Allen Bradley SMC-Flex or equal.

2.02 MANUAL MOTOR STARTERS

- A. Manual motor starters shall be horsepower rated. Provide nameplates and ambient compensated thermal overload protection. Enclosures shall suit the location per Section 16010.
- B. For corrosive locations, provide Crouse-Hinds NFS, or equal. For all other locations, provide Eaton Type MS; Allen-Bradley Bulletin 600; Allen Bradley Bulletin 609; or equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install units plumb within 1/8-inch of vertical, and in accordance with manufacturer's instructions. Make sure that fuse ratings are as shown on the Drawings, and that breaker trip settings are per the Construction Manager's instructions.
- B. Contractor shall adjust motor circuit protector devices to the instantaneous trip setting position recommended for the actual horsepower and full load amps of the motor.
- C. Contractor shall verify that overload devices are proper for equipment installed.
- D. Contractor shall make the necessary changes in overload devices as required for any motors having power factor correction capacitors.
- E. Contractor shall touch up any scratches after the equipment has been installed.

3.02 GROUNDING

- A. Grounding shall be installed in compliance with Section 16450 of these Specifications and as shown on the Contract Drawings.

3.03 FIELD TESTING

- A. As specified in Section 16950.

END OF SECTION

SECTION 16160

PANELBOARDS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provide panelboards complete and operable, in accordance with the Contract Documents.
- B. Single Manufacturer: Like products shall be the end product of one manufacturer in order to achieve standardization of appearance, operation, maintenance, spare parts, and manufacturer's services.

1.02 REFERENCE STANDARDS

- A. American National Standards Institute (ANSI):
 - 1. Z55.1 Gray Finishes for Industrial Apparatus and Equipment
- B. National Electrical Manufacturers Association (NEMA):
 - 1. PB1 Panelboards
 - 2. 250 Enclosures for Electrical Equipment (1,000 Volts Maximum)
- C. Federal Specifications (FS):
 - 1. W-P-115 Panel, Power Distribution
 - 2. W-C-375 Circuit Breakers, Molded Case, Branch Circuit, and Service
- D. Underwriters Laboratories (UL):
 - 1. 50 Enclosures for Electrical Equipment, Non-Environmental Considerations
 - 2. 67 Standard for Panelboards
 - 3. 869A Reference Standard for Service Equipment
 - 4. 1699 Standard for Arc-Fault Circuit-Interrupters
- E. National Fire Protection Association (NFPA):
 - 1. 70 National Electrical Code (NEC)

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with the Product Review category of the General Conditions and the submittal requirements of Section 16010.
- B. Shop Drawings: For each panelboard, submit manufacturer's name and data as required:
 - 1. Bill of materials.
 - 2. Panelboard enclosure type.
 - 3. Main bus and terminal connection sizes.
 - 4. Main bus configuration
 - 5. Bus materials
 - 6. Location of line connections.
 - 7. Scaled and dimensioned cabinet drawings showing conduit entrance and exit locations.
 - 8. Gutter space.
 - 9. Gauge of boxes and fronts

10. Finish data.
 11. Voltage rating.
 12. Continuous current rating.
 13. Short circuit rating.
 14. Breaker types, trip ratings, and interrupting ratings.
 15. Mounting method.
 16. Circuit breaker layout drawing with dimensions and nameplate designations matching the Drawings.
- C. Submit catalog cuts for panelboard, circuit breakers, protective devices, metering, and any other included accessories.
 - D. Submit time current curves for each circuit breaker type included.
 - E. Submit seismic design certifications and anchorage descriptions as required by Section 01190.
 - F. Submit field acceptance test results.

1.04 LOCATIONS

- A. Refer to Section 16010 for definitions of types of locations.

PART 2 - PRODUCTS

2.01 GENERAL

- A. Panelboards shall be factory assembled, dead-front units conforming to NEMA PB 1, UL 50, and UL 67. All panelboards shall be UL labeled.
- B. Unless otherwise indicated, provide enclosure types to match the ratings required for the location in which the panelboard is installed, in accordance with Section 16010.
- C. Provide service entrance rated panelboards where used as a service entrance. Service entrance rated panelboards shall conform to UL 869A and be labeled as such.
- D. Each panelboard shall have a manufacturer's nameplate showing the voltage, bus rating, phase, frequency and number of wires.
- E. Panelboards, circuit breakers, and all major components installed within shall be the product of a single manufacturer.
- F. The number and arrangement of circuits, spares and blank spaces for future circuit breakers shall be as shown on the Drawings.
- G. Circuit breaker ampere trip ratings shall be as required by the equipment.
- H. Ratings:
 1. Voltage: As shown on the Drawings
 2. Continuous current: As shown on the Drawings
 3. Main circuit breaker: As shown on the Drawings
 4. Short circuit:
 - a. Panelboards rated 240 VAC or less, and not used as a service entrance, shall have short circuit ratings not less than 10,000 amperes RMS symmetrical or as indicated by the Short Circuit Study prepared under Specification 16961, whichever is greater.

- b. Service entrance panelboards rated 240 VAC or less shall have short circuit ratings not less than 22,000 amperes RMS symmetrical or as indicated by the Short Circuit Study, whichever is greater.
- c. Panelboards shall be labeled with a UL short circuit rating. Series ratings are not acceptable.

2.02 PANELBOARDS

- A. Panelboards shall meet the requirements of Federal Specification W-P-115 for Type I, Class 1 panelboards with circuit breakers.
- B. Construction:
 - 1. Busbars shall be tinned copper.
 - 2. All circuit breakers shall be bolt-on type, with 1, 2 or 3 poles, as shown on the Drawings. Breakers shall be quick-make, quick-break, inverse time trip characteristics, to trip free on overload or short circuit. Each breaker shall have a single operating handle which indicates the trip condition of the breaker by its position. Circuit breakers shall meet the requirements of Federal Specification W-C-375.
 - 3. Where AFCI circuit breakers are shown on the Drawings or required by NEC, a unit shall be provided that contains a conventional thermal-magnetic trip and an arc-fault sensor, in accordance with UL 1699. The arc-fault sensor shall have the same rating as the circuit breaker and shall have a push-to-test button.
 - 4. Panelboards shall have hinged doors with combination catch and latch and common keying for locks. The front panels shall be arranged such that when the plates are removed, the gutters, terminals and wiring will be exposed and accessible. The doors shall have inner doors within the plates to have only the breaker operating mechanism exposed when they are opened. Live conductors and terminals shall be concealed behind the plates.
 - 5. Unless dictated otherwise by the enclosure type, panelboards shall be constructed of hot dipped zinc galvanized steel with stainless steel screws. Enclosures shall have a factory-applied finish in ANSI 61 grey, in accordance with ANSI Z55.1.
- C. Manufacturers:
 - 1. 240V and below: Eaton Pow-R-Line 1a/2a, Schneider Electric NQ/NF, or approved equal.

2.03 SERVICE PEDESTALS

- A. Provide a free-standing service pedestal which includes a pull section, metering cabinet, panelboard and main circuit breaker. Service pedestal shall meet the requirement of Pacific Gas and Electrical Company (PG&E).
- B. Service Pedestal shall be UL listed meeting the requirement of EUSERC and PG&E.
- C. The meter pedestal shall also have the following properties.
 - 1. Padlock-able, with separate lock hasps for the incoming service conductor section, meter section, and customer sections.
 - 2. NEMA 3R rainproof enclosure with a removable door for the service conductor entrance section, and hinged doors for the meter, panelboard, and control sections.

3. Constructed of 12-gauge, corrosion resistant, zinc coated steel with 14-gauge covers.
 4. Polyester powder-coated finish that exceeds ASTM B-117 Specifications. Color shall be in accordance with *PG&E* requirements.
 5. Metering cabinet shall include 100A 120/240 volt socket for installation of *PG&E* meter.
 6. Utility landing lugs.
 7. Meter socket with 4J test blocks.
 8. Voltage shall be 100A, 240/120 volts single phase.
 9. Main circuit breaker shall be 100A molded case suitable for service entrance.
 10. All interior bussing shall be copper.
- D. Manufacturers: Myers Power Products, Pacific Utility Products, Eaton, or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Panelboards shall be installed as indicated on the Drawings and in accordance with the manufacturer's instructions.
- B. Panelboards shall be mounted with the top of the box 6 feet 6 inches above the floor. Panelboards shall be plumb within 1/8 inch. The highest breaker operating handle shall not be higher than 72 inches above the floor.
- C. Meter Pedestals shall be bolted to the equipment slab in accordance with the manufacturer's requirements. Provide working clearance in accordance with the *PG&E* requirements.
- D. Provide neutral-ground bonding at service entrances as shown on the Drawings and as required by the NEC.
- E. Provide grounding where shown on the drawings and as required by the NEC. Grounding shall be in accordance with Section 16450.

3.02 IDENTIFICATION

- A. Provide a nameplate for each panelboard as required by Section 16010.
- B. Provide a typewritten and printed circuit schedule in each panelboard. Handwritten schedules will not be accepted. Circuit schedule shall be placed within a clear pocket affixed to the inside of the hinged panelboard door.

3.03 FIELD ACCEPTANCE TESTS

- A. Test per Specification 16950.

END OF SECTION

SECTION 16402

UNDERGROUND ELECTRICAL WORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

1.02 APPLICABLE STANDARDS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
 - 1. Federal Specifications (Fed. Spec.):
 - a. RR-F-621C Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole
 - b. RR-G-661D Grating, Metal, Bar Type (Floor, except for Naval Vessels)
 - 2. American Concrete Institute (ACI) Publication:
 - a. 318 Building Code Requirements for Reinforced Concrete
 - 3. American Society of Testing and Materials (ASTM) Publications:
 - a. A36 Structural Steel
 - b. A153 Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - c. A615 Deformed and Plain Billet - Steel Bars for Concrete Reinforcement
 - d. C33 Concrete Aggregates
 - e. C139 Concrete Masonry Units for Construction of Catch Basins and Manholes, Specification for
 - f. C150 Portland Cement
 - g. C478 Precast Reinforced Concrete Manhole Sections, Specification for
 - h. C857 Recommended Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
 - i. C858 Standard Specification for Underground Precast Concrete Utility Structures
 - 4. American Association of State Highway and Transportation Officials (AASHTO) Publication:
 - a. HB-13 Standard Specifications for Highway Bridges
 - 5. American National Standard Institute (ANSI) Publication:
 - a. C2 National Electrical Safety Code
 - 6. National Fire Protection Association (NFPA) Publication:
 - a. 70 National Electrical Code (NEC)
 - [7. Pacific Gas and Electric Company (PG&E) Standard:
 - a. Drawing Primary Electric Underground Equipment 062000 enclosures.]
 - [8. State of California Public Utilities Commission (Cal. PUC) Publication:
 - a. G.O.128 Construction of Underground Electric Supply and Communication System, Rule for]

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with the Product Review category of the General Conditions and the submittal requirements of Section 16010.
- B. Manufacturer's Data and Shop Drawings:
 - 1. Manhole and Handhole - Include a table of dimensions which shows proposed size of each manhole and handhole.
 - 2. Manhole Frame and Cover
 - 3. Handhole Frame and Cover
 - 4. Sealing Material for Precast Manhole and Handhole Joints
- C. Certificates
 - 1. Test Reports: Submit for approval 30 days before the materials are used, copies of laboratory test reports for the following:
 - a. Arc-proofing test for cable fireproofing materials

PART 2 - PRODUCTS

2.01 GENERAL

- A. Materials and equipment shall conform to the respective specifications and standards and to the specifications herein. Electrical ratings shall be as indicated.
- B. Conduit: Provide per Section 16110.
- C. Wire and Cable: Provide per Section 16120 and Section 16124.

2.02 CAST-IN-PLACE AND PRECAST MANHOLES

2.03 HANDHOLES

- A. Provide handholes of reinforced precast concrete, or injection molded composite plastic material. Handholes shall include a base, a body, extensions, and a cover. Handholes with a perimeter of 10 feet or more (e.g., 3 feet by 2 feet) shall have both pulling irons and cable racks. All hardware shall be stainless steel, or hot-dip galvanized after fabrication; cable racking hardware, however, shall be non-metallic and corrosion resistant as manufactured by Pacific Utilities Supply (415) 495-4940 (see PG&E Standard Detail Drawing 028077), or equal. If no handhole size is shown on the Drawings, size units per NEC or provide 12 inches by 24 inches by 18 inches deep, whichever is larger. Structure shall be fabricated in accordance with ACI 318.
- B. (Handholes shall be HS 20-44 as given in AASHTO HB-13.)

PART 3 - EXECUTION

3.01 TRENCHING, BACKFILL, AND COMPACTION

- A. See Section 02300.

3.02 WIRE AND CABLE INSTALLATION

- A. See Section 16120.

3.03 UNDERGROUND RACEWAYS WITH CONCRETE ENCASEMENT

- A. All underground raceways shall be encased in concrete unless otherwise specifically shown otherwise on the Drawings.
1. Concrete encasement shall be minimum of 3 inches around outer walls of raceways and minimum of 2 inches between raceways. Conduits shall be PVC Type EB.
 2. Concrete shall be portland cement type with 4 sacks cement per cubic yard of concrete, maximum coarse aggregate size of 3/8-inches and shall have minimum strength of 2,000 psi after 28 days. Amount of water shall not exceed slump required for placement. Five pounds red lead oxide shall be added per cubic yard of concrete for medium voltage raceway encasement only.
 3. Underground raceways shall slope toward manholes, pullboxes, etc., at minimum rate of 3 inches per 100 feet unless indicated otherwise on Drawings. Raceway entrances in manholes, handholes, etc., shall be by means of bell ends and shall be sealed against entry of silt, debris, rodents, etc., into raceways.
 4. Top of concrete encasement shall be minimum of 24 inches below grade.
 5. Minimum radius of all horizontal bends in underground duct banks shall be 25 feet. Bends shall be formed of factory made sweeps or continuous assembly of bend segments or curved segments, except that polyvinyl chloride conduits may be field formed. Minimum radius of all vertical bends in underground raceways shall be ten times nominal size of conduit. Vertical bends shall be made of rigid steel or permanently coated aluminum conduit.
 6. Underground raceways within roadways shall be run parallel or perpendicular to road centerline.
 7. Pull wires left in underground raceways shall be 1/8-inch nylon rope or 3/16-inch polypropylene.
 8. Terminate conduits in end-bells where duct lines enter manholes and handholes. Provide structural support for concrete encased duct banks at the point where they terminate. Separators shall be of precast concrete, high impact polystyrene, steel, or any combination of these. Stagger the joints of the conduits by rows and layers so as to provide a duct line having the maximum strength. During construction, protect partially completed duct lines from the entrance of debris such as mud, sand and dirt by means of suitable conduit plugs. As each section of a duct line is completed, draw a brush through having the diameter of the duct, and having stiff bristles until the conduit is clear of all particles of earth, sand, and gravel; then immediately install conduit plugs.
- B. Connections to Existing Ducts: Where connections to existing duct lines are indicated, excavate the lines to the maximum depth necessary. Cut off the lines and remove loose concrete from the conduits before new concrete encased ducts are installed. Provide a reinforced concrete collar, poured monolithically with the new duct line, to take the shear at the joint of the duct lines. Remove existing cables that constitute interference with the work. Abandon in place those used ducts and cables that do not interfere with the work.
- C. Removal of Ducts: Where duct lines are removed from existing manholes, close the openings to waterproof the manhole. Chip out the wall opening to provide a key for the new section of wall.
- D. See Section 16110 for additional requirements.

3.04 UNDERGROUND RACEWAYS WITHOUT CONCRETE ENCASEMENT

- A. Provide raceways without concrete encasement only if specifically shown on the Drawings, otherwise, provide concrete encasement as above.
- B. Provide sand backfill three inches all around the raceway.
- C. Construct raceways per the applicable provisions above for underground raceways with concrete encasement.
- D. See Section 16110 for additional requirements.

3.05 HANDHOLES

- A. Provide handholes complete with all accessories, as indicated. Identify each casting by having the manufacturer's name and address cast into an interior face or permanently attached thereto. Stencil manhole number in the neck with 3-inch-high yellow letters.
- B. Installation of Cable in Handholes: Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form all cables to closely parallel walls, not to interfere with duct entrances, and support on brackets and cable insulators at a maximum of 18 inches. Support cable splices in underground structures by racks, leaving top space open for future cables. Provide one spare three-insulator rack arm for each cable rack in each underground structure.

END OF SECTION

SECTION 16450

ELECTRICAL GROUNDING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 *become* a part of this Section as if repeated herein.
- B. Work Included: Furnish all labor, material, equipment, tools and services necessary for the installation, connection and testing of all grounding as specified herein and as shown on the Drawings.

1.02 REFERENCE STANDARD

- A. American Society for Testing and Materials (ASTM) Publication:
 - 1. B228 Copper Clad Steel Conductors Specification
 - 2. D178 Specifications for Rubber Insulating Matting
- B. Institute of Electrical and Electronics Engineers:
 - 1. 142 Grounding of Industrial and Commercial Power Systems (Green Book)
- C. International Electrical Testing Association (NETA) Publication:
 - 1. ATS Acceptance Testing Specifications for Electrical Equipment for Power Systems
- D. National Fire Protection Association (NFPA):
 - 1. 70 National Electrical Code (NEC)
- E. Telecommunications Industry Association (TIA)
 - 1. 607 Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- F. Underwriters Laboratories (UL) Standards:
 - 1. 467 UL Standard for Safety Grounding and Bonding Equipment

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with the Product Information category of the General Conditions and the submittal requirements of Section 16010.

PART 2 - PRODUCTS

2.01 GENERAL

- A. The grounding systems shall consist of the ground rods, grounding conductors, ground bus, ground fittings and clamps, and bonding conductors to water piping, structural steel and UFER grounding as shown on the Drawings. One system shown provides service and separately derived system grounds. A second system is an electronic ground system to provide for the discharge of static electricity.

2.02 SYSTEM COMPONENTS

- A. Ground Rods: Ground rods shall be cone pointed copper clad Grade 40 HS steel rods conforming to UL 467. The welded copper encased steel rod shall have a conductivity of not less than 27% of pure copper. Rods shall be not less than 3/4-inch in diameter and 10 feet long, unless otherwise indicated. Rods longer than 10 feet shall be made up of 10-foot units joined together with threaded couplings. The manufacturer's trademark shall be stamped near the top.
- B. Ground Conductors: Buried conductors shall be medium-hard drawn bare copper; other conductors shall be soft drawn copper. Sizes over No. 6 AWG shall be stranded. Coat all ground connections except the exothermic welds with electrical joint compound, non-petroleum type, UL listed for copper and aluminum applications.
- C. Ground Connections: Connection to ground rods and buried connections shall be by exothermic weld. Lugs for attachment of cables to steel enclosures shall be of the binding post type with a 1/2-13NC stud. Each post shall accommodate cables from #4 AWG to #4/0 AWG.
- D. Ground Rod Boxes: Boxes shall be a 12-inch-diameter (minimum) precast concrete traffic rated unit with cast iron lid. Units shall be 12-inches deep. Covers shall be embossed with the wording "Ground Rod."
- E. Equipment Grounding Plates: Equipment grounding plates shall be of the irreversible compression type suitable for embedment in cast concrete. Equipment grounding plates shall be made of high-strength, high-conductivity cast copper alloy body with a pure wrought copper compression element. Equipment grounding plate shall be 4 hole and suitable for termination with size #2-250kcmil copper conductors. Ground Plates shall be Hubbell/Burndy Type YGF or approved equal.
- F. Exothermic Welds: Exothermic welded connections shall be Erico CADWELD, Hubbell BURNDYWeld, or approved equal.
- G. Insulating Tape: Insulating tape for copper conductors passing through concrete slabs shall be UL Listed, premium grade, 10-mil thick, pressure-sensitive vinyl insulating tape. Tape shall have elastic backing with strong adhesive strength. Tape shall be 3M/Scotch Vinyl Insulation Tape 22 or approved equal.
- H. Ground Enhancement Material (GEM): GEM must be permanent and maintenance free (no recharging with salts or chemicals which may be corrosive), maintain its earth resistance with time and not depend on water to maintain its conductivity. GEM in its set form shall have a resistivity of not more than 20 ohm-cm. GEM shall be suitable for installation in dry form or slurry form, set up firmly and not dissolve or decompose or otherwise pollute the soil or local water table. GEM shall be manufactured by Erico Products or approved equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Ground all equipment for which a ground connection is required per NEC whether or not the ground connection is specifically shown on the Drawings.
- B. Provide a ground wire in every conduit carrying a circuit of over 50 volts to ground.

- C. Sizes shall be as indicated on the Conduit/Cable Schedule and in accordance with NEC Article 250.
- D. Provide a grounding-type bushing for secondary feeder conduits that originate from the secondary section of each MCC section, switchboard, or panelboard.
- E. Individually bond the raceway to the ground bus in the secondary section.
- F. Provide a separate grounding conductor in each individual raceway for parallel feeders. Connect the parallel ground conductors together at each end of the parallel run, as required by the NEC.
- G. Provide a grounding with minimum burial depth of 36 inches or as indicated on the Drawings, whichever is greater.
- H. Embed a grounding conductor in every duct bank as indicated. The ground conductor shall be terminated at the ground grid at each end of the duct bank. Where no ground grid is installed, terminate at a suitable grounding electrode conductor near the end of the duct bank in accordance with the NEC.
- I. Provide a ground rod box for each ground rod so as to permit ready access for the connection and/or removal of any pressure connectors to facilitate testing.
- J. Install ground enhancement material around each ground rod per GEM manufacturer's installation instructions. GEM shall extend 6 inches in all directions around the ground rod surface. GEM shall extend from 8 inches below top of ground rod to bottom of ground rod.
- K. Make embedded or buried ground connections, taps and splices with exothermic. Do not conceal or cover ground connections until the Engineer or an authorized representative has established that every grounding connection conforms to the requirements of the Contract Documents and has given the Contractor written confirmation.
- L. Where bare copper ground conductor is installed through a new concrete slab, wrap the conductor with insulating tape before pouring concrete. Apply tape in half-lapped layers with sufficient tension to produce a uniform wind, with no tension on the last wrap to prevent flagging.
- M. Provide a separate grounding conductor for each motor and connect at motor box. Provide a supplemental ground connection for motor shaft grounding rings, where applicable.
- N. Provide supplemental external bonding jumpers from equipment to the grounding electrode system as shown on the Drawings.
- O. Shielded instrumentation cable shall have its shield grounded at one end only unless the approved Shop Drawings indicate otherwise. The grounding point shall be at the control panel or at the receiving end of the signal carried by the cable. The termination of the shield drain wire shall be on its own terminal. Form a instrument signal ground block by jumping together the shield drain wire terminals, using manufactured terminal block jumpers or a #14 AWG green insulated conductor. Bond the instrument signal ground block to the main ground bus for the panel via a #12 AWG green insulated conductor.

3.02 TESTING

- A. Testing shall be in accordance with Specification 16950 – Electrical Tests.

- B. Furnish to the Engineer a test report with recorded data of each ground rod location.

END OF SECTION

SECTION 16500

LIGHTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.
- B. Work Included: Provide a lighting system complete, including fixtures, lamps, standards, bases, hangers, reflectors, glassware, lenses, auxiliary equipment, ballasts, sockets, and photoelectric cells.

1.02 REFERENCE STANDARDS

- A. Federal Regulations
 - 1. Title 21 Performance Standards for Light Emitting Products CFR 1040
- B. Underwriters Laboratories (UL) Standards
 - 1. 57 Electric Lighting Fixtures
 - 2. 844 Electric Lighting Fixtures for Use in Hazardous (Classified) Locations

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with the Product Review category of the General Conditions and the submittal requirements of Section 16010.
- B. Submit photometric curves for each fixture configuration proposed. Substitutions will not be considered unless the photometric distribution curve indicates the proposed fixture is equal to or exceeds the specified luminaire.
- C. Submit shop drawings showing proposed methods for mounting interior lighting fixtures which are not attached directly to the ceiling or wall.
- D. Submit seismic design certifications and anchorage descriptions as required by Section 01190.

1.04 GUARANTEE

- A. Lamps which fail within 90 days after acceptance by the Owner shall be replaced at no cost to the Owner.

PART 2 - PRODUCTS

FIXTURES

2.01 FIXTURES

- A. Fixtures shall be of the types, wattages and voltages shown on the Drawings, comply with UL 57, and be UL classified and labeled for intended use. Fixtures for use in hazardous locations shall be UL listed per UL Standard 844.

- B. Luminaire wire, and the current carrying capacity thereof, shall be in accordance with the NEC.
- C. Luminaires and lighting equipment shall be delivered to the project site complete, with suspension accessories, aircraft cable, stems, canopies, hickey, castings, sockets, holders, ballasts, diffusers, louvers, frames, recessing boxes and related items, including supports and braces.
- D. Luminaires must be of the types and manufacturers noted on the Drawings including light source, wattage and voltage as indicated. Specific manufacturer and model numbers are indicated as a standard of performance and quality.
- E. All housing finishes must be bake-on enamel, anodized, or powder-coated unless otherwise indicated.
- F. Luminaire shall have an external label per ANSI C136.15.
- G. Luminaire shall have an internal label per ANSI C136.22.
- H. Color of the luminaire must be as specified by the Owner.

2.02 LED DRIVERS

- A. Must have a minimum efficiency of 85%.
- B. Rated case temperature shall be suitable for operation in the luminaire operating in the ambient temperatures.
- C. Input Voltage: capable of 120 to 480 ($\pm 10\%$) volt, single phase as required by the site.
- D. Power supplies can be UL Class I or II output.
- E. Operating frequency must be 50/60 Hz.
- F. Drivers must have a power factor of ≥ 0.90 .
- G. Minimum time between failures (MTBF = total hours of testing / number of failures) shall be greater than 300,000 hours at full load and 25°C ambient, in accordance with MIL-HDBK-217.
- H. Lifetime = 100,000 hours at full load and 25°C ambient.

2.03 2LAMP POSTS AND STANDARDS

- A. Lamp posts and standards shall be of the type, configuration, and dimensions shown on the Drawings, and shall be suitable for the indicated lamp mounting height.
- B. Furnish complete with anchor bolts, bolt circle template, hand holes, and cover plate.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. General:
 - 1. All fixtures and luminaires shall be clean and lamps shall be operable at the time of acceptance.
 - 2. Install luminaires in accordance with manufacturer's instructions, complete with lamps, ready for operation as indicated.
 - 3. Align, mount, and level the luminaires uniformly.
 - 4. Avoid interference with and provide clearance for equipment. Where an indicated position conflicts with equipment locations, change the location of the luminaire by the minimum distance necessary.
- B. Mounting and Supports:
 - 1. Mounting heights shall be as shown on the Drawings. Unless otherwise shown, mounting height shall be measured to the centerline of the outlet box for a wall-mounted fixture and to the bottom of the fixture for all other types.
- C. Mount lamp posts and lighting standards plumb and make free of dents or other damage.
- D. Concrete Bases:
 - 1. Templates and anchor bolts shall be obtained before starting any work.
 - 2. Concrete bases shall be constructed in accordance with Section 03300.

END OF SECTION

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SECTION 16950

ELECTRICAL TESTS

PART 1 - GENERAL

1.01 SCOPE OF WORK

- A. This Section specifies the work necessary to test, commission, and demonstrate that the electrical system satisfies the requirements of these Specifications and functions as required by the Contract Documents. The work of this Section is applicable to both pre and post energization testing required by the Manufacturer to facilitate sign-off on their respective equipment as well as pre and post energization testing performed by an independent third party entity independent of manufacturers, suppliers and installers of electrical equipment, installations and systems.
- B. The Work shall include furnishing the labor, equipment, and power required to support the testing indicated in other Divisions of these Specifications. Electrical testing indicated herein and functional testing of power and controls not tested under Division 17 – Instrumentation, shall be completed before commencement of the Initial Operation Period as defined in Section 01650, for each phase of construction as indicated on the Drawings. This scope may require the Contractor to activate circuits, shutdown circuits, run equipment, make electrical measurements, replace blown fuses, and install temporary jumpers, etc.
- C. Carry out tests indicated herein for individual items of materials and equipment in other Sections. Testing shall be done in accordance with the manufacturer's instructions, these Specifications, and applicable NETA Acceptance Testing Specifications, NEMA, ANSI, NFPA, and ASTM Standards.
- D. Factory Acceptance Testing and other off-site test requirements are included in other Sections.
- E. Corrections and Replacements
 1. Before final acceptance, each part of the work shall be thoroughly tested, and each test shall be documented and submitted in accordance with the Contract Documents.
 2. Any materials or equipment failing any test shall be corrected or replaced as required to pass the test at no additional cost to the Owner.
 3. Any materials or equipment failing any test shall be re-tested after correction or replacement to verify compliance.
 4. Any failures shall again be corrected or replaced, and then re-tested.
 5. The correction/replacement/re-testing cycle shall continue until the item passes the required test(s).

1.02 REFERENCE STANDARDS

- A. Electric equipment, materials, installation, and testing shall comply with the National Electrical Code (NEC), and shall also conform to the following codes and standards:
 1. American National Standards Institute (ANSI)

2. InterNational Electrical Testing Association (NETA)
3. Institute of Electrical and Electronics Engineers (IEEE)
4. Occupational Health and Safety Administration (OSHA)
5. ASTM International Standard E329
6. IEEE 400, Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems
7. IEEE 576, Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in Industrial and Commercial Applications
8. National Fire Protection Association (NFPA) 70B, NEC for Maintenance
9. Telecommunications Industry Association (TIA) 568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standards.

1.03 SUBMITTALS

- A. Submit complete system test procedures and test record forms for review. Test procedures shall include but not be limited to:
 1. Detailed procedures, both pre and post energization testing requirements of the Manufacturer and independent third-party entity, in sufficient detail to verify conformance with these Specifications.
 2. Incorporation of data collection and measurement values as shown in the sample test record forms provided at the end of this Section. Submitted test record forms shall include space for each of the fields listed, at a minimum.
 3. Detailed comprehensive testing schedule including:
 - a. Electrical testing of each major area.
 - b. Each major piece of electrical distribution equipment.
 - c. Each major electrical subsystem.
 - d. Duration of each test.
 - e. Milestone test completion date.
 - f. Date of test results submittals following completion of the tests.
 - g. Names and qualifications of the individual(s) responsible for performing the testing, including a copy of current NETA Technician cards.
 - h. Proof of NETA accreditation for the testing agency.
- B. Following completion of the test submit the completed test results to the Engineer for review. The results shall include a dedicated section with the "as-left" settings of all devices, relays, circuit breakers, etc.
- C. Test results shall be submitted in one submittal.
- D. Test reports shall be based on NETA's latest Acceptance Testing Specifications having a sign-off, pass/fail data filed for each line item covered by NETA's Acceptance Testing Specifications latest edition.

1.04 QUALITY ASSURANCE

- A. Testing Firm Qualifications:
 1. Corporately and financially independent organization functioning as an unbiased testing authority.
 2. Professionally independent of manufacturers, suppliers, and installers of electrical equipment and systems being tested.
 3. Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.

4. Supervising engineer accredited as Certified Electrical Test Technologist by NICET or NETA and having a minimum of 5 years testing experience on similar projects.
 5. Technicians certified by NICET or NETA.
 6. Registered Professional Engineer to provide comprehensive project report outlining services performed, results of such services, recommendations, actions taken, and opinions.
 7. In compliance with OSHA CFR 29, Part 1910.7 criteria for accreditation of testing laboratories or a full member company of NETA.
- B. Test equipment shall have an operating accuracy equal to or greater than requirements established by NETA ATS.
- C. Test instrument calibration shall be in accordance with NETA ATS.

1.05 FIELD TESTS

- A. All testing shall be performed in the presence of the Owner.
- B. Any system material or workmanship that is found to be defective on the basis of acceptance tests shall be reported directly to the Owner.

PART 2 - PRODUCTS

2.01 PRE-ENERGIZATION AND OPERATING TESTS

- A. The complete electrical system for each phase of construction shall be performance tested when first installed on-site. Each protective, switching, and control circuit shall be adjusted in accordance with the recommendations of the Protective Device Coordination Study required by Section 16961 and tested by actual operation using current injection or equivalent methods as necessary to ensure that each and every such circuit operates correctly to the satisfaction of the Owner.
1. Switching Circuits. Each switching circuit shall be observed to operate the associated equipment being switched.
 2. Control and Signal Circuits. Each control or signal circuit shall be observed to perform its proper control function or produce a correct signal output.
 3. Metering Circuits. All metering circuits shall be verified to operate correctly from voltage and current sources, similarly to protective relay circuits.
 4. Acceptance Tests. Complete acceptance tests shall be performed, after the station installation is completed, on all assemblies, equipment, conductors, and control and protective systems, as applicable, to verify the integrity of all the systems.
- B. Test Report. A test report covering the results of the tests required in the Pre-Energization and Operating Tests shall be delivered to the Engineer prior to energization. Acceptance Testing shall be in accordance with NETA ATS-2021, *Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems*, published by the InterNational Electrical Testing Association. Tests shall be provided by both the manufacturer representative and independent third-party NETA accredited testing agency where required.

2.02 FIELD TESTS BY MANUFACTURER'S OR SUPPLIERS

- A. All field tests shall be performed by the Manufacturers or Suppliers.

2.03 TEST REQUIREMENTS

- A. The following test requirements supplement test and acceptance criteria that may be stated elsewhere.
 - 1. Lighting: Switching. Circuitry is in accordance with panel schedules. All interior and exterior lighting shall be checked for proper operation.
 - 2. Activate ground fault tripping by operating test features provided with ground current protective systems and by injecting a known and reasonable current in the ground current sensor circuit. In general, ground fault tripping should occur at a ground current equivalent to 20 percent of phase current. Current injection is not required of circuit 400 amperes or less.
- B. Low Voltage Cables-600 volts Maximum
 - 1. Visual and Mechanical Inspection
 - a. Compare cable data with Drawings and Specifications.
 - b. Inspect exposed sections of cables for physical damage and correct connection in accordance with single-line diagram.
 - c. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use of low-resistance ohmmeter
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - d. Inspect compression-applied connectors for correct cable match and indentation.
 - e. Inspect for correct identification and arrangements.
 - f. Inspect cable jacket insulation and condition.
 - 2. Electrical Tests
 - a. Perform insulation-resistance test on each conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Test duration shall be 1 minute.
 - 1) Motor feeders tested with motors disconnected and controller open.
 - 2) Motor control circuits tested and verified for proper operation with control stations and overcurrent devices connected.
 - 3) Panelboard feeders tested with feeder breaker open and panelboard connected. If a lighting transformer is associated with the panelboard, it shall be connected and the test made for both primary and secondary sides.
 - 4) Conductors of main lighting feeders, including lighting panel with branch circuits open.
 - 5) Prior to performing insulation resistance tests on cables, verify that they are not connected to a solid state device.
 - 6) Equipment which may be damaged during this test shall be disconnected.
 - 7) The Engineer shall be consulted if minimum insulation values cannot be obtained.

- b. Perform resistance measurements through all bolted connections with low-resistance ohmmeter, if applicable.
 - c. Perform continuity test to ensure correct cable connection.
 - d. Perform the following industry-standard operational and performance tests on each Category 6 Ethernet cable as detailed in ANSI/EIA-568-C:
 - 1) Wire map (pass/fail)
 - 2) Propagation delay (pass/fail)
 - 3) Delay skew (pass/fail)
 - 4) Cable length
 - 5) Insertion loss (attenuation)
 - 6) Return loss (pass/fail)
 - 7) Near-end crosstalk (NEXT) (pass/fail)
 - 8) Power sum near-end crosstalk (PSNEXT) (pass/fail)
 - 9) Equal level far-end crosstalk (ELFEXT)
 - 10) Power sum equal level far-end crosstalk (PSELFEXT).
 - 3. Test Values - Visual and Mechanical
 - a. Compare bolted connection resistance to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with NETA ATS Table 100.12 unless otherwise specified by the manufacturer.
 - 4. Test Values - Electrical
 - a. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Insulation-resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations shall be investigated.
 - c. Cable shall exhibit continuity.
 - d. Deviations in resistance between parallel conductors shall be investigated.
 - e. Compare Category 6 Ethernet test values against TIA 568-C for determination of pass/fail status.
- C. Molded and Insulated Case Circuit Breakers
- 1. Visual and Mechanical Inspection
 - a. Compare equipment nameplate data with drawings and specifications.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage and alignment.
 - d. Verify the unit is clean.
 - e. Operate the circuit breaker to insure smooth operation.
 - f. Inspect bolted electrical connections for high resistance using one or more of the following methods:
 - 1) Use of a low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12
 - g. Inspect operating mechanism, contacts, and arc chutes in unsealed units.

- h. Perform adjustments for final protective device settings in accordance with the coordination study.
- 2. Electrical Tests
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to ground with the circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.1.
 - c. Perform a contact/pole-resistance test.
 - d. Determine long-time pickup and delay by primary current injection.
 - e. Determine short-time pickup and delay by primary current injection.
 - f. Determine ground-fault pickup and time delay by primary current injection.
 - g. Determine instantaneous pickup by primary current injection.
 - h. Test functions of the trip unit by means of secondary injection.
 - i. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data.
 - j. Verify correct operation of auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, anti-pump function, and trip unit battery condition. Reset all trip logs and indicators
 - k. Verify operation of charging mechanism.
- 3. Test Values – Visual and Mechanical
 - a. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - c. Settings shall comply with coordination study recommendations.
- 4. Test Values – Electrical
 - a. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Insulation-resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.1. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated.
 - c. Microohm or dc millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's published data is not available, investigate values that deviate from adjacent poles or similar breakers by more than 50 percent of the lowest value.
 - d. Insulation-resistance values of control wiring shall not be less than two megohms.
 - e. Long-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors. If manufacturer's curves

are not available, trip times shall not exceed the value shown in NETA ATS Table 100.7.

- f. Short-time pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.
- g. Ground fault pickup values shall be as specified, and the trip characteristic shall not exceed manufacturer's published time-current tolerance band.
- h. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances. In the absence of manufacturer's published data, refer to NETA ATS Table 100.8.
- i. Pickup values and trip characteristics shall be within manufacturer's published tolerances.
- j. Minimum pickup voltage of the shunt trip and close coils shall conform to the manufacturer's published data. In the absence of the manufacturer's published data, refer to NETA ATS Table 100.20.
- k. Breaker open, close, trip, trip-free, anti-pump, and auxiliary features shall function as designed.
- l. The charging mechanism shall operate in accordance with manufacturer's published data.

D. Grounding System

- 1. Visual and Mechanical Inspection
 - a. Verify ground system is in compliance with drawings, specifications, and NFPA 70 National Electrical Code Article 250.
 - b. Inspect physical and mechanical condition.
 - c. Inspect bolted electrical connections for high resistance using one or more of the following methods:
 - 1) Use of low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - d. Inspect anchorage.
- 2. Electrical Tests
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Perform fall-of-potential or alternative test in accordance with ANSI/IEEE 81 on the main grounding electrode or system.
 - c. Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and derived neutral points.
- 3. Test Values – Visual and Mechanical
 - a. Grounding system electrical and mechanical connections shall be free of corrosion.
 - b. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - c. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- 4. Test Values – Electrical

- a. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. The resistance between the main grounding electrode and ground shall be no greater than five ohms for large commercial or industrial systems and one ohm or less for generating or transmission station grounds unless otherwise specified by the owner. (Reference ANSI/IEEE Standard 142)
 - c. Investigate point-to-point resistance values that exceed 0.5 ohm.
- E. Low Voltage Motor Starters
 - 1. Visual and Mechanical Inspection
 - a. Compare equipment nameplate data with drawings and specifications.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, and grounding.
 - d. Verify the unit is clean.
 - e. Inspect contactors.
 - 1) Verify mechanical operation.
 - 2) Verify contact gap, wipe, alignment, and pressure are in accordance with manufacturer's published data.
 - f. Inspect bolted electrical connections for high resistance using one or more of the following methods:
 - 1) Use of a low-resistance ohmmeter.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12
 - g. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
 - 2. Electrical Tests
 - a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.
 - b. Perform insulation-resistance tests on each pole, phase-to-phase and phase-to-ground with starter closed, and across each open pole for one minute. Test voltage shall be in accordance with manufacturer's published data or NETA ATS Table 100.5.
 - c. Perform insulation-resistance tests on all control wiring with respect to ground. Applied potential shall be 500 volts dc for 300-volt rated cable and 1000 volts dc for 600-volt rated cable. Test duration shall be one minute. For units with solid-state components, follow manufacturer's recommendation.
 - d. Test motor protection devices in accordance with manufacturer's published data.
 - e. Perform operational tests by initiating control devices.
 - 3. Test Values – Visual and Mechanical
 - a. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - 4. Test Values – Electrical

- a. Compare bolted connection resistance values to values of similar connections. Investigate values which deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - b. Insulation-resistance values shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.5. Values of insulation resistance less than this table or manufacturer's recommendations should be investigated.
 - c. Insulation-resistance values of control wiring shall not be less than two megohms.
 - d. Motor protection parameters shall be in accordance with manufacturer's published data.
 - e. Control devices shall perform in accordance with system design requirements.
- F. Voltage Field Test:
 - 1. Check and record voltage at point of termination of Pacific Gas & Electric supply system after the installation is essentially complete and has been made operational.
 - 2. Check and record voltage amplitude and balance between phases for loaded and unloaded conditions.
 - 3. Unbalance Corrections:
 - a. Notify the Owner if balance (as defined by NEMA) exceeds 1%, or if voltage varies throughout the day and from loaded to unloaded condition more than plus or minus 4% of nominal.
 - 4. Voltage Balance Report:
 - a. Submit Voltage Balance Report for each switchboard, distribution panel-board, load center, motor control center, and transformer.
- G. Equipment Line Current Tests:
 - 1. Check and record line current in each phase for each major piece of electrically-operated equipment.
 - 2. Make a line current check after Pacific Gas & Electric has made final adjustments to supply voltage magnitude or balance.
 - 3. If any phase current for any piece of equipment is above rated nameplate current, prepare a supplement to the Equipment Line Current Report that identifies any causes of problems and corrective action that was taken.
 - 4. Submit Equipment Line Current Report for each point of connection to motors, transformers, branch circuit distribution connections, and incoming utility service connection.

2.04 TEST REPORTS

- A. The test report shall include the following:
 - 1. Summary of project.
 - 2. Description of equipment tested.
 - 3. Description of test.
 - 4. Test data.
 - 5. Analysis and recommendations.
- B. Test data records shall include the following minimum requirements:
 - 1. Identification of the testing organization.
 - 2. Equipment identification.

3. Humidity, temperature, and other atmospheric conditions that may affect the results of the tests/calibrations.
 4. Date of inspections, tests, maintenance, and/or calibrations.
 5. Identification of the testing technician.
 6. Indication of inspections, tests, maintenance, and/or calibrations to be performed and recorded.
 7. Indication of expected results when calibrations are to be performed.
 8. Indication of "as-found" and "as-left" results.
 9. Sufficient spaces to allow all results and comments to be indicated.
- C. The Contractor shall submit the complete report to the Engineer for review.

PART 3 - EXECUTION

3.01 FIELD TESTS

- A. The Contractor shall provide ten Working Days' notice to the Owner prior to any field testing to permit witnessing of the testing.

TEST RECORD SHEETS

The test record sheets listed below are provided as an example to demonstrate the minimum requirements to be included on test record sheets for electrical equipment and of the electrical installation as required by these specifications. Sample copies of each sheet are attached.

Sheet No.	Title
1	Insulation Resistance (Power, Control Wire, and Cable) Test Record
2	Insulation Resistance (Instrument Wire and Cable) Test Record
3	Ground Electrode Testing Test Record
4	Bonding Resistance Readings (Nonelectrical Equipment/Structures) Test Record
5	Bonding Resistance Readings (Electrical Equipment) Test Record
6	Insulation Resistance (Rotating Equipment) Test Record
7	Electric Motor Run-In Test Record

**INSULATION RESISTANCE
(POWER, CONTROL WIRE, AND CABLE)
TEST RECORD**

TEST EQUIPMENT: _____ TEST VOLTAGE: _____
 TEST EQUIPMENT: _____ TEST VOLTAGE: _____
 AMBIENT TEMPERATURE: _____ °C _____ °F DATE: _____

- NOTES: 1. Perform Insulation Resistance Test (megger) between each conductor and all other conductors and metallic sheath for cables with nonshielded conductors. Test between each conductor and shield for multiconductor cables with shielded conductors. Record lowest reading for each cable.
2. Use 1,000-V test set for cable rated 600 volts and 2,500-V test set for cable rated over 600 volts.
3. Readings will vary inversely with temperature and cable length. When the use of temperature correction factors is specified, attach a second sheet with computed values. Indicate on each sheet "measured" or "temperature corrected."

Panel No. Circuit No. Feeder No.	Wire Tagging	Cable Rated Voltage	Wire or Cable				Insulation Resistance (megohms) *	Initial s
			Quantity	Size	From	To		

*Minimum acceptable values:

Cable Rated <u>Voltage</u>	Test <u>Duration</u>	Resistance for <u>Cable Only</u>	Cable/Wire Size <u>or Amperage</u> (megohms)	Resistance When Cable <u>Connected to Equipment</u> (ohms)

 DISTRIBUTION: _____

CONTRACTOR/Date _____

INSULATION RESISTANCE (INSTRUMENT WIRE AND CABLE) TEST RECORD

TEST EQUIPMENT: _____ TEST VOLTAGE: _____
 TEST EQUIPMENT: _____ TEST VOLTAGE: _____
 AMBIENT TEMPERATURE: _____ °C _____ °F DATE: _____

- NOTES: 1. Record only the lowest value.
2. MP - Multi-pair cable. SP - Single pair cable.
3. Megger with instruments disconnected.
4. Use 250 volt (or lower voltage, when specified) range on DC test set.
5. Readings will vary with temperature and cable length.

Cable Number or Instrument Number	Indicate MP or SP Type (2)	Conductor to Conduit (Single Pair Non-Shielded Cables) (megohms)	Conductor to Conductor (megohms) (1)	Shield to Conductor to Shield (megohms) (1)	Overall Shield to Shield (Multipair Cables Only) (megohms) (1)	Lead and Armor (Multipair Cables Only) (megohms)	Shield to Conduit (Single Pair Cables Only) (megohms)	Initials

 DISTRIBUTION: _____ CONTRACTOR/Date _____

GROUND ELECTRODE TESTING TEST RECORD

TEST EQUIPMENT: _____ (Note 1) _____ (Note 2)

REFERENCE DRAWING: _____

- NOTES: 1. Record resistance-to-earth for each electrode with all other conductors disconnected. Resistance not to exceed 25 ohms for any single anode.
2. Check continuity from each electrode to any test bar or other electrode such that the complete ground loop is tested.

Rod Number	Resistance to Earth (ohms)	Ambient Temperature (°C/°F)	Weather	Taps	Initials/Date

 DISTRIBUTION: _____ CONTRACTOR/Date _____

NOTES: 1. Vessels, tanks, and structural steel bonded to the main grounding system, dedicated ground rod or foundation, as indicated on drawings listed below.

2. Measure resistance from ground wiretap (or anchor bolt) to tagged equipment frame or structural steel.

[illegible]

CONTRACTOR/Date _____

BONDING RESISTANCE READINGS (ELECTRICAL EQUIPMENT) TEST RECORD

TEST EQUIPMENT USED: _____ WEATHER: _____

NOTES: 1. Electrical equipment bonded to the main grounding system or dedicated ground rod, as indicated on drawings listed below.

2. Measure resistance from ground wiretap to tagged equipment bus bars, tagged equipment enclosures, and any other points indicated on the drawings.

[illegible]

DISTRIBUTION:

CONTRACTOR/Date _____

INSULATION RESISTANCE (ROTATING EQUIPMENT) TEST RECORD

TEST EQUIPMENT: _____ TEST VOLTAGE: _____
 AMBIENT TEMPERATURE: _____ °C _____ °F DATE: _____
 EQUIP. TEMP., IF KNOWN: _____ °C _____ °F HOW KNOWN: _____

- NOTES: 1. Use 1,000-V test set for equipment 600-volt and below, 2,500/5,000-V test set for equipment rated over 600 volts.
2. Test duration shall be 1 minute, note if otherwise: _____.
3. Isolate all motor leads from one another and from frame, test phase separately, wherever practical.
4. Document testing of low voltage and medium voltage equipment on separate sheets.
5. Readings will vary inversely with temperature. When the use of temperature correction factors is specified, attach second sheet with computed values. Indicate on each sheet "measured" or "temperature corrected."

Equip. Tag No.	INSULATION RESISTANCE (megohms) *						Rated Voltage	Equipment Initial/Date
	ØA to G	ØB to G	ØC to G	ØA to ØB	ØB to ØC	ØC to ØA		

*Minimum acceptable values:

VOLTAGE CLASS

RESISTANCE (megohms)

 DISTRIBUTION:

CONTRACTOR/Date _____

ELECTRIC MOTOR RUN-IN TEST RECORD

TEST EQUIPMENT: _____ REFERENCE DRAWING: _____

NOTES: 1. Duration of tests to comply with specifications.

TEST	REMARKS	INITIALS/DATE
RESISTANCE: Bonding resistance measured from motor frame to main ground/earth system tap. _____ ohms		
VOLTAGE: Actual voltage measured at Motor Control Center. _____ volts		
ROTATION CHECK: Bump motor to verify rotation. Motor to be uncoupled.		
NO LOAD CURRENT: At beginning of test _____ amps At end of test _____ amps		
TEMPERATURE OF BEARING: Check bearing for high temperature: Before start: 15 minutes after start 30 minutes after start 1 hour after start 2 hours after start 3 hours after start		
VIBRATION: Make visual inspection during run-test. Record any unusual vibration in remarks column.		
NOISE: Record any unusual noise in remarks column.		

DISTRIBUTION:

CONTRACTOR/Date _____

END OF SECTION

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SECTION 16955
CONTROL DEVICES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.
- B. Work Included: Furnish and install all control devices complete, including, as applicable, enclosures, engraved escutcheons or nameplates, gaskets, lenses, lamps and mounting provisions.

1.02 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. ICS1 General Standards for Industrial Controls and Systems
 - 2. ICS2 Standards for Industrial Control Devices, Controllers and Assemblies
 - 3. ICS6 Enclosures for Industrial Controls and Systems

1.03 SUBMITTALS

- A. Submit material or equipment data in accordance with the Product Review category of the General Conditions and the submittal requirements of Section 16010.

PART 2 - PRODUCTS

2.01 GENERAL

- A. All control devices shall conform to applicable provisions of NEMA Standards ICS1 and ICS2.

2.02 CONTROL AND TIMER RELAYS

- A. General: Relays shall be provided as necessary to perform switching functions required of control panels and other control circuits. Relays shall be of the following types (abbreviations in parentheses correspond to labels on the Drawings):
 - 1. Size 0 Magnetic Contactors (MS): Provide Size 0 magnetic contactors for driving Size 4 and Size 5 ac operated motor starters. Provide Size 0 contactors of the same type and manufacture as the motor starter contactors.
 - 2. Relays (CR):
 - a. Provide machine tool relays for the following applications:
 - 1) All relays driving 120 Vac motor starters up to and including Size 3.
 - 2) All relays driving non-motor loads up to 6 amps (or 720 VA).
 - b. Provide machine tool type relays with convertible contacts rated 10 amperes continuous with NEMA Rating Designation A600 for ac applications and N600 for dc applications. Coils shall be designed for

- continuous duty and shall have the voltage rating indicated on the Drawings.
- c. Relays shall be the magnetically held type unless designated otherwise on the Drawings. For each relay provide one spare Form C contact over and above the number indicated on the Drawings. In addition, for latching relays, provide coil clearing contacts as necessary.
 - d. Manufacturer: Square D, Class 8501, Type X; General Electric CR120B; or equal.
3. General Purpose Control (GR) or (AR) Relays (plug-in):
- a. Provide plug-in style 2-, 3-, or 4-pole enclosed relays with integral neon or LED indicators for the following applications:
 - 1) Relay logic (relays driving other relays, including machine tool relays) operating at voltages up to 120 Vac.
 - 2) Control power switching.
 - 3) All relays driving non-motor loads up to 2 amps (240 VA) at 120 Vac.
 - b. Provide relay sockets rated for 10 amp, 240 Vac with screw-type barriered terminals.
 - c. Manufacturer: Square D, Class 8501, Type R; Allen-Bradley Bulletin 700; or equal.
4. Timing Relays (TR) and (TD):
- a. General: Relays designated TR shall be machine tool industrial relays, while those designated as TD shall be general purpose plug-in time delay relays.
 - b. Timing Relay (TR): Timing relay shall be machine tool industrial relay with solid-state timer and external adjustment dial. Range shall be 0 to 120 seconds unless indicated otherwise on the Drawings. Relay shall include an LED indicator and instantaneous and time-delay contacts rated at 10 amps, meeting NEMA A600 designation. Timing relay shall be "on delay" or "off delay" as indicated on the Drawings and shall be Allen Bradley Type RT-RTA; Square D; or equal.
5. General Requirements:
- a. Provide relays rated for 1 million operations at 10 amp, 120 Vac, at power factor of 0.2.
 - b. Where timing relays are interfaced to motor starters or adjustable speed motor controllers, provide auxiliary machine-tool relays or Size 0 magnetic contactors. Refer to previous specifications for machine-tool relays and Size 0 magnetic contactors.
 - c. Where timing relays or control relays require additional contacts, provide auxiliary control relays, properly sized for the application as described previously in this Section.

2.03 ROTARY-ACTION SOLENOID DRUM PROGRAMMER (DP)

A. General:

- 1. Provide 12-position solenoid driven rotary-action drum programmer (stepping switch) where shown on the elementary diagrams. Provide step switch which advances one position as the solenoid is de-energized.
- 2. Provide a rotary tap switch which provides an input circuit for each step switch position.
- 3. Provide easily removable stackable switch assemblies. Provide easily settable switch trip positions. Provide switch contacts rated for 10 amps resistive load at 120 Vac.

- B. Manufacturer: Provide Eagle Signal Model MT12, ATC Series 1800; or equal.

2.11 ELAPSED TIME METERS (ETM)

- A. Elapsed time meters shall be of the synchronous motor-driven type having a minimum of six (6) decimal digits where the least significant digit shall represent tenths (1/10ths) of hours. Unless specified otherwise, they shall not be equipped with a reset button. They shall be for panel mounting with a square bezel approximately 2-1/2 inches on a side. Meter voltage shall be not more than 120 Vac for meters mounted in instrumentation panels. Elapsed time meters shall be ATC 5702; Yokogawa/General Electric Series 200; Type 240; or equal.

2.12 CONTROL PANEL ACCESSORIES

- A. Relays, timers and other internally mounted equipment shall be of the types specified in other sections of these Specifications.
- B. Panel face mounted equipment shall be of the types specified in other sections of these Specifications.
- C. Standards: All control devices shall conform to applicable provisions of NEMA Standards ICS 1 and ICS 2.
- D. Pushbuttons, Selector Switches and Pilot Lights:
 - 1. Shall be heavy-duty oiltight units; each unit shall have an engraved escutcheon plate unless nameplates are indicated on the Drawings or are necessary because of length of identification. Pushbuttons and selector switches shall have contacts rated 10 amperes continuous, Rating Designation A600 in conformance with NEMA ICS 2.
 - 2. Pushbuttons used as emergency stop devices shall have a padlockable means for maintaining an open circuit. Indicating lights shall be push-to-test transformer type with lenses of the colors shown on the Drawings.
- E. Multiposition control switches shall have rotary action, round knurled handle and the number of positions and stages shown on the Drawings. They shall be suitable for panel mounting. Each position shall have a positive detent. Contacts shall have a continuous current rating of 10 amperes at 300 Vac. Switches shall have integral indicator.
- F. For 4-20 mAdc and 1 to 5 Vdc signal selector switches, provide oiltight selector switches with electronic duty gold contact blocks. Provide sliding contacts for reliable operation without benefit of thermal cleaning action.
- G. Manufacturer: Provide Eaton HT series control devices, no equal to match existing facilities.
- H. Colors and Descriptions:
 - 1. Indicating Lamps: Unless otherwise noted on the Drawings, the following color code and inscriptions shall be followed for the lenses of all indicating lights.

Indicating Lamp Inscription	Color
ON/START	Green
OFF/STOP	Red
CLOSED	Red
LOW	Amber
FAIL	Red
HIGH	Amber
OPEN	Green
POWER ON	White
RESET	Red
AUTO	Blue

2. Lettering shall be black on white and amber lenses. Lettering shall be white on red and green lenses.
 3. Pushbuttons: Follow color coding for indicating lamp above.
 4. All unused or noninscribed buttons shall be black. Lettering shall be black on white and yellow buttons. Lettering shall be white on black, red and green buttons.
- I. Panel Lights and Receptacles: Panels shall be internally lighted by LED lamps, provided with guards and a toggle switch located convenient to each access door. One duplex GFI type receptacle shall be provided in each panel section per Section 16140. The lights and receptacles shall be wired to outgoing terminal blocks for 120 volt, 60 Hertz, single phase supply.
 - J. Nameplates: Unless specified otherwise in the Drawings, nameplates shall be black lamacoid with minimum 3/16-inch-high white letters for major area titles, 5/32-inch for component titles, and 1/8-inch for subtitles, and shall be fastened with a permanent but dissolvable adhesive or by screws.

PART 3 - EXECUTION

3.01 GENERAL

- A. Identify all control devices with engraved plastic nameplates or escutcheons, as applicable. Install control devices as recommended by the manufacturer.

END OF SECTION

SECTION 16961

POWER SYSTEM STUDIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Applicable provisions of Section 16010 become a part of this Section as if repeated herein.

1.02 SCOPE OF WORK

- A. Obtain the services of an independent firm to provide complete Short-Circuit and Protective Device Coordination studies, and Arc Flash Risk Assessment for the electrical system as defined below. The firm performing the work shall have been regularly engaged in short-circuit and protective device coordination services for a period of at least 10 years.
- B. The firm performing the work shall be responsible for the collection of all data required to perform the studies, including the electrical utility company's short-circuit current contribution.
- C. For the purpose of this specification Section, the "Electrical System" shall be defined as the entire power distribution system, including the utility company's main service disconnect down through the main circuit breaker on each 240/120VAC and 208/120 VAC panelboard of all distributed branch circuits. Some equipment not modified as part of this contract is required to be included in the studies defined in this Section. Items within the "Electrical System" are comprised of:
 - 1. Utility transformers
 - 2. All 480 VAC motor control center and motors
 - 3. All 480-208 VAC and 480-240 VAC transformers feeding panelboards
 - 4. All 208 VAC and 240 VAC panelboards including Service Pedestal.
- D. The Short-Circuit Study shall provide for the calculation of fault currents at each piece of gear in the Electrical System for the entire Site. Fault currents shall be calculated for scenarios of utility and standby power, as outlined in this Section.
- E. The Protective Device Coordination Study shall include trip characteristics for all protective devices in the Site Electrical System, from the utility company's main service disconnect through the main circuit breaker on each 208/120 VAC or 240/120V panelboard of all distributed branch circuits. Trip characteristics shall be analyzed for scenarios of utility and standby power, as outlined in this Section.
- F. The Arc Flash Risk Assessment shall provide for arc flash incident energy calculations at all panels as required by IEEE 1584 (2018 Edition) and NFPA 70E.
- G. Reports:
 - 1. Reports for the Short-Circuit Study, Protective Device Coordination Study, and Arc Flash Risk Assessment shall be stamped and signed by a California Registered Electrical Engineer.
 - 2. Report calculations shall be generated by a software analysis application with proven accuracy and reliability at performing 3-phase fault calculations.

1.03 REFERENCE STANDARDS

- A. Institute of Electrical and Electronics Engineers, Inc. (IEEE)
- B. American National Standards Institute (ANSI)
- C. The National Fire Protection Association (NFPA)
- D. InterNational Electrical Testing Association (NETA) Standard for Acceptance Testing Specifications (ATS)
- E. NFPA 70E, Standard for Electrical Safety in the Workplace
- F. IEEE 1584 (2018 Edition), Guide for Performing Arc-Flash Hazard Calculations
- G. Occupational Safety and Health Administration (OSHA) (29 CFR PART 1910), Occupational Safety and Health Standards for General Industry

1.04 SUBMITTALS

- A. Submit data in accordance with the Product Review category of the General Conditions and the submittal requirements of Section 16010.
- B. Submit credentials of firm performing the studies to demonstrate sufficient experience with performing this type of work, as specified herein.
- C. Preliminary: Preliminary Short-Circuit Study, Protective Device Coordination Study, and Arc Flash Risk Assessment shall be submitted to the Engineer for review prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.
- D. Results of the Short-Circuit Study, Protective Device Coordination Study, and Arc Flash Risk Assessment shall be summarized in a final report. Submit hardbound copies of the complete final report and one digital copy in PDF on a CD. Electronic delivery shall contain full searchable text, and include any computer models developed for the studies at no additional cost.
- E. Sample arc flash warning labels for each piece of equipment. Submit copies of labels at full size, with all required information as calculated by the Arc Flash Risk Assessment.

1.05 DATA COLLECTION

- A. The firm performing the Short-Circuit Study, Protective Device Coordination Study, and Arc Flash Risk Assessment shall furnish the Contractor with a listing of required data. The Contractor shall collect and furnish all required data. The Contractor shall expedite collection of the data to eliminate unnecessary delays and assure completion of the studies as required for final acceptance of the equipment shop drawings and/or prior to the release of the equipment for manufacturing.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS

- A. The Short-Circuit Study and Protective Device Coordination Study shall be performed as outlined in InterNational Electrical Testing Association (NETA) Standard for Acceptance Testing Specifications, Section 6 with exceptions as included in this Section.
- B. In order to select relays and fuse characteristics as required for optimum coordination, the coordination study shall be performed as soon as the vendors for the new electrical equipment are identified. Relays and fuse selection by the power distribution equipment suppliers shall be based on the results of the favorably reviewed study.
- C. The studies shall be submitted to the Engineer for acceptance before final acceptance of power distribution equipment submittals and before any settings are made on equipment.
- D. The final report for the Short-Circuit Study, Protective Device Coordination Study, and Arc Flash Risk Assessment shall be bound in a standard 8 1/2-inch by 11 inch sized report. The selection of all protective relay types, current transformers, and fuse types and ratings shall be the responsibility of the manufacturer and shall be based on the preliminary draft of the coordination study, which shall be submitted with the equipment shop drawings (or earlier). The studies shall be accepted by the Engineer before any equipment is shipped. See Paragraph 1.04 for submittal requirements.
- E. The report shall include a single line diagram depicting the entire Electrical System included in the analysis. At a minimum, the single line diagram shall be on an 11-inch by 17-inch sheet, and include the following information:
 - 1. Equipment/bus tags which match the contract documents
 - 2. Equipment/bus ampacity ratings
 - 3. Motor horsepower
 - 4. Protective device frame rating, trip setting, and curve options, as applicable
 - 5. Transformer primary/secondary voltages, kVA rating, and impedance
 - 6. Conductor materials, insulation types, and lengths
- F. The studies shall be run on each of the following scenarios:
 - 1. Utility power
 - 2. Generator power

3.02 SHORT-CIRCUIT STUDY

- A. Provide a complete Short-Circuit Study. The study shall include, but shall not be limited to, the following, as applicable:
 - 1. Full compliance with applicable ANSI and IEEE Standards.
 - 2. Performed on nationally recognized computer software, such as ETAP or SKM Power Tools.
 - 3. Overall system impedance diagram. The diagram shall include the power company's impedance and X/R ratios and circuit element impedances (e.g., transformers, generators, motors, VFDs, RVSS, feeders, distribution buses as applicable).

4. Available three phase and ground fault asymmetrical and symmetrical short-circuit fault currents at each piece of electrical equipment, bus, transformer, etc.
5. The momentary and interrupting rating of all elements of the distribution system shall be listed. The maximum available short-circuit fault current available at each element shall be calculated.
6. Executive summary describing the distribution system, the procedures used to develop the study, utility related information furnished by the utility company, including the name and telephone number of the individual supplying the information, identification of all assumptions made in the preparation of the study, identification of any problem areas, and a definitive statement concerning the adequacy of the distribution system to interrupt and withstand the maximum possible short-circuit fault current.
7. Computer printouts for the three phase, single phase and ground fault studies. Printouts shall indicate the short-circuit fault current available at each major equipment and distribution bus within the medium and low voltage distribution systems.

3.03 PROTECTIVE DEVICE COORDINATION STUDY

- A. Provide a complete Protective Device Coordination Study. The Protective Device Coordination Study shall include, but shall not be limited to:
 1. Utility protective devices.
 2. Service entrance and distribution switchgear.
 3. Medium and low voltage power system transformers.
 4. Low voltage switchgear, switchboards, power distribution panels and motor control centers.
 5. Power factor correction and harmonic mitigation equipment.
 6. Motor starters and variable frequency drives.
 7. Standby generators.
 8. A tabulation of all the settings for every over current protective device, timer, power system relays (e.g., ANSI 50, 51), circuit breaker, recommended fuse and current transformer ratings, etc.
 9. Transformer excitation current.
 10. Motor and cable damage curves in accordance with the manufacturer's recommendations.
 11. Select relay types (e.g., inverse, very inverse, extremely inverse, overcurrent with or without voltage restraint, timers), current transformer ratings and types, fuse, residually or zero sequence connected ground faults protection, etc. that will allow the system to be protected within the equipment fault ratings and provide the maximum possible coordination between the protective devices.
 12. Provide recommended settings for protective devices, such as relays and circuit breakers, to achieve the best selectivity to minimize system disturbances during fault clearing.
 13. Provide a complete set of time-current coordination curves on log-log paper for every protective relay, circuit breaker, fuse, timer, etc. serving or located in the electrical equipment furnished for the project, including the utility protective devices. Provide a separate time-current curve for each unique feeder system, without displaying parallel devices powered from a common bus. The time-current curves shall display the coordination from the lowest device in the distribution system up through the utility's protective device. Clearly identify each device curve displayed on the graph, by color coding

and text callouts. Include specific settings used for the curve (as applicable) in the text callout. A single line diagram depicting the portion of the distribution system under study shall appear with each curve. The minimum size log paper to be submitted shall be 11-inch by 17-inch.

14. Time current curves shall include transformer ANSI damage and inrush curves, cable damage curves, circuit breaker and fuse ratings and settings, protective relay settings, and any other information required by ANSI and good design practices. As a minimum, provide curves for:
 - a. Each medium voltage and low voltage feeder down to 480-volt motor control centers and panelboards.
 - b. Each main, tie and feeder circuit breakers located in medium voltage and low voltage switchgear, motor control centers and panelboard. Include the largest feeder circuit breaker in each motor control center and panelboard.
 - c. Each ground fault protective device provided for the medium voltage and low voltage power distribution systems.

- B. The report shall include a reference to any part of the Electrical System where selectivity cannot be achieved, and a brief explanation of the cause. Provide recommendations where applicable for alternate methods that would improve selectivity.

3.04 ARC FLASH RISK ASSESSMENT

- A. Provide a detailed Arc Flash Risk Assessment. The analysis shall include, but shall not be limited to:
 1. Determine potential arc flash incident energies, arc flash boundaries, shock hazard boundaries and proper personal protection equipment (PPE) for all energized electrical equipment.
 2. The study shall determine worst-case scenarios for the arc flash energy level calculations, and any suggested changes to the protection scheme or equipment selection that will result in improved system reliability and safety.
 3. The study shall indicate the worst-case values for each of the scenarios listed in Paragraph 3.01F. Provide values in tabular format including at a minimum, location of fault, incident energy, arc flash boundary, working distance, acting protective device, protective device activation time, and arcing fault current.
 4. Provide executive summary, including introduction, methodology, information sources, key assumptions, NFPA 70E considerations and calculations.
 5. Develop and install arc flash warning labels based on arc flash study results.

3.05 FIELD ADJUSTMENT

- A. All field adjustment and modifications shall be performed in the presence of the Owner, before energizing equipment.
- B. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments shall be completed by the equipment manufacturer.
- C. Make minor modifications to equipment as required to accomplish conformance with Short-Circuit and Protective Device Coordination studies.

3.06 MODIFICATIONS

- A. Notify the Owner in writing of any required major equipment modifications. Major modifications to the equipment shall not be allowed unless otherwise approved in writing by the Engineer and the Owner.

3.07 ARC FLASH WARNING LABELS

- A. The vendor shall provide a 4 inch by 4 inch thermal transfer type label of high adhesion polyester for each work location analyzed. Labels shall be machine printed, with no field markings.
- B. The label shall have an orange header, compliant with ANSI Z535, with the wording, "WARNING, SHOCK & ARC FLASH HAZARD", and shall include the following information:
 - 1. Location designation (equipment identification tag)
 - 2. Nominal voltage
 - 3. Arc flash boundary
 - 4. Incident energy at working distance (in calories/centimeter-squared)
 - 5. Working distance
 - 6. Shock boundaries
 - a. Limited approach distance
 - b. Restricted approach distance
 - 7. Required personal protective equipment,
 - 8. Engineering report number, revision number and issue date.
 - 9. Where voltage exceeds 600 VAC or incident energy is greater than 40 cal/cm², label header shall be changed to "DANGER, SHOCK & ARC FLASH HAZARD."
- C. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
 - 1. For each 600, 480 and applicable 240 and 208 VAC panelboards and disconnects, one arc flash label shall be provided.
 - 2. For each industrial control panel, provide one arc flash label.
 - 3. For each transformer, provide one arc flash label at both the front and rear access points, as applicable.
 - 4. For each low voltage motor control center, at least one arc flash label shall be provided. Motor control centers larger than five sections shall bear one arc flash label for each five sections. Back-to-back or turned corner configurations shall be treated as two motor control centers for the purpose of labeling.
 - 5. Where equipment includes a "maintenance mode" bypass setting on a protective device as a temporary arc-flash reduction measure, provide one arc flash label at the applicable protective device which indicates the calculated values when maintenance mode is enabled. This label shall be clearly marked to indicate what it represents.
- D. The Contractor shall affix the labels in accordance with the following:
 - 1. Labels shall be in a clearly visible location on the front panel of the equipment near the incoming service or main protective device. Labels on equipment with bottom-entry incoming service shall be placed a minimum of 60-inches from the bottom of the equipment.
 - 2. Labels affixed to outdoor equipment which includes an outer door and inner deadfront panel shall be placed on the deadfront panel to avoid fading due to exposure to the elements.

3. For labels affixed to removable compartment doors or covers, the removable cover shall be clearly marked to identify the specific compartment for which it is intended to be used.

3.08 ARC FLASH TRAINING

- A. The equipment manufacturer shall provide arc flash training to the Owner's staff. At a minimum, the training shall include potential arc flash hazards associated with working on energized equipment and maintenance procedures in accordance with the requirements of NFPA 70E, Standard For Electrical Safety Requirements For Employee Workplaces. The training shall be recorded in a video format and provided on a DVD or solid-state media to the Owner.

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SECTION 17010

INSTRUMENTATION AND CONTROLS, GENERAL REQUIREMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Work Included:

1. Provide all tools, equipment, materials, and supplies and be responsible for all labor required to complete the installation, startup and operational testing of a complete and operable Instrumentation and Control (I&C) System as indicated on the Drawings and as specified herein.
2. Provide all the necessary equipment components and interconnections along with the services of manufacturers' engineering representatives necessary to ensure that the Owner receives a completely integrated and operational I&C system as herein specified.
3. Provide all terminations for wiring at field-mounted instruments, equipment enclosures, alarm, and status contacts.
4. Provide all Instrumentation and Control wire required for a fully functioning Instrumentation and Controls System as shown on the Drawings except for wire specifically specified in Division 16. See Section 16010.
5. Coordinate all work with TESCO Controls, the I&C Subcontractor responsible for PLC and HMI SCADA programming.

B. Work Specified in Other Divisions:

1. Process piping, installation of inline instrumentation, gas monitors, chlorinators and sulfonators, air compressors, main air supply headers, and other mechanical work and equipment as specified in Divisions 11, 13, 14, or 15.
2. Instruments and controls which are not directly used for process control, i.e., those provided as part of a package system, such as a boiler, air compressor, etc. as specified in Divisions 11, 13, 14, 15, or 16.
3. Division 16 work, including all instrumentation and controls conduit, and only that wire specified in Division 16. Refer to Division 16 Specifications for specific requirements for wire, conduit, grounding, and other electrical equipment.
4. Final control elements as specified in Section 15050.
5. General mechanical requirements as specified in Section 11001.

1.02 REFERENCE STANDARDS

A. American National Standard Institute (ANSI) Publications:

1. Y14.15a Drafting Practice
2. C62.1 Surge Arrestors

B. Instrumentation Society of America (ISA) Publications:

1. S5.4 Instrument Loop Diagrams
2. S20 Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves

1.03 I&C SUBCONTRACTOR QUALIFICATIONS

- A. An I&C Subcontractor shall be an electrical contractor who has demonstrated experience in purchasing, calibrating, fabricating, installing and testing the Instrumentation and Control (I&C) products listed in this Specification Section. Normally, the I&C Subcontractor is a systems house regularly engaged in the business of panel fabrication, control component procurement, programmable logic controller and personal computer (PC) application in the process control industry.
- B. The I&C Subcontractor has been regularly engaged for a period greater than five years in performing all aspects of the type of work specified in this Section and shown on the Drawings and must prequalify as specified below.

1.04 I&C SUBCONTRACTOR SYSTEM RESPONSIBILITIES

- A. General: The I&C equipment as specified in this Division shall be considered an integrated system. Entire system installation including calibration, verification, startup, operation testing, and training shall be performed by qualified personnel, possessing all the necessary skills and equipment, and who have had experience performing similar installations. Instrumentation and control systems drawings are diagrammatic only; it is the responsibility of the Contractor to obtain technical data, determine performance requirements, develop instrumentation detail installation designs, and coordinate the selection of specified equipment with Contractor supplied equipment to meet the design conditions stated.
- B. System Responsibilities:
 - 1. Instrumentation and control system drawings are diagrammatic only. Ensure that all components of the instrumentation system, including primary measuring, indicating, transmitting, receiving, recording, totalizing, controlling, and alarming devices and all appurtenances are completely compatible and shall function as outlined and shall furnish and install such additional equipment, accessories, etc., as are necessary to meet these objectives at no cost to the Owner.
 - 2. Compatibility: See that all components of the instrumentation system, including equipment specified under other Divisions, are completely compatible and function properly as a system. Provide such additional equipment, accessories, etc., as are necessary to meet these objectives at no cost to the Owner.
 - 3. Coordination: For control components, devices, and systems specified in Divisions 11, 12, 13, 14, 15, 16, and 17 or shown on the Drawings.
 - a. Provide technical advice to mechanical and electrical subcontractors as necessary regarding their installation of instruments.
 - b. Verify the correctness of installation of all instruments.
 - c. Verify that the proper type, size, and number of control wires with their conduits are provided.
 - d. Verify that the proper type, size, and number of pneumatic tubes with their conduits are provided.
 - e. Verify that proper electric power circuits provided for all components and systems.
 - f. Resolve all manufacturers' installation discrepancies between requirements and the detail requirements of the Drawings and Specifications.

- g. Supervise final signal connections, both electric and pneumatic, to all process instrumentation and control equipment.
 - h. Adjust, startup, and test all process instrumentation and control equipment.
 - i. Provide specified documentation and training.
 - 4. Performance: While the Drawings provide sufficient information to establish the form and function of the systems and their relationships, the responsibility for system integration and performance rests solely with the Contractor. The Engineer provides technical instruction and guidance where needed.
 - 5. Site and Instrument Inspection: Inspect site for conformance to Drawings, paying special attention to space allocation and dimensions shown or required on Drawings. Inspect completed work and verify that it is ready for installation of instruments and equipment. Inspect each instrument and piece of equipment for damage, defects, completeness, and correct operation before installing.
- C. PLC and SCADA System Coordination: Coordinate work including testing plans with TESCO Controls, the I&C Subcontractor. Refer to Section 17330.

1.05 SUBMITTALS

- A. Refer to Section 01300 for required method of preparation and transmittal, and conform to requirements herein.
- B. Shop Drawings: Submit shop drawings (diagrams) for review in complete bound sets indexed by Specification number, with exterior tabs marked by subject. Submit manufacturer's catalog cuts for each item for which shop drawings are not required. Manufacturer's catalog cuts, specifications or data sheets shall be clearly marked to delineate the options or styles to be furnished. Show dimensions, physical configurations, methods of connecting instruments together, mounting details, and wiring schematics. Drawings shall be complete with device tag numbers, wire numbers and terminal board numbers. Submit fabrication details, nameplate legends, and control panel internal wiring and piping schematic drawings. Submit panel graphic drawings where applicable. Include material lists and/or bills of material.
 - 1. Interconnection Diagrams: Submit point-to-point type interconnection diagrams conforming to ANSI Y14.15a. Include each conduit run, with wirefill noted for each run. Include electric panel and circuit numbers for all sources of 120 Vac power. Show conduit and wiring interconnections between each control panel, instrument, multiplexer or telemetry unit, motor control center, motor combination starter, motor, valve actuator, and other field-mounted device. Include all equipment and appurtenances provided in this contract regardless of the Division in which it is specified.
 - 2. Elementary Diagrams: Submit an elementary diagram (also known as a schematic diagram) for control, protection, and monitoring circuits. Elementary diagrams are not required for lighting, communications and those systems clearly defined on the single line diagram. Show all interconnections between power sources, apparatus, and device elements of a particular system or equipment, and all interlocks with other systems in a manner, which fully indicates circuit function and operation. Refer to the Drawings for functional and operational requirements.
- C. Specification Forms:

1. Submit completed Specification Forms per ISA S20, including those instrumentation and control components directly related to process control, but specified in other Divisions of these Specifications.
 2. Include on each form the assigned tag numbers, manufacturer's part numbers, and device data. More than one tag numbered item may be included on a sheet.
- D. As-Built Drawings: Submit a revised set of shop drawings that incorporates all change orders and modifications made during performance of the work. In addition to updated loop diagrams, interconnect diagrams and elementary diagrams, submit equipment and device wiring diagrams and other drawings as necessary to depict the "as-built" condition of equipment. Include all installed field and panel conduit and piping/tubing runs and routing, tray systems, supports, mounting details, interconnection diagrams with cable, wire, tube and termination numbers. Coordinate all drawings with the conductor identification requirements in Section 16120 and Section 16124. Submit a copy of CAD produced drawings on magnetic media in AutoCAD DWG format.
- E. Operation and Maintenance Manuals: Furnish Operation and Maintenance Manuals, including Instruction Manuals and Part Lists, for equipment provided under Division 17 as required by Division 1. Obtain data from manufacturers, and format and bind as specified. Obtain distribution method instructions from the Owner or his representative.
1. Schedule: Deliver at least two (2) copies of manuals in 3-ring binders (8-1/2 by 11-inch format) not later than the equipment shipment date.
 2. Contents: Include in manuals not less than the following information, as applicable, for each instrument, equipment, subsystem and/or control loop:
 - a. General, introduction and overall description, purpose, functions, simplified theory of operations, etc.
 - b. Specifications (including equipment specification data sheet as described above under Shop Drawings), sufficiently detailed for reordering exact duplicates of the original items.
 - c. Installation instructions, procedures, sequences, tolerances, and precautions.
 - d. Operational procedures.
 - e. Shutdown procedures.
 - f. Maintenance, calibration, and repair instructions.
 - g. Parts list and spare parts recommendations.
 - i. Software programs (PLC Ladder Logic) files and hard copies.
 - j. Operator Interface screens. Wonderware files and hard copies.
 3. Format:
 - a. Use drawings and pictorials to illustrate the text to the extent necessary to insure a clear, concise presentation. If manuals have been written to cover a family of similar instruments or equipment, strike out inapplicable information in a neat fashion or emphasize applicable portion by heavily weighted arrows, circles or boxes; whichever provides the clearest and neatest presentation.
 - b. Group manuals by system control panels, including field instrumentation connected or associated with the panel. Where identical instruments are used in more than one control loop or subsystem, include only one

- instruction manual, per panel grouping; however, an index by tag number for all instruments shall identify its location in that manual.
- c. Provide control loop and/or subsystem operational descriptions to identify the function of each instrument and its relation to the other instruments in the loop.
 4. Binding: Bind each manual in a cover which indicates the panel or process area to which it applies, manufacturer's name, local address and telephone number, and year of purchase. Punch and bind manuals in standard three ring binders and include system name and subcontractor's name on binding.
- F. Test Reports: Submit the following test reports as described herein:
1. Instrument Calibration Data Sheets (para. 2.12)
 2. Factory Testing of Control Panels (para. 2.13)
 3. Instrument Verification Report (para. 3.06.C)
 4. Final Operational Testing (para. 3.06.D)
- G. Submit a construction and Test Plan for implementing the construction sequence described in Section 01010-1.07 of the Specification.
- H. Demonstration and Final Operation Test Plan and Results: Submit a document that outlines all procedures to be used in final operational testing of instrument and control systems. Include a description of each system, the scope of testing, test methods and materials, testing instruments and recorders, a list of functional parameters to be recorded on each item, and Shop Drawings showing temporary bypasses, jumpers, and devices.
- I. The Test Plan shall be jointly produced by TESCO Controls and the I&C subcontractor.

1.06 QUALITY ASSURANCE

- A. Standard of Quality: The Contractor shall provide equipment of the types and sizes specified which has been demonstrated to operate successfully. Provide equipment which is new and of recent proven design.

1.07 INSPECTIONS

- A. The Engineer may inspect the fabricated equipment at the factory before shipment to job site. Provide the Engineer with sufficient prior notice so that an inspection can be arranged at the factory.
- B. Inspection of the equipment at the factory by the Engineer will be made after the manufacturer has performed satisfactory checks, adjustments, tests and operations.
- C. Favorable review of the equipment at the factory only allows the manufacturer to ship the equipment to the project site. The Contractor shall be responsible for the proper installation and satisfactory startup operation of the equipment to the satisfaction of the manufacturer and the Engineer.

1.08 DRAWINGS

- A. Drawings: The Instrumentation Drawings are diagrammatic; exact locations of instrumentation products shall be determined in the field by the Engineer. Except where special details are used to illustrate the method of installation of a particular piece or type of equipment or material, the requirements or descriptions in this Specification shall take precedence in the event of conflict.
 - 1. Locations of equipment, inserts, anchors, motors, panels, pull boxes, manholes, conduits, stub-ups, fittings, power and convenience outlets, and ground wells are approximate unless dimensioned; verify locations with the Engineer prior to installation. Field verify scaled dimensions on Drawings.
 - 2. Review the Drawings and Specification Divisions of other trades and perform the instrumentation work that will be required for the installations.
 - 3. Should there be a need to deviate from the Instrumentation Drawings and Specifications, submit written details and reasons for all changes to the Engineer for favorable review.
 - 4. Resolution of varying interpretations of the Contract Documents shall conform to Division 0, General and Supplementary Conditions.
 - 5. The Drawings provide details of installation and supersede the manufacturer's recommendation where a conflict exists.

1.09 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Box, crate, or otherwise enclose and protect instruments and equipment during shipment, handling, and storage. Keep all equipment dry and covered from exposure to weather, moisture, corrosive liquids and gases or any element, which could degrade the equipment. Protect painted surfaces against impact, abrasion, discoloration, and other damage. Notify the Engineer in writing in the event that any equipment or material is damaged. Obtain prior favorable review by the Engineer before making repairs to damaged products.

1.10 INSTRUMENT SCHEDULE

- A. See Appendix B for Instrument Schedule.

PART 2 - PRODUCTS

2.01 MATERIALS AND STANDARD SPECIFICATIONS

- A. Provide instruments, equipment and materials suitable for service conditions and meeting standard specifications such as ANSI, ASTM, ISA, and SAMA. The intent of this Specification is to secure instruments and equipment of a uniform quality and manufacture throughout the plant. All instruments in the plant of the same type shall be made by the same manufacturer.

2.02 NAMEPLATES

- A. For each piece of equipment, provide a manufacturer's nameplate showing his name, location, the pertinent ratings and the model designation.

- B. Identify each piece of equipment and related controls with a rigid laminated engraved phenolic nameplate. Engrave nameplates with the inscriptions indicated on the Drawings and, if not so indicated, with the equipment name. Securely fasten nameplates in place using two stainless steel screws or, where favorably reviewed by the Engineer, with epoxy cement. Where no inscription is indicated on the Drawings, furnish nameplates with an appropriate inscription furnished by the Engineer upon prior request by the Contractor.
- C. Each control device, including pushbuttons, control switches, and indicating lights, shall have an integral legend plate or nameplate indicating the device function. These shall be inscribed as indicated on the Drawings or as favorably reviewed by the Engineer.
- D. Provide CAUTION or SAFETY nameplates to alert operators of special conditions that may result in faulty equipment operations. Devices containing batteries that must be replaced periodically must be clearly identified. Nameplates are not required if the device senses and displays a low battery warning.

2.03 NAME TAGS

- A. All instrumentation and equipment items or systems shall be identified by nametags. Field equipment shall be tagged with the assigned instrumentation tag number listed in the Instrument Schedule.
- B. Name tags shall be stainless steel with engraved or stamped black characters of 3/16-inch minimum height. Tags shall be attached to equipment with a tag holder and stainless steel band with a worm screw clamping device. Use 20-gauge stainless steel wire where banding is impractical. For field panels or large equipment cases use stainless steel screws; however, such permanent attachment shall not be on an ordinarily replaceable part.

2.04 FIELD-MOUNTED EQUIPMENT

- A. All instrument and control equipment mounted outside of protective structures shall be equipped with suitable surge arresting devices to protect the equipment from damage due to electrical transients induced in the interconnecting lines from lightning discharges or nearby electrical devices. Protective devices used on 120 Vac inputs to field mounted equipment shall be secondary valve surge protectors conforming to the requirements of ANSI C62.1.

2.05 EQUIPMENT OPERATING CONDITIONS

- A. All equipment shall be rated for normal operating performance with varying operating conditions over the following minimum ranges:
 - 1. Electrical Power: 120 Vac $\pm 10\%$, 60 Hz, unregulated, except where specifically stated otherwise on the Drawings or in the Specifications, or when two-wire, loop-powered devices are specified.
 - 2. Air: 85 psig, ± 5 psig
 - 3. Field Instruments:
 - a. Outdoor Areas:
Ambient Temperature: $+15^{\circ}\text{F}$ to $+120^{\circ}\text{F}$

- Ambient Relative Humidity: 5% to 100%
- Weather: Rain, sleet, snow and ice
- b. Indoor Unheated Areas:
 - Ambient Temperature: +40°F to +120°F
 - Ambient Relative Humidity: 5% to 95%, non-condensing
- c. Indoor Environmentally Controlled Areas:
 - Ambient Temperature: +60°F to +104°F
 - Ambient Relative Humidity: 10% to 90%, non-condensing

2.06 EQUIPMENT LOCATIONS

- A. Provide equipment and materials suitable for the types of locations in which they are located as defined under Division 16. All equipment specified for field mounting shall be weatherproof and splash proof as a minimum. If electrical or electronic components are contained within the equipment, they shall be housed in NEMA 3R gasketed cases outside, NEMA 4X in wet, damp or corrosive locations, and NEMA 7 in hazardous locations unless noted otherwise on the Drawings.

2.07 ANALOG SIGNAL INDICATED UNITS

- A. For all instruments with local or remote indicators, provide indicators scaled in actual engineering units, i.e., gallons per minute, feet, psi, etc., rather than 0 to 100%, unless noted otherwise on the Drawings or Instrument Schedule.

2.08 SIGNAL TRANSMISSION

- A. Analog:
 - 1. Signal transmission between electric or electronic instruments shall be 4-20 mA and shall operate at 24 Vdc. Signal output from all transmitters and controllers shall be current regulated and shall not be affected by changes in load resistance within the unit's rating. Where practical, milliampere signals from the field shall be converted to a voltage signal at the external terminals of each panel, and all instruments within a panel shall be parallel wired.
 - 2. Nonstandard transmission systems such as impulse duration, pulse rate, and voltage regulated will not be permitted except where specifically noted in the Instrument Schedule or shown on the Drawings. When transmitters with nonstandard outputs do occur, their output shall be converted to 4-20 mA prior to transmission.
- B. Discrete: All alarm and status signals shall be 120 Vac unless specified otherwise on the Instrument Schedule.
- C. Proprietary data highway or serial bit transmissions such as RS232C, etc. shall be allowed to the extent shown on the Drawings.

2.09 PAINTING

- A. Factory paint all instruments and equipment except where installed in pipelines. Where instrument panels are installed adjacent to electrical control panels provided under Division 16, provide instrument panels of identical color to that of electrical control panels. Paint as required in Division 9 for structural supports, brackets, etc.

Repair damaged factory paint to satisfaction of the Engineer. Feathering, priming and painting shall produce a reasonable match to the surrounding paint work.

2.10 FASTENERS

- A. Fasteners for securing equipment to walls, floors and the like shall be either hot-dip galvanized after fabrication or stainless steel. Provide stainless steel fasteners in corrosive locations. When fastening to existing walls, floors, and the like, provide capsule anchors, not expansion shields. Size capsule anchors to meet load requirements. Minimum size capsule anchor bolt is 3/8-inch.

2.11 INTRUSION SWITCHES

- A. Intrusion switches shall be outdoor type housed in a cast metal enclosure, UL listed with NPT conduit connection. Switch shall be corrosion resistant, 2 circuit, Normally Closed type, rated for 120 VAC switching voltage. Intrusion switches shall be Allen Bradley Series 802MC, or equal.

2.12 INSTRUMENT CALIBRATION

- A. Each field instrument shall be calibrated at 0%, 25%, 50%, 75% and 100% of span using test instruments to simulate inputs and read outputs that are rated to an accuracy of at least 5 times greater than the specified accuracy of the instrument being calibrated. Such test instruments have accuracies traceable to the National Institute of Standards and Technology (NIST).
- B. Submit a written report to the Engineer on each instrument. This report shall include a laboratory calibration sheet or the manufacturer's standards calibration sheet on each instrument and calibration reading as finally adjusted within tolerances.
- C. The Contractor may, at his option, choose to perform calibration on an instrument by acquiring the services of an independent test lab, or by obtaining the required test instruments and performing the calibration.

2.13 FACTORY TESTING OF CONTROL PANELS

- A. All fabricated equipment shall be tested before it leaves the factory. At the factory verify wiring continuity and equipment operation by simulating input and output.
- B. Factory testing of control panels/devices/equipment shall be accomplished. Refer to individual Specification sections for tests requiring favorable review.
- C. Upon completion of factory testing, submit a report certifying the control panels/devices/equipment are operable and meet the Specifications.

PART 3 - EXECUTION

3.01 EQUIPMENT MOUNTINGS

- A. Mount and install equipment as indicated. Mount field instruments on pipe mounts or other similar means in accordance with suppliers' recommendation. Where mounted in control panels, mount according to requirements of that section.
- B. Equipment specified for field mounting shall be suitable for direct pipe mounting or surface mounting, surface-mounted indicators and equipment with calibration adjustments or requiring periodic inspection shall be mounted not lower than 3 feet 6 inches nor higher than 6 feet above walkways, platforms, catwalks, and the like.
- C. Note that applicable specifications require detail drawings showing seismic sway bracing design and anchorage requirements for their equipment. Seismic zone requirements are specified in Division 1.
- D. All devices shall be accessible to operators for servicing, operating, reading, etc. Provide permanent platforms to assure devices are continuously accessible.

3.02 PROCESS CONNECTIONS

- A. Provide instrument impulse tubing (see Part 2) to meet the intended process service and ambient environmental condition for corrosion resistance, etc. Install impulse tubing with a continuous slope according to service to promote self-draining or venting back to the process. Terminate connection to process lines or vessels in a service rated roof valve, provided under other Divisions, that will permit closing off the impulse line or removal of the element without requiring shut down of the process. Include blowdown of drip legs and valves for terminations of impulse lines at the instruments.
- B. Process vessels, line penetrations, and root valves shall be furnished and installed under other Divisions of these Specifications. Instrument tubing, valve manifolds, and test taps are installed as part of this Specification.

3.03 FIELD WIRING

- A. Ring out signal wiring prior to termination and perform surge withstand tests where required (see Section 16010, Part 3 for methods). Verify wire number and terminations are satisfactory as designated on the Loop and Interconnect Diagrams. Verify all terminations are tight and shields are uniformly grounded at one location.

3.04 ELECTROMAGNETIC INTERFERENCE (EMI)

- A. Construction shall proceed in a manner which minimizes the introduction of noise (RFI/EMI) into the I&C System.
- B. Cross signal wires and wires carrying ac power or control signals at right angles.
- C. Separate signal wires from wires carrying ac power or switched ac/dc control signals within control panels, terminal cabinets, telemetry equipment, multiplexer cabinets, and data loggers as much as possible. Provide the following minimum separations within such equipment unless indicated otherwise on the Drawings:

Power Wiring Capacity	Separation (Inches)

120 volts ac or 10 amps	12
240 volts ac or 50 amps	18
480 volts ac or 200 amps	24
4,160 volts ac or 800 amps	48

3.05 SIGNAL GROUNDING

- A. Proper grounding of equipment and systems in this Division is critical. The Drawings and Division 16, Section 16450, specify safety grounding for all equipment in this Division.
- B. A single-point grounding system for instrument signals is required for all instrument panels. This instrument single point grounding system does not use building steel or conduit systems for its ground path.
 - 1. Ground all signal shields, signal grounds, and power supplies at an isolated signal bus within each instrument panel, rack, or enclosure. See Section 17510 for isolated bus requirements. The shields at the far ends of these signal cables must be disconnected (floated) from any ground to prevent ground loops.

3.06 FIELD TESTING

- A. General: The purpose of the field testing is to verify instruments are calibrated and operationally performing their intended function. Provide the services of factory trained and experienced engineers to perform verification and operational testing as prescribed below. Since the initial calibration of instruments may not satisfy the final operation of system, perform recalibration or adjust setpoints as required to satisfy the performance requirements of the system. Notify the Engineer in writing a minimum of 48 hours prior to the proposed date for commencing final operational testing and acceptance.
- B. Coordinate with Tesco Controls, programming subcontractor, for testing of all PLC and SCADA functions. Testing and scheduling shall be coordinated with TESCO Controls and Engineer.
- C. System Verification Testing: Verify that each instrument shown on the Instrument Schedule is operating and calibrated as specified in the Instrument Schedule by simulating inputs at the primary element in each system loop and verify performance at loop output devices (i.e. recorder, indicator, alarm, etc., except controllers). Simulate inputs at 0%, 25%, 50%, 75%, and 100% of span or with on-off inputs, as applicable. During system verification:
 - 1. Make initial or provisional settings on levels, alarms, etc. listed in the Instrument Schedule.
 - 2. Verify controllers by observing that the final control element moves in the proper direction to correct the process variable as compared to the set point.
 - 3. Cause malfunctions to sound alarms or switch to standby to check system operation.
 - 4. Check all loop instruments thoroughly for correct operation.
 - 5. Immediately correct all defects and malfunctions disclosed by tests.
 - 6. Submit a report certifying completion of verification of each instrument system. This report shall include a data sheet on each instrument tested that indicates

instrument tolerances, instrument calibration verification, data and initial settings made to devices.

- D. Final Operational Testing: Upon completion of instrument verification, test all systems under process conditions in the presence of the Engineer and Tesco Controls. System testing shall be accomplished in accordance with the approved Test Plan (Paragraph 1.05H). The test for each portion thereof shall be witnessed, documented and signed off upon completion by the Engineer. The intent of this test is to demonstrate and certify the operational interrelationship of plant instrumentation and control systems. This testing shall include, but not be limited to:
1. Making final adjustments to levels, alarms, etc.
 2. Checking all alarms, failure interlocks, and operational interlocks.
 3. Immediately correcting all defects and malfunctions and retesting.
 4. Submit the witnessed test results and a transmittal letter indicating that all required systems have been tested satisfactorily and the systems meet all the functional requirements of their applicable specifications.

3.08 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide the services of a factory trained and field experienced instrumentation engineer to conduct group training of up to ten of the Owner's designated personnel in the operation of each instrument system. This training shall be for the time period of up to two working days and shall be performed during the operational testing period. Include instruction covering basic system theory, operating principles and adjustments, routine maintenance and repair, and "hands on" operation. The text for this training shall be the Operation and Maintenance Manuals furnished under these Specifications.

END OF SECTION

INSTRUMENTATION SCHEDULE

ATTACHMENT TO SPECIFICATION SECTION 17010

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SECTION 17140

LEVEL MEASUREMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Requirements of Division 1 and Section 17010 form a part of this Section.
- B. Work Included: Level measurement devices for process instrumentation, auxiliary equipment and supplies directly related to the installation of and operation of these level measurement devices, to perform the required functions in conjunction with information and equipment specified in other sections of Division 17. Refer to the Instrument Schedule in Section 17010 for a listing of required devices.

1.02 SUBMITTALS

- A. Shop drawings to be submitted in this section shall be made in one package under the Product Review Category of Shop Drawings.
- B. Shop Drawings: In addition to the requirements of Section 17010, shop drawings shall include for each type of instrument: supply voltage and frequency, electrical load, accuracy, description of operation, operating instructions, and calibration procedure.
- C. Installation Method: The proposed method of mounting sensors and instruments shall accompany all shop drawings.
- D. Parts List: Submit a Parts List with current net prices and a list of recommended spares.

1.03 QUALITY ASSURANCE

- A. Manufacturer: In addition to the requirements of Section 17010, level measurement devices furnished shall be manufactured by firms regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of current design.
- B. Maintainability: All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.
- C. Materials and Installation: Materials and installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum

quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Drawings or specified.

PART 2 - PRODUCTS

2.01 LEVEL TRANSMITTER – SUBMERSIBLE HYDROSTATIC PRESSURE TYPE

- A. General: Submersible hydrostatic pressure transmitters shall convert a differential or gauge pressure measurement to a linear electric output signal.
- B. Type 1: Clean water:
 - 1. Specific Requirements:
 - a. Accuracy of 0.25% of full scale and operating temperature from -4°F to 140°F.
 - b. Overrange protection shall be at least 1-1/2 times span without degradation of accuracy.
 - c. Reference accuracy shall be plus or minus 0.2% of calibrated span or better.
 - d. Integral adjustable hydraulic or electronic damping shall be provided.
 - e. Pressure range shall be as indicated on the Instrument List.
 - 2. Construction:
 - a. The transmitter shall be a sealed, 17.5mm diameter, fully-welded titanium probe with polyurethane depth cable, internal lightning protection, and integral isolated diaphragm sensor.
 - b. Cable shall be shielded, #16 AWG conductors minimum, with integral vent tube. Provide sufficient cable length to reach termination box without splicing.
 - 3. Mounting: Submerged, suspended
 - 4. Signal/Output: 4 to 20 milliamperes into 0 to 600 ohms
 - 5. Power: 24 Vdc loop power
 - 6. Accessories:
 - a. Provide separate NEMA 4X termination box with the following:
 - 1) Terminals for breather tube and signal conductors.
 - 2) Desiccant filter to eliminate moisture from the breather tube.
 - 7. Manufacturers: Druck 1800 series; Dwyer; TE Connectivity/Masurement Specialties KPSI; or approved equal.

2.02 LEVEL SWITCH – FLOAT TYPE

- A. General: Level switch shall use the movement of a float, the weight of whose moving parts is less than that of the displaced process liquid, to actuate switches as the level changes. The switch(es) shall be integrally mounted within the float and connected to a terminal box by a waterproof electric cable. A movable weight shall be mounted on the cable to keep the cable immersed in the liquid.

- B. The switch operating levels shall be adjusted by moving the weight along the cable or altering the height of the cable fixing point.
 - 1. The switch covering shall be made of indestructible polypropylene material. The cable shall be PVC coated.
 - 2. The switches shall be reversible such that the switching action operates on rising or falling level.
 - 3. The switch shall be snap action with no mercury content.
 - 4. The float shall be rated for 150-psi (10.5 kg/cm²) pressure and 140°F (60°C) temperature. The float shall not be greater than 7 inches (178 mm) in diameter.
 - 5. The switches shall be rated for 250 volts ac or dc and 5 amperes minimum, and shall be terminated with 14 AWG wires in a NEMA 4X terminal box.
- C. Manufacturer: Float type sump level switches shall be as manufactured by Kari, Flyght, or equal

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation, testing, calibration, validation, startup and instruction shall be in accordance with Section 17010.

END OF SECTION

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SECTION 17200

MISCELLANEOUS FIELD INSTRUMENTS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Requirements of Division 1 and Sections 16010 and 17010 form a part of this Section.
- B. Work Included: This Section specifies the panel mounted and miscellaneous field instruments and equipment to perform the required functions in conjunction with information and equipment specified in other sections of Division 17. Refer to the Instrument Schedule in Section 17010 for a list of required devices. This Schedule shall not be construed as complete bills of material.
- C. Unit Responsibility: It shall be the responsibility of the qualified single firm as described in Section 17010 of this Division to ensure that the instruments and equipment furnished under this Section are compatible with the equipment furnished under sections of this Division and other Divisions of these Specifications, and that the signal transmission methods are compatible.
- D. Control and Performance Terminology used hereinafter in this Section shall be as defined in SAMA Standard PMC20-2-1970, "Process Measurement and Control Terminology."
- E. Cases: Cases of front of panel mounted instruments shall be of uniform design and color scheme wherever possible. Front of case colors shall be compatible with panel colors, subject to final approval by the Owner. Normally, compatible standard colors of the manufacturer shall be acceptable.
- F. Panel Mounted Equipment:
 - 1. All flush mounted miniature electronic controllers, recorders, and stations shall be a matching style family of instruments utilizing multiple unit mounting cases and back of panel plug-in cable connections. The overall height shall be 6 inches. A nine station multi-unit case shall fit standard 19-inch rack spacing. Each multi-unit case and instrument shall be equipped for standby manual operation.
 - 2. All front panel mounted instruments shall be capable of withdrawing chassis to all service and test positions without affecting operation, and complete removal by a single plug connection from the front.
 - 3. All instruments shall accept 4-20 mAdc or 1 to 5 Vdc input signals and shall produce 4-20 mAdc or 1 to 5 Vdc output signals as specified in the Schedules. Internal panel signals may be of either type. All signals coming to or leaving the panel shall be 4-20 mAdc.

1.02 RELATED WORK SPECIFIED ELSEWHERE

- A. Panels: Section 17510.

1.03 SUBMITTALS

- A. Shop drawings to be submitted in this section shall be made in one package under the Product Review Category of Shop Drawings.
- B. Refer to Section 17010 for additional submittals required for each item herein.
- A. Submit material or equipment data in accordance with the Product Review category of the General Conditions and the submittal requirements of Section 16010.
- B. Shop Drawings: Submit shop drawings complete with a system single line diagram, equipment outline drawings, elementary diagrams, wiring diagrams, battery performance data and nameplate schedules.
- C. Submit catalog cuts and calculations which demonstrate that the battery pack will run the inverter at rated power for the specified duration.
- D. Seismic design certifications and anchorage descriptions as required by Section 01190.
- E. Spare Parts List: Submit a spare parts list showing recommended parts and quantities as well as complete ordering information for replacement components.
- F. Manuals: Provide manuals as specified in Section 16010.

1.04 QUALITY ASSURANCE

- A. Manufacturer: In addition to the requirements of Section 17010, instrumentation and control equipment furnished shall be manufactured by firms regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of the most recent design. Except where specified otherwise, the instruments furnished under this Section shall be as manufactured by Fischer & Porter; Foxboro; or equal. Behind-the-panel equipment shall be as manufactured by the above or by AGM Electronics; Moore Products; or equal.
- B. Maintainability: All equipment shall be designed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.
- C. Materials and Installation: Materials and installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer. Capacities of all equipment shall not be less than that indicated on the Drawings or specified.

1.03 QUALITY ASSURANCE

- A. Comply with the following reference standards:
 - 1. Inverter Standards Institute of Electrical and Electronic Engineers (IEEE)
 - 2. C-39.1-1964: American National Standards Institute (ANSI) Standards

PART 2 - PRODUCTS

2.01 SEISMIC CONTROL STATION

- A. General: Controllers shall compare a process variable input signal with a remote or locally adjusted set point and shall produce a control output signal to correct any deviation of the process variable from the set point by means of a final control element. Manual control stations shall convert a remote or locally adjusted set point value to an output control signal to control a process variable by means of a final control element.
- B. Triaxial Seismic Motion Sensor
 - 1. General: Provide a ground motion (seismic) trigger with relay contacts for connection to the Programmable Logic Controller system specified in Section 17330.
 - 2. Specific Requirements:
 - a. Provide vertical and horizontal ("triaxial") axis sensing, with an adjustable sensing over a range of 0.025 to 0.25G. Provide factory setting of 0.1G.
 - b. Provide the triaxial motion sensor in a NEMA 4 enclosure approximately 8 inches wide x 8 inches high x 8 inches deep. Provide mounting of the sensor case to a concrete floor with a 1/4-20 bolt with concrete anchor.
 - c. Provide the triaxial motion sensor with all solid-state construction, with 12 Vdc power supply module suitable for plugging into a 120 Vac duplex receptacle. Provide SPST relay contacts rated at 10 Watts dc or 12 Vac at 0.5 Amp.
 - 3. Manufacturer: Provide Kinemetrics Model TS-3A Triaxial Seismic Trigger; equivalent as manufactured by Terra Technology; or equal.
- C. Annunciator Panels
 - 1. All windows in the alarm and status annunciator panels shall be single, dual, triple configuration (as shown on the Drawings) white plastic windows, each rear-lighted with low voltage, heavy filament lamps. Lamps shall be continuously energized by a low current. The plastic windows shall be engraved with black letters in accordance with the Drawings. The windows shall be removable from the front for lamp replacement.
 - 2. The monitoring modules shall utilize modular package design combined with microprocessor technology. Each point shall be supplied with logic sequence card, optically-coupled input with adjustable time delay, optically-coupled contact to power, and auto acknowledge. A group alarm output shall be provided.
 - 3. The annunciator power supply shall be sufficient to drive all required loads. Alarm points shall be driven by modules with the operating sequence shown below.

4. The windows for status indication color shall be white or as shown on the Drawings.
 - a. Color, when specified, shall be imparted by detachable and replaceable filters behind the windows except when a "first out" sequence is required.

ALARM MODULE OPERATIONAL SEQUENCE

Condition	Display
AC POWER 'ON'	Off
SERVICE REQUIRED	Flash

- b. A "first out" sequence shall be provided in which the first alarm in a related group shall flash red while subsequent alarms in the group shall be non-flashing white. A first out reset button shall be provided for each designated group.
 5. The alarm or status inputs shall be contacts or as shown on the Drawings. The Annunciator shall accept either N.O. or N.C. contacts. The sensing voltage shall be 120 Vac. The units shall be supplied with audible-flasher cards as required that shall operate on receipt of alarms from any of the alarm points to the panel. On receipt of any alarm, the sequence card shall cause the flasher to flash all the appropriate indicating windows. A normally open relay contact shall be provided to activate an external horn. This contact shall be rated 5 amps minimum at 120 Vac.
 6. There shall be a test button, acknowledge button, and reset button. Buttons and horn shall be provided where shown on the Drawings.
 7. Test button shall actuate all alarm and status points and sound the horn. The acknowledge and reset buttons shall perform the functions as outlined in the operational sequence, but shall not prevent any future alarm points from being annunciated visually and audibly. The horn shall be rated at 85 dbA at 3 feet minimum. The unit shall operate from 120 Vac, 60 Hertz commercial power. The auto acknowledge feature shall silence the horn automatically after an adjustable time delay of 20 seconds. Auxiliary relay contacts or communications shall be inhibited during lamp test.
 8. The annunciator panel shall be by Ametek Panalarm Series 90, Rochester Instrument Systems, or equal; but only one manufacturer's panels shall be used throughout the plant.
 9. Provide an RS-232C communication option for remote monitoring of each annunciator point.
- D. Control Panel Accessories
1. Relays, timers and other internally mounted equipment shall be of the types specified in other sections of these Specifications.
 2. Panel face mounted equipment shall be of the types specified in other sections of these Specifications.
 3. Standards: All control devices shall conform to applicable provisions of NEMA Standards ICS 1 and ICS 2.
 4. Pushbuttons, selector switches and pilot lights shall be heavy-duty oiltight units. Pushbuttons and selector switches shall have contacts rated

10 amperes continuous, Rating Designation A600 in conformance with NEMA ICS 2.

- a. Pushbuttons used as emergency stop devices shall have a padlockable means for maintaining an open circuit. Indicating lights shall be push-to-test transformer type with lenses of the colors shown on the Drawings.
 - b. Multiposition control switches shall have rotary action, round knurled handle and the number of positions and stages shown on the Drawings. They shall be suitable for panel mounting. Each position shall have a positive detent. Contacts shall have a continuous current rating of 10 amperes at 300 Vac. Switches shall have integral indicator.
 - c. For 4-20 mAdc and 1 to 5 Vdc signal selector switches, provide oiltight selector switches with electronic duty gold contact blocks. Provide sliding contacts for reliable operation without benefit of thermal cleaning action.
 - d. Manufacturer: Provide Microswitch heavy duty oiltight manual controls, Type PT or CMC, with electronic duty gold contact blocks; Allen-Bradley Bulletin 800T oiltight selector switch with stackable "Logic-Reed" contact blocks; or equal.
5. Colors and Descriptions:
- a. Indicating Lamps: Unless otherwise noted in the individual Loop Specifications, the following color code and inscriptions shall be followed for the lenses of all indicating lights and annunciators.

Indicating Lamp Inscription	Color	Annunciator Lamp Inscription
FAULT	Red	
AC POWER LOSS	Amber	
SEISMIC TRIP	Red	
DC POWER 'ON'	White	

- b. Lettering shall be black on white and amber lenses. Lettering shall be white on red and green lenses.
 - c. Pushbuttons: Follow color coding for indicating lamp above. All unused or noninscribed buttons shall be black. Lettering shall be black on white and yellow buttons. Lettering shall be white on black, red and green buttons.
6. Nameplates: Unless specified otherwise in the Drawings, nameplates shall be black lamacoid with minimum 3/16-inch-high white letters for major area titles, 5/32-inch for component titles, and 1/8-inch for subtitles, and shall be fastened with a permanent but dissolvable adhesive or by screws.
- E. Instrument Loop Power Supplies
1. General:
 - a. For each two-wire transmitter, provide a 24 Vdc regulated 50 mA power supply with 120 Vac input. Output voltage may be 24 Vdc $\pm 5\%$ manufacturing tolerance at no load, but shall hold within 1% from no load to full load at 120 Vac $\pm 10\%$ input.
 - b. Line-to-load regulation shall be within 0.1% from no-load to full load. Ripple shall be less than 15 mV peak-to-peak.

2. Manufacturer: Provide Model AP9046 instrument loop power supply as manufactured by Action Instruments with plug-in mounting base; equivalent capacity Lambda power supply with terminal blocks for external connections; or equal.

F. UPS

1. General: Provide a UPS system consisting of input isolating transformer, rectifier, battery charger, static inverter, solid state static transfer switch, manual transfer switch, battery system, and a system monitoring and control panel; all of which shall be housed in a floor standing NEMA 1 enclosure. The UPS shall be a solid-state unit meeting the requirements of UL 1012. Units shall be Exide Electronics; Liebert; or equal.
2. Description of Operation
 - a. The UPS shall be designed to operate as follows:
 - 1) Normal: The load is continuously supplied by the inverter. The rectifier/battery charger derives power from the normal ac source and supplies dc power to the inverter while simultaneously float charging the battery.
 - 2) Emergency: Upon failure of the normal ac power, the critical load is supplied by the inverter, which without any switching obtains its power from the storage battery. There shall be no interruption to the critical load upon failure or restoration of the commercial ac source.
 - 3) Recharge: Upon restoration of the commercial ac source, the rectifier/charger powers the inverter and simultaneously recharges the battery. This shall be an automatic function and shall cause no interruption to the critical load.
 - 4) Bypass Mode: The static switch shall transfer the load to the normal source without an interruption.
3. Rating:
 - a. Input Voltage: 120 volts, 1 phase, 60 Hz.
 - b. Inverter Output Voltage: 120 volts, 1 phase, 60 Hz ± 0.5 Hz.
 - c. Output Capacity: 1.5 kVA, minimum for 15 minutes.
 - d. Output voltage waveform will be sinusoidal, 5% THD, 3% maximum single harmonic.
 - e. Audible noise level shall not exceed 50 dB.
 - f. Protection: The UPS shall have built-in circuit breaker, fuse and thyristor protection against undervoltage, overcurrent, and overvoltage on input and output.
 - g. Ambient Temperature: Equipment ratings shall be based on operation in an ambient temperature not exceeding 40°C at a site altitude of 100 feet.
4. Static Switch: The static switch shall transfer the load to the normal source on any malfunction of the inverter circuit or if the load exceeds the output of the UPS. Switch shall retransfer automatically when the overload or malfunction is removed.
5. Control Panel:
 - a. Provide a control panel equipped with the following controls and LED indicators:
 - 1) Three position control switch for inverter operation (On/Off/Automatic).

- 2) Charger On/Off switch.
- 3) Indicators for inverter standby, inverter on, line ac failure, battery charger on, high and low battery, high and low ac.
- b. Provide an alarm panel which shall have LED indicators for the following alarms:
 - 1) High/Low float voltage.
 - 2) Battery discharge.
 - 3) Battery charger failure.
 - 4) Overload.
 - 5) Normal power fail.
 - 6) Inverter failure.
 - 7) Inverter ac overvoltage.
 - 8) Inverter ac undervoltage.
 - 9) Ventilation fan failure.
- c. Provide SPDT 10 ampere contacts for composite repeat of the above alarms for remote connection.
- d. Provide audible horn on the control panel which is activated upon any UPS alarm.
- 6. Battery Pack: The battery shall be sealed, maintenance-free lead-acid cells with an expected life of five years. The battery shall be sized to support the inverter at rated capacity for 15 minutes.
- 7. Enclosures
 - a. The UPS shall be housed in free-standing, dead-front enclosures with a welded steel framework. Doors shall be of 14-gauge steel; framework shall be of 12-gauge steel.
 - b. Forced-air cooling shall be provided to ensure that all components are operated within their environmental ratings. Blower motors shall be equipped with sealed bearings. All air inlet and exhaust openings shall be protected by perforated or slotted metal guards.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation, testing, calibration, verification, startup and instruction shall be in accordance with Section 17010.
- B. Wiring: Refer to Section 17010, Part 3.
- C. Switching Circuit Schematics: Schematics shown are illustrative of the desired function only, the Contractor may elect to perform the required functions by other standard logic techniques. Components and circuits used shall be subject to review and approval. All switching circuits shall be checked and verified by testing before shipment.
- D. Control Voltage:
 - 1. When the control voltage is not specified in the schematics, the Contractor may elect to use the 120 Vac power, as supplied from the power panels supplies under Division 16; however, he shall provide a separate low voltage circuit for the indicating lamps or provide individual transformers with lamps. In any event the lamp voltage shall not exceed 30 Vac or dc.

2. Manual disconnect switches (and relays if necessary) shall be provided internal to the panel to isolate process related groups of circuit elements from panel power and foreign voltages to permit troubleshooting without disabling controls for other processes. Safety interlock switches shall be provided on access doors to disconnect local and foreign voltages if required by safety codes of applicable regulating authorities.

3.02 FACTORY TEST

- A. Subject the UPS to a complete operational test and submit certified test report to the Engineer before equipment is shipped.

3.03 INSTALLATION

- A. Installation shall be in conformance with Section 16010.
- B. Install UPS on a 3-inch concrete pad.
- C. Provide the services of a factory trained service technician to inspect and check out the equipment before energizing.

3.04 FIELD TESTING

- A. Provide the services of a factory trained technician to make final adjustments and carry out a full operational test in the presence of and to the satisfaction of the Engineer.

3.05 TRAINING

- A. Provide one man-day of time of a factory trained technician to instruct operating personnel in the operation, maintenance and adjustment of the system and installation.

END OF SECTION

SECTION 17330

PROGRAMMABLE LOGIC CONTROLLER

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Requirements of Division 1 and Section 17010 form a part of this Section.
- B. Related Sections Include:
 - 1. Section 17010: Instrumentation and Controls, General Requirements
 - 2. Section 17510: Panels

1.02 SUBMITTALS

- A. The following items shall be submitted in this Section shall be made in one package under the Product Review category of Shop Drawings.
 - 1. Catalog cuts for programmable logic controller (PLC) panel components. These shall include, but not be limited to the central processing unit, input modules, output modules, programmer, magnetic program storage device, interfacing equipment, power line voltage regulation transformer, power line surge protection device, Ethernet to fiber optic media converters and fiber optic patch panels.
 - 2. An Input/Output (I/O) record containing a textual description for each item of input and output, connection diagram addressing (rack, module, channel and address numbers), and data table bit and data table word assignments.
 - 3. A layout drawing of PLC control panel.
 - 4. Software documentation to include fully-annotated, line-by-line diagram.
 - 5. A typewritten document containing startup, operation, and maintenance procedures.
 - 6. The Factory and Field Witnessed Test procedure.
 - 7. The Factory and Field Witnessed Test results.
 - 8. Spare Parts Items: As specified herein.

1.03 UL LABEL

- A. Programmable logic controller enclosures shall bear the UL label.

1.04 APPENDICES

- A. Appendix A: Control Strategies. These strategies are to be used to program the PLC.

PART 2 - PRODUCTS

2.01 PROGRAMMABLE LOGIC CONTROLLERS

- A. General: The I&C Subcontractor shall provide programmable logic controller hardware as described herein and as shown on the Drawings. PLC software and ladder logic programming shall be provided by TESCO Controls, no equal.
- B. Programmable Logic Controller: Provide each PLC with the following hardware.
 - 1. I/O Chassis: Provide a universal I/O chassis to house the processor, power supply and I/O modules. Provide at least two spare slots for future modifications/additions.
 - 2. Power Supply: Provide 12 VDC or 24 VDC power supply module to power the processor and local I/O modules. I/O back plane loading shall not exceed 75% of power supply rating amps on any chassis.
 - 3. Memory Enhancement: Provide memory enhancement if the program exceeds 75% of capacity.
 - 4. Cables: Provide a full complement of cables for connecting to programming terminal and interface devices.
 - 5. Central Processing Unit: The Central Processing Unit (CPU) shall be powered by 12 or 24 VDC, and shall have the following:
 - a. PLC "ladder logic" software with extend math functions and on line/off line programming functions.
 - b. Local I/O Scanner.
 - c. Floating point arithmetic.
 - d. PID loop control.
 - e. Battery-backed (10-year lithium) CMOS RAM.
 - f. CPU shall be ControlLogix 5550 system model no. 1756-L1, no equal.
 - 6. Input and Output Modules:
 - a. Analog inputs (AI) shall meet the following requirements:
 - 1) 4 to 20 mA_{dc} inputs, 250-ohm impedance maximum, 16 single ended configuration.
 - 2) Accuracy of $\pm 0.15\%$ of span.
 - 3) Resolution: 16 bits
 - 4) Common Mode Rejection of 100 dB at 60 Hz, minimum.
 - 5) Normal Mode Rejection of 80 dB at 60 Hz, minimum.
 - 6) Isolation shall meet or exceed surge-withstand test, IEEE-472.
 - 7) Drift shall not exceed 1.5% within a one-year period @ 25 °C
 - 7. Communications: Provide PLCs with Ethernet communications (Ethernet/IP) using TCP/IP protocol and RS-232 serial communication for 450 MHZ radio system.
 - 8. Operator Interface: Provide a door mounted L 3000E operator interface panel to indicate measured parameters and alarms similar to existing systems.
 - 9. PLC I/O: Refer to PI&Ds . No listing of I/O is included in this document due to simplicity of project
- C. PLC Software: Use TESCO programming language, no equal.

- D. Radio: Provide 450-512 MHZ licensed radio system, MDS SD4 to match existing radio system.
- E. Radio Antenna: Provide Yagi type antenna with Polyphaser 1S-50NX-C2 lightning protection and UHF 50 Ohm coaxial cable to match existing system.
- F. Programmable Logic Controller Enclosure:
 - 1. The PLC hardware shall be furnished completely assembled and wired in control panel in a NEMA 4 free standing enclosure. Refer to Section 17510. Provide for serviceable layout of parts. Provide enclosure finish and color to match City's standard units.
 - 2. Note that certain selector switches, pushbuttons, relays and instruments shall be furnished and installed in addition to the programmable logic controller hardware proper.
- G. Battery Backup Power Supply: Provide a battery unit with battery charger rated for 200% of PLC load with batteries sized to provide at least 30-minute service.
- H. Manufacturer: Programmable logic controllers shall be TESCO Controls L 3000E, no equal to match existing system.

PART 3 - EXECUTION

3.01 WITNESSED FACTORY TEST

- A. General: The PLC shall be tested at the factory together with the computer system and Human Machine Interface (HMI) software:
 - 1. Programming of the PLC and HMI shall be by TESCO Controls, no equal. The programs shall be loaded to each PLC during the Witnessed Factory Test and the entire system shall be tested jointly by the I&C Subcontractor and TESCO Controls.
- B. Prior to shipment of the PLC to the jobsite, perform a Witnessed Factory Test. This test shall demonstrate full compliance of the PLC with Contract requirements.
- C. Prepare a detailed written witnessed test procedure to be submitted at least two weeks prior to start of the test and shall be jointly produced by the I&C Subcontractor and TESCO Controls. The test procedure shall describe testing methods and provide detailed specification of the input data and data sequences to be used in the test. If, in the opinion of the Engineer, a resubmission of the proposed test procedure is required, the date for the performance of this test shall be set at least six weeks following delivery of the resubmitted test procedure.
- D. Perform the witnessed test in accordance with the test procedure and coordinate with TESCO Controls. Any deviation in performance from that specified in these Specifications shall be corrected prior to shipment. If the deviation in performance is deemed by the Engineer to be substantial and if it is not corrected within the period allowed for the test, a second test shall be performed. No extension of Contract Time will be allowed in the event that this second test is necessary.
- E. Submit the results of the test in a formal document within two weeks following satisfactory performance of the test. The test results shall document all problems

encountered in running the test, corrective action taken, and the detailed results of each phase of the test.

3.02 FIELD TEST

- A. After the PLC has been installed at the jobsite, a demonstration of compliance with all functional objectives shall be made under actual or simulated operating conditions, subject to favorable review by the Engineer.
- B. Prepare a detailed written witnessed test procedure to be submitted at least two weeks prior to start of the test. The test procedure shall describe testing methods and provide detailed specification of the input data and data sequences to be used in the test. If, in the opinion of the Engineer, a resubmission of the proposed test procedure is required, the date for the performance of this test shall be set at least six weeks following delivery of the resubmitted test procedure.
- C. Submit the results of the test in a formal document within two weeks following satisfactory performance of the test. The test results shall document all problems encountered in running the test, corrective action taken, and the detailed results of each phase of the test.

3.03 TRAINING

- A. General: To familiarize the Owner's personnel with PLC operation, training shall be provided as detailed hereunder. The training course shall be conducted under the direction of a training director who shall design a detailed training plan that complements the experience and skill levels of the Owner's personnel. The training course shall be conducted at the treatment plant. The text for both training courses below shall be the O&M Manual and selected handouts. The Owner may videotape the training at the Owner's expense.
- B. PLC Operations Training: A minimum one-day course shall be provided for up to six persons. The level of training shall be sufficient to familiarize the personnel with the operation of the PLC and programming and program storage device. All essential system operating procedures shall be described as required to enable Owner's personnel to observe the controller operation via the programming device displays.

END OF SECTION

APPENDIX A

CONTROL STRATEGY 1

TITLE: PLC /SCADA Configuration and Screens

- A. General: The PLC-based control system shall include the East Dunne Reservoir PLC that communicate via radio to the existing Holiday Tank repeater (RTU 33) and City's SCADA system. The existing SCADA system includes two servers and Historian utilizing Wonderware system Platform operator interface software.
- B. Work Description: TESCO Controls shall provide PLC and SCADA programming for the East Dunne Reservoir and integrate it to the existing SCADA and Historian similar to other reservoirs for the City of Morgan Hill. The work shall include:
 - 1. Providing graphic displays on SCADA system
 - 2. Providing alarms and trends for measure variables
 - 3. Providing radio communications from East Dunne Reservoir to existing SCADA system
 - 4. Providing PLC programming for proper interlocks and pumping to East Dunne Reservoir
- B. Screens: Provide the following SCADA screens as developed for SCADA displays. These exclude any pop-up screens, alarms screens, real-time and historical trend screens, and reports. The screens can be combined where practical.
 - Screens # 1: Overview with Remote Sites (Update existing and add as needed)
 - Screen # 2: East Dunne Reservoir
 - Screen # 3: As required by City

CONTROL STRATEGY 1.1

TITLE: General Equipment Interface

- A. General: This strategy describes typical interface logic with final control elements such as pumps and other equipment. This control strategy applies to all control strategies on this project. Signals that are required to be indicated shall be displayed on SCADA screens.
- B. Description: The PLC shall monitor the equipment's related inputs/outputs as follows:
1. Monitor whether equipment is in "READY" mode before initiating or queuing equipment for control. A "READY" display shall be indicated (YI***).
 2. If equipment is ready, the PLC shall activate a normally open discrete output "DO" to start the equipment. A "RUN" symbol shall be indicated (XI***).
 3. The PLC shall interrogate the circuit and monitor the input "RUN" discrete input.
 4. If the "RUN" input is not activated within an adjustable time of t=0-60 seconds, the PLC shall annunciate a SCADA display of equipment "FAIL," (XA***). See paragraph E for additional clarification for tandem pumps.
 5. The PLC shall also annunciate equipment "FAIL" if a separate discrete input signal is detected.
 6. SCADA display shall include the equipment "RUN," "READY," and "FAIL" status. The "FAIL" signal shall also be added to the alarm list.
 7. The "RUN" signal shall activate an elapsed time register to monitor the total run time of the equipment.
 8. Monitor equipment in "HAND" status (Hlxxx).
- C. Equipment Alternation: For two pieces of equipment of the same function, the PLC shall alternate their operation in one of the following manners. The selection shall be made manually from the CRT. (Note: One or more of these methods can be chosen for this project.)
1. Manual: The "LEAD" piece of equipment is assigned and will continue to run unless it fails or process conditions require the "STANDBY" equipment to run. In the next cycle of operation, the same equipment continues the same assignment unless manually reassigned.
 2. Automatic (Run Time): The equipment alternates between "LEAD" and "STANDBY" based on manually set maximum run time. When the actual run time of a piece of equipment exceeds the set maximum run time, the PLC places the currently used equipment in "STANDBY", resets the run time and starts the designated "STANDBY" equipment as "LEAD".
 3. Automatic (Last Off): The equipment alternates based on the process cycle where after each cycle the PLC switches the sequence to equalize the run time.
- E. Lead-Lag-Standby Operation (typical for tandem pump arrangements):
1. The Lag or Standby Pump starts if the Lead Pump fails.
 2. A pump failure shall occur if a pump fails to run after a call to run following a 0-60 second delay, or while called-to-run but fails to continue running,
 3. A failed pump shall be locked OFF and prevented from restarting until reset by the operator. A pump is reset from failed condition by a "Reset" icon on the SCADA screen.

CONTROL STRATEGY 1.2

TITLE: Typical Alarms

- A. General: This strategy describes the monitoring and display of alarm conditions. The alarm conditions can be 1) Discrete input, 2) Derived, and 3) Deviation.
- B. Descriptions:
 - 1. Discrete Input Alarms: Whenever a discrete input alarm is detected, the PLC shall annunciate an alarm after an adjustable delay 0-5 seconds.
 - 2. Derived Alarms: A derived alarm consists of monitoring of analog inputs and/or logic derivation within control strategies. The PLC monitors these events and annunciates alarms after an adjustable delay of 0-5 seconds. Settings of alarms shall be available from the SCADA screens.
 - 3. Deviation Alarms: Whenever a process variable deviates from a setpoint value, whether the setpoint is manual or calculated, the PLC shall flag the event and annunciate a "Deviation Alarm". An adjustable time delay of 0-30 minutes shall be provided.

CONTROL STRATEGY 2

TITLE: East Dunne Reservoir Seismic Isolation System

AREA: East Dunne Reservoir

SHEET: I-03

LOOP NUMBERS:

RELATED EQUIPMENT: Motorized Butterfly Valve FCV-101, Seismic Sensor HS-101, Valve Position Switch (open) ZSO-101, Valve Position Switch (closed) ZSC-101, Seismic Sensor Actuated Valve Controller

- A. General: This control strategy provides closes the outlet valve of the reservoir in response to a seismic event to prevent potential water loss from pipe breaks in the distribution piping system.
- B. Monitoring:
 - 1. Alarms
 - a. Seismic Sensor Alarm – HS101
- C. System Controls:
 - 1. An 'OPEN' push-button operator shall be provided on the Seismic Sensor Actuated Valve Controller (valve controller) to drive the motorized valve operator to open the motorized butterfly valve, FCV-101. Upon reaching the full-open position, valve position switch ZSO-101, shall send an input signal to the valve controller, providing local indication of valve opening, an output signal to the PLC, and stopping the motorized valve operator.
 - 2. A 'CLOSE' push-button operator shall be provided on the valve controller to drive the motorized valve operation to closed the motorized butterfly valve, FCV-101. Upon reaching the full-closed position, valve position switch ZSC-101, shall send an input signal to the valve controller, providing local indication of valve closure, an output signal to the PLC, and stopping the motorized valve operator.
 - 3. In response to a seismic event, the seismic sensor HS-101 shall provide in an input signal to the valve controller. The valve controller shall send an output alarm signal to the PLC.
 - 4. The input signal to the valve controller, above, shall close a control relay (or motor contactors) within the controller to drive the motorized valve operator to close the motorized butterfly valve, FCV-101. Upon reaching the full-closed position, valve position switch ZSC-101, shall send an input signal to the valve controller, providing local indication of valve closure and an output signal to the PLC. The closed relay shall disable operation of the 'OPEN' push-button operator.
 - 5. The relay shall remain closed until manually reset via push-button operator at the Seismic Sensor Actuated Valve Controller.

CONTROL STRATEGY 3

TITLE: East Dunne Reservoir

AREA: East Dunne Reservoir

SHEET: I-03

LOOP NUMBERS:

RELATED EQUIPMENT: Level Transmitter LIT-101, Level Switch LSHH-102, Hatch Intrusion Switch ZS-103, Ladder Intrusion Switch ZS-104

- A. General: This control strategy provides operational and safety monitoring of the reservoir, to be controlled through the local PLC at the reservoir.
- B. Monitoring:
 - 2. Alarms
 - b. Reservoir Level – LI101
 - c. High Level Alarm - LAH101
 - d. Low Level Alarm - LAL101
 - e. Low-Low Level Alarm - LALL101
 - f. Overflow Alarm - LAHH102
 - g. Hatch Intrusion - ZIO103
 - h. Ladder Intrusion – ZIO104

CONTROL STRATEGY 4

TITLE: Holiday Zone 1 Pump System

AREA: East Dunne Booster Pump Station **SHEET:** I-04

PLC: 1

LOOP NO.: xxxx

RELATED EQUIPMENT: LI101, P3A, P3B, FIT3A, FIT3B

- A. This control strategy includes modification of existing PLC controls at the pump station.
- B. The level signal from the East Dunne Reservoir (LIT101) shall be used to control Pumps P3A and P3B.
- C. Monitoring:
 - 1. Pumps: Ready (YI 3A,3B)
Run (XI 3A,3B)
Fail (XA 3A, 3B)
 - 2. Flow and Level: FIT3A, FIT3B. Display, totalize, trend and record. The level signal currently exists in database.
 - 3. Alarms
 - a. Fail Alarm
 - b.
- D. Pump Controls:
 - 1. Pump Alternation; Provide Lead/Lag pump alternation
 - 2. PLC shall start "Lead" pump based on an operator-adjustable setpoint for falling level in the East Dunne Reservoir. If lead pump fails to start or level falls to a second operator-adjustable lower level setpoint, the PLC shall start "Lag" pump. The pumps shall stop when the level in the tank reaches a common, operator-adjustable setpoint.
 - 3. Provide a SCADA display to allow a setpoint adjustment for Lead, Lag, Stop, and tank level alarms.

END OF SECTION

SECTION 17425

NETWORK AND COMMUNICATION EQUIPMENT

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements of Division 1 and Section 17010 form a part of this Section. This Section specifies network and communication equipment for Process Control System (PCS) and ancillary data systems to perform the required functions in conjunction with information and equipment specified in other sections of Division 17.
- B. Provide all network and communications identified in the Contract Drawings.

1.02 REFERENCE STANDARDS

- A. Section 16124 Signal Cable
- B.
- C. Federal Communications Commission (FCC):
 - 1. Title 47, Part 15.5 Low Power (unlicensed) communication devices
- D. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. 802.3 Standard for Ethernet
 - 2. 802.11 Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications
- E. International Organization for Standardization (ISO):
 - 1. 11801 General Cabling for Customer Premises
- F. National Institute of Standards and Technology (NIST)
 - 1. Framework for Improving Critical Infrastructure Cybersecurity
- G. Telecommunications Industry Association (TIA):
 - 1. 568-B Commercial Building Telecommunications Cabling Standard
 - 2. 569-B Commercial Building Standard for Telecommunications Pathways and Spaces
 - 3. 606-A Administration Standard for Commercial Telecommunications Infrastructure
 - 4. J-STD-607-A Commercial Building Grounding and Bonding Requirements for Telecommunications
 - 5. 942 Telecommunications Infrastructure Standard for Data Centers
- H. Underwriters Laboratories Incorporated (UL):
 - 1. 497 Protectors for Paired-Conductor Communications Circuits

1.03 SYSTEM DESCRIPTION

- A. Radio system integrator shall coordinate all radio and radio modem equipment to assure compatibility of RF signals, digital protocols, and with the control system hardware and protocols. Radio integrator shall conduct a survey of locations with actual equipment of the manufacturer and models proposed for the project. If required, radio integrator shall acquire all licenses needed for all emitters and shall assure that the system complies with all applicable FCC regulations. If unlicensed

radio is used, integrator shall assure that directional antennas and transmitter output are coordinated in compliance with FCC regulations for unlicensed emitters and if applicable, the owner's existing system.

1.04 SUBMITTALS

- A. Submit agendas for two mandatory radio system coordination meetings.
- B. Submit a radio path study including an overview of the paths and profiles for each path analyzed for the study. Note any airports within 2 miles of any radio site. Path calculation shall include:
 - 1. Direction of path (degrees).
 - 2. Distance between sites for each path.
 - 3. Coordinates and elevation of each site.
 - 4. Tilt angle and height of each antenna.
 - 5. Estimated signal strength.
- C. Submit data on the proposed wireless service carrier including:
 - 1. Confirmation of service availability at the project location(s).
 - 2. Proposed service plan showing all monthly/annual fees.
- D. Submit a pre-construction Network Topology Diagram showing the planned topology of the control network with sufficient detail such that the Owner could recreate the network. Information shown shall include the following:
 - 1. Network One-Line: a drawing showing the logical topology of the network:
 - a. Show different OSI layer 1 physical media with unique line styles with associated legend.
 - b. TCP/IP Networks: For each node, show its IP address(es), subnet mask, default gateway, and DNS server assignment (if applicable). Denote subnets by network ID.
 - c. Modbus, Profibus, and other master/slave protocols: List all parameter settings used to configure the node's interface to the network such as station ID, transmission speed, etc.
 - d. Identify each node with the ID on the nameplate used in the field. Include a part ID bubble corresponding to a line item in the Bill of Materials, also in this drawing set, to identify the hardware factor of each node.
 - 2. Layer 2 Switch Configuration:
 - a. Show the physical cable connection being made to each switch port.
 - b. STP settings for each switch port.
 - c. Quality of Services and other traffic shaping settings.
 - d. Management interface login information
 - 3. Network Site Plan: Submit a set of drawings showing the physical topology of the network. Include dimensioned and directional conduit routing, the locations with ID of all pullboxes, panels, and handholes. Mark the aforementioned and all other network hardware with part ID bubbles corresponding to line items on the Bill of Materials. If this information is included on an Electrical Site Plan submittal, then that submittal satisfies the requirements of this clause.
 - 4. Bill of Materials: Include a detailed Bill of Materials. Create a line item for each network component purchased individually including a part ID, description, quantity, manufacturer, and the manufacturer's part number. For PLCs, computers, switches, and other network hardware requiring an operating system and application software, note the versions installed.

- E. Prepare shop drawings for all network and communication systems, either as part of the PCS submittal or separate submittals for network and communication equipment.
 - 1. Submit elevation drawings for all communication cabinets and racks including component location, nameplates, dimension and construction information.
 - 2. Submit a block diagram of the communication and control system detailing the connections between new and existing equipment.
 - 3. Submit details necessary for radio antenna and antenna mast mounting, and other physical installation requirements. Include wind load calculations and anchorage product data.
 - 4. Submit complete bill of materials, with quantity, manufacturer, model number, and recommended spares.
 - 5. Submit product data for all network and communication components provided.
- F. Submit complete and signed copies of testing reports which include a description of the testing, detailed test results, and descriptions of issues encountered during testing and any additional action required.
- G. Record Drawings: Submit record drawings as described in Part 3 of this Section.
- H. Operations and Maintenance Manual: Provide in accordance with Section 01300.

PART 2 - PRODUCTS

2.01 RADIO EQUIPMENT – GENERAL

- A. Radios shall match existing equipment operating at 450-512 MHz.
- B. Provide antenna feeder cables as shown on the Drawings and specified in Section 16124.
- C. Provide communication system grounding in accordance with Section 16450.
- D. Antennae will be provided by the Owner for installation by the Contractor.

2.02 RADIO EQUIPMENT – POINT TO POINT, LICENSED

- A. Radio
 - 1. Provide radio(s), antenna(e), transmission cables, connectors, surge protection devices, software and other components for a complete wireless communication system.
 - 2. Data interface: Ethernet as appropriate for the control hardware used in the project. Ethernet shall be capable of connecting to TCP/IP based industrial protocols
 - 3. Band: 450MHz, licensed,
 - 4. Power Supply: 12 to 30 VDC
 - 5. Data Requirements: Ethernet.
 - 6. Accessories:
 - a. Provide Ethernet for communication with local wired network.
 - 7. Manufacturer: GE MDS series; or approved equal.
- B. Antenna

1. Radio Integrator shall select antenna type and mounting hardware (including towers if necessary) and correct cable for use with antennas. Radio Integrator to provide data converters as necessary to interface transceiver equipment with the control hardware utilized on the project.
 2. Provide a directional, yagi-style antenna suitable for communication in the 450MHz to 512Mhz frequency range.
 3. Construction:
 - a. Antenna shall have an "N" style female endboom connector for cable attachment.
 - b. Nominal impedance: 50 ohms.
 - c. Antenna boom shall be DC-grounded.
 - d. Antenna shall be constructed of 6061-T6 aluminum with corrosion-resistant finish.
 - e. Provide a bracket for mounting to a 1-1/2" minimum diameter mast, with vertical aiming adjustability.
 - f. Wind rating: 100 mph minimum.
 - g. Power rating: 150 watts minimum.
 - h. Front-to-back ratio: 15 dB minimum.
 - i. Gain and number of elements shall be determined based on the recommendations of the Radio Path Study.
 - j. Provide all required mounting hardware including brackets, clamps, and associated components for a complete installation.
 4. Manufacturer: GE MDS ClearWave Series; PCTEL MAXRAD MYA Series; or approved equal.
- C. Lightning Arrester
1. Provide a lightning arrester in the feeder cable between the antenna and radio, bonded to the facility grounding system. Lightning arrester shall be mounted outside of the enclosure containing the radio.
 2. Manufacturer: Polyphaser; Phoenix Contact; Commscope; or approved equal.
- D. Antenna Feeder Cable
1. Provide antenna feeder cable in accordance with Section 16124. Transmission cable of one continuous length from the lightning arrester to the antenna shall be 50-ohm weatherproof coaxial cable suitable for a corrosive environment.
 2. Provide weatherproofing kit for all exposed connectors.

PART 3 - EXECUTION

3.01 RADIO SYSTEM COORDINATION MEETINGS

- A. Coordinate, schedule, and lead two meetings with the Owner focused on radio communication systems.
1. First meeting held within 30 days of the contract award for the Contractor to summarize the radio system requirements or propose alternatives. Request additional information and arrange site access for onsite radio testing.
 2. Second meeting held after completing the radio path study to review the Contractors findings and discuss proposed solutions.

3.02 CONFIGURATION

A. General

1. Coordinate with owner's IT department policies. Configure firewall, VPN devices, and managed switches in accordance with owner's standards.
2. Password policies shall be developed for all devices on the network, including SCADA, HMI, PLC, and smart control elements. Passwords should be developed for three function levels:
 - a. Operator
 - b. Maintenance
 - c. Administrator
3. Each individual shall be assigned a password, which will be assigned one of these function levels. Different levels will have access to different functions. In coordination with owner's IT policies, passwords should be changed periodically. Each device is to be logged into and out of individually, i.e., a maintenance technician logging into SCADA does not automatically log that account into a PLC for ladder editing or vice-versa. Certain logins may be set to time out after a certain period, requiring a subsequent login.

3.03 INSTALLATION

A. Ethernet Terminations:

1. Terminate cables at each end into Category 6 crimp connectors or punch-down terminals.
2. Where multiple cables are routed to a single location (such as at a network rack), bundle and route cables in a neat and workmanlike manner to their point of termination. Arrange connections to patch panels in a logical fashion such that adjacent patch panel jacks are connected to adjacent jacks located in the field.

B. Ethernet Switches:

1. Where rack-mounted, install cable management devices in the space immediately below each switch.

C. Ethernet Patch Panels:

1. Label each port with an alphanumeric identification tag which matches the opposite end of the installed cable. At the opposite end, affix the identification tag on the wall plate or at the cable termination, whichever is most visible.
2. Install cable management devices in the space immediately below each patch panel.

D. Radio antenna and cable:

1. Install according to radio system integrator's instruction.
2. Antenna mounting height and aiming shall be as defined in the Radio Path Study.
3. Provide stainless steel U-bolt and anti-twist saddle bracket to mount antenna to mast.
4. Securely affix cable to antenna mast using stainless steel clamps or equal. Provide protective rubber to prohibit the clamp from damaging the cable jacket.
5. Provide waterproof boots and masking for all exterior connections.
6. Provide a drip loop adjacent to each exterior connection and at the point of transition from exterior to interior.

7. Ground the antenna cable surge suppressor to the nearest point of the electrical grounding electrode system.
- E. Antenna and cables:
1. Provide stainless steel U-bolt and anti-twist saddle bracket to mount antenna to mast.
 2. Securely affix cable to antenna mast using stainless steel clamps or equal. Provide protective rubber to prohibit the clamp from damaging the cable jacket.
 3. Provide waterproof boots and masking for all exterior cable connections.
 4. Provide weatherheads for all exterior antenna cable entrances. Use caulk to seal around conduit penetrations through exterior walls.
 5. Provide a drip loop adjacent to each exterior connection and at the point of transition from exterior to interior. Coordinate length of slack at antenna with Owner, who will install antenna.
 6. Ground antenna cable surge suppressors to the nearest point of the electrical grounding electrode system.

3.04 TESTING

- A. Installed Ethernet cables: Perform testing in accordance with Section 16950 – Electrical Tests.
- B. Radio antenna and cable installations: Perform testing in accordance with the equipment manufacturer's recommendations.

3.05 RECORD DRAWINGS

- A. Prepare and submit a revised Network Topology Diagram to reflect the as-built conditions of the control network. Include any necessary revisions to the information shown in the pre-construction diagram.

END OF SECTION

SECTION 17510

PANELS

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Provisions: Requirements of Division 1 and Section 17010 form a part of this Section.
- B. Work Included: This Section covers control panels shown on the Electrical or Instrumentation Drawings, or as specified in either Division 16 or 17, and sets minimum standards for all packaged unit panels specified in Divisions 11 to 15, unless modified under those sections.
- C. Related Sections Specified Elsewhere:
 - 1. Section 17330: Programmable Logic Controller

1.02 REFERENCE STANDARDS

- A. National Electrical Manufacturers Association (NEMA) Publications:
 - 1. ICS 1 Industrial Control and Systems: General Requirements
 - 2. ICS 2 Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts
 - 3. ICS 4 Industrial Control and Systems: Terminal Blocks
 - 4. ICS 6 Industrial Control and Systems: Enclosures
- B. Underwriters Laboratories (UL) Publication: 508, Industrial Control Equipment.

1.03 SUBMITTALS

- A. Shop drawings to be submitted in this Section shall be made in one package under the Product Review Category of Shop Drawings.
- B. Shop Drawings: Submit shop drawings for all control panels, including details for the following items:
 - 1. Electric power wiring schematics.
 - 2. Electric signal wiring schematics.
 - 3. Elementary control diagram.
 - 4. Fabrication drawings, including a dimensioned outline drawing to scale, showing space for conduits, etc.
 - 5. Details of seismic restraints (refer to Division 1 for requirements).
 - 6. Details of all panel accessories.
 - 7. A detailed Bill of Materials.
 - 8. Panel layouts and nameplate inscriptions.
 - 9. Connections to external equipment.
 - 10. Wire marking scheme.

- C. Arrange submissions in a logical manner and on the shop drawings use the device abbreviation identifications and equipment names as shown on the Drawings, in order to expedite and facilitate review by the Engineer.
- D. Where unit arrangement or wiring deviates in any way from that shown on the Drawings, provide a complete record and explanation of such deviations.
- E. Spare Parts List: Include a spare parts list showing recommended parts and quantities as well as complete ordering information for replacement components. Provide instruction books for special control devices and special equipment installed in the control panels. Submit these to the Engineer prior to installation of the equipment.
- F. Manuals: Provide manuals as specified in Section 17010.

1.04 UL LABEL

- A. UL Label:
 - 1. Each control panel and terminal cabinet shall bear the UL label except as noted in the following paragraph. The UL label shall apply to the enclosure, the specific equipment supplied with the enclosure, and the installation and wiring of the equipment within and on the enclosure. If required for UL labeling, provide ground fault interrupters, isolation transformers, fuses, and any other necessary equipment, even though such equipment is not indicated on the Drawings. The fabricator shall be an approved UL listed manufacturer.
 - 2. Control panel enclosures containing instruments mounted through the enclosure walls or door shall meet all requirements for UL labeling as above, but no UL label is required. This exception applies only if UL Recognized instruments for the intended purpose are not made.

PART 2 - PRODUCTS

2.01 CONSTRUCTION

- A. General:
 - 1. Provide panels as shown on the Drawings. Panels shall conform to the requirements of NEMA Standards ICS 1 (General Standards for Industrial Controls and Systems) and ICS 2 (Standards for Industrial Control Devices, Controllers and Assemblies). The panels shall be wall-mounted or freestanding floor mounted, as shown. Provide sufficient access to the panels.
 - 2. The enclosures shall be code gauge steel of adequate strength, when complete, to withstand seismic forces equivalent to those noted in Division 1. Enclosures shall conform to requirements of NEMA Standard ICS 6 (Enclosures for Industrial Controls and Systems).
 - 3. The enclosures shall have vertically hinged front doors; provide hinge on side of panel that ensures compliance with the 30-inch rule in NEC Paragraph 110-16(a). Freestanding enclosures shall have doors secured by keyed three point latches. Mount the devices through the doors or on recessed plates Each component within the panel shall be securely mounted and arranged for easy servicing, such that all adjustments and component removal can be accomplished without disturbing other components. No fastening

devices shall project through the outer surfaces of the cabinet and all components and terminals shall be mounted on mounting pans within the panels.

4. Construction requirements on a specific type of panel are provided in subsequent paragraphs.
 5. Panels covered under this specification are:
 - a. Tesco L3000E PLC
- B. Safety Requirements: The electrical supply to each control panel shall be arranged to be disconnected by a single switch or circuit breaker, except for necessary foreign circuits. Any live parts within the control panel fed from foreign control or signal circuits shall be covered or arranged to be disconnected by one of the following methods:
1. Enclosed relays that are automatically de-energized when the main disconnecting switch is opened.
 2. Door-operated enclosed disconnect switches; or
 3. Clearly identified enclosed manually operated disconnect switches, which may be located inside the control panel door, provided the operating handles are isolated or barriered from all open live parts. Each control panel shall be arranged so that adjustments to timing relays or replacement of fuses can be done without exposure to live parts.
- C. Wiring: Factory wire control panels. Cable all panel wiring by securing to the panel surfaces with plastic cable ties. Permanently identify each wire at each termination by means of a heatshrink numbered sleeve. Number all electrically common wires the same, and number each electrically different wire uniquely. Provide red wire color for ac wiring, with white neutral and green ground. Provide blue wiring for dc wiring. Power and control wiring shall be single conductor stranded copper NFPA No. 70, Type MTW, No. 16 AWG minimum. Wiring for signals including PLC I/O shall be No. 18 AWG stranded copper NFPA No. 70, Type MTW, THHN, or TFFN. Wiring shall be supported independently of terminations by lacing to panel support structure or by slotted flame retardant plastic wiring channels. Wiring channels shall comply with UL 94, Type V. Wiring channel fill shall not exceed 40 percent. Where wiring crosses hinged surfaces, provide an 18-inch "U" shaped hinge loop of extra flexible wires secured at both ends. Where crimp lugs are used, use ratchet type crimping tools that do not release until proper crimp pressure has been applied.
- D. Terminal blocks shall be single height, 8mm, compression box type rated for 600 volts and mounted to DIN rail. Each box lug shall be capable of accepting two #12 wires. Each terminal strip shall have a unique identifying alphanumeric code at one end and a vinyl marking strip running the entire length of the terminal strip with a unique number for each terminal. Numbers shall be machine printed and 1/8 inch high. No more than two wires shall be connected to a terminal. Connections between adjacent terminals, if required, shall be made by means of prefabricated metal jumpers. All fuses, terminals, ground terminals, etc. shall be from the same manufacturer and family. Terminal blocks shall be Phoenix 31-06-013 or Entrelec M6/8 series (115 118 11).
- E. Field connections shall be on separate terminal blocks. Terminal blocks for field terminations shall be along the right side of the panel. An incoming wire duct (2"x3" or larger) shall be mounted to the right of the terminal strip with 2" spacing to

accommodate field wiring entering the panel. Field terminals shall have no internal panel wiring attached thereto.

- F. Fuses: Circuits shall be fused. Fuses shall be 1/4 x 1-1/4 inches. Fuses on 120V AC circuits shall be ceramic tube type with 25,000 amperes interrupting capacity at 125 volts. Fuses for low voltage DC circuits shall be fast acting glass tube type rated 1/8 or 1/10 amp for 4-20 MA loops and 1/2 amp for the power supply to individual instruments. Fuse holders shall be swing out type with an internal neon blown fuse indicator for 120V AC and an integral LED blown-fuse indicator for 24VDC. Fuse holders and terminal blocks shall be the same manufacturer and series.
- G. Nameplates: Provide nameplates as shown on the Drawings, and as specified in Section 17010. A "CAUTION" nameplate shall be attached to the outside of access doors warning of foreign voltages inside the panel (see "Safety Requirements").
- H. Finish:
 - 1. After fabrication all external welds shall be ground smooth. The entire unit shall be thoroughly degreased, then filled and sanded. All metal surfaces shall be given a rust-inhibiting treatment or passivator, then one coat of synthetic primer, followed by two coats of synthetic enamel. The average overall finish shall be at least 3 mils in thickness. All damage to the finish during installation shall be touched up at the jobsite as approved.
 - 2. Exterior panel color shall complement adjacent panels and shall be approved by the Owner. Sharp angled horizontal front edges of panels shall be protected by brushed and coated stainless steel angled strip with concealed fasteners.
- I. Size and Supports:
 - 1. Panels shall be of sufficient size to adequately enclose all instruments designated as "panel-mounted" plus ample interior clearance to allow for installation, general servicing, and maintenance of the instruments. Weight of instruments shall be supported by Unistrut, Famet, Caine, or equal, channel supports. Panel size shall be as indicated on the Drawings.
 - 2. Provide rigid supports for all devices. Supports shall not cause warping or bowing sides or mounting plates.
- J. Mounting:
 - 1. Attachment methods shall be detailed on panel fabrication drawing submittals. Seismic restraints shall be installed as specified by the manufacturer.
- K. Arrangement:
 - 1. The instruments mounted in the panels shall have the nominal size and general arrangement shown. Panel layouts and nameplates shall conform to the approved submittal.
- L. Ventilation:
 - 1. Ventilation shall be provided to prevent internal panel temperatures from exceeding 140°F.
 - 2. Louvers shall be provided, when required for cooling, near the bottoms and tops on the rear doors and side of panels. 80-mesh screens shall cover the insides of louvers.
 - 3. Provide a thermostatically controlled fan in each enclosure when louvers cannot dissipate heat adequately or cause sufficient flow to all panel areas. Ventilation

- fans shall be low acoustic type suitable for control rooms. Provide removable cleanable or disposable dust filter for each remote site enclosure.
4. Provide heaters and circulating fans in all outdoor panels to prevent condensation.
 5. Provide air control cooling system for panels requiring less than 1,500 Btu/hr heat dissipation.
 6. Provide air conditioning for panels requiring high heat removal.
- M. Cable Entry Plates:
1. For top entry panels, a gasketed 10-gauge steel cover plate shall be cut that is suitable for the number of conduits. Cable entry plates are not required for bottom, side, or back conduit entry unless the Contractor must specifically control the position, size, and location of cutouts.
 2. Cable entry plates shall mount to and be fastened along panel stiffeners and framing segments. Tee nut fasteners are preferred.
- N. Panel Lights and Receptacles: Panels shall be internally lighted by LED lamps, provided with guards and a toggle switch located convenient to each access door. One duplex GFI type receptacle shall be provided in each panel section per Section 16140. The lights and receptacles shall be wired to outgoing terminal blocks for 120 volt, 60 Hertz, single-phase supply.

2.02 MANUFACTURER

- A. Manufacturers of the control panels and terminal cabinets enclosure shall be TESCO Controls, no equal.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Installation, testing, calibration, validation, startup and instruction shall be in accordance with Section 17010.
- B. Install each control panel level and plumb, and secure by the favorably reviewed seismic mounting method. Doors shall swing freely and close tightly.
- C. Provide a 3-inch-high concrete pad for each field-mounted, freestanding control panel. Provide a 3-1/2-inch-high I-beam kick panel for each control-room mounted, freestanding panel.
- D. Carefully repair any damage to the structure, components or finish to the satisfaction of the Engineer. Clean all nameplates.

END OF SECTION

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Appendix A: East Dunne Hillside Reservoir Site Boring Logs



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BORING NUMBER B-1

PAGE 1 OF 2

CLIENT <u>Kennedy-Jenks</u>	PROJECT NAME <u>E. Dunne Tank</u>
PROJECT NUMBER <u>160200</u>	PROJECT LOCATION <u>Morgan Hill, California</u>
DATE STARTED <u>4/11/2016</u> COMPLETED <u>4/13/2016</u>	GROUND ELEVATION _____ DATUM <u>Site Specific</u> HOLE SIZE <u>6 in.</u>
DRILLING CONTRACTOR <u>Britton Exploration</u>	COORDINATES: LATITUDE <u>37.13802</u> LONGITUDE <u>-121.59519</u>
DRILLING RIG/METHOD <u>6-in. Solid Flight Auger, Rotary Wash</u>	GROUNDWATER AT TIME OF DRILLING --- N/A
LOGGED BY <u>R. Fisher</u> CHECKED BY _____	GROUNDWATER AT END OF DRILLING --- N/A
HAMMER TYPE <u>140 lb hammer with 30 in. autotrip</u>	GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
								LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	
0		LEAN CLAY (CL), dark brown, moist, firm (COLLUVIUM)									
5		SANDSTONE, brown, weak to medium strength, massive, moist, severely weathered, trace 1/8 in. gravel, otherwise medium gravel (BEDROCK WEATHERED to SILTY SAND)	CM	9-13-16		96	18	39	28	11	27
10		dark yellow brown	CM	10-13-14		100	15				15
15		CLAYEY SANDSTONE with GRAVEL, olive brown, weak to medium strong, medium hardness, massive, severely weathered, estimated 30 % subrounded gravel up to 1/2 in., CaCO3 in matrix. (WEATHERED to CLAYEY SAND)	CM	10-14-17		111	16				16
20		SANDSTONE, pale olive, moist, medium to weak, massive, (WEATHERED to SANDY CLAY)	CM	11-25-40		85	35				54
25			SPT	9-14-24			33				
30		Clay content increasing CLAYSTONE, mottled olive brown and gray, weak, massive, moist, severely weathered	CM	19-17-30		102	22				
35											

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BORING NUMBER B-1

PAGE 2 OF 2

CLIENT Kennedy-Jenks

PROJECT NAME E. Dunne Tank

PROJECT NUMBER 160200

PROJECT LOCATION Morgan Hill, California

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
								LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	
35		light yellowish brown to olive brown, weak to medium strength, massive, moist, severely weathered, sand is very fine to fine CLAYSTONE, mottled olive brown and gray, weak, massive, moist, severely weathered (<i>continued</i>)	CM	14-30- 50/6"		97	21				
40		SANDSTONE, olive brown and gray, medium strength, medium hard, massive, dry, intensely fractured, caliche, severely weathered Very hard drilling, switched over to Rotary Wash	SPT	28-50/3"							
45			SPT	50/0"							
50		No recovery, sandstone in wash	SPT	50/0"							

Bottom of borehole at 51.5 ft. Borehole backfilled with grout.



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BORING NUMBER B-2

PAGE 1 OF 2

CLIENT <u>Kennedy-Jenks</u>	PROJECT NAME <u>E. Dunne Tank</u>
PROJECT NUMBER <u>160200</u>	PROJECT LOCATION <u>Morgan Hill, California</u>
DATE STARTED <u>4/13/2016</u> COMPLETED <u>4/13/2016</u>	GROUND ELEVATION _____ DATUM <u>Site Specific</u> HOLE SIZE <u>6 in.</u>
DRILLING CONTRACTOR <u>Britton Exploration</u>	COORDINATES: LATITUDE <u>37.13799</u> LONGITUDE <u>-121.59494</u>
DRILLING RIG/METHOD <u>6-in. Solid Flight Auger</u>	GROUNDWATER AT TIME OF DRILLING --- N/A
LOGGED BY <u>R. Briseno</u> CHECKED BY _____	GROUNDWATER AT END OF DRILLING --- N/A
HAMMER TYPE <u>140 lb hammer with 30 in. autotrip</u>	GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
								LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	
0											
5		SANDY LEAN CLAY (CL), olive brown, moist, firm (COLLUVIUM)									
10		SANDSTONE, olive brown, friable, loosely consolidated, moist, severely weathered, fine sand up to small subrounded gravel, weak (WEATHERED to WELL GRADED SAND with SILT)	CM	7-8-10		100	12				10
15		SILTY SANDSTONE, olive gray, weak, moist, severely weathered, some isolated 1 in. gravel, some iron staining along fractures, severe caliche at 15 ft. (WEATHERED to SILTY SAND)	CM	7-11-14		100	17				26
20		CLAYSTONE, gray, hard, moist, some iron stains sandy lens at 20 ft. very fine to fine sand	CM	15-35-50/4"		100	22				
25		SANDY CLAYSTONE, olive, weak, thumbnail can penetrate, moist, very fine sand, iron stained mottled with gray at 24.5 ft. sandy lens at 25 ft.	CM	9-20-50		104	22				
30		SANDSTONE, olive mottled with gray, friable, moist, severy weathered, few iron stains	CM	21-50/5"		104	19				
35			CM	27-50/3"		99	20				

(Continued Next Page)



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BORING NUMBER B-2

PAGE 2 OF 2

CLIENT Kennedy-Jenks PROJECT NAME E. Dunne Tank
PROJECT NUMBER 160200 PROJECT LOCATION Morgan Hill, California

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
								LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	
35											
		Increase in iron staining at 34.5 ft.									
40		SANDSTONE interbedded with CLAY STONE, olive and gray respectively, CaCO ₃ vein between beds. beds are at least 1 ft. thick	SPT	17-28-50							
45		SANDSTONE, olive, hard, moist	SPT	18-30-39							
50		CLAYSTONE, dark gray, weak, thumbnail can penetrate, moist, caliche lens between yellowish brown SANDSTONE, mottle with gray, heavily iron stained. bedded	SPT	15-23-34							

Bottom of borehole at 50.0 ft. Borehole backfilled with grout.



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BORING NUMBER B-3

PAGE 1 OF 2

CLIENT <u>Kennedy-Jenks</u>	PROJECT NAME <u>E. Dunne Tank</u>
PROJECT NUMBER <u>160200</u>	PROJECT LOCATION <u>Morgan Hill, California</u>
DATE STARTED <u>4/11/2013</u> COMPLETED <u>4/11/2016</u>	GROUND ELEVATION _____ DATUM <u>Site Specific</u> HOLE SIZE <u>6 in.</u>
DRILLING CONTRACTOR <u>Britton Exploration</u>	COORDINATES: LATITUDE <u>37.13781</u> LONGITUDE <u>-121.59481</u>
DRILLING RIG/METHOD <u>6-in. Solid Flight Auger</u>	GROUNDWATER AT TIME OF DRILLING --- N/A
LOGGED BY <u>R. Fisher</u> CHECKED BY _____	GROUNDWATER AT END OF DRILLING --- N/A
HAMMER TYPE <u>140 lb hammer with 30 in. autotrip</u>	GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
								LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	
0		SANDY LEAN CLAY (CL), light yellowish brown, moist, firm (COLLUVIUM)									
5		CLAYEY SANDSTONE, light olive brown, low hardness, weak, easily carved with knife, possible 1 in. clay interbeds, fracture indeterminate, moist, severely weathered, CACO3 distributed throughout rock mass (BEDROCK WEATHERED to SANDY CLAY)	CM	9-16-21		94	27				52
10		SANDSTONE, light yellowish brown, weak, low hardness, massive, fracture indeterminate, moist to dry, severely weathered, very fine sand to silt	CM	21-50		102	21				
15		SANDSTONE interbedded with CLAYEY SANDSTONE, light yellowish brown to gray, weak to medium strength, low hardness, possible 3/4 in. beds, fracture indeterminate, dry, severely weathered, sand fine to medium	CM	15-29-50/5"		95	24				
20		SANDSTONE with pebbly interbeds, grayish brown, friable to weak, low hardness, 3 in. beds, fracture indeterminate, dry to slightly moist, severely weathered	SPT	7-8-11			11				24
25		CLAYEY SANDSTONE with GRAVEL, grayish brown, weak, medium hardness, 3 in. pebbly beds, fracture indeterminate, fracture indeterminate, dry to slightly moist, severely weathered with CACO3 in rock matrix, some angular gravel	CM	12-19-30		108	11				
30			CM	25-30-36		112	11				
35											

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CLIENT Kennedy-Jenks

PROJECT NAME E. Dunne Tank

PROJECT NUMBER 160200

PROJECT LOCATION Morgan Hill, California

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE		BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
									LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	
35				SPT	11-13-23			22				
40		CLAYEY SANDSTONE interbedded with SANDY CLAYSTONE, light yellowish brown, weak, low hardness, 4 in. beds at 50 degrees dip, fracture indeterminate, moist, severely weathered										
		SANDY CLAYSTONE, yellowish brown, weak, low hardness, possibly massive, moist, severely weathered		CM	13-32-45		100	25				
45		mottled with olive brown and dark gray		CM	14-15-21		97	25				
50		CLAYEY SANDSTONE interbedded with SANDY CLAYSTONE, dark yellowish brown, weak, low hardness, 2-6 in. beds, fracture indeterminate, moist, severely weathered		CM	15-24-47		101	24				
Bottom of borehole at 51.5 ft. Borehole backfilled with grout.												



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BORING NUMBER B-4

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CLIENT <u>Kennedy-Jenks</u>	PROJECT NAME <u>E. Dunne Tank</u>
PROJECT NUMBER <u>160200</u>	PROJECT LOCATION <u>Morgan Hill, California</u>
DATE STARTED <u>4/12/2016</u> COMPLETED <u>4/12/2016</u>	GROUND ELEVATION _____ DATUM <u>Site Specific</u> HOLE SIZE <u>6 in.</u>
DRILLING CONTRACTOR <u>Britton Exploration</u>	COORDINATES: LATITUDE <u>37.13762</u> LONGITUDE <u>-121.59516</u>
DRILLING RIG/METHOD <u>6-in. Solid Flight Auger</u>	GROUNDWATER AT TIME OF DRILLING <u>--- N/A</u>
LOGGED BY <u>R. Briseno</u> CHECKED BY _____	GROUNDWATER AT END OF DRILLING <u>--- N/A</u>
HAMMER TYPE <u>140 lb hammer with 30 in. autotrip</u>	GROUNDWATER AFTER DRILLING <u>--- N/A</u>

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
								LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	
0											
		SANDY FAT CLAY (CH), very dark gray brown, moist, firm, sparse rootlets (COLLUVIUM)	CM	4-5-7		95	24	66	25	41	64
5		SANDY CLAY (CL), brown, moist, firm, caliche, iron stains caliche increases at 5 ft. (HIGHLY WEATHERED BEDROCK)	CM	5-8-14		105	21				75
10		SILTY SANDSTONE, light yellowish brown, hard, dry to moist, very severely weathered, caliche in matrix (WEATHERED BEDROCK)	CM	11-13-31		92	18				
15		CLAYSTONE, gray, weak to medium strength, dry to moist, severely weathered, caliche in matrix, isolated fine gravel	CM	11-30-42		109	19				
20		mottled with brown, iron stains along fractures, sparse caliche, some very fine sand	CM	15-35-43		106	21				

Bottom of borehole at 20.0 ft. Borehole backfilled with grout.



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BORING NUMBER B-5

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CLIENT Kennedy-Jenks PROJECT NAME E. Dunne Tank
 PROJECT NUMBER 160200 PROJECT LOCATION Morgan Hill, California
 DATE STARTED 4/12/2016 COMPLETED 4/12/2016 GROUND ELEVATION _____ DATUM Site Specific HOLE SIZE 6 in.
 DRILLING CONTRACTOR Britton Exploration COORDINATES: LATITUDE 37.13733 LONGITUDE -121.59485
 DRILLING RIG/METHOD 6-in. Solid Flight Auger GROUNDWATER AT TIME OF DRILLING --- N/A
 LOGGED BY R. Briseno CHECKED BY _____ GROUNDWATER AT END OF DRILLING --- N/A
 HAMMER TYPE 140 lb hammer with 30 in. autotrip GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
								LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	
0											
		LEAN CLAY (CL), dark brown, moist, firm, rootlets (COLLUVIUM)	CM	4-8-9		77	32				
5		CLAYEY SANDSTONE with GRAVEL, gray, friable, loosely consolidated, dry to moist, very severely weathered, silt to fine sand, subangular gravel (HIGHLY WEATHERED BEDROCK) color change to light olive brown	CM	4-5-6		93	15				
10		CLAYSTONE, gray, hard, dry to moist, severely weathered, some very fine sand	CM	8-18-25		104	20				
15		isolated grains of coarse sand SANDSTONE, olive yellow, hard, dry, coarse grained, iron bands	CM	15-18-32		110	9				
20		color change to brown, fine sand CLAYSTONE interbedded with SANDSTONE, gray and brown respectively, hard, dry, severely weathered, caliche stains	CM	15-24-40		104	18				
25		greater than or equal to 6 in. interbeds	SPT	11-14-15			20				

Bottom of borehole at 25.0 ft. Borehole backfilled with grout.



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BORING NUMBER B-6

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CLIENT Kennedy-Jenks PROJECT NAME E. Dunne Tank
PROJECT NUMBER 160200 PROJECT LOCATION Morgan Hill, California
DATE STARTED 4/12/2016 COMPLETED 4/12/2016 GROUND ELEVATION _____ DATUM Site Specific HOLE SIZE 6 in.
DRILLING CONTRACTOR Britton Exploration COORDINATES: LATITUDE 37.1372 LONGITUDE -121.59523
DRILLING RIG/METHOD 6-in. Solid Flight Auger GROUNDWATER AT TIME OF DRILLING --- N/A
LOGGED BY R. Briseno CHECKED BY _____ GROUNDWATER AT END OF DRILLING --- N/A
HAMMER TYPE 140 lb hammer with 30 in. autotrip GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
								LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	
0											
		SANDY FAT CLAY (CH), dark gray brown, moist, firm (COLLUVIUM) rootlets at 1.5 ft. caliche, iron staining and sparse isolated pebbles at 2.5 ft.	CM	3-5-6		99	18	57	21	36	62
5		SANDY CLAY (CL), very dark gray brown, moist, firm, caliche, iron staining (HIGHLY WEATHERED BEDROCK)	CM	3-5-9		93	26				79
10		CLAYEY SANDSTONE with GRAVEL, light yellowish brown, friable, dry, fine sand to coarse subrounded to rounded gravel, clay nodules	CM	20-23-30		106	14				
15		some chert observed	SPT	13-17-23			11				
20			CM	27-50			14				
25			SPT	15-30-31			10				

Bottom of borehole at 25.0 ft. Borehole backfilled with grout.



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BORING NUMBER B-7

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CLIENT Kennedy-Jenks PROJECT NAME E. Dunne Tank
 PROJECT NUMBER 160200 PROJECT LOCATION Morgan Hill, California
 DATE STARTED 4/12/2016 COMPLETED 4/12/2016 GROUND ELEVATION _____ DATUM Site Specific HOLE SIZE 6 in.
 DRILLING CONTRACTOR Britton Exploration COORDINATES: LATITUDE 37.13705 LONGITUDE -121.59554
 DRILLING RIG/METHOD 6-in. Solid Flight Auger GROUNDWATER AT TIME OF DRILLING --- N/A
 LOGGED BY R. Briseno CHECKED BY _____ GROUNDWATER AT END OF DRILLING --- N/A
 HAMMER TYPE 140 lb hammer with 30 in. autotrip GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
								LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	
0											
		LEAN CLAY (CL), dark brown, moist, firm	CM	11-17-18		99	10				
		CLAYEY SANDSTONE with GRAVEL, light yellowish brown, dry, friable, fine sand to coarse subrounded gravel, chert clay nodules	CM	19-21-25		111	12				
5											
		SANDSTONE interbedded with CLAYEY SANDSTONE, olive yellow and gray respectively, medium strength, dry, severely weathered	CM	23-34-47		104	19				
10											
		CLAYEY SANDSTONE with GRAVEL, light yellowish brown, dry, friable, fine sand to coarse subrounded gravel, chert, clay nodules, iron stained, caliche	CM	50							
15											
		SANDSTONE, light olive brown, friable, weak, dry	SPT	17-23-32			11				
20											
		CLAYEY SANDSTONE with GRAVEL, light yellowish brown, dry, friable, coarse sand to subangular gravel, chert, clay nodules, iron stained, caliche	SPT	14-19-35							
25											

Bottom of borehole at 25.0 ft. Borehole backfilled with grout.



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BORING NUMBER Probe

PAGE 1 OF 2

CLIENT Kennedy-Jenks PROJECT NAME E. Dunne Tank
 PROJECT NUMBER 160200 PROJECT LOCATION Morgan Hill, California
 DATE STARTED 4/13/2016 COMPLETED 4/13/2016 GROUND ELEVATION _____ DATUM Site Specific HOLE SIZE 6 in.
 DRILLING CONTRACTOR Britton Exploration COORDINATES: LATITUDE 37.13786 LONGITUDE -121.59513
 DRILLING RIG/METHOD 6-in. Solid Flight Auger GROUNDWATER AT TIME OF DRILLING --- N/A
 LOGGED BY R. Briseno CHECKED BY _____ GROUNDWATER AT END OF DRILLING --- N/A
 HAMMER TYPE 140 lb hammer with 30 in. autotrip GROUNDWATER AFTER DRILLING --- N/A

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE	BLOW COUNTS (FIELD VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
								LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	
0		LEAN CLAY (CL), dark brown, moist (COLLUVIUM)									
5		CLAYEY SANDSTONE, olive. Driller indicates that drilling is very consistent all the way, no gravel, feels like claystone									
10											
15											
20											
25											
30											
35											

(Continued Next Page)



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PROJECT NAME E. Dunne Tank

PROJECT LOCATION Morgan Hill, California

Bottom of borehole at 40.0 ft. Borehole backfilled with grout.